



भारत हेवी इलेक्ट्रिकल्स लिमिटेड

(भारत सरकार का उपक्रम)

BHARAT HEAVY ELECTRICALS LIMITED

(A Govt. of India Undertaking)

Ref: PSER: PUR: PMX-380(II):107 : (ENQ:19:PP:0015: PUR:140)

Date 24/02/2020

NOTICE INVITING TENDER

NOTE: INTENDING BIDDER TO PARTICIPATE MAY DOWNLOAD FROM WEB SITES

Sealed offers in two part bid system are invited from reputed & experienced bidders (meeting [PRE QUALIFICATION CRITERIA](#) as mentioned in Annexure-1) through E-Procurement Portal <https://bhel.abcprocure.com> only, for the subject job by the undersigned on the behalf of BHARAT HEAVY ELECTRICALS LIMITED as per the tender document. Issue/ forwarding intimation regarding tender to any bidder shall not construe that the bidder is considered to be qualified. Following points relevant to the tender may please be noted and complied with.

1.0 Salient Features of NIT

SL NO	ISSUE	DESCRIPTION
i	TENDER NUMBER	PSER: PUR: PMX-380(II):107:(ENQ:19:PP:0015: PUR:140) Date:24/02/2020
ii	Broad Scope of job	SUPPLY OF FABRICATED STRUCTURAL STEEL MATERIALS FROM CUSTOMER APPROVED SHOP INCLUDING PAINTING, TRANSPORTATION TO 4X250 MW, BRBCL NABINAGAR SITE-BIHAR FOR FGD SYSTEM PACKAGE.
iii	DETAILS OF TENDER DOCUMENT	
a	Volume-IA	<i>General conditions of contract (Supply)</i>
B	Volume-IB	<i>General conditions of contract (Service)</i>
C	Volume-IC & ID	<i>Special conditions of contract (Supply & Service-Common)</i>
D	Volume-IC	<i>Technical Conditions of Contract / Scope of Work)</i>
E	Volume-ID	<i>Special conditions of contract (Service)</i>
F	Volume-IE	<i>Forms & Procedures</i>
G	HSEP:14, Rev-00	<i>HSE Plan</i>
H	Volume-III	<i>Price Schedule (Absolute value) – Rev-0</i>
iv	ISSUE OF TENDER DOCUMENTS	a) Online through e-procurement platform at https://bhel.abcprocure.com. Offers are invited in two-parts only. b) In BHEL website (www.bhel.com & CPP Portal) : For tender view purpose only. Start date of the tender : 24/02/2020
v	DUE DATE & TIME OF OFFER SUBMISSION	Date: 05/03/2020, Time: 15:00 Hrs. IST The bidder should respond by submitting their offer online in our e-Procurement platform at https://bhel.abcprocure.com only. Offers are invited in two-parts only. Hard copy bid or bids through email/fax shall not be accepted.

vi	OPENING OF TENDER	<i>Date:05/03/2020, Time: 16:00 Hrs. IST</i> <i>Note(s):</i> <i>(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.</i>	<i>Applicable.</i>
vii	EMD AMOUNT	<i>Not Applicable</i>	<i>Not Applicable</i>
viii	COST OF TENDER	<i>Not Applicable</i>	<i>Not Applicable</i>
ix	LAST DATE FOR SEEKING CLARIFICATION	<i>Date:28/02/2020, Time: 11:00 Hrs. IST</i> <i>Along with soft version also, addressing to undersigned & to others as per contact address given below</i>	<i>Applicable.</i>
x	SCHEDULE OF PRE BID DISCUSSION (PBD)		<i>Shall be intimated later if required.</i>
xi	INTEGRITY PACT & DETAILS OF INDEPENDENT EXTERNAL MONITOR (IEM)	<i>IEM DETAILS:</i> <i>Refer Clause No 40.0 below</i>	<i>Applicable</i>
xii	Latest updates	Latest updates on the important dates, Amendments, Correspondences, Corrigenda, Clarifications, Changes, Errata, Modifications, Revisions, etc to Tender Specifications will be hosted in BHEL webpage (www.bhel.com) ; CPP portal & E-Procurement Site https://bhel.abcpurchase.com only. Bidders to keep themselves updated with all such information.	<i>Shall be intimated to bidder</i>

- 2.0 The offer shall be submitted as per the instructions of tender document and as detailed in this NIT. Bidders to note specifically that all pages of tender document, including these NIT pages of this particular tender together with subsequent correspondences shall be submitted by them, duly digitally signed & stamped on each page, as part of offer. Rates/Price including discounts/rebates, if any, mentioned anywhere/ in any form in the techno-commercial offer other than the Price Bid, shall not be entertained.
- 3.0 Unless specifically stated otherwise, bidder shall remit cost of tender (non-refundable) and courier charges if applicable, in the form of Demand Draft drawn in favour of Bharat Heavy Electricals Ltd, payable at Kolkata, issuing the Tender, along with techno-commercial offer.
- 4.0 Unless specifically stated otherwise, bidder shall have to deposit EMD through Demand Draft/Pay Order in favour of Bharat Heavy Electricals Ltd, payable at Kolkata. For other details please refer General Conditions of Contract.
- 5.0 **Procedure for Submission of Tenders:** The Tenderers must submit their Tenders as detailed below:
This is an E-tender floated online through our E-Procurement Site <https://bhel.abcpurchase.com>. The bidder should respond by submitting their offer online only in our e-Procurement platform at <https://bhel.abcpurchase.com>. Offers are invited in two-parts only. No Hard copy bid or bids through email/ fax shall be accepted. Bids are invited in two parts & shall be submitted as described below:

DOCUMENTS TO BE UPLOADED & MODALITY OF UPLOADING

Sl. No.	Description	Remarks
PART-I A	(TECHNO COMMERCIAL BID)	
	CONTAINING THE FOLLOWING:-	
i.	Covering letter/Offer forwarding letter of Tenderer. (To be attached in relevant Attachment section)	
ii.	Duly filled-in 'No Deviation Certificate' as per prescribed format. (To be attached in relevant Attachment section) <u>Note:</u> a. In case of any deviation, the same should be submitted separately for technical & commercial parts, indicating respective clauses of tender against which deviation is taken by bidder. The list of such deviation shall be attached in relevant attachment section of the e –procurement portal. It shall be specifically noted that deviation recorded elsewhere shall not be entertained. b. BHEL reserves the right to accept/reject the deviations without assigning any reasons, and BHEL decision is final and binding. i). In case of acceptance of the deviations, appropriate loading shall be done by BHEL ii). In case of unacceptable deviations, BHEL reserves the right to reject the tender	
iii.	Supporting documents/ annexures / schedules/ drawing etc as required in line with Pre-Qualification criteria. It shall be specifically noted that all documents as per above shall be attached in relevant attachment section and credential certificates issued by clients shall distinctly bear the name of organization, contact ph no, FAX no, etc.	
iv.	All Amendments/Correspondences/Corrigenda/Clarifications/Changes/ Errata etc pertinent to this NIT. (To be attached in relevant Attachment section)	
v.	Integrity Pact Agreement (Duly signed by the authorized signatory)	
vi.	Duly filled-in annexures, formats etc as required under this Tender Specification/NIT (To be attached in relevant Attachment section)	
vii.	Notice inviting Tender (NIT) (To be attached in relevant Attachment section)	
viii.	Volume – IC : Technical Conditions of Contract / Scope of Work (To be attached in relevant Attachment section)	
ix.	Volume – IA : General conditions of contract (Supply) (To be attached in relevant Attachment section)	
x.	Volume – IE : Annexures, Formats, etc. (To be attached in relevant Attachment section)	
xi.	Volume–III – (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item. (To be attached in Unpriced Bid Attachment section)	
xii.	Any other details preferred by bidder with proper indexing. (To be attached in relevant Attachment section)	

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PART-I B	COST OF TENDER	
	CONTAINING THE FOLLOWING:-	
i.	1. Earnest Money Deposit (EMD) in the form as indicated in this Tender 2. Cost of Tender (Demand Draft or copy of Cash Receipt as the case may be)	1. Not Applicable 2. Not Applicable
PART-II	PRICE BID- Online submission only	
	CONTAINING THE FOLLOWING:-	
i	Covering letter/Offer forwarding letter of Tenderer enclosed in Part-I	
ii	Volume III – PRICE BID (Duly Filled in Schedule of Rates – rate/price to be entered in words as well as figures) Any other document uploaded in the price bid, apart from above tender format, shall not be taken into cognizance for evaluation of offer.	

SPECIAL NOTE:

A) Your offer & documents submitted along with offer shall be digitally signed & stamped in each page by your authorized representative. No overwriting/ correction in tender documents by bidders shall be allowed. However, if correction is unavoidable, the same may be signed by authorized signatory.

B) The credentials/documents submitted towards compliance of Pre-qualification requirement shall be physically signed by the authorized signatory & stamped before uploading/submission with the offer in the e-procurement portal.

C) All documents/ annexures submitted with the offer shall be properly attached in the respective sections. BHEL shall not be responsible for any missing documents.

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

7.0 BHEL reserves the right to accept or reject any or all Offers without assigning any reasons thereof. BHEL also reserves the right to cancel the Tender wholly or partly without assigning any reason thereof. Also BHEL shall not entertain any correspondence from bidders in this matter (except for the refund of EMD, as applicable). However, BHEL may communicate rejection to the unsuccessful bidder after award of work and acceptance by the successful bidder.

8.0 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. No additional claim shall be entertained by BHEL in future, on account of non-acquaintance of above.

9.0 For any clarification on the tender document, the bidder may seek the same in writing, through e-mail or through **E-Procurement Site** <https://bhel.abcpocure.com>, as per specified format, within the scheduled date for seeking clarification, from the office of the undersigned. BHEL shall not be responsible for receipt of queries after due date of seeking clarification due to any delay. Any clarification / query received after last date for seeking clarification may not be normally entertained by BHEL and no time extension will be given.

10.0 BHEL may decide holding of pre-bid discussion [PBD] with all intending bidders as per date indicated in the NIT. The bidder shall ensure participation for the same at the appointed time, date and place as may be decided by BHEL. Bidders shall plan their visit accordingly. The outcome of pre-bid discussion (PBD) shall also form part of tender.

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- 11.0 In case of absence of any queries from bidder(s), their quoted price will be PRESUMED to be final and complete with reference to the tender documents (including Tender change notes (TCNs), clarifications, corrigendum issued by BHEL, if any). Bidders are requested to study the tender documents in detail and prepare their queries/clarifications accordingly. All such queries / clarifications shall be cleared/replied by BHEL. Such clarification letters, corrigendum and/or Tender change notes (TCNs), if issued by BHEL, shall form part of tender document.
- 12.0 In the event of any conflict between requirement of any clause of this specification/ documents/drawings/data sheets etc or requirements of different codes/standards specified, the same to be brought to the knowledge of BHEL in writing for clarification before due date of seeking clarification (whichever is applicable), otherwise, interpretation by BHEL shall prevail. Any typing error/missing pages/ other clerical errors in the tender documents, noticed must be pointed out before pre-bid meeting/submission of offer else BHEL's interpretation shall prevail & binding on you.
- 13.0 Unless specifically mentioned otherwise, bidder's quoted price shall deemed to be in compliance with tender along with TCNs including PBD, if any.
- 14.0 Bidders shall submit Integrity Pact Agreement (Duly signed by authorized signatory who signs in the offer), along with techno - commercial bid. This pact shall be considered as a preliminary qualification for further participation. The names and other details of Independent External Monitor (IEM) for the subject tender is as given at point (xi) of 1 above.
- 15.0 The Bidder has to satisfy the Pre Qualifying Requirements stipulated for this Tender in order to be qualified. The Price Bids of only those bidders will be opened who will be qualified for the subject job on the basis of satisfying the Pre Qualification Criteria specified in this NIT as per Annexure-1 (as applicable), past performance etc. and date of opening of price bids shall be intimated to only such bidders. BHEL reserves the right not to consider offers of parties under HOLD. BHEL's decision in this regard shall be final & binding.
- 16.0 While BHEL reserve the right to open the price bid of the offers in camera, the date & time to open the PRICE BID, tender opening shall be intimated to the bidders in case BHEL decides it to be 'Public opening' and in such a case, price bid (Volume-III) uploaded in E-Procurement Site <https://bhel.abcprocure.com> will be opened.
- 17.0 Validity of the offer shall be for 90 days from the latest due date of offer submission (including extension, if any) unless specified otherwise.
- 18.0 Bidders are required to submit their **BEST** price as per tender Price Schedule format in e-procurement portal/platform in the form & manner as mentioned in tender.
- 19.0 BHEL reserves the right to go for Reverse Auction (RA) (Guidelines as available on www.bhel.com) instead of opening the sealed envelope price bid, submitted by the bidder. This will be decided after techno-commercial evaluation. Bidders to give their acceptance with the offer for participation in RA. Non-acceptance to participate in RA may result in non-consideration of their bids, in case BHEL decides to go for RA.

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

The bidders have to necessarily submit online sealed bid less than or equal to their envelope sealed price bid already submitted to BHEL along with the offer. The envelope sealed price bid of successful L1 bidder in RA, if conducted, shall also be opened after RA and the order will be placed on lower of the two bids (RA closing price & envelope sealed price) thus obtained. The bidder having submitted this offer specifically agrees to this condition and undertakes to execute the contract on thus awarded rates.

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If it is found that L1 bidder has quoted higher in online seal bid in comparison to envelope sealed bid for any item(s), the bidder will be issued a warning letter to this effect. However, if the same bidder again defaults on this count in any subsequent tender in the unit, it will be considered as fraud and will invite action by BHEL as per extant guidelines for suspension of business dealings with suppliers/ contractors (as available on www.bhel.com).

- 20.0 However, if Reverse Auction process is not adopted or Reverse Auction is unsuccessful as defined in the RA rules/procedures, or for whatsoever reason, then the 'PRICE BID' and price impacts (if any), already submitted in e-procurement portal/platform, submitted by the bidder shall be opened for deciding the successful bidder, as per BHEL's standard practice. BHEL's decision in this regard will be final and binding on bidder.
- 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 The bidder shall submit documents in support of possession of 'Qualifying Requirements' duly self-certified and stamped/ digitally signed (as applicable) by the authorized signatory, indexed and properly linked in the format for PQR. In case BHEL requires any other documents/proofs, these shall be submitted immediately.
- 25.0 The bidder may have to produce original document for verification if so decided by BHEL.
- 26.0 The offers of the bidders who are on the banned list as also the offer of the bidders, who engage the services of the banned firms, shall be rejected. The list of banned firms is available on BHEL Website (www.bhel.com).

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

a) Commitment by BHEL:

BHEL commits to take all measures necessary to prevent corruption in connection with the tender process and execution of the contract. BHEL will during the tender process treat all Bidder(s) in a transparent and fair manner, and with equity.

b) Commitment by Bidder/ Supplier/ Contractor:

b.i) The bidder/ supplier/ contractor commit to take all measures to prevent corruption and will not directly or indirectly influence any decision or benefit which he is not legally entitled to nor will act or omit in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India.

b.ii) The bidder/ supplier/ contractor will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract and shall adhere to relevant guidelines issued from time to time by Govt. of India/ BHEL.

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

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If any bidder/ supplier/ contractor during pre-tendering/ tendering/ post tendering/ award/ execution/ post-execution stage includes in mal-practices, cheating, bribery, fraud or and other misconduct or formation of cartel so as to influence the bidding process or influence the price or acts or omits in any manner which tantamount to an offence punishable under any provision of the Indian Penal code, 1860 or any other law in force in India, then, action may be taken against such bidder/ supplier/ contractor as per extant guidelines of the company available on www.bhel.com and/ or under applicable legal provisions.

- 27.0 Corrigendum/ corrigendum/ extension/ addendum, if any, pertaining to this tender will be published in the web sites CPP Portal, www.bhel.com, <https://bhel.abcpocure.com> etc. or will be issued directly to you, as applicable.
- 28.0 Unsolicited discounts received after opening of techno commercial bid shall not be considered for evaluation. However, if the party who has submitted the unsolicited discount/rebate becomes the L-1 party, then the awarded price shall be after considering the discount.
- 29.0 The offers of the bidders who are on the banned list as also the offer of the bidders, who engage the services of the banned firms, shall be rejected. The list of banned firms is available on BHEL Website (www.bhel.com).
- 30.0 It may please be noted that applicable Guidelines/Rules in respect of Suspension of business dealings, Vendor Evaluation formats, quality, safety and HSE guidelines, standard T&P hire charges of BHEL etc. may undergo change from time to time and the latest one shall be followed. Latest applicable "Guidelines for Vendor Evaluation" is web based, quality, safety & HSE"; standard T&P hire charges shall be available at site and shall be given to the successful vendors/ subcontractors during execution.
- 31.0 Bidders are requested to note that the accepted / agreed tender terms (technical, commercial or on Reverse Auction) in their original offer can not be altered / withdrawn by their own during the processing of tender.
- 32.0 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.
- 33.0 Suspension of Business dealings with Suppliers/ Contractors: BHEL reserves the right to take action against contractors who fail to perform or indulge in malpractices, by suspending business dealings with them as detailed in Annexure-F.
- 34.0 "For this procurement, Public Procurement (Preference to Make in India), Order 2017 dated 15/06/2017 & 28/05/2018 and subsequent Orders issued by 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".
- 35.0
 - a) Cost of Tender: Not Applicable
 - b) Earnest Money Deposit (EMD): Not Applicable
 - c) Security Deposit (SD): Not Applicable
 - d) Performance Bank Guarantee (PBG): Applicable
 - e) Performance Bond: Not Applicable
 - f) Additional Security Deposit: Not Applicable
- 36.0 "MSE suppliers can avail the intended benefits in respect of the procurements related to the Goods and Services only (Definition of Goods and Services as enumerated by Govt. of India vide Office Memorandum F.

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No. 21(8)/2011-MA dtd. 09/11/2016 office of AS & DC, MSME) if they submit along with the offer, attested copies of either EM II certificate having deemed validity (five years from the date of issue of acknowledgement in EM II) /Udyog Aadhar Memorandum(UAM) or valid NSIC certificate or EM II certificate along with attested copy of a CA certificate (Format enclosed at Annexure-B where deemed validity of EM II certificate of five years has expired) applicable for the relevant financial year (latest audited). Date to be reckoned for determining the deemed validity will be the date of bid opening (Part 1 in case of two part bid). Non submission of such documents will lead to consideration of their bid at par with other bidders. No benefit shall be applicable for this enquiry if any deficiency in the above required documents are not submitted before price bid opening. If the tender is to be submitted through e-procurement portal, then the above required documents are to be uploaded on the portal. Documents should be notarized or attested by a Gazetted officer."

Any Bidder falling under MSME category, shall furnish the following details & submit documentary evidence/Govt. Certificate etc. in support of the same along with their techno-commercial offer: -

Type under MSME	SC/ST owned	Women owned	Others
Micro			
Small			
Medium			

Note: - If the bidder does not furnish the above, offer shall be processed construing that the bidder is not falling under MSME category.

37.0 Annexure-B – Terms & conditions of Reverse Auction is enclosed herewith.

38.0 Annexure-E – State wise GST Registration nos. is enclosed herewith.

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

40.0 **Integrity Pact (IP) –**

(a) IP is a tool to ensure that activities and transactions between the Company and its Bidders/ Contractors are handled in a fair, transparent and corruption free manner. Following Independent External Monitors (IEMs) on the present panel have been appointed by BHEL with the approval of CVC to oversee implementation of IP in BHEL.

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

(b) The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory) along with techno-commercial bid (Part-I, in case of two/three part bid). Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this Pact would be a preliminary qualification.

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- (c) Please refer Section-8 of IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to any of the above IEM(s). All correspondence with the IEMs shall be done through email only.

Note:

No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc. on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing (procurement) department's officials whose contact details are provided below:

Details of contact person(s):

Name	Mr. Avijit Pan	Mr. Ujjwal Howlader
Dept.	Purchase Dept., BHEL PSER, Kolkata	Purchase Dept., BHEL PSER, Kolkata
Address	DJ-9/1, Sector – II, Salt Lake, Kolkata – 700091	DJ-9/1, Sector – II, Salt Lake, Kolkata – 700091
Phone	033-2339 8220	033-2339 8223
Email	avijitpan@bhel.in	ujjwalh@bhel.in
FAX	033-2321 1960	033-2321 1960

41.0 Rights of BHEL:

- 41.1 To withdraw any portion of work and/or to restrict / alter the quantum of work as indicated in the contract during the progress of work and get it done through other agency and/or by departmental labour to suit BHEL's commitment to its customer or in case BHEL decides to advance the date of completion due to other emergency reasons / BHEL's obligation to its customer.
- 41.2 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:
- 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.
 - Withdrawal from or abandonment of the work by contractor before completion of the work as per contract.
 - 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.
 - Termination of Contract on account of any other reason (s) attributable to Contractor.
 - Assignment, transfer, subletting of Contract without BHEL's written permission.
 - Non-compliance to any contractual condition or any other default attributable to Contractor.
- (#) In-case inputs from BHEL/Customer are likely to be delayed or are actually delayed, this delay may also be taken into account while considering balance period available for execution of Contract.

Risk & Cost Amount against Balance Work:

Risk & Cost amount against balance work shall be calculated as follows:

$$\text{Risk \& Cost Amount} = [(A-B) + (A \times H/100)]$$

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):

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

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

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

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

NOTE: 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 as per GCC/SCC/TCC/Special note/any other annexure of tender document (in compliance with order of precedence), for the delay attributable to contractor. For limiting the maximum value of LD, contract value shall be taken as Executed Value of work till termination of contract.

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

- i) Let the time period from scheduled date of start of work till termination of contract excluding the period of Hold (if any) not attributable to contractor = T1
- ii) Let the value of executed work till the time of termination of contract= X
- iii) Let the Total Executable Value of work for which inputs/fronts were made available to contractor and were planned for execution till termination of contract = Y
- iv) Delay in executed work attributable to contractor i.e. $T2 = [1 - (X/Y)] \times T1$
- v) LD shall be calculated in line with LD clause [as per GCC/SCC/TCC/Special note/any other annexure of tender document (in compliance with order of precedence)] of the Contract for the delay attributable to contractor taking "X" as Contract Value and "T2" as period of delay attributable to contractor.

41.3 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.

- 41.4 To terminate the contract or to restrict the quantum of work and pay for the portion of work executed in case BHEL's contract with their customers are terminated for any reason.

42.0 ARBITRATION & CONCILIATION:42.1 ARBITRATION:

42.1.1 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 2.14.2 herein below or otherwise) in respect of any dispute or difference; arising out of the formation, breach, termination, validity or execution of the Contract; or, the respective rights and liabilities of the Parties; or, in relation to interpretation of any provision of the Contract; or, in any manner touching upon the Contract (hereinafter referred to as the 'Dispute'), then, either Party may, commence arbitration in respect of such Dispute by issuance of a notice in terms of section 21 of the Arbitration & Conciliation Act, 1996 (hereinafter referred to as the 'Notice'). The Notice shall contain the particulars of all claims to be referred to arbitration in sufficient detail and shall also indicate the monetary amount of such claim. The arbitration shall be conducted by a sole arbitrator to be appointed by the Head of the BHEL Power Sector Region issuing the Contract within 60 days of receipt of the complete Notice. The language of arbitration shall be English.

The Arbitrator shall pass a reasoned award.

Subject as aforesaid, the provisions of Arbitration and Conciliation Act 1996 (India) or statutory modifications or re-enactments thereof and the rules made thereunder as in force from time to time shall apply to the arbitration proceedings under this clause. The seat of arbitration shall be Kolkata (the place from where the contract is Issued). The Contract shall be governed by and be construed as per provisions of the laws of India. Subject to this provision 42.1.1 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.

42.1.2 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.

42.1.3 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.

42.1.4 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.

42.2 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.

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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 : "Procedure for conduct of conciliation proceedings" (as available in www.bhel.com). The Procedure 2.3: "Procedure for conduct of conciliation proceedings" (as available in www.bhel.com) together with its Formats (as available in www.bhel.com) 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 : "Procedure for conduct of conciliation proceedings" (as available in www.bhel.com) from time to time and confirms that it shall be bound by such amended or modified provisions of the Procedure 2.3 : "Procedure for conduct of conciliation proceedings" (as available in www.bhel.com) with effect from the date as intimated by BHEL to it.

42.3 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.

- 43.0 It may please be noted that Bid should be free from correction, overwriting, using corrective fluid, etc. Any interlineation, cutting, erasure or overwriting shall be valid only if they are attested under full signature(s) of person(s) signing the bid, else bid shall be liable for rejection.

All overwriting/ cutting, etc. will be numbered by bid opening officials and announced during bid opening.

44.0 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/Schedule – Volume-III
- d) Technical Conditions of Contract / Scope of Work (TCC) – Volume-IC
- e) General conditions of contract (Supply) – Volume- IA
- f) Forms and Procedures – Volume-IE

for BHARAT HEAVY ELECTRICALS LTD.

SDGM (Purchase)

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Agency	Contact details	
BHEL, PSER, Kolkata	Address	BHARAT HEAVY ELECTRICALS LIMITED, POWER SECTOR – EASTERN REGION 2ND FLOOR, BLOCK-DJ, PLOT- 9/1, SECTOR, SALT LAKE CITY, KOLKATA – 700 091
	Phone no.	033-23398220, 23211690
	FAX no.	033-23211960
	E-mail ID	avijitpan@bhel.in ,
M/s E-PROCUREMENT TECHNOLOGIES LIMITED	For E-PROCUREMENT ASSISTANCE & TRAINING, M/s E-PROCUREMENT TECHNOLOGIES LIMITED HELPDESK PERSONS AS PER FOLLOWING: - 1) Mr. Swapnil Hamilton, Support Executive, Ph: +91 (79)68136849, e-mail ID: swapnil.h@eptl.in 2) Ms. Himanshi Kumari, Support Executive, Ph: +91 (79)68136809, e-mail ID: himanshi.k@eptl.in 3) Mr. Ankur Bhatt, Support Executive, Ph: +91 (79)68136823, e-mail ID: ankur.bhatt@eptl.in 4) Mr. Prashant Rajyaguru, Asst. Manager - Implementation & Support, Ph: +91 (79)68136872 / 08160087732 / 09016859416, e-mail ID: prashant@eptl.in	

Enclosure:

01. Annexure-1: Pre-Qualification Criteria.
02. Annexure-2: Format for No Deviation Certificate.
03. Annexure-3: Format for seeking clarification.
04. Annexure-4: Check List.
05. Annexure-A: Suspension of Business dealings with Suppliers/ Contractors.
06. Annexure-B: Terms & conditions of Reverse Auction.
07. Annexure-C: CA certificate Format.
08. Annexure-E: State wise GST Registration nos.
09. Integrity Pact Agreement Format (Separate).
10. Other Tender documents as per this NIT.

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ANNEXURE – 1**PRE QUALIFICATION CRITERIA**

JOB	SUPPLY OF FABRICATED STRUCTURAL STEEL MATERIALS FROM CUSTOMER APPROVED SHOP INCLUDING PAINTING, TRANSPORTATION TO 4X250 MW, BRBCL NABINAGAR SITE-BIHAR FOR FGD SYSTEM PACKAGE
SL NO	CRITERIA
A	FINANCIAL CRITERIA
1(a)	BIDDER SHOULD HAVE AVERAGE MINIMUM ANNUAL FINANCIAL TURNOVER INR 1169.57 LACS DURING LAST 3 (THREE) YEARS, ENDING ON 31.03.2019 AND HAVING POSITIVE NET WORTH AS ON LATEST AUDITED ACCOUNTS AS SUBMITTED FOR PARA 1(C).
1(b)	BIDDER MUST HAVE EARNED PROFIT IN ANY ONE OF THE LAST THREE FINANCIAL YEARS ENDING ON 31.03.2019. AUDITED BALANCE SHEET AND PROFIT & LOSS ACCOUNT OF THE COMPANY FOR LAST 3 (THREE) FINANCIAL YEARS, ENDING ON 31.03.2019 NEED TO BE SUBMITTED IN SUPPORT OF ABOVE.
1(c)	IN CASE AUDITED BALANCE SHEET AND PROFIT & LOSS ACCOUNT HAS NOT BEEN SUBMITTED FOR ALL THREE YEARS INDICATED ABOVE THEN THE APPLICABLE FINANCIAL AUDITED STATEMENTS SUBMITTED BY THE BIDDERS AGAINST THE REQUISITE THREE YEARS WILL BE AVERAGED FOR THREE YEARS.
1(d)	IF FINANCIAL STATEMENTS ARE NOT REQUIRED TO BE AUDITED STATUTORILY, THEN INSTEAD OF AUDITED FINANCIAL STATEMENTS FINANCIAL STATEMENTS ARE REQUIRED TO BE CERTIFIED BY CHARTERED ACCOUNTANT.
2.0	INDIAN BIDDERS SHOULD HAVE VALID PAN.
B	TECHNICAL CRITERIA
1(a)	BIDDER SHOULD HAVE EXECUTED STRUCTURAL STEEL FABRICATION & SUPPLY WORK Or STRUCTURAL STEEL ERECTION WORK AT POWER /INDUSTRIAL PROJECT HAVING ERECTED STRUCTURAL STEEL QUANTITIES NOT LESS THAN 3774 MT WITHIN A COMMON PERIOD OF TWELVE CONSECUTIVE MONTHS IN CUMULATIVE OF TWO RUNNING/COMPLETED CONTRACTS Or NOT LESS THAN 251 QUANTITIES FOR STRUCTURAL FABRICATION WORK, WITHIN A PERIOD OF TWELVE CONSECUTIVE MONTHS IN ONE RUNNING/COMPLETED CONTRACT , DURING LAST 07 (SEVEN) YEARS ENDING ON THE LATEST DATE OF BID SUBMISSION. BIDDER SHALL FURNISH PURCHASE ORDER COPY/COPIES OR WORK ORDER COPY/COPIES & SUPPORTING DOCUMENTS OF EXECUTED/RUNNING CONTRACTS TO FULFIL THE CRITERIA AS MENTIONED ABOVE AT B 1(a) w.r.t PQR.

NOTE:

a)	TIE UP BIDDING IS ALLOWED. BIDDERS NOT HAVING ANY NTPC APPROVED STRUCTURAL FABRICATION WORK SHOP MAY TIE UP WITH ANY OTHER NTPC APPROVED STRUCTURAL FABRICATION WORK SHOP & MAY PARTICIPATE IN THE BIDDING.
b)	COPY OF LATEST DELIVERY CHALLAN / LATEST RA BILL IS TO BE SUBMITTED IN SUPPORT OF RUNNING PURCHASE ORDER/WORK ORDER. COPY OF SUPPLY COMPLETION CERTIFICATE /WORK COMPLETION CERTIFICATE / INVOICE WITH RECEIPTED CHALLAN IS TO BE SUBMITTED IN SUPPORT OF COMPLETED PURCHASE ORDER /WORK ORDER. COPY OF ANY ADDITIONAL DOCUMENT REQUIRED IN SUPPORT OF THE ABOVE DOCUMENTS TO ESTABLISH THE CORRELATION BETWEEN THE ABOVE DOCUMENTS AND THE SUPPLIED/EXECUTED ITEMS SHALL BE PROVIDED BY THE BIDDER.
c)	BIDDER TO SUBMIT ALL SUPPORTING DOCUMENTS IN ENGLISH. IF DOCUMENTS SUBMITTED BY BIDDER ARE IN LANGUAGE OTHER THAN ENGLISH, A SELF-ATTESTED ENGLISH TRANSLATED DOCUMENT SHOULD ALSO BE SUBMITTED.
d)	NOTWITHSTANDING ANYTHING STATED ABOVE, BHEL RESERVES THE RIGHT TO ASSESS THE CAPABILITIES AND CAPACITY OF THE BIDDER /COLLABORATORS TO PERFORM THE CONTRACT, SHOULD THE CIRCUMSTANCES WARRANT SUCH ASSESSMENT IN THE OVERALL INTEREST OF BHEL.
e)	AFTER SATISFACTORY FULFILMENT OF ALL THE ABOVE CRITERIA/ REQUIREMENT, OFFER SHALL BE CONSIDERED FOR FURTHER EVALUATION AS PER NIT AND ALL THE OTHER TERMS OF THE TENDER.
f)	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.

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ANNEXURE - 2**FORMAT FOR NO DEVIATION CERTIFICATE**
(To be submitted in the bidder's letter head)

To,
BHARAT HEAVY ELECTRICALS LIMITED,
Power Sector - Eastern Region,
Plot no 9/1, DJ Block, Sector – II, Salt Lake City,
Kolkata – 700 091

SUB	NO DEVIATION CERTIFICATE.	
JOB	SUPPLY OF FABRICATED STRUCTURAL STEEL MATERIALS FROM CUSTOMER APPROVED SHOP INCLUDING PAINTING, TRANSPORTATION TO 4X250 MW, BRBCL NABINAGAR SITE-BIHAR FOR FGD SYSTEM PACKAGE	
REF	1.0	TENDER NO. PSER:PUR:PMX-380(II):107:(ENQ:19:PP:0015:PUR:140) Dated:24/02/2020
	2.0	ALL OTHER PERTINENT ISSUES TILL DATE.

Dear Sir/Madam,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed/ modified the tender documents as appeared in the website/ issued by you and in case of such observance at any stage, it shall be treated as null and void.

We hereby confirm that we have not taken any deviation from tender clauses together with other references as enumerated in the above referred NIT. We hereby confirm our unqualified acceptance to all terms & conditions, unqualified compliance to technical specification, integrity pact (if applicable) and acceptance to reverse auctioning process.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted/uploaded offer/documents in accordance with tender instructions with acceptance of the terms & conditions of the tender by us and as per aforesaid references.

Thanking you,

Yours faithfully,

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

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ANNEXURE - 3**FORMAT FOR SEEKING CLARIFICATION**

JOB	SUPPLY OF FABRICATED STRUCTURAL STEEL MATERIALS FROM CUSTOMER APPROVED SHOP INCLUDING PAINTING, TRANSPORTATION TO 4X250 MW, BRBCL NABINAGAR SITE-BIHAR FOR FGD SYSTEM PACKAGE
TENDER NO.	PSER:PUR:PMX-380(II):107:(ENQ:19:PP:0015:PUR:140) Dated:24/02/2020

SI no	Reference clause of tender document	Existing provision	Bidder's query	BHEL's clarification

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ANNEXURE - 4**CHECK LIST**

NOTE:- Tenderers are required to fill in the following details and no column should be left blank

1	Name and Address of the Tenderer		
2	Details about type of the Firm/Company		
3.a	Details of Contact person for this Tender	Name : Mr/Ms Designation: Telephone No: Mobile No: Email ID: Fax No:	
3.b	Details of alternate Contact person for this Tender	Name : Mr/Ms Designation: Telephone No: Mobile No: Email ID: Fax No:	
4	EMD DETAILS (If applicable)	DD No: Date : Bank : Amount: Please tick (✓) whichever applicable:- ONE TIME EMD / ONLY FOR THIS TENDER	
5	Validity of Offer	TO BE VALID FOR 90 DAYS FROM DUE DATE	
		APPLICABILITY(BY BHEL)	ENCLOSED BY BIDDER
6	Whether the format for compliance with PRE QUALIFICATION CRITERIA (ANNEXURE-I) is understood and filled with proper supporting documents referenced in the specified format	Applicable	YES / NO
7	Audited profit and Loss Account for the last three years	Applicable/Not Applicable	YES/NO
8	Copy of PAN Card	Applicable/Not Applicable	YES/NO
9	Whether all pages of the Tender documents including annexures, appendices etc are read understood and signed	Applicable/Not Applicable	YES/NO
10	Integrity Pact	Applicable/Not Applicable	YES/NO
11	Declaration by Authorised Signatory	Applicable/Not Applicable	YES/NO
12	No Deviation Certificate	Applicable/Not Applicable	YES/NO
13	Declaration confirming knowledge about Site Conditions	Applicable/Not Applicable	YES/NO
14	Declaration for relation in BHEL	Applicable/Not Applicable	YES/NO
15	Non Disclosure Certificate	Applicable/Not Applicable	YES/NO
16	Bank Account Details for E-Payment	Applicable/Not Applicable	YES/NO
17	Capacity Evaluation of Bidder for current Tender	Applicable/Not Applicable	YES/NO
18	Tie Ups/Consortium Agreement are submitted as per format	Applicable/Not Applicable	YES/NO
19	Power of Attorney for Submission of Tender/Signing Contract Agreement	Applicable/Not Applicable	YES/NO

NOTE: STRIKE OFF 'YES' OR 'NO', AS APPLICABLE. TENDER NOT ACCOMPANIED BY THE PRESCRIBED ABOVE APPLICABLE DOCUMENTS ARE LIABLE TO BE SUMMARILY REJECTED.

DATE :

AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

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ANNEXURE-A

1.0	<u>Suspension of Business dealings with Suppliers/ Contractors</u>
1.1	BHEL reserves the right to take action against Suppliers/ Contractors who fail to perform or indulge in malpractices, by suspending business dealings with them.
1.2	Suspension of business dealings with Suppliers/ Contractors could be in the form of following: -- a) Hold within the unit for specific item(s)/ material category(ies)/ type of work(s) for one year. b) Hold within the unit for all item(s)/ material category(ies)/ type of work(s) for two years c) Banning across BHEL for all items/ material category(ies)/ type of work(s) for three years. The Supplier may be either put on hold or banned, as detailed hereinafter on the basis of one or more of the category wise reasons as enumerated hereunder.
1.3	1.3.1 Hold within the unit for a specific item(s)/ material category(ies)/ type of work(s) shall be imposed in the following cases, if i) In the last three consecutive supplies of a specific material category, average quality rating, as provided in the supplier performance rating (SPR) as per SEARP, falls below 80% of the quality weightage. This is irrespective of supplies against PO(s) having single/ multiple delivery schedules. Note: Not applicable in cases for erection works of Power Sector Regions, where separate guidelines for evaluation of capacity of bidders is being followed. ii) Two consecutive delays, for reasons of delay attributed to the Supplier, in execution of the contracts where delay occurred is such that a) prescribed maximum LD time limits of the contracts is exceeded or b) delay period has equaled/ exceeded half the original delivery period specified in the contracts whichever among the above is earlier. iii) a) Overall SPR (Supplier Performance Rating) in that particular Unit in line with SEARP falls below 60% of the specific material category. b) Bids of contractors (in PS-MSX portal) shall not be considered (if average score of last six months falls 60% or below as per guidelines for evaluation of capacity of bidders formula).
1.3.1	

1.3.2	Hold within the unit for all item(s)/material category(ies)/ type of work(s) shall be put in the following cases, if i) Supplier tampers with tendering procedure affecting ordering process. ii) Supplier has misused BHEL documents/ drawings/ technical information or has breached the confidentiality agreement with BHEL. iii) after placement of order, Supplier fails to execute the contract. iv) within warranty period as per contract, Supplier continues to supply low/ less/ non-performing equipment/ services, repetitive failures, remains non-responsive. v) Wherever risk purchase clause (amounting to more than 5% of contract value) has been invoked.
1.4	Banning across BHEL shall be imposed in following cases, if
1.4.1	i) After price bid opening but before placement of order, Supplier withdraws his offer or varies it in any manner within the validity period. ii) "Supplier is found to be responsible for submitting fake/ false/ forged documents, certificates, or information or misrepresentation/ wilful suppression of facts, or has resorted to unethical, illegal means or has forged BHEL documents, certificates etc. for securing business, meeting PQR or for enlistment in BHEL or with customers other than BHEL." iii) In spite of warnings, the Supplier persistently violates or circumvents the provisions of labour laws/ regulations/ rules or other statutory requirements. iv) Supplier is found to be involved in cartel formation or in any other act so as to influence the bidding process or influence the price. v) The Supplier has indulged in malpractices or misconduct such as bribery, corruption and fraud, pilferage, coercion etc. vi) The Supplier is found guilty by any court of law for criminal activity/ offences involving moral turpitude in relation to business dealings. vii) Supplier is found to have obtained any internal information/ documentation of BHEL by unauthorized means. viii) The foreign Principals along with the representing Agent shall be banned together if information submitted by them about their precise relationship, commission/ remuneration etc. payable/ receivable and other particulars as asked by BHEL, as per the extant guidelines regarding dealing with Agents of Foreign Suppliers is found false/ incorrect, at any stage. ix) Supplier has substituted, damaged, failed to return, or unauthorizedly disposed off
1.4.2	A Supplier can also be banned with the approval of Director (E, R&D) provided a direction to this effect has been received from the administrative ministry of the Government.

Note: Above shall be applicable along with **Guidelines for "Suspension of Business dealings with Suppliers/ Contractors"** available in BHEL website <http://www.bhel.com>. These shall form part of tender documents.

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Annexure -BTerms & Conditions of Reverse Auction

Against this enquiry for the subject item/ system with detailed scope of supply as per enquiry specifications, BHEL may resort to "REVERSE AUCTION PROCEDURE" i.e., ON LINE BIDDING (THROUGH A SERVICE PROVIDER). The philosophy followed for reverse auction shall be English Reverse (No ties).

1. For the proposed reverse auction, technically and commercially acceptable bidders only shall be eligible to participate.
2. Those bidders who have given their acceptance for Reverse Auction (quoted against this tender enquiry) will have to necessarily submit 'online sealed bid' in the Reverse Auction. Non-submission of 'online sealed bid' by the bidder for any of the eligible items for which techno-commercially qualified, will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines in vogue.
3. BHEL will engage the services of a service provider who will provide all necessary training and assistance before commencement of on line bidding on internet.
4. In case of reverse auction, BHEL will inform the bidders the details of Service Provider to enable them to contact & get trained.
5. Business rules like event date, time, bid decrement, extension etc. also will be communicated through service provider for compliance.
6. Bidders have to fax the Process Compliance form (**Annexure-III of Business Rule Document of Reverse Auction – shall be shared to bidders along with intimation of RA schedule**) before start of Reverse auction. Without this, the bidder will not be eligible to participate in the event.
7. In line with the NIT terms, BHEL will provide the calculation sheet (e.g., EXCEL sheet) which will help to arrive at "Total Cost to BHEL" like Packing & forwarding charges, Taxes and Duties, Freight charges, Insurance, GST and loading factors (for non-compliance to BHEL standard Commercial terms & conditions) for each of the bidder to enable them to fill-in the price and keep it ready for keying in during the Auction.
8. Reverse auction will be conducted on scheduled date & time.
9. At the end of Reverse Auction event, the lowest bidder value will be known on auction portal.
10. The lowest bidder has to fax/e-mail the duly signed and filled-in prescribed format for price breakup including that of line items, if required, (**as per Annexure-IV of Business Rule Document of Reverse Auction**) as provided on case-to-case basis to Service provider within two working days of Auction without fail.
11. In case BHEL decides not to go for Reverse Auction procedure for this tender enquiry, the Price bids and price impacts, if any, already submitted and available with BHEL shall be opened as per BHEL's standard practice.
12. Bidders shall be required to read the "Terms and Conditions" section of the auctions site of Service provider, using the Login IDs and passwords given to them by the service provider before reverse auction event. Bidders should acquaint themselves of the 'Business Rules of Reverse Auction', which will be communicated before the Reverse Auction.
13. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action as per extant BHEL guidelines, shall be initiated by BHEL and the results of the RA scrapped/ aborted.
14. The Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party.
15. In case BHEL decides to go for reverse auction, the H1 bidder (whose quote is highest in online sealed bid) will not be allowed to participate in further RA process provided minimum three bidders are left after removal of H1 bidder. In case of tie for H1 bid (identical online sealed bids), 15 minutes' additional time shall be provided and all the participating bidders shall be informed by mail/message on bidding screen to enable bidders submit revised online sealed bids so as to break the tie.
16. In case H1 bidder happen to be MSE and was removed from further bidding but is within L1 + 15% band, then this bid shall also be considered and to be processed in line with 'Public Procurement Policy for Micro & Small Enterprises (MSEs) order, 2012'.

पावर सेक्टर पूर्वी क्षेत्र (मुख्यालय)

POWER SECTOR EASTERN REGION, DJ-9/1, SECTOR-II, SALT LAKE CITY, KOLKATA - 700 091

फैक्स/Fax : +91 33 23211960

फोन/Phone : बोर्ड/EPABX : +91 33 23398000, Dir: +91 33 23211690

Annexure -C**Certificate by Chartered Accountant on letter head**

This is to to Certify that M/S,
(hereinafter referred to as 'company') having its registered office at
..... is registered under MSMED Act 2006, (Entrepreneur
Memorandum No (Part-II) dtd:.....,
Category:..... (Micro/Small)). (Copy enclosed).

Further verified from the Books of Accounts that the investment of the company as per the latest audited financial year as per MSMED Act 2006 is as follows:

1. **For Manufacturing Enterprises:** Investment in plant and machinery (i.e. original cost excluding land and building and the items specified by the Ministry of Small Scale Industries vide its notification No.S.O.1722(E) dated October 5, 2006 :
Rs.....Lacs
2. **For Service Enterprises:** Investment in equipment (original cost excluding land and building and furniture, fittings and other items not directly related to the service rendered or as may be notified under the MSMED Act, 2006:
Rs.....Lacs

(Strike off whichever is not applicable)

The above investment of Rs.....Lacs is within permissible limit of Rs.....Lacs for Micro / Small (Strike off which is not applicable) Category under MSMED Act 2006.

Or

The company has been graduated from its original category {Micro/ Small} (Strike off which is not applicable) and the date of graduation of such enterprise from its original category is (dd/mm/yyyy) which is within the period of 3 years from the date of graduation of such enterprise from its original category as notified vide S.O. No. 3322(E) dated 01.11.2013 published in the gazette notification dated 04.11.2013 by Ministry of MSME.

Date:

(Signature)

Name-

Membership number-

Seal of Chartered Accountant

पावर सेक्टर पूर्वी क्षेत्र (मुख्यालय)

POWER SECTOR EASTERN REGION, DJ-9/1, SECTOR-II, SALT LAKE CITY, KOLKATA - 700 091

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ANNEXURE-E

<u>State wise GST Registration nos.</u>		
Sl. No.	State / UT	GST Reg. No.
1	Andhra Pradesh	37AAACB4146P7Z8
2	Assam	18AAACB4146P1ZE
3	Bihar	10AAACB4146P1ZU
4	Chandigarh	04AAACB4146P1ZN
5	Chattishgarh	22AAACB4146P1ZP
6	Daman & Diu	25AAACB4146P1ZJ
7	Delhi	07AAACB4146P1ZH
8	Gujarat	24AAACB4146P1ZL
9	Haryana	06AAACB4146P1ZJ
10	HP	02AAACB4146P1ZR
11	Jharkhand	20AAACB4146P5ZP
12	Karnataka	29AAACB4146P1ZB
13	Kerala	32AAACB4146P1ZO
14	Maharashtra	27AAACB4146P1ZF
15	MP	23AAACB4146P1ZN
16	Punjab	03AAACB4146P2ZO
17	Rajasthan	08AAACB4146P1ZF
18	Tamil Nadu	33AAACB4146P2ZL
19	Telangana	36AAACB4146P1ZG
20	Tripura	16AAACB4146P1ZI
21	UP	09AAACB4146P2ZC
22	Uttarakhand	05AAACB4146P1ZL
23	West Bangal	19AAACB4146P1ZC
24	Mizoram	15AAACB4146P1ZK
25	Orissa	21AAACB4146P1ZR
26	Arunachal Pradesh	12AAACB4146P1ZQ

पावर सेक्टर पूर्वी क्षेत्र (मुख्यालय)

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[Annexure- CPP-GST/I](#)**Please arrange to submit this filled-up format along with Tender**

Name of the Company	
Address of Company*	
Company Registration Number*	
Name of Partners / Directors	
ALL THE STATES WHERE BIDDER HAS A PLACE OF BUSINESS*	
ALL ADDRESS OF VENDOR MENTIONING THEIR PIN AS PER THE LATEST GST REGISTRATION*	
GSTN OF ALL THE ABOVE NOTED PLACES OF VENDOR*	
Bidder Type: Indian/ Foreign*	
City*	
State*	
Country*	
Postal Code*	
PAN/TAN Number*	
Company's Establishment Year	
Company's Nature of Business*	
Company's Legal Status* {limited /undertaking/joint venture/partnership/other}	
Company Category* {micro unit as per MSME/small unit as per MSME/medium unit as per MSME/Ancillary unit/project affected person of this company/ssi/ other}	
Enter Company's Contact Person Details	
Title(Mr. / Mrs. / Ms. / Dr. / Shri)*	
Contact Name*	
Date Of Birth*	
Correspondence Email*	
(Correspondence Email ID can be same as your Login ID. All the mail correspondence will be sent only to the Correspondence Email ID.)	
Designation	
Phone*	
Fax*	
Mobile*	

पावर सेक्टर पूर्वी क्षेत्र (मुख्यालय)

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PRICE SCHEDULE (UNPRICED)- VOLUME-III

PLEASE REFER

E-PROCUREMENT PORTAL <https://bhel.abcpurchase.com>

पावर सेक्टर पूर्वी क्षेत्र (मुख्यालय)

POWER SECTOR EASTERN REGION, DJ-9/1, SECTOR-II, SALT LAKE CITY, KOLKATA - 700 091

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PRICE SCHEDULE - VOLUME-III

PLEASE REFER

E-PROCUREMENT PORTAL <https://bhel.abcprocure.com>

**ABOVE TO BE READ ALONG WITH PREAMBLE AND SCHEDULE-2
(WEIGHTAGE) OF PRICE SCHEDULE (VOLUME-III)**

पावर सेक्टर पूर्वी क्षेत्र (मुख्यालय)

POWER SECTOR EASTERN REGION, DJ-9/1, SECTOR-II, SALT LAKE CITY, KOLKATA - 700 091

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VOLUME-III PRICE SCHEDULE, REV-0	
JOB:SUPPLY OF FABRICATED STRUCTURAL STEEL MATERIAL FROM CUSTOMER APPROVED SHOP INCLUDING PAINTING, TRANSPORTATION TO SITE ETC. OF FGD SYSTEM PKG FOR 4X250 MW, BRBCL NABINAGAR TPP, BIHAR .	
TENDER NO. PSER:PUR:PMX-380(II):107:(ENQ:19:PP:0015:PUR:140) Date:24/02/2020	
PREAMBLE	
SL NO	DESCRIPTION
1.0	This preamble forms part of tender document and schedule of items. The tenderer should read this preamble carefully before filling in rates for various items. Clauses under this preamble shall be read in conjunction with various volumes of tender and other tender sections as applicable and shall have precedence over any contrary statement mentioned any where in this document.
2.0	The job shall be carried out strictly as per specifications, description of the items in these schedule and / or engineer's instructions. Drawings enclosed with the tender are only preliminary and for tender purposes and giving some idea of the job involved. The job is to be executed as per drawings & documents, which shall be furnished during execution.
3.0	Items of job provided in this schedule but not covered in this specification shall be executed strictly as per instruction of the engineer.
4.0	Unless specifically mentioned otherwise in the tender document, the tenderer shall quote for the finished items and shall provide for the complete cost towards power, fuel, tools, tackles, equipment, constructional plants, temporary works, labour, dismantling of all temporary piping, structures, valves, pumps, tanks & other misc. equipment, strengthening of roads/culverts/bridges etc. including arranging all clearances etc. required for carrying out different activities & tests, materials, levies, transport, layout, repairs, rectification, maintenance till handing over, supervisions, colonies, shops, establishments, overheads, profits and all incidental items not specifically mentioned but reasonably implied and necessary to complete the job according to the complete tender document and this schedule.
5.0	The quantities of the various items mentioned in this schedule of items are approximate, based on very preliminary information and may vary to any extent or be deleted altogether. The quoted rates of each item will remain firm throughout the period of execution including extension, for reasons whatsoever, as long as variation in the total value of job executed under any part of this contract including extra items, if any but excluding any price variation remains, within plus minus thirty percent ($\pm 15\%$) of the awarded price as per LOI.
6.0	Prior written approval of BHEL shall be sought by the contractor in case quantity variation of any item crosses +50% (plus fifty percent) limit during execution, an approval to be obtained before execution of further quantity for this item.
7.0	In case Sealed /Paper Price Bids are opened for finalisation of the tender, for any Item Rate/BOQ based contract, possibility of variation of quantity/ addition/deletion of items can not be ruled out. Under such circumstances, after execution of job, if it is observed that standing as L-1 is changed based on actual quantity executed, the bidder shall give suitable rebate to maintain standing as L-1. Since this aspect can be assessed at the end of execution, necessary adjustment will be effected at the end of execution in final bill. This condition shall not be applicable where the tender is finalised through Reverse Auction.
8.0	BHEL reserve the right to rationalize the rates, quoted by L-1 bidder against unit rate items and/ or other optional items with respect to item-wise lowest rates (amongst the participating bidders), before placement of order.
9.0	Rates shall be quoted in figures and in words in clear legible writing. No overwriting is allowed. All scoring and cancellations should be countersigned and in case of illegibility the interpretation of engineer shall be final. All entries shall be in English language.
10.0	All jobs item wise shall be measured upon completion and paid for at the rates quoted and accepted as per BHEL approved payment schedule/billing break-up.
11.0	The tender shall be deemed to have visited site and made himself aware of all the site conditions, studied the specifications and details of job to the done within the time schedule attached and to have acquainted himself of the conditions prevailing at site.
12.0	No splitting of the job is envisaged. Decision of BHEL in this regard shall be final and binding to the bidders.
13.0	Bidders are not allowed to alter the Price Schedule format including item description, quantity etc. and the offer is liable for rejection if the bidders submit their prices in Price Schedules modified by them. BHEL reserves the right to reject the offers of bidders who submit offers in Price Formats which are modified/ altered by them. Also putting any comments instead of rates/price in the designated column of the rate schedule shall make the offer liable for rejection.
14.0	BHEL decision shall be final and binding on the contractor regarding clarification of items in the schedule with respect to the other sections/volumes of the contract.
15.0	No interest, whatsoever, shall be payable by BHEL on the security deposit, any bank guarantee submitted or any amount due to successful bidder/contractor.
16.0	Size and weights of various items are mentioned in the attached BOQ cum rate/price schedule for reference purpose only & these shall not be taken into consideration for quoting/calculating amount in the rate schedule. These shall be utilised as per relevant sections of tender.
17.0	Bidder's Total price for supply of fabricated structural steel material shall be considered for evaluation unless stated otherwise.

VOLUME-III PRICE SCHEDULE, REV-0			
JOB:SUPPLY OF FABRICATED STRUCTURAL STEEL MATERIAL FROM CUSTOMER APPROVED SHOP INCLUDING PAINTING, TRANSPORTATION TO SITE ETC. OF FGD SYSTEM PKG FOR 4X250 MW, BRBCL NABINAGAR TPP, BIHAR .			
TENDER NO. PSER:PMX-380(II):107:(ENQ:19:PP:0015:PUR:140) Date:24/02/2020			
SCH-1 : TOTAL PRICE			
SL NO	DESCRIPTION	PRICE SCHEDULE REF	TOTAL PRICE (IN INR)
1.0	TOTAL PRICE FOR JOB:SUPPLY OF FABRICATED STRUCTURAL STEEL MATERIAL FROM CUSTOMER APPROVED SHOP INCLUDING PAINTING, TRANSPORTATION TO SITE ETC. OF FGD SYSTEM PKG FOR 4X250 MW, BRBCL NABINAGAR TPP, BIHAR .	SCH 2 - PRICE BREAK UP	IN FIGURES:- IN WORDS:-
NOTE			
1.0	Bidder shall quote total price for SCH-1 Part only at SI No. 1 above. All other amounts / rates of each item of job in respective schedules / parts will be derived based on allocated percentages. As such, any uncalled figure/ amount noted at any other place / schedule of Volume-III will not be recknoed & will stand null & void.		
2.0	Bidder to note that total price at SI No. 1 above shall be considered for evaluation & awarding. As such , total price should be complete in all respect for the full scope defined and considering all terms and conditions.		
3.0	Bidder's quoted total price of SCH-1 at SI. No 1 above, shall be apportioned into amount of various items of job based on allocated percentages against respective item, in respective schedules / parts. As such, bidder shall not indicate / quote any amount / rate in these schedules / parts and any amount / rate quoted against any item shall not be taken into cognizance / account and offer may be liable for rejection.		
4.0	Based on the itemwise percentage allocations, the amount for the individual items of the Bill of Quantity shall be arrived at. The rates of individual items shall be derived from the amount against each items and its quantity after rounding off to upto 2 decimal places. However, RA bill payment shall be done after rounding off the gross amount to two decimal points. Any adjustment, if required, due to such methodology, will be effected / adjusted in final bill.		
5.0	Bidders to note that this is an item rate contract. Payment shall be made for the actual quantities of job executed at the unit rate arrived at as per SI No.4 above.		
6.0	Any item as per scope of job, if not included in the price quoted above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.		
7.0	Price format shall not be changed by bidder in any case and it may lead to cancellation of their offer.		
8.0	The quoted price shall be excluding GST but including transportation charges on FOR site basis.		
9.0	The quantity of items may vary during execution mainly due to actual requirement etc. The unit rates work out from the overall amount quoted & accepted by BHEL shall be considered and no separate unit rates shall be allowed. Unit rates shall be valid throughout the contract period.		

VOLUME-III PRICE SCHEDULE, REV-0				
JOB:SUPPLY OF FABRICATED STRUCTURAL STEEL MATERIAL FROM CUSTOMER APPROVED SHOP INCLUDING PAINTING, TRANSPORTATION TO SITE ETC. OF FGD SYSTEM PKG FOR 4X250 MW, BRBCL NABINAGAR TPP, BIHAR .				
TENDER NO. PSER:PUR:PMX-380(II):107:(ENQ:19:PP:0015:PUR:140) Date:24/02/2020				
SCH-2 : PRICE BREAK UP				
ST NO.	ITEM DESCRIPTION	UNIT	QTY.	WEIGHTAGE
2300	STRUCTURAL STEEL			
	STRUCTURAL WORKS: Structural steel works including all labour, material (unless otherwise specified in BOQ/contract specification), equipments unless otherwise specified, transportation, handling etc. at all level as per specification, drawings and as directed by engineer - in - charge for the following:			
B2301	Supply, fabrication (shop fabricated in customer approved shop as per specification), transportation, from work shop to site etc. of structural steel with mild steel (E250) rolled section / built up section / combination of both (shop connections (factory fabricated) will be welded type and field connections will generally be bolted type unless otherwise specified) conforming to IS:2062 and technical specification, pipes conforming to IS:1161/ IS:1239, chequered plate conforming to IS: 3052, mild steel rounds, monorails, stays, safety chains, ladders, MS grating etc. in columns, beams, gantry girders, bunkers, silos, hoppers, roof trusses, portals, laced purlins, space frames, hangers, struts, monorails, galleries, stiffeners, wall beams, sheeting runners, brackets, stub columns, bracings, cleats, trestles, base plates, splice plates, chequered plate flooring, decking and seal plates, steel frame grid over false ceiling, walkway platforms, ladders, stairs, stringers, treads, landings, hand-rails etc., including blast cleaning, application of primer, intermediate & finish paint as mentioned below and as given in specification, connection design & preparation of fabrication drgs, fabrication, straightening, cutting, bending, rolling, grinding, machining, drilling, welding, electrodes and other consumables, alignment (weight of welds not payable), assembly, edge preparation, preheating (min preheat and interpass temperature of 20° C for welding over 20 mm and upto 40 mm & 66° C for welding over 40 mm and upto 63 mm & 110° C for thickness over 63 mm & use of low hydrogen / radiogenic electrodes), post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, installation of temporary structures, setting column bases, rectification, dismantling and removal of all temporary structures (weight of temporary structures not payable), etc all complete as per technical specification including appointment of a separate agency, approved by BHEL, for review and approval of fabrication drgs, in consultation with BHEL. - Blast cleaning for making surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron and providing with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT, including other associate works etc all complete. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00. -Providing and applying Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique including protection and cleaning, scaffolding etc. all complete as per specification. -Providing and applying Finish Coat of two pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT including protection and cleaning, scaffolding , touchup painting etc. all complete as per specification. This coat shall be applied at shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the BHEL / NTPC.	MT	6110	
C2301	Supply, fabrication (shop fabricated in customer approved shop as per specification), transportation, from work shop to site etc. of structural steel with high strength steel (E350) rolled section / built up section / combination of both (shop connections (factory fabricated) will be welded type and field connections will generally be bolted type unless otherwise specified) conforming to IS:2062 and technical specification, pipes conforming to IS:1161/ IS:1239, chequered plate conforming to IS: 3052, mild steel rounds, monorails, stays, safety chains, ladders, MS grating etc. in columns, beams, gantry girders, bunkers, silos, hoppers, roof trusses, portals, laced purlins, space frames, hangers, struts, monorails, galleries, stiffeners, wall beams, sheeting runners, brackets, stub columns, bracings, cleats, trestles, base plates, splice plates, chequered plate flooring, decking and seal plates, steel frame grid over false ceiling, walkway platforms, ladders, stairs, stringers, treads, landings, hand-rails etc. including blast cleaning, application of primer, intermediate & finish paint as mentioned below and as given in specification, connection design & preparation of fabrication drgs, fabrication, straightening, cutting, bending, rolling, grinding, machining, drilling, welding, electrodes and other consumables, alignment, (weight of welds not payable), assembly, edge preparation, preheating (min preheat and interpass temperature of 120-140° C for welding over 20 mm thickness use of low hydrogen/ radiogenic electrodes), post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, installation of temporary structures, setting column bases, rectification, dismantling and removal of all temporary structures (weight of temporary structures not payable), etc all complete as per technical specification including appointment of a separate agency, approved by BHEL, for review and approval of fabrication drgs, in consultation with BHEL. (Rolled sections, etc. of E250 grade welded to main member of E350 for cleats, grout pipes etc. shall also be measured in this item alongwith E350 grade steel.) - Blast cleaning for making surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron and providing with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT, including other associate works etc all complete. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00. -Providing and applying Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique including protection and cleaning, scaffolding etc. all complete as per specification. -Providing and applying Finish Coat of two pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT including protection and cleaning, scaffolding , touchup painting etc. all complete as per specification. This coat shall be applied at shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the BHEL / NTPC.	MT	180	
TOTAL				

FORMS & PROCEDURES

Form No: F-01 (Rev 00)

OFFER FORWARDING LETTER / TENDER SUBMISSION LETTER

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

Offer Reference No:.....

Date:.....

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : Submission of Offer against Tender Specification No:

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

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

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

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

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

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

Authorised Representative of Bidder

Signature :

Name :

Address :

Place:

Date:

FORMS & PROCEDURES

Form No: F-02 (Rev 00)

DECLARATION BY AUTHORISED SIGNATORY OF BIDDER

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

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration by Authorised Signatory**

Ref : 1) NIT/Tender Specification No:,
2) All other pertinent issues till date

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

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

Yours faithfully,

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

Date:

Enclosed : Power of Attorney

FORMS & PROCEDURES

Form No: F-04 (Rev 00)

DECLARATION CONFIRMING KNOWLEDGE ABOUT SITE CONDITIONS

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

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

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

Ref : 1) NIT/Tender Specification No:
2) All other pertinent issues till date

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

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

Yours faithfully,

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

Date :

Place:

FORMS & PROCEDURES

Form No: F-05 (Rev 00)

DECLARATION FOR RELATION IN BHEL

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

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration for relation in BHEL**

Ref : 1) NIT/Tender Specification No:,

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

Tick(✓) any one as applicable:

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

OR

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

(i)

(ii)

Signature of the Authorised Signatory

Note:

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

BANK GUARANTEE FOR PERFORMANCE SECURITY

Bank Guarantee No:

Date:

To

NAME

& ADDRESSES OF THE BENEFICIARY

Dear Sirs,

In consideration of the Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at BHEL House, Siri Fort, Asiad, New Delhi – 110049 through its Unit at Bharat Heavy Electricals Limited, Power Sector Eastern Region, BHEL Bhawan, Plot No 9/1, DJ Block, Sector-II, Salt lake City, Kolkata – 700091 having awarded to (Name of the Vendor / Contractor / Supplier) having its registered office at _____¹ hereinafter referred to as the 'Contractor/Supplier', which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns), a contract Ref No.....dated ² valued at Rs.....² (Rupees -----)for <Nature of Work>³ (hereinafter called the 'Contract') and the Contractor having agreed to provide a Contract Performance Guarantee, equivalent to% (.... Percent) of the said value of the Contract to the Employer for the faithful performance of the Contract,

we, ..., (hereinafter referred to as the Bank), having registered/Head office at and inter alia a branch at being the Guarantor under this Guarantee, hereby, irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer a maximum amount Rs ----- (Rupees -----)⁴ without any demur, immediately on a demand from the Employer, .

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor/ Supplier in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment thereunder and the contractors/supplier shall have no claim against us for making such payment.

We the bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We BANK further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said Contractor/Supplier from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Contractor/Supplier and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor/Supplier or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Contractor/Supplier or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

This Guarantee shall remain in force upto and including.....⁵ and shall be extended from time to time for such period as may be desired by Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor/Supplier but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof.

Unless a demand or claim under this guarantee is made on us in writing on or before the ⁶ (3 months more than the present date of validity of Bank Guarantee) we shall be discharged from all liabilities under this guarantee thereafter.

We, ... BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

- a) The liability of the Bank under this Guarantee shall not exceed.....⁷
- b) This Guarantee shall be valid up to ⁸
- c) Unless the Bank is served a written claim or demand on or before ⁹ (3 months more than the present date of validity of Bank Guarantee) all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

Any claim or dispute arising under the terms of this document shall only be enforced or settled in the courts of at Kolkata only.

For and on behalf of
(Name of the Bank)

Dated.....

Place of Issue.....

¹ NAME AND ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.

² DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE

³ PROJECT/SUPPLY DETAILS

⁴ BG AMOUNT IN FIGURES AND WORDS

⁵ VALIDITY DATE

⁶ DATE OF EXPIRY OF CLAIM PERIOD

⁷ BG AMOUNT IN FIGURES AND WORDS.

⁸ VALIDITY DATE

⁹ DATE OF EXPIRY OF CLAIM PERIOD

Note:

1. Units are advised that expiry of claim period may be kept 2/3 months after validity date.

2. In Case of Bank Guarantees submitted by Foreign Vendors-

- a. **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.

- b. From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**
- b.1** In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.
- b.2** In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.
- b.3** The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.
- b.4** The BG should clearly specify that the demand or other document can be presented in electronic form.

List of Consortium Banks *

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

* wef 22.03.2016

RTGS DETAILS OF BHEL-PSER FOR EFT BY BIDDER/CONTRACTOR

Form for getting payment through RTGS (Real Time Gross Settlement)

01. Name of Vendor **BHARAT HEAVY ELECTRICALS LTD.**
02. Address **~~BHEL~~ BHEL HOUSE, SIRI FORT, N. DELHI**
03. Vendors Bank A/c Name **BHARAT HEAVY ELECTRICALS LTD.**
04. Vendors Bank A/c No. **11107800029**
05. Name of Bank **STATE BANK OF INDIA**
06. Name of Branch **COMMERCIAL BR., SALT LAKE, SECTOR-V**
07. Branch Phone No. **KOLKATA**
08. City **033-23575666**
09. IFSC Code of the Branch **KOLKATA**
SBIN 0004289

The charges if any for payment through RTGS may be recovered from the Bill submitted by us.

Signature of Authorized Representative of Vendor
के. के. कोआरी / K. K. Coari
उप महाप्रबंधक (वित्त) / Dy. General Manager (Fin)
बी. एच. ई. एल. : पी.एस.ई.आर. : कोलकाता - 700 091
BHEL: PSER / Kolkata-700 091

Confirmation by Banker
with office seal

Note : Incorrect information will create Accounting complications and payment will be delayed

RTGS FORMAT

Form for getting payment through RTGS (Real Time Gross Settlement)

01. NAME OF VENDOR
02. ADDRESS
03. VENDOR'S BANK A/C NAME
04. VENDOR'S BANK A/C NO.
05. NAME OF BANK
06. NAME OF BRANCH
07. BRANCH PH. NO.
08. CITY
09. IFSC CODE OF THE BRANCH

THE CHARGES IF ANY FOR PAYMENT THROUGH RTGS MAY BE RECOVERED FROM THE BILL SUBMITTED BY US.

SIGNATURE OF AUTHORISED REPRESENTATIVE
OF VENDOR WITH DATE & SEAL

CONFIRMATION BY BANKER WITH
OFFICE SEAL

Note : Incorrect information will create accounting complications and payment will be delayed.

INTEGRITY PACT**Between**

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi - 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

and

_____, (description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for _____

_____. The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint Independent External Monitor(s), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1- Commitments of the Principal

1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-

1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.

1.1.3 The Principal will exclude from the process all known prejudiced persons.

1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions:



Section 2 - Commitments of the Bidder(s)/ Contractor(s)

- 2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.
- 2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he/ she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.
- 2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.
- 2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant Indian Penal Code (IPC) and Prevention of Corruption Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
- 2.1.4 Foreign Bidder(s)/ Contractor(s) shall disclose the name and address of agents and representatives in India and Indian Bidder(s)/ Contractor(s) to disclose their foreign principals or associates. The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.
- 2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.
- 2.3 The Bidder(s)/ Contractor(s) shall not approach the Courts while representing the matters to IEMs and will await their decision in the matter.

Section 3 - Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/ Contractor(s) from the tender process or take action as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 4 - Compensation for Damages

- 4.1 If the Principal has disqualified the Bidder from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent Earnest Money Deposit/ Bid Security.
- 4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to

demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee, whichever is higher.

Section 5 - Previous Transgression

- 5.1 The Bidder declares that no previous transgressions occurred in the last 3 years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.
- 5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Section 6 - Equal treatment of all Bidders/ Contractors / Sub-contractors

- 6.1 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors. In case of sub-contracting, the Principal contractor shall be responsible for the adoption of IP by his sub-contractors and shall continue to remain responsible for any default by his sub-contractors.
- 6.2 The Principal will disqualify from the tender process all bidders who do not sign this pact or violate its provisions.

Section 7 - Criminal Charges against violating Bidders/ Contractors /Subcontractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 - Independent External Monitor(s)

- 8.1 The Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.
- 8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.
- 8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality in line with Non- disclosure agreement.
- 8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

Abhijit Pan

- 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

अभिजीत पान / AVIJIT PAN
 उप महाप्रबंधक (क्रय) / Dy. General Manager (PUR)
 (Office Seal) पी.एस.ई.आर / BHEL / PSER
 डी जे - 9/1, सॉल्ट लेक / DJ-9/1, SALT LAKE
 कोलकाता-700 091 / KOLKATA-700 091

Place-----

Date-----



Witness:_____

(Name & Address) _____

उज्ज्वल हाउलादार / Ujjwal Howladar
 वरिष्ठ अभियन्ता (क्रय) / Sr. Engineer (PUR)
 बी. एच. ई. एल. / पी.एस.ई.आर / BHEL-PSER
 डी.जे-9/1, सॉल्ट लेक / DJ-9/1, Salt Lake
 कोलकाता-700 091 / Kolkata-700 091

For & On behalf of the Bidder/

Contractor

(Office Seal)

Witness:_____

(Name & Address) _____

PART – A: GENERAL CONDITIONS OF CONTRACT (GCC)**Volume - IA**

Sl. No.	BHEL STANDARD TERMS	Supplier confirmation	Deviation
01	Our requirement is for <u>use 4X250 MW, BRBCL NABINAGAR SITE-BIHAR</u> Offers are invited to submit in two-parts. <u>Part-I : TECHNICAL-CUM-COMMERCIAL AND UN PRICED BID :</u> Consisting of complete technical details, catalogues, drawings and all commercial terms. (Money values shall not be indicated i.e; un price bid). Following formats are to be filled and submitted in a single cover super scribing as Technical - cum - Commercial and Un Priced Bid, Tender Enquiry No. and Due Date. (i) Technical Specification (Catalogues to be enclosed if any) (ii) BHEL Standard Terms & Conditions (iii) No deviation certificate (Part-D) (iv) Un Price Bid <u>Part-II : PRICE BID</u> Price to be indicated in the format enclosed. (Any preconditions for price will not be accepted and the tender will be rejected). The Technical-Cum-Commercial offer will be opened first, discussed, finalized and only then the price bid of technically acceptable offers will be opened. Tenders will be received up to 15.00 Hours on the said due date. <u>If the vendor submits offer i.e. Technical & Price bid together in single envelope, the offer will be liable for rejection.</u>		
02	If any vendor sought to quote through their agents "They have to inform to BHEL in advance, before opening date. Otherwise the offer will be treated as Unsolicited Offer and same will not be opened".		
03	BHEL keeps its right to reject / load any offer which is having deviations to BHEL Specifications, Standard Terms & Conditions. All the bidders shall submit their offers only by filling the original BHEL tender documents. No other offer will be entertained. In case of Technical-Cum-Commercial bid, copy of the price bid has to be used to indicate commercial terms without price.		
04	Tender shall be strictly in accordance with the tender specifications.		
05	No revision in rates shall be entertained after opening of the tenders.		
06	<u>Warranty /GUARANTEE (As per cl 20.0 of TCC)</u> The material supplied will be covered under 18 MONTHS guarantee. Defects if any found within this period shall be replaced by supplier free of cost within one month notice.		

Sl. No.	BHEL STANDARD TERMS	Supplier confirmation	Deviation
07	Terms of payment : AS PER TECHNICAL CONDITIONS OF CONTRACT (SUPPLY)- VOLUME-IC, R-0 CL. NO.-11.0		
08	TERMINATION OF CONTRACT If at any time during the currency of the order, BHEL comes to conclusion that the tenderer is not discharging his obligations according to the terms of this contract, then BHEL will be at liberty to terminate the contract after giving 07 days' NOTICE BY Regd. A.D. post and the tenderer shall comply with the requirement of such notice.		
09	Liquidated Damage (LD) : It is to be clearly understood among the parties to the contract that the delivery of the goods specified in the purchase order should be made within the time limit prescribed. If the party fails to deliver the stores or any part thereof within the period fixed for delivering the quantity of materials, purchase may without any prejudice to the right of the bidder, make liable to an LD shall be 0.5% of basic value of undelivered portion per week of delay or part thereof subject to a maximum of 10% of the total Contract value(i.e. excluding elements of taxes) For this purpose, the period of delay shall be the delay attributable to the Fabricator for the completion of job as per contract. Contract value for this purpose, shall be the final executed value exclusive of Extra Works, Supplementary/Additional Items and PVC (if any). In case of LD recovery, the applicable GST shall be recoverable from the supplier.		
10	Inspection : BHEL reserves the right to inspect the type, routine and acceptance tests on one sample for each type as per applicable standards. The sample shall be drawn at the rate of one per type and size for every lot offered for inspection. Inspection call has to be raised with a minimum seven days' notice.		
11	TAXES & DUTIES : AS PER TECHNICAL AND SPECIAL CONDITIONS OF CONTRACT (SUPPLY)- VOLUME-IC, R-0 CL. NO.-17.0		
12	The quotation should be valid at least for a period of 90 days from the tender due date of submission for placement of order (extended, if any). Price Variation Clause will not be entertained.		
13	Transit Insurance(As per clause no-14.0 of TCC) Transit insurance charge is to be borne by BHEL. BHEL shall arrange comprehensive MCE insurance policy. The vendor shall be responsible for timely intimation of dispatch particulars to the underwriter and BHEL, failing which the vendor shall be held responsible for the, loss/damage/theft/ of materials during transit. Vendor shall intimate dispatch particulars to the underwriter at the address as mentioned in the PART B before dispatch of the material with copy to BHEL Site office.		

Sl. No.	BHEL STANDARD TERMS	Supplier confirmation	
14	Force Majeure : This force majeure is herein defined as any cause which is beyond the control of the tenderer which they would not have foreseen or with a reasonable amount of diligence could not have foreseen and which subsequently affect the performance of the contract such as SRCC (strike riot and civil commotion), earthquake, flood, acts of god, acts of any government, domestic or foreign including but not limited to war. The tenderer shall not be liable for delay in performing his obligation resulting from any force majeure clause as referred to and/or defined above. The date of completion will be subject to hereinafter provided be extended by a reasonable time even though such cause may occur after tenderer's performance of his obligation has been delayed for other causes.		
15 15.1 15.1.1	Arbitration & Conciliation Arbitration: 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 15.2 herein below or otherwise) in respect of any dispute or difference; arising out of the formation, breach, termination, validity or execution of the Contract; or, the respective rights and liabilities of the Parties; or, in relation to interpretation of any provision of the Contract; or, in any manner touching upon the Contract (hereinafter referred to as the 'Dispute'), then, either Party may, commence arbitration in respect of such Dispute by issuance of a notice in terms of section 21 of the Arbitration & Conciliation Act, 1996 (hereinafter referred to as the 'Notice'). The Notice shall contain the particulars of all claims to be referred to arbitration in sufficient detail and shall also indicate the monetary amount of such claim. The arbitration shall be conducted by a sole arbitrator to be appointed by the Head of the BHEL Power Sector Region issuing the Contract within 60 days of receipt of the complete Notice. The language of arbitration shall be English.		
	The Arbitrator shall pass a reasoned award. Subject as aforesaid, the provisions of Arbitration and Conciliation Act 1996 (India) or statutory modifications or re-enactments thereof and the rules made thereunder as in force from time to time shall apply to the arbitration proceedings under this clause. The seat of arbitration shall be Kolkata (the place from where the contract is Issued). The Contract shall be governed by and be construed as per provisions of the laws of India. Subject to this provision 15.1.1 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.		
15.1.2	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.		
15.1.3	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.		
15.1.4	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		

15.2	Contract by BHEL. 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 available www.bhel.com. The Procedure 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 to this GCC from time to time and confirms that it shall be bound by such amended or modified provisions of the Procedure with effect from the date as intimated by BHEL to it.		
15.3	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.		
16	Jurisdiction : All disputes or differences arising under out of or in connection with the purchase order shall be subject to the exclusive jurisdiction of court at Kolkata.		

17	Rights of BHEL: (A) To withdraw any portion of work/supply and/or to restrict / alter the quantum of work/supply as indicated in the contract during the progress of work/supply and get it done through other agency and/or to suit BHEL's commitment to its customer or in case BHEL decides to advance the date of completion due to other emergency reasons / BHEL's obligation to its customer. (B) To terminate the contract or withdraw portion of work/supply 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/Supplier's poor progress of the work vis-à-vis execution timeline as stipulated in the Contract, backlog attributable to contractor/supplier including unexecuted portion of work/supply does not appear to be executable within balance available (#) period considering its performance of execution. ii) Withdrawal from or abandonment of the work by contractor before completion of the work as per contract. iii) Non-completion of work/Non-supply by the Contractor / Supplier within scheduled completion/delivery period as per Contract or as extended from time to time, for the reasons attributable to the contractor/supplier. iv) Termination of Contract on account of any other reason (s) attributable to Contractor/Supplier. v) Assignment, transfer, subletting of Contract without BHEL's written permission resulting in termination of contract or part thereof by BHEL. vi) Non-compliance to any contractual condition or any other default attributable to Contractor/Supplier. (#) In-case inputs from BHEL/Customer are likely to be delayed or are actually delayed, this delay may also be taken into account while considering balance period available for execution of Contract. (C) Risk & Cost Amount against Balance Work: Risk & Cost amount against balance work shall be calculated as follows: $\text{Risk \& Cost Amount} = [(A-B) + (A \times H/100)]$ Where, A= Value of Balance scope of Work/Supply (*) as per rates of new contract B= Value of Balance scope of Work/Supply (*) as per rates of old contract being paid to the contractor / supplier 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 / supply (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 / Supply for calculating risk & cost amount. Contract quantities are the quantities as per original contract. If, Contract has been amended, quantities as per amended Contract shall be considered as Contract Quantities. Items for which total quantities to be executed have exceeded the Contract Quantities based on drawings issued to contractor from time to time till issue of Termination letter, then for these items total Quantities as per issued drawings would be deemed to be contract quantities. Substitute / extra items whose rates have already been approved would form part of contract quantities for this purpose. Substitute / extra items which have been executed but rates have not been approved, would also form part of contract quantities for this purpose and rates of such items shall be determined in line with contractual provisions. However, increase in quantities on account of additional scope in new tender shall not be considered for this purpose. NOTE: In-case portion of work is being withdrawn, contract quantities pertaining to portion of work withdrawn shall be considered as 'Balance scope of work / supply' for calculating Risk & Cost amount.	

Sl. No.	BHEL STANDARD TERMS	Supplier confirmation	Deviation
	(D) LD against delay in executed work / supply in case of Termination of Contract : LD against delay in executed work / supply shall calculated in line with LD clause as per GCC/SCC/TCC/Special note/any other annexure of tender document (in compliance with order of precedence), for the delay attributable to contractor / supplier. For this purpose, contract value shall be taken as Executed Value of work / supply for the purpose of limiting the maximum LD value. Method for calculation of "LD against delay in executed work / supply" 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 / supplier = T1 ii) Let the value of executed work / supply till the time of termination of contract= X iii) Let the Total Executable Value of work / supply for which inputs/fronts were made available to contractor / supplier and were planned for execution till termination of contract = Y iv) Delay in executed work / supply attributable to contractor/supplier i.e. $T2 = [1 - (X/Y)] \times T1$ v) LD shall be calculated in line with LD clause [as per GCC/SCC/TCC/Special note/any other annexure of tender document (in compliance with order of precedence)] of the Contract for the delay attributable to contractor / supplier taking "X" as Contract Value and "T2" as period of delay attributable to contractor/ supplier. (E) Recoveries arising out of Risk & Cost and LD or any other recoveries due from Contractor Following sequence shall be applicable for recoveries from contractor / supplier on whom risk & cost has been invoked, after informing the contractor / supplier of the total proposed recovery : a) Dues available in the form of Bills payable to contractor / supplier, SD, BGs against the same contract. b) Demand notice for deposit of balance recovery amount shall be sent to contractor/ supplier, if funds are insufficient to effect complete recovery against dues indicated in (a) above. c) If contractor / supplier 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 / supplier against other contracts in the same Region / Unit shall be considered for recovery. ii) If recovery cannot be made out of dues payable to the contractor / supplier 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 / supplier. iii) In-case recoveries are not possible with any of the above available options, Legal action shall be initiated for recovery against contractor / supplier.		
18	DISCOUNTS Discounts offered by the vendor in price shall not be entertained by BHEL. The vendor should factor in his discount in the price offer only. In spite of the same, if a discount is offered by the bidder, the same shall not be considered for evaluation of the offer, but purchase order shall be issued on bidder's final discounted price.		
	LOADING FACTORS FOR DEVIATION TO BHEL STANDARD TERMS & CONDITIONS		
19	Penalty Clause : Non acceptance of LD Clause will attract maximum 10% loading on the offer and accordingly proportionate percentage will be loaded for accepting less percentage of LD clause. Example : If the supplier has accepted for maximum 5% LD clause, then balance 5% will be loaded.		
20	For all other Terms & Conditions, if the offer is not confirming to the same, BHEL at its discretion shall load the same and the loading pattern shall be intimated to the bidders before price bid opening. However BHEL reserves the right to cancel a bid in case of non - acceptance of any terms and conditions finally arrived before price bid opening.		
21	The offers not complying the above Terms & Conditions may not be accepted.		

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SUPPLY OF FABRICATED STRUCTURAL STEEL MATERIAL FROM
CUSTOMER/BHEL APPROVED SHOP INCLUDING PAINTING,
TRANSPORTATION TO SITE ETC AT 4x250 MW, BRBCL NABINAGAR
FGD PROJECT, BIHAR



Bharat Heavy Electricals Limited
(A Govt. of India Undertaking)
Power Sector– Eastern Region
Plot–DJ9/1, Sector-II, Salt Lake
Kolkata-700091

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These Technical conditions for SUPPLY OF FABRICATED STRUCTURAL STEEL MATERIAL FROM CUSTOMER/BHEL APPROVED SHOP INCLUDING PAINTING, TRANSPORTATION TO SITE ETC. FOR FGD SYSTEM PKG ETC OF 4X250 MW, BRBCL NABINAGAR TPP, BIHAR shall be construed as part of tender document and shall be read along with other volumes of tender, i.e. general conditions of contract (GCC), Volume-III etc. and in case of any conflict or inconsistency, the provision of the TCC, "Volume- IC" shall prevail.

All the tender clauses are individually applicable for respective package unless specifically mentioned separately/differently, as applicable.

CLAUSE NO	DESCRIPTION
1.0	NAME OF JOB AND PROJECT SYNOPSIS & GENERAL INFORMATION The scope covers supply of fabricated structural steel materials from Customer/BHEL approved shop including painting, transportation to 4x250 MW, BRBCL Nabinagar Site-Bihar for FGD Package. BRBCL is setting up a coal based 4x250 MW Thermal Power Project at Nabinagar, Dist: Aurangabad, Bihar. 1. OWNER : BHARTIYA RAIL BIJLEE COMPANY LIMITED (BRBCL) 2. PROJECT TITLE : NABINAGAR THERMAL POWER PROJECT 3. PROJECT RATING : 4X250 MW 4. LOCATION : NABINAGAR, DIST-AURANGABAD , BIHAR 5. NEAREST RLY STN : DEHRI-ON-SON (30 KM FROM PROJ ECT LOCATION) 6. NEAREST PORT : PARADIP 7. NEAREST AIRPORT : GAYA (100 KM FROM PROJECT LOCATION) 8. ROAD APPROACH : NH-2 (25 KM FROM PROJECT LOCATION) 9. LATTITUDE : 24°42' 30'' N 10. LONGITUDE : 84°05' 36'' E 11. AVG ELAVATION : 138 MTR. 12. AVG TEMP : 40-50°C DURING SUMMER 13. AVG RAINFALL : 50-75 CM Above information furnished are for general guidance of Contractor. However, Contractor has advised to visit the site and appraise himself about the conditions of site and infrastructure available in the area for fulfilling their commitments under the contract.
2.0	BROAD SCOPE OF JOB
2.1	THE WORK TO BE CARRIED OUT UNDER THE SCOPE OF THESE SPECIFICATIONS IS BROADLY AS UNDER: The scope of supply job under this contract covers procurement of raw material from customer approved supplier, Fabrication and supply of finished product for this Package as per BOM/Drawings, Detailed drawing preparation based on Input design drawings provided by BHEL-Engineering Centers for Flue Gas Desulphurization (FGD) package as specified in scope and getting approval from BHEL Engineering Centers / NTPC, including transportation to BRBCL-NABINAGAR site storage yard of FGD Unit No. # 1, 2,3 & 4 of 4x250 MW Project. Fabrication shall be done at Customer/BHEL approved shop. The scope of work will include but not limited to Structure Steel works for the following buildings / structures of Flue Gas Desulphurization of Unit No. # 1, 2, 3 & 4 of 4x250 MW BRBCL Nabinagar Project:

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	a) Truck Hopper Super Structure Framing and Roofing, b) FGD Control Room Building, MCC Building. c) Ball Mill Building & Lime Stone Storage Building, Transfer Point (TP's), Conveyor and trestle. d) Gypsum Dewatering Building, Crusher House (CR Building), Gypsum Storage Shed. Pent House. e) Misc. Pump & Equipment Shed. f) Flue Duct and Pipe Line Duct Support. g) Pipe & Cable Trestles, Air & Water pipe line Support structure. h) Limestone Storage Silo. i) Misc. Structures, etc.
3.0	SUPPLY OF FABRICATED STRUCTURES :
3.1	The job is to be carried out under the scope of these specifications is broadly as under:
3.2	Preparation of detailed drawings, bill of materials, material codification, obtaining approvals from BHEL Engineering centers / NTPC.
3.3	Joint design calculations and all other general and special requirements, including appointment of a separate agency for the above job, approved by BHEL for review.
3.4	Approval of fabrication drawings from BHEL Engineering centres / NTPC. (Approval of fabrication drawing does not relieve the bidder from the responsibility of its correctness and accuracy).
3.5	All the steel structures need to be fabricated in an established factory, transported to BRBCL Nabinagar site. The factory referred shall be in operation for the last two years from the date of techno-commercial bid opening and should be a BHEL / NTPC approved factory.
3.6	Material required for the fabrication job (excluding Stainless Steel liners which are to be fabricated at site) for the scope i.e. Chq. Plates / MS plates, Flats / beams / channel / , angles etc. have to be arranged by the bidder within his quoted price and all required material to be procured from Main Steel Producers enlisted by NTPC from time to time. Currently, Main Steel Producers enlisted by NTPC are SAIL, JSW Steel Ltd., Jindal Steel & Power Ltd. (JSPL). RINL & Monnet Ispat & Energy Ltd. (for Rolled Section, Long Products), ESSAR Steel (for Flat Product, Steel Plates). Subsequent, if any new Main Steel Producer/s are enlisted by NTPC, they may also be considered for procurement during execution of the contract if proposed by the successful bidder.
3.7	Unloading and Receipt of structural steel raw materials from vehicles of supplier using bidder's own T & P and manpower at bidder's facilities / workshop/ factory, stacking, stock keeping, watch & ward etc.
3.8	Supply of finished materials at site to be as per BOQ of scope of supply work consisting of following:
3.8.1	Fabrication, welding, destructive, non-destructive and any other tests as per approved QP / FQP/ BHEL / NTPC requirement.
3.8.2	All fabricated Steel members shall be blast cleaned and primer coat, intermediate coat and final coat to be applied as per requirement of Technical Specification & Schedule of Item.
3.8.3	Straightening, making cutting plan, cutting, bending, rolling, grinding, drilling, bolting, temporary pre assembly- full length column height (Trial assembly), edge preparation, preheating , post heating, testing of welders, inspection of welds, visual inspection, non-destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing as per erection scheme.

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3.8.4	Preassembly of Columns, Trial assembly of finished material at bidder's works / factory as per BHEL instructions / approved drawings. Trial Pre assembly activity will be at bidder shop or at site as required by BHEL / NTPC by using bidders T&P in his own cost, no separate cost will be paid for Trial Pre assembly activity. Bidders may quote considering all such hidden activity as extra in their quoted price. BHEL may visit for inspecting the Trial Pre assembly activity.
3.8.5	Delivering finished products from works / factory to BRBCL Nabinagar FGD Project site as per BOQ of rate schedule - specification, drawings and instructions of the Engineer.
3.9	BHEL / NTPC may visit fabrication shop for checking eligibility / competency of shop after Techno-commercial bid opening or before start the fabrication job. Approval from BHEL is required before start the fabrication job. In case of any discrepancy observed, bidder shall comply as per BHEL / NTPC requirement at any stage of job.
3.10	The technical requirements for work to be executed under this specification shall be as per BHEL Specification VOLUME: II B SECTION - C SPECIFICATION NO. PE-TS-463-600-001, SPECIFIC TECHNICAL REQUIREMENTS FOR CIVIL, STRUCTURAL & ARCHITECTURAL WORKS and VOLUME: II B SECTION - D (PART I) SUB-SECTION - D 17 SPECIFICATION NO. PE-TS-463-600-C017 FABRICATION OF STRUCTURAL STEEL WORK and other tender documents/Specification/amendments enclosed with this tender document.
3.11	Bidder/Bidder's agency must be possessing established fabrication work shop / factory equipped with all kinds of T & P's and other necessary requirement for supply of finished material as per specification at their own cost Tentative requirement of Factory is stipulated in Annexure -A. All other equipments and T&Ps (if required) for supply of finished material, shall be arranged by Fabricator.
3.12	Inspection of finished product will be conducted as per customer BHEL / NTPC requirement as mentioned in approved Quality Plan.
3.13	Detailed Technical specification for the job is attached with this tender as a separate annexure. Bidder is requested to refer relevant applicable portion.
3.14	Important Notes: • The scope of Permanent / Erection bolts, it is not in Vendor scope. • Supply and fixing of Electro forged gratings is not in bidder scope. • Painting specifications are covered under CI No.31.03.00, Sec VI, Part B, Sub section IV-D of technical specification • All structural steel works including tubular sections shall be painted as per specification. • All factory fabricated structures shall have bolted field connections. • Splice is permitted only for longer length of members and at selected and approved location finalized during detailed engineering. • Price quoted shall be inclusive of ODC Consignment also.

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4.0	SPECIFIC CONDITIONS FOR SUPPLY OF FABRICATED STRUCTURES
4.1	After receipt of Order, Bidder shall discuss with project manager / construction manager of BHEL regarding starting of structural fabrication job. The successful bidder will tie up with approved detailers of BHEL / NTPC for preparation of detailed fabrication drawing, BOM preparation, submission of same to BHEL and getting approval from BHEL / NTPC. Appointed Detailers by the successful bidder will co-ordinate with BHEL-PSER / ISG / PEM / NTPC for approval of drawing and also interact with BHEL for day to day routine co-ordination for any clarification during fabrication. On receipt of approval of detailed drawings, successful bidder will start fabrication job in Customer/BHEL approved "FABRICATION WORKSHOP / FACTORY" in line with approved drawings, specifications and quality plan. Bidder shall mobilize further resources at workshop as per requirement to commence the job of fabrication, testing, shot blasting, painting etc. to match schedule of the project.
4.2	Material required for the job for the completion of entire scope, Chq. Plates / MS plates, Flats / beams / channel / angles etc. (rolled sections) etc. have to be arranged by the bidder. The total quantity of steel required for the job will be calculated from the approved fabrication drawings. BHEL reserves the right to reject any material not found satisfactory.
4.3	The bidder shall procure raw material / components / sub-assemblies only from BHEL / NTPC approved vendors namely from SAIL, RINL or JINDAL or others NTPC approved list for BRBCL Nabinagar site directly and shall be backed up with required correlated test certificates. In case of procurement from Sole Selling Agents / Authorized Dealers of these suppliers, supporting correlated test certificates of manufacture shall be furnished. In the absence of such certificates, tests as per the governing specifications shall be arranged in independent test house / laboratory approved by BHEL / NTPC for BRBCL Nabinagar FGD Project by the bidder at his own cost.
4.4	Items covered under this contract shall be subjected to Inspection / Testing and Quality Surveillance. The inspection agency shall at reasonable times, have access to vendor's works and Quality control records. All reasonable facilities required for carrying out the inspection and testing efficiently, shall be provided by the vendor, free of cost including proper Office space with Desktop Computers/Laptop with Internet facility to BHEL/NTPC/Third Party officials for routine Check-Up and during inspection.
4.5	The method of inspection shall be agreed upon in the Approved "Quality Plan" which shall form part of the contract.
4.6	The bidder shall fully abide by all the clauses of Shop inspection and tests covered in the Technical Specification, attached with this tender. BHEL reserves the right to consider any stage of inspection / test as a "Hold Point", beyond which job shall not proceed without acceptance of that stage.
4.7	The minimum Inspection / Testing requirements shall conform to relevant codes / standards as well as Statutory Regulations applicable, whether or not specifically mentioned in the specification, in addition to those normally carried out by the bidder.
4.8	Unless the Inspection / Test is waived, the inspection agency shall attend the Inspection / Test within 15 days of the date of receipt of notice from the bidder, failing which the bidder may proceed with the Inspection / Test and shall forward duly certified copies of the Inspection / Test Reports. After successful completion of the Inspection / Test or receipt of bidder's Test reports mentioned above, the Inspection agency (BHEL / NTPC / TPIA of BHEL or NTPC shall issue the acceptance certificate

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	within 15 days. Wherever Customer / Consultant "Hold Points" are indicated in the approved Quality Plan an additional 10 days' notice shall be given for Inspection / Testing.
4.9	Before sending written notice to the Inspection Agency, the bidder's own inspection staff should have fully assessed the item/s wrt. Readiness of the same for joint inspection/testing. If the visit of the Inspection Agency proves to be futile on account of the item not being ready for inspection / Testing or the same being rejected to reasons which could otherwise, have been detected during bidder's own Inspection / Test, the cost incurred by Inspection Agency on such visits shall be borne by the bidder.
4.10	Approval or passing of Inspection / Test and thereby issue of the acceptance Certificates or waive of Inspection by the Inspection Agency shall not relieve the bidder of his responsibilities and obligations under the contract and also shall not bind BHEL to accept the item should it, on further tests after receipt at destination, erection / commissioning be found not complying with the Contract.
4.11	All necessary documents such as test reports, test certificates, test curves, stress relieving charts, radio graphic films and other non-destructive tests, copies of the welding procedure, welder qualification certificates and other documents in support of adherence to Quality plan shall be furnished to the Inspection agency. The Quality Assurance document consisting of certified copies of all of the above complied sequentially by the bidder shall be sent to BHEL prior to dispatch.
4.12	The vendor shall provide test pieces as required by Inspection agency to enable him to determine the Quality of Material supplied under the contract. If any test piece fails to comply with the requirements the inspection agency may reject the whole material represented by the test piece.
4.13	If considered necessary by Inspection Agency, multiple assemblies shall be fully erected and tested at Vendor's work prior to packing and dispatch to site.
4.14	In the event of inspection revealing poor quality of goods, BHEL shall be at liberty to specify additional Inspection / Test, required ascertaining bidder's compliance with the equipment specification.
4.15	All welding shall be carried out in accordance with applicable codes or approved equal. Welding procedure and Welder's qualification shall be got approved. Welding consumables etc. used shall be approved by the BHEL / NTPC. Approved methods of radiographic, ultrasonic or other non-destructive testing as applicable shall be used for the welding of critical components / assembly.
4.16	None of the item shall be dispatched without the receipt of "Quality Surveillance Note" from the Inspection Agency as well as the written approval in the form of Material Dispatch Clearance Certificate (MDCC) unless specifically agreed.
4.17	All supplied fabricated structures shall be marked with clearly identifiable erection mark numbers as shown in the fabrication/ detailed drawings. This will be duly verified at site during material receipt based on which MRC shall be prepared.
4.18	The affixing of Inspection Stamp on the item by the Inspection Agency is for the purpose of identification only and shall not be considered as a token of acceptance.
4.19	To address any mismatch during erection stage, the successful bidder shall deploy a technical person on continuous basis at site for proper co-ordination with various agencies so that problem is attended / rectified without any time gap.
4.20	The above conditions are equally applicable to the agency on which the vendor has sub ordered as it shall be construed as if the works are manufactured or assembled at Vendor's own premises of works.
5.0	MATERIAL DESPATCH CLEARANCE CERTIFICATE (MDCC)
5.1	MDCC for Supply of Fabricated Structures to be issued by customer / BHEL before

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	supply of finished material.
5.2	When the tests have been satisfactorily completed at the Seller / Bidder's workshop, the Inspection Agency shall issue a certificate to that effect within fifteen (15) days after completion of tests, but if the tests were not witnessed by the Inspection Agency or his representative, the certificate would be issued within fifteen (15) days of the receipt and verification of the test certificates by the Inspection Agency. BHEL / NTPC will issue MDCC to the bidder based on the physical inspection / QS Note / Report / Manufacturer's Test certificate for raw materials with COC (Certificate of conformance) by the bidder.
5.3	Seller / Bidder's shall not dispatch any material before issue of MDCC by BHEL /NTPC.
5.4	The satisfactory completion of these tests or the issue of MDCC, shall not bind BHEL / NTPC to accept the supply of fabricated steel items in case it is found any non-compliance during / after erection / testing with the contract provisions.
5.5	For all category item (Cat -I, II & III), MDCC shall be issued by BHEL / NTPC and it is the responsibility of bidder to collect MDCC from BHEL / NTPC and original MDCC shall be attached with Invoice by bidder for claiming payment from BHEL. Validity of MDCC shall be not more than 60 days. Bidder to arrange for dispatch of the material to site within this period.
5.6	GENERAL INSTRUCTION FOR DISPATCH
5.6.1	Immediately after the shipment is made, necessary shipping / transport documents shall be sent by the vendor in accordance with the instructions of BHEL. The shipping documents / transport documents shall comprise of the following:
5.6.1.1	a) Bill of lading/ Railway Receipt / Lorry Receipt as applicable b) Freight invoice c) FOB/FOR Invoice d) Packing List (No of copies as required) e) Certificate of origin f) Letter to Insurers g) Quality Surveillance Note
5.6.2	Seller / contractor to note that to effect "Sale in Transit", BHEL shall issue "Delivery Note" to the Transporter for transferring the ownership from BHEL to customer (NTPC).
5.6.3	Delivery note shall be carried by transporter along with other dispatch documents.
5.6.4	PACKING
5.6.4.1	The packing shall be in conformity with specification and shall be such as to ensure prevention of damages, corrosion, deterioration, shortages, pilferage and loss in transit or storage.
5.6.4.2	Packing list shall be submitted as per standard format along with advance set of documents for claiming payment which shall also indicate: -
5.6.4.2.1	a) Packing size. b) Gross weight and net weight of each package. c) Contents of the package with quantity of each item separately.
5.5	MODE OF DISPATCH: BY ROAD It is Seller / contractor responsibility to ensure availability of trucks well in advance for dispatch of material to meet contractual delivery requirement and as per instruction of BHEL engineer.
5.6	TRANSPORTATION & FREIGHT CHARGES
5.6.1	Owing to any reason, in case the seller / contractor has to resort to a mode of transport other than what was contemplated, to keep up the delivery / completion schedule incurring extra expenditure, such extra expenditure shall be borne by the

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	seller / contractor.
5.6.2	Freight charges shall be borne by the seller / contractor.
5.7	DISPATCH DOCUMENTS REQUIRED (TO BE FURNISHED BY VENDOR) FOR CUSTOMER BILLING BY PSER
5.7.1	Supplier shall provide the following documents to BHEL-PSER in 4 sets:
	1. Copy of vendor Invoice 2. Copy of Packing List Indicating Quantity / Gross weight/Net Weight and NTPC approved BBU item no. wherever applicable against each item dispatched. 3. MDCC (Original NTPC MDCC, if applicable). 4. CHP issued by NTPC - Original (if applicable). 5. Insurance intimation copy 6. Test certificate / Inspection Reports- Original (For Cat I,II & III packages).
6.0	MATERIAL RECEIPT CERTIFICATE (MRC)
	The bidder shall arrange Material Receipt Certificate (MRC) at project site, duly signed by the BHEL / NTPC Site Engineer, after receipt of the material at site and after it's physical verification.
7.0	SHORTAGES/DAMAGES
	Any shortages or damages during transit, transportation to site, shall be made good by the bidder at his risk and costs, to meet the project schedule. In case of faults / discrepancies in any material, component, assembly, sub-assembly etc., the same shall be supplied / replenished free of cost to enable the erection. Shortages shall also be replenished free of cost.
8.0	QUALITY PLAN
8.1	The Quality Plan is a document, which presents in a tabular form for the Quality checks exercised by the bidder during the various stages of manufacture and dispatch in order to meet the requirements of this specification. This plan details, step by step, the operations, components and characteristics being controlled, method of exercising such controls, the importance (criticality) of the control (critical major or minor) with respect to the requirement of the item, the extent to which the controls are exercised (100% samples, one per heat, etc.). Acceptance norms for the characteristics, method of maintaining records thereof as a proof of having exercised the control successfully, the agency responsible for performing and witnessing the checks and for verifying the records thereof.
8.2	The bidders shall furnish the Quality Plan for approval from BHEL / NTPC. In case the Standard Quality plans are included in tender specification, the bidder shall furnish his Quality Plan strictly in line with the same.
8.3	Copies of Bidder's / Bidder's Collaborators catalogues / drawings / standards / specifications / procedures etc. as mentioned in reference document of the Quality Plan shall be furnished for approval.
8.4	In the Quality Plan, the bidder shall give in detail, the quality control checks exercised by him during the various stages such as: a. All bought out items and incoming material checks carried out at sources and on receipt. b. Process of manufacture i.e. welding, heat treatment etc. c. Manufacture of various components, assemblies and sub-assembly. d. Final Inspection and Testing including Performance Test at shop e. Surface preparation and painting f. Packing, Marking and Despatch.

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	g. Proper Loading on transporting vehicle to reach safely to site.
9.0	INSPECTION OF FABRICATED STRUCTURES
	Inspection of packages shall be carried out by agency as per below Inspection category of packages: 1. Cat I: - Inspection shall be done jointly by NTPC, BHEL & bidder. 2. Cat-II: - Inspection shall be done by BHEL & bidder. 3. Cat-III: - Internal Inspection Reports along with the NDT reports & MTCs for raw materials & Certificate of Compliance shall be furnished by bidder. Please note, for Cat I & II items BHEL reserve the right to carry inspection by themselves or through nominated third party and for Cat-III items BHEL reserve the rights to do random 10% surveillance inspection. For Inspection agency of various items, bidder may refer to Quality Plan. Bidder to raise all inspection calls in BHEL online portal http://cqir.bhel.in only. The nominated TPIA for subject inspection shall be intimated to successful bidder separately.
10.0	CONSIGNEE ADDRESS FOR SUPPLY OF FABRICATED STRUCTURES:
10.1	Details of the Consignee for supply of the fabricated structures shall be intimated by BHEL Site / Project Management Department later during execution.
11.0	TERMS OF PAYMENT
11.1	90 % of basic price of materials supplied against receipt of material at site on pro-rata basis as per approved billing schedule. Documents (required sets) required, as applicable, for such payment are as follows.
11.1.1	GST Complaint Invoice (1 Original + 2 copies)
11.1.2	LR / RR (consignee copy).
11.1.3	Packing list.
11.1.4	BHEL / customer MDCC enclosing QS note, inspection & test certificate, wherever applicable.
11.1.5	Copy of letter, addressed to insurance company intimating dispatch.
11.1.6	Material Receipt Certificate (MRC) (will be issued after receipt of materials and its physical verification at site). Collection of MRC from the site shall be bidder's responsibility.
11.1.7	Guarantee Certificate
11.2	Payment will be made after 45 days after submission of appropriate invoice along with all other required supporting documents to BHEL.
11.4	5 % of the basic price shall be released after completion of Erection and Alignment of respective supplied structures at BHEL site.
11.10	Balance 5% amount shall be retained towards 'Performance Guarantee for Material/Workmanship' and shall become refundable after expiry of Guarantee period, provided all the defects noticed during the guarantee period have been rectified to the satisfaction of BHEL Site Engineer/BHEL Construction Manager, and after deducting all expenses/other amounts due to BHEL under the contract/other contracts entered into by BHEL with them. This portion of the retention amount can be released on commencement of the Guarantee period, on submission of equivalent Bank Guarantee.

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11.11	GST, shall be released to the bidder upon compliance of following: - Bidder declaring such Invoice in his GSTR-1 - Receipt of Goods / services and Tax Invoice by BHEL - Confirmation of payment of GST thereon by bidder on GSTN Portal Above is subject to receipt of goods / service and tax invoice thereof along with bidder declaring invoice in his return and paying GST within timeline prescribed for availing ITC by BHEL.
11.12	Paying Authority shall be Construction Manager, BHEL , Nabinagar FGD Project.
11.13	Supplier shall provide the following documents to BHEL-PSER in 4 sets
11.13.1	Original vendor Invoice
11.13.2	LR copy (Consignee address shall be BHEL BRBCL Nabinagar FGD project site).
11.13.3	Packing list.
11.13.4	Copy of insurance intimation letter / e-mail. (Intimation to Insurance agency to be sent on the same day of dispatch.)
11.13.5	Guarantee certificates in line with PO terms- Original.
11.13.6	MDCC - Copy.
11.13.7	In addition to the above, vendor may furnish mfg. clearance/drg/docs approval date for the purpose of determining contractual delivery for expeditious processing of Invoices.
11.13	CHECKLIST FOR SUBMISSION OF BILLS
11.14.1	Fabricator should ensure that the following documents are submitted for bill processing to avoid any delay in processing of payment:
11.14.1.1	Invoice - duly signed by Fabricator with seal. Fabricator shall submit 100% Invoice.
11.14.1.2	Invoice Annexures - duly signed by Fabricator with seal.
11.14.1.3	GST Invoice - Original for buyer and Duplicate for transporter copies
11.14.1.4	Original Inspection Reports (IRs) - with relevant painting/SB remarks and ODC details (if applicable) - duly signed by BHEL QC inspector and Fabricator with seal.
12.0	EXTENSION OF TIME FOR COMPLETION
12.1	If the completion of job as detailed in the scope of job gets delayed beyond the contract/ completion period, the bidder shall request for an extension of the contract and BHEL at its discretion may extend the contract.
12.2	Based on the reviews jointly signed, the scope balance at the end of original contract period less the backlog attributable to the bidder shall be quantified, and the number of days of 'Time extension' required for completion of the same shall be jointly worked out. Within this period of 'Time extension', the bidder is bound to complete the portion of backlog attributable to the bidder. Any further 'Time extension' or 'Time extensions' at the end of the previous extension shall be worked out similarly.
12.3	However, if any 'Time extension' is granted to the bidder to facilitate continuation of job and completion of contract, due to backlog attributable to the bidder alone, then it shall be without prejudice to the rights of BHEL to impose penalty / LD for the delays attributable to the bidder in addition to any other actions BHEL may wish to take at the risk and cost of bidder.
12.4	A joint programme shall be drawn for the balance quantity of job to be completed during the period of 'Time Extension'. Review of the programme and record of shortfall shall be done.

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12.5	At the end of total job completion as certified by BHEL engineer, and upon analysis of the total delay, the portion of time extensions attributable to (i) bidder, (ii) Force majeure conditions, and (iii) BHEL, shall be worked out and shall be considered to be exhausted in the same order. The total period of time extensions shall be the sum of (i), (ii) and (iii) above and shall be equal to period between the scheduled date of completion and the actual date of completion of contract. LD shall be imposed/ levied for the portion of time extensions attributable to bidder and recoverable from the dues payable to the bidder.
13.0	SECURITY DEPOSIT (SD)
13.1	Security Deposit is not applicable for this contract.
14.0	TRANSIT INSURANCE
14.1	BHEL shall arrange comprehensive MCE (marine cum erection) Insurance Policy for total project supply & services including balance of plant package covering transit risks & loss, destruction or damage during handling at Site, Storage, civil works ,erection, testing and commissioning up to trial operation completion of unit including theft, sabotage, fire, lightning and other natural calamities.
	Prior dispatch intimation shall be issued to Insurance agency about the value of consignment, dispatch details, along with one set of documents consisting of LR/RR copy, packing list / Challan indicating the items dispatched (with their weights.) A copy of above should be sent to BRBCL Nabinagar FGD site office (address same as consignee address).
14.2	Contractor shall report to BHEL in writing any damages to equipment/components in transit to site. The above report shall be as prescribed by BHEL site management. Any consequential loss arising out of non-compliance of this stipulation will be borne by contractor.
14.3	In case the damage/loss/theft of materials are attributable to negligence/failure in discharging the duties and obligations of the contractor, the expenses incurred for repair/replacement of such components in excess of the amount realized from the underwriters, limited to Normal Excess (Deductible Franchise) shall be recovered from the contractor.
14.4	Other conditions of Insurance shall be as per relevant clause of GCC.
15.0	COMPLETION PERIOD
15.1	Total pre-fabricated structural steel Supply to erection site i.e. BRBCL Nabinagar TPP pertaining to FGD, Lime Storage System (LSS) ,Gypsum Storage System (GSS) and all other structures etc. to be completed by 10 (Ten) Months from date of Commencement of contract period .
15.2	The job under the scope of contract will be deemed to be completed in all respects only when all the components are erected and alignment completed successfully. The decision of BHEL shall be final and binding on the bidder.
15.3	Fabrication schedule / sequence shall be furnished by bidder before start of fabrication job and same shall be approved by BHEL in concept of as per site erection sequence. BHEL has right to change this fabrication schedule at any stage as per the requirement of project.

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16.0	TIME SCHEDULE
16.1	MOBILIZATION (FOR SUPPLY) FOR COMMENCEMENT OF WORK
16.1.1	After receipt of Purchase Order, Fabricator shall discuss with project manager / construction manager regarding initial mobilization. The successful bidder will tie up with approved detailers of BHEL/NTPC for preparation of detailed fabrication drawing, submission of same to BHEL ENGINEERING DIVISION and approval from them. Appointed Detailers by the successful bidder will co-ordinate with BHEL ENGINEERING DIVISION/NTPC for approval of drawing and day-to-day routine co-ordination with site team(Bidder/BHEL/NTPC) for any clarification during fabrication & erection.
16.2	COMMENCEMENT OF CONTRACT PERIOD
16.2.1	Commencement of contract period shall be considered as Fifteen Days (15 Days) from date of issue of letter of intent (LOI)/Purchase Order or from the date of issuance of approved design drawing to contractor, whichever is later. The contractor has to subsequently augment his resources in such a manner that the entire work is completed as per the completion period.
16.3	A bar chart showing various milestones to be submitted by the bidder within 15 days from date of LOI to BHEL PMX/ Site Construction Manager, BHEL site for approval.
17.0	TAXES AND DUTIES
17.1	All taxes excluding GST & BOCW Cess (as specified elsewhere in the tender) but including Charges, Royalties, any State or Central Levy and other taxes for materials if any obtained for the job and for execution of the contract shall be borne by successful bidder and shall not be payable extra by BHEL. Any increase of above at any stage during execution of contract, including extension of the contract, shall have to be borne by successful bidder. Bidder's quoted/ accepted rates/ price shall be inclusive of all such requirements.
17.2	GST along with Cess (as applicable) legally leviable & payable by successful bidder as per GST Law shall be paid by BHEL, extra. Hence, bidder shall not include GST along with Cess (as applicable) in their quoted rates/ price.
17.3	Successful bidder shall furnish proof of GST registration with GSTN Portal covering the services under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by successful bidder on BHEL for this project /job.
17.4	Since GST on output will be paid by BHEL separately as enumerated above, bidder's your quoted rates / price should be after considering the Input Credit under GST law at bidder's end.
17.5	TDS under Income Tax shall be deducted at prevailing rates on gross invoice value from the running bills (RA bills) unless exemption certificate from the appropriate authority / authorities is furnished.
17.6	TDS under GST shall be deducted at applicable rates on gross invoice value from the running bills (RA bills).
17.7	Bidder shall note that GST Tax Invoice complying with GST Invoice Rules (Section 31 of GST Act & Rules referred thereunder) wherein the 'Bill To' details shall encompass following. BHEL GSTN - 20AAACB4146P5ZP. Name - BHARAT HEAVY ELECTRICALS LIMITED Address - Shall be intimated later. Specific details of BHEL GSTN, Name and Address as stated above, have been specified elsewhere in the tender.

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17.8	Successful bidder to intimate immediately on the day of removal of goods (in case of any supply of goods) to BHEL along with all relevant details and send a scanned copy of Tax Invoice to BHEL through following communication mode for enabling BHEL to meet its GST related compliances. Portal address. and Email address - Shall be intimated later. Specific details of above shall be intimated to successful bidder by BHEL at appropriate juncture.
17.9	In case of delay in submission of above mentioned documents on the date of despatch, BHEL may incur penalty / interest for not adhering to Invoicing Rules under GST Law. The same will be liable to be recovered from successful bidder, in case such delay is not attributable to BHEL.
17.10	In case of raising any Supplementary Tax Invoice (Debit / Credit Note), successful bidder shall issue the same containing all the details as referred to in Section 34 read with Section 31 of GST Act & Rules referred there under.
17.11	Successful bidder shall comply with the Time Limit prescribed under the GST Law and rules thereof for raising of the Tax Invoice. If any supply of goods is applicable, successful bidder shall also ensure prompt delivery of goods after dispatch.
17.12	Bidder shall note that in case GST credit is delayed / denied to BHEL due to delayed / non receipt of goods and / or Tax Invoice or expiry of the timeline prescribed in GST Law for availing such ITC, or any other reasons, not attributable to BHEL, GST amount shall be recoverable from successful bidder along with interest levied/ leviable on BHEL, as the case may be.
17.13	Successful bidder shall upload the invoices raised on BHEL in GSTR-1 within the prescribed time as given in the GST Act. Bidder shall note that in case of delay in declaring such invoice in your return and GST credit availed by BHEL is denied or reversed subsequently as per GST Law, GST amount paid by BHEL towards such ITC reversal as per GST law shall be recoverable from the successful bidder along with interest levied / leviable on BHEL.
17.14	Way Bill: Successful bidder to arrange for way bill / e-waybill for any transfer of goods for the execution of the contract. Successful bidder has to make their own arrangement at their cost for completing the formalities, if required, with Issuing Authorities, for bringing materials, plants & machinery at site for execution of the jobs under this contract, Road Permit / Way Bill, if required, shall be arranged by successful bidder and BHEL will not supply any Road Permit/ Way Bill for this purpose.
17.15	Any new taxes & duties, if imposed subsequent to due date of offer submission as per NIT & TCN, by statutory authority during contract period (including extension, if the same is not attributable to you), shall be reimbursed by BHEL on production of relevant supporting document to the satisfaction of BHEL. However, you shall obtain prior approval from BHEL before depositing new taxes and duties.
17.16	Benefits and / or abolition of all existing taxes must be passed on to BHEL against new taxes, if any, proposed to be introduced at a later date.
17.17	Other than above, no taxes & duties are payable.
18.0	PRICE VARIATION COMPENSATION (PVC)
18.1	Price Variation Compensation (PVC) is not applicable for this contract
19.0	OVER RUN COMPENSATION(ORC)
19.1	ORC is not applicable for this contract.

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20.0	GUARANTEE PERIOD
20.1	The successful bidder shall warrant that the fabrications comply fully with the drawings and other technical conditions specified by BHEL. If the fabrications are found defective / mismatch owing to faulty supply / workmanship / incomplete job within a period of eighteen (18) months from the date of dispatch of last consignment, the bidder shall do the necessary repair / rework / rectification or replace the defective items free of cost (including repair materials). In case bidder fails to repair the defective items or replace the defective items within the time specified by BHEL, BHEL may proceed to undertake the repairs of such defective jobs at bidder's risk and cost without prejudice to any other rights.
21.0	LIQUIDATED DAMAGES (LD)
21.1	LD shall be 0.5% of basic value of undelivered portion per week of delay or part thereof subject to a maximum of 10% of the total Contract value (i.e. excluding elements of taxes) For this purpose, the period of delay shall be the delay attributable to the bidder for the completion of job as per contract. Contract value for this purpose, shall be the final executed value exclusive of Extra Works, Supplementary / Additional Items and PVC (if any).
22.0	COMMUNICATION
	The bidder shall be responsible for arranging all communication facilities at office. The bidder's office/work shop must have facilities of communications like Fax, E-mail, and telephone with STD facility etc for time to time communication with BHEL / NTPC.
23.0	ENGINEERING SERVICES
	As part of the overall project management activity, the bidder shall be responsible for proper engineering and coordination activities during various phases of execution of the contract. The bidder shall identify one Engineering Manager with whom BHEL will interact on all matters on coordination between BHEL and the contractors. The Engineering Manager shall be the single point contact person on behalf of the bidder and shall be responsible for all engineering co ordination.
24.0	OTHER TERMS
24.1	WELDING, RADIOGRAPHY AND OTHER NON-DESTRUCTIVE TESTING, POST WELD HEAT TREATMENT
24.1.1	THE SCOPE OF WORK INVOLVES GOOD QUALITY WELDING, NDE CHECKS, POST WELD HEAT TREATMENT ETC. CONTRACTOR'S PERSONNEL ENGAGED SHOULD HAVE ADEQUATE QUALIFICATION ON THE ABOVE WORKS.
24.1.2	THE METHOD OF WELDING WILL BE INDICATED IN THE DETAILED DRAWING/DOCUMENTS. BHEL ENGINEER WILL HAVE THE OPTION OF CHANGING THE METHOD OF WELDING AS PER PROJECT REQUIREMENT.
24.1.3	BEFORE ANY WELDER IS ENGAGED ON WORK, HE SHALL BE TESTED AND QUALIFIED BY BHEL/ CUSTOMER, THOUGH THEY MAY POSSESS THE PREVIOUS CERTIFICATE. BHEL RESERVES THE RIGHT TO REJECT ANY WELDER WITHOUT ASSIGNING ANY REASON. ALL THE EXPENDITURE IN TESTING/QUALIFICATION OF THE CONTRACTOR'S WELDER SHALL BE BORNE BY CONTRACTOR.
24.1.4	UNSATISFACTORY AND CONTINUOUS POOR PERFORMANCE MAY RESULT IN DISCONTINUATION OF CONCERNED WELDER.
24.1.5	THE WELDED SURFACE SHALL BE CLEANED OF SLAG AND PAINTED WITH PRIMER PAINT TO PREVENT RUSTING, CORROSION. FOR THESE CONSUMABLES LIKE PAINT /PRIMER ETC WILL BE IN THE CONTRACTOR'S SCOPE.
24.1.6	WELDING ELECTRODES HAVE TO BE STORED IN ENCLOSURES HAVING TEMPERATURE AND HUMIDITY CONTROL ARRANGEMENTS. THIS ENCLOSURE SHALL MEET BHEL SPECIFICATIONS.

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24.1.7	WELDING ELECTRODES, PRIOR TO THEIR USE, CALL FOR BAKING FOR SPECIFIED PERIOD AND WILL HAVE TO BE HELD AT SPECIFIED TEMPERATURE FOR SPECIFIED PERIOD. ALSO, DURING EXECUTION, THE WELDING ELECTRODES HAVE TO BE CARRIED IN PORTABLE OVENS
24.2	HEAT TREATMENT
24.2.1	FOR THE PURPOSE OF TEMPERATURE RECORDING OF STRESS RELIEVING PROCESS, THERMOCOUPLES HAVE TO BE ATTACHED TO THE WELD JOINT. THE NUMBER OF TEMPERATURE MEASURING POINTS AND LOCATIONS SHALL BE AS PER THE STANDARDS OF BHEL. THERMOCOUPLES HAVE TO BE ATTACHED USING CAPACITOR DISCHARGE TYPE PORTABLE THERMOCOUPLE ATTACHMENT UNIT. CONTRACTOR SHALL ARRANGE SUFFICIENT NUMBER OF THERMOCOUPLE ATTACHMENT UNITS.
24.2.2	CONTRACTOR SHOULD PROVIDE TEMPERATURE INDICATOR / TEMPERATURE RECORDER FOR MEASURING TEMPERATURE DURING PRE-HEATING FOR WELDING OR FOR CONTROLLING TEMPERATURE OF METAL FOR HOT CORRECTION ETC. THE TEMPERATURE RECORDERS SHOULD BE PREFERABLY OF SOLID STATE TYPE.
24.2.3	HEAT TREATMENT MAY REQUIRE TO BE CARRIED OUT AT ANY TIME (DAY OR NIGHT) TO ENSURE THE CONTINUITY OF THE PROCESS. THE CONTRACTOR SHALL MAKE ALL NECESSARY ARRANGEMENTS INCLUDING LABOURER REQUIRED FOR THE SAME AS PER DIRECTIONS OF BHEL.
24.2.4	IN CERTAIN CASES ONLY THE PRE-HEATING OF WELD JOINTS MAY BE CALLED FOR.
24.2.5	FOR WELD JOINTS OF HEAVY STRUCTURAL SECTIONS, IF HEAT TREATMENT IS REQUIRED, THE SAME SHALL BE CARRIED OUT AS PART OF THE WORK.
24.2.6	CHECKING EFFECTIVENESS OF STRESS RELIEVING BY HARDNESS TESTS (BY DIGITAL HARDNESS TESTER OR OTHER APPROVED TEST METHODS AS PER BHEL ENGINEER'S INSTRUCTION) INCLUDING NECESSARY TESTING EQUIPMENTS IS WITHIN THE SCOPE OF THE WORK / SPECIFICATION.
24.2.7	PREHEATING, INTER-PASS HEATING, POST WELD HEATING AND STRESS RELIEVING AFTER WELDING ARE PART OF SCOPE OF WORK AND SHALL BE PERFORMED BY THE CONTRACTOR IN ACCORDANCE WITH BHEL ENGINEER'S INSTRUCTIONS. WHERE THE ELECTRIC RESISTANCE HEATING METHOD IS ADOPTED CONTRACTOR SHALL MAKE ALL ARRANGEMENT INCLUDING HEATING EQUIPMENT WITH AUTOMATIC RECORDING DEVICES, ALL HEATING ELEMENTS, THERMOCOUPLES AND ATTACHMENT UNITS, GRAPH SHEETS, THERMAL CHALKS, & INSULATING MATERIALS LIKE MINERAL WOOL, ASBESTOS CLOTH, CERAMIC BEADS, ASBESTOS ROPES ETC, REQUIRED FOR ALL HEATING AND STRESS RELIEVING WORKS.
24.2.8	ALL THE RECORDED GRAPHS FOR HEAT TREATMENT SHALL BE HANDED OVER TO BHEL/ IBR AUTHORITIES AND DUE CLEARANCES OBTAINED.
24.2.9	RESULTS OF THESE PROCESSES SHALL BE VERIFIED/ VALIDATED AS PER REQUIREMENTS OF BHEL / CLIENT.
24.3	PRESERVATION & PROTECTION OF COMPONENTS
24.3.1	AT ALL STAGES OF WORK, EQUIPMENTS / MATERIALS IN THE CUSTODY OF CONTRACTOR WILL HAVE TO BE PRESERVED AS PER RELEVANT MATERIAL IS CODES.

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24.4	TECHNICAL SPECIFICATION OF CUSTOMER (NTPC) MAY BE FOLLOWED ON ANY CASE RAISED BY CUSTOMER DURING EXECUTION. NECESSARY RECTIFICATION TO BE DONE AT SITE BY BIDDER IN CASE OF ANY MISMATCH OR DEVIATION IN FABRICATED STRUCTURE FROM APPROVED DRAWING OBSERVED DURING ERECTION OF STRUCTURE OTHERWISE DEBIT ACCEPTANCE SHALL BE GRANTED BY BIDDER.
24.5	THE QUOTED RATES SHALL REMAIN FIRM IRRESPECTIVE OF ANY VARIATIONS IN THE INDIVIDUAL QUANTITIES. NO COMPENSATION BECOMES PAYABLE IN CASE THE VARIATION OF THE FINAL EXECUTED CONTRACT VALUE IS WITHIN THE LIMITS OF PLUS (+) OR MINUS (-) 15% OF AWARDED CONTRACT VALUE.
24.6	ALL OTHER TERM & CONDITIONS OF THIS SPECIFICATION SHALL BE GOVERNED BY THE PERTINENT PROVISIONS OF GCC & OTHER VOLUMES OF THIS TENDER, AS APPLICABLE.

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ANNEXURE - A

Tentative requirement for FACTORY for Fabrication of Steel Structures		
S. No	Characteristic	Check List
1.	License	A. Availability of factory registration License ,GST Registration etc.
2.	Quality management	A. Availability of work instruction/procedures for critical activities & its implementations.
3.	Raw material control	A. Incoming raw material acceptance -MTC review records available B. Availability of material correlation/identification procedures & its implementations by hard punching/by record keeping/painting etc C. Storage/stacking of raw material-in organized manner or elevated platform with proper identification
4.	Material handling	A. Availability of EOT crane/ Gantry Crane of required capacity to handle maximum Load required for movement. B. Availability of gantry cranes/Hydra/other handling equipment's capable to handle proposed heaviest component(if required other than EOT crane)
5.	Handling of weld consumables	A. Availability of calibrated baking oven, holding oven & portable ovens (in sufficient quantities) B. Proper storage of weld consumables or racks & other controlled conditions C. Weld consumables handling: Issue/return of electrodes from store properly documented/recorded.
6.	Welding qualification	A. Availability of qualified WPS & PQR B. Availability of sufficient no of qualified welders C. Availability of welder performance monitoring/defect rate monitoring systems
7.	Machinery	A. Availability of sufficient no of SAW welding machines B. Availability of sufficient number of GTAW welding machines C. Availability of sufficient number of welding machinery-SMAW/GTAW/FCAE etc. D. Availability of CNC plasma/torch cutting machines/profile cutting machines E. Availability of PUG/Gas cutting machines F. Availability of radial drilling machine-capacity matching to proposed thickness & size of component G. Availability of weld edge preparation/bevel end cutting machines
8.	Spare/Inspection Area	A. Availability of said levelled floor for trial assembly adequate for proposed size of components with required material handling capacity
9.	NDT/HEAT treatment/hydr/leak test facility	A. Availability of sufficient size covered shed with concrete platform for fabrication activities B. Availability of beam straightening machine C. Availability of DPT/MPI facility-in house /outsourced to other agency D. Availability of RT facility-in house/outsourced (as applicable) E. Availability of UT facility-in house/outsourced (however done inside vendors

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Tentative requirement for FACTORY for Fabrication of Steel Structures		
S. No	Characteristic	Check List
		own works) F. Availability of RT film viewer/dark room, densitometer, reference photograph etc. if RT is done
10.	Professional qualification/quality manpower	A. Availability of qualified & experience manpower for quality B. availability of qualified welding inspectors C. Availability of DP/MPT Level II qualified personal D. Availability of RT level II qualified personal if applicable E. Availability of UT level II qualified personal if required
11.	Testing facility	A. Availability of in house/outsourced testing facilities for chemical testing by spectro/PMI B. Availability of in house/outsourced testing facilities like UTS, % elongation/bend/impact testing /hardness etc. C. Availability of calibrated tape/laser beam instruments to measure long column length for proto /assembly/ D. Availability of calibrated weld gauge, vernier, micrometer & measuring instruments
12.	Surface cleaning & painting	A. Availability of covered shot/grit blasting facility with air compressor, mechanism to segregate fine shot (sieves) shots/grits re-collection mechanism, surface compactor/surface roughness meter etc. B. Availability of in house painting facility (separate covered area) airless gun for painting etc. C. Availability of in house testing facility, paint thickness & paint adhesion

NTPC Limited

(A Government of India Enterprise)



LOT 1A PROJECTS

**PART – B
(DETAILED TECHNICAL SPECIFICATION)**

**SUB-SECTION-IV-D
(CIVIL WORKS)**

**SECTION – VI
TECHNICAL SPECIFICATION
FOR
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE**

BIDDING DOCUMENT NO. : CS-0011-109(1A)-2

PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-IV-D (CIVIL WORKS)

SUB-SECTION-IV-D

CIVIL WORKS

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.00	GENERAL		
1.01.00	This section of the bidding document deals mainly with the technical specification for the design and preparation of detailed drawings, getting the design and drawings approved by the Employer, fabrication, erection and construction of the necessary civil, structural and architectural works associated with the FGD package for Lot-1A. The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, silos, sumps, Limestone storage hopper & shed, Crusher House, Transfer points, Conveyor Galleries, Tunnels, Gypsum storage shed, Chimney, Gypsum dewatering building, Ball Mill building, FGD control room building, Tank Foundations, absorber tower foundation, transformer foundation, MCC Building, finishes, complete architectural aspects, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete FGD package.		
1.02.00	The specifications are intended for the general description of the work, quality and workmanship. The specifications are not, however, intended to cover minutest details and the work shall be executed according to the relevant latest Indian Standard Codes / I. R. S. / I. R. C. specifications. In absence of the above, the work shall be executed according to the best prevailing local Public Works Department practices or to the recommendations of relevant American and British Standards or to the instructions of the Engineer. Some of the relevent I. S. Codes to be followed is mentioned in the Technical Specifications. The Contractor is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Employer in respect of interpretation of any portions of this document.		
1.03.00	Bidder or his agencies engaged as detailer for fabrication drawings should have the experience of detailing for power plant structures or steel plant or Industrial structures like Petro/ Chemical/ Refinery/ Cement/FGD Plant/Coal Handling Plant/Ash Handling Plant etc. The designer responsible for preparation of scope drawings shall review and approve the fabrication drawings prepared by the detailer before releasing them for fabrication.		
2.00.00	Sub QR for Civil Works:		
2.01.00	Bidder or its agency should have in past executed civil and structural works for 500 MW or higher capacity coal based/Lignite based power plant including earthwork in filling involving mechanical compaction and cutting in hard rock, foundations, Bulk material handling plant involving underground storage hopper and underground tunnels.		
2.02.00	Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 2.01.00. The agency being engaged for a particular work should have in the past executed such works of 500 MW or higher capacity plant.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.03.00	For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height.		
2.04.00	In case Bidder or its agency do not meet the requirements at 2.01.00 and the Bidder proposes to engage agency (ies) for civil & structural works on work volume basis (except for Chimney), Bidder or its agency (ies) should have executed such works in the past and the annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, (structural steel fabrication & erection, RCC, earthwork in filling involving mechanical compaction and cutting in hard rock, RCC in underground storage hopper and underground tunnels) for which it is being engaged. Successful Bidder shall finalize the agency (ies) for each work in consultation with Engineer-in-charge at site before engaging them. Design agency for Civil & Steel Structural Works:		
2.05.00	Bidder or its agency (ies) should have carried out the design and detailed engineering of following works: (i) Civil & Structural works associated with at least one bulk material handling plant for 500 MW or higher capacity coal based/Lignite based power plant. (ii) For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height. (iii) Machine foundations such as Mill foundations/ Block foundations.		
2.06.00	Bidder can engage more than one agency (of repute), in case the Bidder itself is not able to meet the requirement at 2.05.00. The design agency (ies) proposed by the Bidder shall be subject to Employer's approval.		
3.00.00	Work Description		
3.01.00	Truck Hopper, Limestone Storage hopper and Underground Tunnel Truck Hopper shall consist of underground portion, which shall be of R. C. C. with structural steel shed covered with permanently Colour coated profiled steel sheets. Limestone storage hopper shall be of RCC with structural steel shed covered with permanently Colour coated profiled steel sheets. The structural arrangement to be adopted for the design and construction of Limestone Storage hopper shall essentially consist of R. C. C. frames spaced at approx. 3.0M centers with R. C. C. wall panels on the sides and R. C. C. raft at the bottom, fixed to the frames. Minimum thickness of R. C. C. raft at bottom shall be 600		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top. The vertical and inclined portion of hopper shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification. Expansion joints shall be provided at a maximum distance of 40m. 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material. Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Side drains and sump shall have removable type steel grating cover. Water proofing / Damp proofing of under ground Truck hopper, Limestone Storage hopper, tunnels and underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments: Chemical injection grouting for inner faces (details as specified elsewhere). Polymer modified cementitious coating on earth side face as per the following : (1) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface. (2) 50 mm thick P. C. C. (1 : 2 : 4 with 10 mm nominal size stone aggregates) shall be provided under the raft i.e. over the lean concrete, followed by polymer modified cementitious coating in two layers (slurry mix application) as per manufacturer's specification. 50 mm thick P. C. C. (1 : 2 : 4) with 10 mm nominal size stone aggregates shall then be laid over the polymer modified cementitious coating before laying the raft. Truck hopper and its gratings shall be designed for movement of front end loader/ bulldozer over them. Bull dozer weight shall be considered as about 35T. The gratings shall be built of min. 200x28mm thick flats in main direction and min.100mm x 20mm thick in secondary direction. No painting/galvanization shall be provided in gratings. However, two coats of Red oxide Primer to be provided immediately after fabrication. Plinth protection along with drains shall be provided along the Hopper complex. However, 5m wide paving shall also be provided around machinery hatches. Earth pressure to be considered for design shall be due to earth pressure at rest (Ko) condition only. Earth pressure due to surcharge intensity of Uniformly Distributed Load (U. D. L) of intensity 2 T / Sq. M. shall be considered in the design. A minimum safety factor of 1.2 against uplift due to ground water shall be ensured during execution and after execution, considering dead weight of the structure to be		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.02.00	0.9 times only, ground water table to be taken at adjoining formation level and soil wedge angle of not more than 15 degrees. Also, FOS against uplift, to be taken as 1.0, considering the dead wt. of structure and soil resting on side projections if any in the vertical plane. Inclined wedge action of soil shall not be considered in this case. Wherever, slope of tunnel exceeds 10°, R. C. C. steps shall be provided for the entire width of each walkway.		
	Overhead / Ground Conveyor Galleries and Trestles		
	Overhead conveyors shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of single rolled steel beam or single channel section (ISMB or ISMC) or plate girder. Horizontal bracings are to be provided at top & bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure. Contractor can also use tubular steel sections for roof truss only of conveyor galleries. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS 1161 and rectangular/square steel sections shall conform to IS 4923. The steel structures using tubular sections shall be designed and fabricated as per IS 806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. The maximum span of overhead gallery shall be limited to 25 meters unless higher span is required due to site conditions, which shall be subject to approval of the Engineer. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made.		
	Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor.		
	The ground conveyors shall be located in suitably enclosed gallery of structural steel consisting of rigid portal frames spaced at regular intervals and suitably braced. Plinth protection along with drains shall be routed along the ground conveyors.		
	For double stream conveyor gallery, two side and one central walkway of width 800 mm and 1100 mm respectively shall be provided. The width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery. Where the slope of walkway is more than 10°, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates and other drainage arrangements as specified elsewhere		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Adequate provision of windows shall be kept on both sides of conveyor gallery as appended in Mechanical Section (Belt conveyor system). Windows shall be provided with wire mesh as specified elsewhere in this specification. Cross - over with chequered plate platform and ladder for crossing over the conveyors shall be provided at approximately every 100 M intervals of conveyor. Crossover shall preferably be located over four-legged rigid trestle location. For railway tracks passing below overhead conveyor gallery and along conveyors, the railway clearances both underground as well as over ground shall have to be adhered to for design, execution and erection of foundations, trestles, galleries etc., so that movement of locomotives and wagons is not hampered in any way during execution and afterwards. However at the location where the overhead conveyor gallery crosses road / rail line, minimum clearance of 8.0m above the road crest / rail top shall be provided. For calculation of material load on moving conveyor, a multiplication factor 1.6 shall be used to take care of inertia force, casual over burden and impact factor etc. Thus material load per unit length of each moving conveyor shall be Rated capacity of conveyor system 1.6 X ----- x F Conveyor Belt Speed Where, F = 1700/1400 for lime & 1250/900 for gypsum It should be noted that for structural design, unit weight of lime shall be assumed as 1700 Kgs. / Cu. M. instead of 1400 Kgs. / Cu. M., unit weight of gypsum shall be assumed as 1250 Kgs. / Cu. M. instead of 900 Kgs. / Cu. M. considered for system sizing purpose. Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously. Conveyor gallery and supporting trestles located between transfer houses / buildings shall be arranged in any one of the following ways. a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.03.00	b) In between transfer houses / buildings, four legged trestles shall be placed at a maximum interval of 90 metres. The arrangement shall be such so as to ensure that force in the longitudinal direction (i. e. along the conveyor length) of conveyor gallery of length not more than 90 m is transferred to any four legged trestle. In the space between each successive four legged trestles, two legged trestles shall be provided at regular intervals. The end supports resting on the four-legged trestle can have either ends hinged or one hinge and the other on slide type depending on the arrangements. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements. End of conveyor gallery which will be supported over transfer house, shall be so detailed that only vertical reaction is transferred from conveyor gallery and no horizontal force in longitudinal direction is transferred from conveyor gallery to transfer house structure and vice - versa. For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and under ground facilities, location and details of these trestles and foundations shall have to be decided such that there is no interference both underground as well as over ground with existing structures and facilities. Trestle columns / ground conveyor portal column base shall be kept 300 mm higher than the existing ground level.		
	Transfer Houses		
	The over ground portion of the transfer house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding (from lowest working floor level till top) and R. C. C. floors comprising of RCC slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. However, the lower portion of side cladding, at ground, for a minimum height of 0.9 m above the finished floor level shall be one brick thick wall plastered on both side. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Contractor shall have option to use tubular steel sections for roof truss only. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with 0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.		
	Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting.		
	The roof of Transfer points shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.04.00	Crusher House			
	The crusher house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding. However, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The lower portion of side cladding, at ground, for a height of minimum 0.9m above the finished floor level shall be of one brick thick wall plastered on both faces. Floors shall be of R. C. C. slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. Within this building cubicles are to be provided for resting room of operators and these shall be constructed with one brick thick brickwork having both sides plastered and roof slab. Adequate steel doors and windows for natural lighting and ventilation shall be provided. Contractor shall have option to use tubular steel sections for roof truss only . Vertical bracings shall be provided only on four sides along the periphery. The roof of Crusher house shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water. Crushers shall be supported on R. C. C. deck, which in turn will rest on suitable vibration isolation system consisting of springs and dampers. This R. C. C. deck shall be isolated from the floor. However, the vibration isolation system consisting of springs and dampers may rest on main building framework. Detailed specification of vibration isolation system including the unbalanced force, frequency and amplitude criteria and other design requirements are appended elsewhere in this specification			
	3.05.00	Control building, M. C. C. Buildings		
These shall be steel or RCC framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams. Cladding shall be of brickwork/concrete blockwork with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations. All air - conditioned areas, shall be provided with the suspended permanently colour coated aluminium false ceiling system (details specified elsewhere) with under deck insulation. Adequate aluminium doors and windows shall be provided for natural lighting, ventilation and view. All windows in air conditioned rooms shall have hermetically sealed double glazing.				
3.06.00		Pent House		
	These shall be of R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof			
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CLAUSE NO.	TECHNICAL REQUIREMENTS
3.07.00 3.08.00 3.09.00	shall be provided with roof water proofing treatment as specified elsewhere. Adequate nos. of steel doors and windows shall be provided for natural lighting and ventilation. Gypsum Storage Shed The Gypsum storage shed shall be RCC framed structure with structural steel work shed with permanently colour coated profiled steel sheet roof and side cladding, grade slab and RCC foundations etc. Roof shall be provided with troughed profile permanently colour coated sheet with adequate slope for quick drainage of rain water. Toilets Toilet with potable water line facilities shall be provided in each of the following locations: (a.) In all M. C. C. Rooms (b.) Control Building Staircases, Gratings, Handrails All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. All staircases of Transfer points and crusher house shall be of steel. Cage ladders (min. 450mm wide) shall be provided for access to roof of penthouses, single storey mcc rooms & mumty. All Stairs shall be minimum 1200 mm wide, maximum rise should not be more than 180 mm and minimum tread with 250 mm. Numbers and arrangement (including enclosures etc.) of stair cases shall be such as to meet the fire safety requirement as per guide lines of statutory regulatory bodies. For steel staircases , Stringers shall be of rolled steel channel (minimum ISMC 250) and tread shall be of steel gratings. Out side stairs to transfer points/crusher house shall be open type. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's All gratings shall be electro forged types. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation. However, at entry or road crossing point's minimum thickness of grating shall be 40 mm The opening size shall not be more than 30mmx100mm. The minimum thickness of the main bearing bar shall be 6 mm or as per design requirement whichever is higher. All gratings shall be designed for minimum imposed load of 500Kgs. / Sq. M. If actual expected load is more than the specified load, then actual load is to be considered. All gratings shall be hot dip galvanized at the rate of 610 g. per sq.m. after surface preparation by means of blast cleaning/ acid pickling. Minimum 1000 mm high hand railing shall be provided around all openings, projections / balconies, walkways, platforms, Stairs, etc. All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class) as per IS:1161. Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100
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3.10.00	mm high and 6 mm thick). All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. M as per IS:4736. Trenches All trenches for cables or any other underground facility as detailed out elsewhere shall be of R. C. C. Cable trenches shall be provided with pre - cast R. C. C. covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Proper drainage arrangement shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers. For cable trenches outside buildings, top level shall be 200 mm above G. L and sand filling shall be overlaid with 50 thk. PCC. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting grating/precast RCC covers, edges of R. C. C. trenches supporting pre - cast covers, supported edges of pre - cast cover 3.11.00 Cable gallery/trestles Cable galleries/trestles shall be made of structural steel. The contractor can use either rolled sections or tubular steel sections. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall confirm to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. 3.12.00 Transformer Foundation 3.12.01 Foundations of transformers shall be designed for seismic and wind loads in addition to other applicable loads. Block foundations shall be provided for the main transformer block. The oil soak pit, if provided, shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store complete oil of the transformer/reactor along with 10 minutes of fire water considering only 40% of the volume as available voids between gravel filling. However, in case a separate oil collection tank is provided for the transformer/reactor, oil soak pit of volume equivalent to one-third (1/3) the oil volume of transformer/reactor shall be provided around transformer/reactor. The oil collection tank, in such cases, shall be designed for an effective capacity of complete oil of the transformer along with 10 minutes of fire water. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit. Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/ reactor foundations.
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3.12.02	RCC Firewall shall also be provided between the transformers wherever required. 300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of gravel filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement. Fencing Fencing with toe wall and steel gates shall be provided around the transformers. Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. Fence posts shall be of pre – cast R. C. C. of minimum M20 grade. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions. Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 1. 5: 3) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing 3.13.00 Booster Fan Foundation Booster Fan foundations shall be RCC block foundation directly resting on virgin soil/ pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round. 3.14.00 CHIMNEY 3.14.01 Salient Features Single-flue or multi-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level. The chimney shell (windshield) shall be constructed using slip form shuttering. Internal platforms of steel structure shall be provided for enabling access to various elevations of the chimney and to provide support to the flue liners. Spacing of internal platforms shall not exceed 45.0 M. The platform beams shall be supported on concrete shell using suitable load bearing arrangement in the recesses provided for the purpose. The platform beams getting supported in the chimney shell shall have complete bearing support within the thickness of shell at that location and shall in no case be supported completely/partially on corbels/ brackets from the shell. "Through openings" in shell if provided to facilitate erection of platform beams shall be closed with cast-in-situ RCC closure wall on the external face of the shell. Necessary dowel
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	bars shall be provided in the shell during construction for this purpose. Openings in the concrete shell for flue duct entry, access door & truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around internal staircase & around the ventilation voids in the internal platform using min. 32 mm nominal bore MS pipes of medium class conforming to IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1200 mm. The handrail shall have three rows of horizontal members between the railing posts including the top member. Kick plate of min. size 100x6 thick shall be provided in the hand railing. The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be bottom supported and shall be profiled into a circular shape to connect to the flue liner. The flue duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic fluoroelastomeric fabric expansion joint. The expansion joint in the flue liner shall comprise of non-metallic fluoroelastomeric material suitable to withstand a temperature of 300 Deg C, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable to withstand a temperature of 300 Deg C and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh. Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell with chequered plate floor panels and pipe handrails, shall be provided for full height of the chimney and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch. The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, mild steel wind strakes (if required), all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects. Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open able from interior of chimney shell) fixed to openings in the chimney shell at locations and levels specified elsewhere. Suitable provision for approach to the AWL shall be provided at the platform level. AWL shall be located at about 1-1.5 metre above the top of platform to enable easy handling for maintenance. The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation & erection of flue segments.		
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3.14.02	Design Concept Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in Indian Standard, reference shall be made to ACI, BS, CICIND and other international standards. In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail. Imposed loading for design of all chimney components shall not be less than 5 kN/Sq.m. An additional 25% of liner load shall be taken as impact loading for liner erection in addition to the liner load. The min. thickness of web for plate girders shall be kept as 12 mm. Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document. Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document. The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings. Design of all chimney components shall be based on working stress method.		
3.14.03	Wind Shield The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The load calculation and load combinations shall be as detailed in IS 4998 (Part 1) : 1992. The wind shield shall be analysed for cases with and without flue liner loads. Forces/stresses in the wind shield due to eccentricity effects of local (e.g. corbel) loadings, insulations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered. Seismic response of the chimney shall be computed by the response spectrum method. At least, the first five modes of vibrations shall be used for this analysis. The cross wind analysis of the chimney shall be carried out irrespective of the value of the Scruton Number for the chimney and other empirical considerations which suggest structural immunity to cross wind oscillations. The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm. The stresses for the shell design shall not exceed the limits given in Cl. 7.0 of IS:4998 (PART-I) 1975 for various combinations of loads, excepting the stress in concrete for the case of dead load + wind load which shall not exceed $0.30f_{ck}$ where f_{ck} is the characteristic compressive strength of concrete. The minimum vertical reinforcement shall be 0.3% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 250 mm on each face. The minimum circumferential reinforcement shall be 0.2% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The circumferential reinforcement in the top 3 meters of the windshield		
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3.14.06	the liner erection works. The platform shall be made up of chequered floor panels supported on grid of structural steel beams. All beams shall have bolted connections. The maximum permissible deflection in main steel girders supporting flue liner shall be span/1000.			
	Internal Staircase			
	The staircase shall have a clear passage way width of not less than 800 mm and a clear headroom of not less than 2100 mm. The riser height shall not be more than 175 mm and tread width shall not be less than 225 mm.			
3.14.07	Foundation			
	The chimney foundation shall be designed for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation for any loading condition. Since chimney is a wind sensitive structure no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. No allowance shall be made in the stresses for design of foundation for wind loading. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 25.			
3.14.08	Thermal insulation			
	The insulation shall be semi-rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. The density of insulation shall not be less than 64 kg/cu.m for resin bonded glass wool insulation and 100 kg/cu.m for resin bonded rock wool. The coefficient of thermal conductivity of insulation shall not be more than 0.52mW/cm/oC at a mean temperature of 100oC.			
	The insulation thickness shall be determined based on the maximum/minimum ambient temperature, surface air velocity worked out based on the draught of ventilation air in the annular space between the flue liner and chimney shell, insulation surface emissivity of 0.3 and the insulation cold face maximum temperature not exceeding 55 degree Celsius. The draught of air in the annular space shall be the natural draught created by the heating of air by the flue liner and the air being vented out through the openings in the chimney shell. The increase in the annulus air temperature due to the rising heated air shall be taken into account while calculating the insulation thickness.			
The insulation thickness shall not be less than 100 mm, in any case, and shall be provided in two layers with the second layer of insulation covering the joints of the first layer. The insulation shall be wrapped on the outer-most surface with galvanised wire mesh using MS galvanised pins and speed washer.				
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3.14.09	Chimney Painting						
	(i) All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) except surfaces of steel wind strakes shall be painted as specified in corrosion protection clause of this specification. (ii) All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT. a) All steel surfaces shall be provided with two component epoxy primer coat (having solid by volume minimum 51% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. b) Primer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied in shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer. (iii) All steel parts embedded in concrete like Strake embedment assembly including bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes. (iv) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab, external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT. a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free. b) Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours <tr><td colspan="2">LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</td><td>SUB-SECTION-IV-D CIVIL WORKS</td><td>PAGE 15 OF 69</td></tr>			LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-IV-D CIVIL WORKS
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3.14.10	exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer. d) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iv) above in alternate bands of 'signal red' and 'bright white' colours. Electrical System 415V, normal and emergency AC power supply for chimney shall be derived from main plant power supply system. Emergency supply shall feed 20% of platform lighting, 50% of staircase lighting, aviation obstruction lighting and elevator load. All other loads shall be connected on normal power supply. Ambient temperature for design of all equipment shall be considered as 55 deg. C which is likely to be encountered inside the chimney. The equipment shall be suitable for installation and render trouble free operation at higher ambient temperature and rigorous weather conditions prevailing at chimney. All equipment supplied shall comply with relevant IS Standards. The distribution boards of chimney shall comprise switch fuse units of appropriate ratings. Emergency board shall have two incomers, one from emergency supply and other from normal AC distribution board itself. Auto changeover scheme shall be provided in emergency board to enable changeover to healthy source on failure of any source. Dry type isolating transformer of Dyn connection shall be provided in emergency board to obtain neutral lead, in case 3 phase 3 wire emergency supply is derived from main plant. Various platforms shall be illuminated by dust tight HPSV well glass lighting fixtures. Average illuminations level of 150 lux shall be maintained on equipment and 70 lux on platforms & 100 lux on staircases (minimum 1 lighting fixture at each landing). Any additional fixture to take care of dark patches/shadows shall also be provided. Lighting system shall be controlled through MCB provided in lighting panel. A lighting and power panel each shall be located at grade level and at other in between levels as required. All distribution boards, aviation lighting controls, etc. shall be located at grade level only. At each platform, 1 No. 63A, 415V welding receptacle and 1 No. 20A, 240V receptacle shall be provided and shall be fed from power panel. Wiring installation for lighting fixture shall be of PVC insulated copper/aluminium wires through galvanised steel conduits. Aviation obstruction lighting system shall conform to the requirements of the latest rules and regulations of the International Civil Aviation Organization (ICAO), National Airports Authority (NAA) and Directorate of Air Routes and Aerodromes (DARA). The type of aviation obstruction lighting system shall be of medium intensity aviation obstruction lights having an effective intensity of 2000 to 20,000 cd depending upon back ground illuminance. Obstacle lights shall have a day time effective intensity of minimum 20000 cd. The intensity of lights shall be 20000 cd $\pm$ 25% at twilight and shall reduce automatically to a night time intensity of 2000 cd $\pm$ 25% through the use of photo-cell. The obstacle lights shall flash simultaneously at a rate between 20 to 60 per minute. A minimum of three levels will be provided with aviation obstruction
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3.14.11	lights and there will be four light units per level. The lowest level should not be lower than 45 meters above the ground and vertical spacing of the intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc.. A temporary aviation obstruction lighting system shall be provided during construction of the chimney. Cables from distribution board to lighting panels/power panels/receptacles shall be 1100V grade, multicore FRLS HR-PVC insulated, PVC inner sheathed, armoured, PVC outer sheathed stranded copper/ Aluminum laid on galvanised sheet steel cable trays. Cables shall be terminated using double compression type cable glands and solder less crimping type tinned copper cable lugs. Minimum size of the power cable shall not be less than 2.5 sq.mm copper or 4 sq.mm Aluminum. Minimum size of control cable shall not be less than 1.5 sq.mm. Lightning protection system shall comprise minimum 3 vertical air terminations for each flue liner, horizontal air terminations and minimum 4 Nos. of down conductors spaced 90 degrees apart routed all along chimney height on external surface and connected to the earthing system. Down conductors shall be of minimum 50x6 mm galvanized steel strip. Each down conductor shall be provided with a test link at 1 metre above ground level. Each test link shall be enclosed in a galvanised sheet steel enclosure. Above ground level earthing and lightning protection system shall comprise galvanised steel strips. These materials provided at top 12 meters shall have additional coating of 2 mm thick seamless lead cover and the accessories like nuts, bolts, washers etc. shall be of stainless steel to take care of corrosion. Chimney earthing system shall be interconnected to main plant earthing system. A temporary lightning protection & earthing system shall be provided during construction of the chimney till a permanent lightning protection & earthing system is installed. In no case reinforcement bars of Shell should be used as earthing Down Conductors Communication system comprising of telephone socket at every internal platform level and at grade level, necessary wiring installation, a telephone hand set, junction boxes etc. shall also be provided. Telephone cables shall be of minimum 0.6 mm diameter annealed high conductivity electro copper conductor, PVC insulated, twisted, PVC tape wrapped, screened, rip corded, PVC sheathed, conforming to relevant ITD (Indian Telephones Department) specifications. All equipment to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all type tests as listed below: (A) Distribution boards/panels-Degree of protection tests (B) Aviation lights: (1) Intensity Test (2) Degree of protection test For various equipment, the technical requirements and practices shall conform to the relevant clauses of the main plant electrical specification.		
	Rack and Pinion Elevator A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed		
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	of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual		
4.00.00	Drainage & Water Supply Works		
4.01.00	Drainage System: The drainage arrangements shall be so planned so as to ensure quick disposal of drainage water without stagnation and / or overflow. It is envisaged to clean the facility buildings etc. with water periodically. Minimum 4 nos. down comers shall be provided in each building at corners. For Conveyors, each down comer shall lead the water / slurry to pit (of 2 Cu.M capacity) to allow settling of lime/gypsum. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road. For Ball Mill building, Gypsum dewatering building, FGD control room building, peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / slurry to a local pit (of 2 Cu. M. capacity) near each facility to allow settling. The water from the pit shall overflow into contractor's R.C.C drain, and finally into owner's drain routed alongside the nearby road. In case of Control rooms and M. C. C. buildings Pump houses, etc, water / slurry coming from down comers shall discharge into peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / slurry into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road. Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards and approval of Railway culverts from concern Railway authorities.		
4.02.00	Internal and external water supply, drainage etc. The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc. as required and as described here or elsewhere in the specifications.		
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	The scope for service water supply and dust control water supply shall be as described elsewhere in the specifications. For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be used. All facility buildings shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth all around the periphery. All drains excepting the peripheral drains around facility building shall be of R. C. C. construction. Drains shall have removable steel grating cover and shall be provided with edge protection angles. The scope for foul water from toilets shall include layout and laying of sewers up to the Employer's main sewer line for sewerage system together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers within the building and from the building to the Employer's sewer line. For rain water down comer and those to be used for conveying water / slurry generated from cleaning of buildings floors, Galvanised MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be used for MCC buildings, penthouse, control rooms, ball mill building, gypsum dewatering building, storage sheds. Galvanising shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 400 gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629. All rain water down comers shall be provided with roof drain heads and complete with shoes bends, junctions, sockets, adapters, brackets and finished with anti corrosive painting over a coat or primer. For design of building drainage system IS: 1742 shall be followed. For sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints. For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided. For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch.		
5.00.00	COLOUR COATED AND OTHER SHEETING WORK		
5.01.00	Material		
	a) Wall Cladding & Roofing Material		
	Troughed permanently colour coated sheet of approved shade and colour shall be		
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5.02.00	i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254. b) Metal Deck Roof Material Troughed permanently colour coated metal decking sheets shall be i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 ii) or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 iii) or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275. Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254 can also be used for metal decking. Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided.			
	5.03.00	Colour Coating Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 4 of AS/NZ2728. Design Criteria For wall cladding insulated / uninsulated sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm.		
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5.04.00	For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. For metal deck sheets used for roofing (with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition.		
	Fasteners Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self-drilling special coated fasteners confirming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location. Shear anchor studs shall also be provided through troughed permanently colour coated metal decking sheets metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams. The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet. The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet. Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.		
5.05.00	Miscellaneous Details To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing.		
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5.06.00	Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners. Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277 Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer. All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer. Pre-Fabricated Insulated Metal Sandwich Panels For structures where Pre-Fabricated Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently colour coated sheet & bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150. Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254. Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron (nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade.		
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5.07.00	Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below. The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site. Polycarbonate Sheets The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points & pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details			
	6.00.00	Roof Details		
	6.01.00	Roof slab shall be minimum 150 mm thick(above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.		
	6.02.00	900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs of all buildings. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings.		
	6.03.00	Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet.		
6.04.00	Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster.			
6.05.00	Roofs of all control rooms, M. C. C. rooms, penthouse etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as follows:			
6.06.00	1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat. 2) Application of high solid content liquid applied urethane based elastomeric water proofing membrane, over the primer coat, to give uniform joint less dry film thickness of minimum 1.5 mm (as per ASTM C 836 and C 898). 3) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1: 100. This gradient shall be provided by screed concrete M-15 (using 12.5 mm coarse aggregate) and / or cement mortar (1: 4) over the elastomeric water proofing membrane with 25mm thick cement mortar (1:4) topping. 4) Wearing course at top, shall consist of 25 mm thick P. C. C. (M-15) cast in panels of maximum 1.2 x 1.2 m size and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealing compound / elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS : 13801 for a width of 1000 mm in place of P. C. C.			
	For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1:100. This gradient can be provided either in structure or subsequently by			
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6.07.00	screed concrete M-15 (using 12.5 mm coarse aggregate) and/ or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface. Medium class galvanised mild steel pipes conforming to IS: 1239/ IS: 3589 with welded joints shall be provided for rain water down comers to drain off rain water from the roof. These shall be suitably concealed with masonry work, to match with the exterior finish. The number and size of down comers shall be governed by IS: 1742 and IS: 2527. RCC roof shall be provided with 45 x 45 cm size Khurras having minimum thickness of 30 mm with M-15 concrete over PVC sheet of 1mx1mx400micron and finished with 12 mm thick cement sand plaster 1:3.		
6.08.00	Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through RCC staircase, and roof access to all other buildings all shall be through cage ladder as per requirement.		
6.09.00	Fillets at junction of roof and vertical walls shall be provided with cast - in - situ cement concrete (M-15) nominal mix followed by 12 mm thick 1:4 cement sand plaster.		
6.10.00	The rainwater down comers shall be provided with suitable C.I. grating at inlet point.		
7.00.00	RCC Floors, Paving & Grade Slab details The floor slabs shall be minimum 150 mm thick(above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification. Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates suitably. Chequered plates shall be fixed by staggered welding of suitable size. Floors of trenches shall have integral finish to concrete base. Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided. R. C. C. floors (where no brick masonry walls are provided) shall be provided with handrails all along the periphery. RCC paving of minimum 150 mm thick with M25 grade concrete, over an under bed as specified herein shall be provided for areas mentioned below. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick for normal duty paving and 400mm		
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	compacted thick for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. For normal duty paving, reinforcement of the RCC paving shall consist of minimum 8mm dia bars @ 200 mm c / c in both directions at the centre of the slab. For heavy duty paving/ passage, reinforcement of the RCC paving shall consist of minimum 10mm dia bars @ 200 mm c / c in both directions at the centre of the slab. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification. Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the equipment lay down area, unloading & maintenance area with 50 mm thick metallic hardener topping. Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving. All facility buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection. Further, heavy duty paving shall be provided for passages connecting the outer periphery road to have access to the various facilities/buildings. Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level. Suitable open RCC drains shall be provided to dispose off storm water drain. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD block to sewage pump house. GRADE SLAB OF BUILDINGS AT GROUND FLOOR In buildings, the grade slab shall consist of 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm dia. bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at unloading & maintenance area, stone soiling of minimum 400mm thick and grade slab with minimum 10mm dia bars @ 200 mm c/c at top and bottom in both directions shall be provided. Further, top surface of grade slabs shall be finished with 50mm thick metallic hardener topping.		
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8.00.00	Brickwork and allied masonry works		
	All brick walls shall be non - load bearing in-filled panel walls.		
	All brickwork shall be designed as per Indian Standards and shall be plastered on both faces. All external walls shall be minimum one brick thick in 1: 6 cement: sand mortar. Brick walls shall be provided with 12 mm and 18 mm thick 1: 6 cement: sand plaster on smooth and rough face of the brick work respectively.		
	Bricks to be used in brickwork shall be of minimum Class designation 50.		
	Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be suitably encased with plaster or 1: 2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness.		
9.00.00	Parapets, chajjas, windows and door heads, architectural faces, fins etc. shall be provided with drip course in 1 : 4 cement sand mortar.		
	50 mm thick Damp proof course shall be provided at plinth level for all brick wall.		
	All R. C. C. ceilings shall be rendered smooth and finished with whitewash unless otherwise specified. Ceiling of control rooms, M. C. C. rooms (except areas provided with false ceiling) shall be provided with 6 mm thick plaster.		
	Earthing Mat		
	40 mm Dia MS Rods as earthing mat, placed at a distance of 1.0M away and at depths between 0.60M and 1.00M shall be supplied and laid all around the periphery of buildings, structures, and outdoor equipment, as per the approved drawings. Risers of 40 mm Dia MS Rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Contractor, as per the approved drawings. Risers shall be laid up to a height of 300 mm above the local Ground level, at each of the columns of the buildings on outside of the buildings, and minimum 2 (Two) numbers for structures and outdoor equipment. The contractor also supply and lay necessary number of 3.0 M deep vertical 40 mm Dia MS Rods Earthing electrodes and connecting them to the Earthing mat, as per the approved drawings and the supplying and laying of 40 mm Dia MS Rods for connecting the Contractor's earthing mat with the Employer's earthing mat separately at two locations.		
10.00.00	SITE LEVELLING		
	Site leveling of gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing. Bidder shall deploy adequate number of experienced site leveling contracting agency(s) with requisite earth moving and compacting equipment to complete the work as per schedule.		
Bidder shall carry out the topographical survey before he commences detailed design and site leveling. This survey shall cover the entire FGD area including gypsum			
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	storage ,gypsum handling area , lime storage area ,gypsum dewatering area , truck hopper area, limestone grinding and slurry storage area in Bidder's scope of work. Based on field observations the contractor shall prepare and submit for Owners review the survey maps of the surveyed sited on suitable scale, indicating grid lines, contour lines and demarcating all permanent features like roads, railways, waterways, buildings, power lines, natural streams, trees etc. For each area two sets of survey maps shall be prepared and submitted, one showing the spot levels and contours with grid lines and the other showing the grid lines, contours and permanent features Since the construction of roads and drains for the FGD area including gypsum storage ,gypsum handling area , lime storage area ,gypsum dewatering area , truck hopper area, limestone grinding and slurry storage area is included in the scope of Bidder, it shall be the responsibility of the Bidder to ensure that these facilities are also constructed along with site leveling works. Bidder shall ensure that road access and drainage facilities for each block is available when site leveling in that block is completed. Unless otherwise instructed by the Engineers, all roads and drains within a block shall be constructed by the bidder within a month from the date of completion of site leveling of that block. The specified formation level(s) shall be achieved either by excavation where the existing ground levels are higher than the specified formation level or by raising by controlled filling with borrowed earth where the existing ground levels are lower than the specified level All materials arising out of site clearance and excavation shall be the property of owner. They shall be dealt with in the manner specified by the Engineer. Earth / boulders / rock etc. excavated and useful portion (serviceable materials) of trees cut shall be stacked at suitable places within Owner's acquired land for the plant including the reservoir and the ash disposal area in a manner as directed by the engineer. Woods, branches, trunks of trees shall be termed as serviceable material. Other materials like twigs, leaves, roots, vegetable and organic matters etc. shall be termed as unserviceable material and shall be sorted out from the serviceable materials before disposal. They shall be cleared from the area and disposed off at places within Owner's acquired land for the plant including the reservoir and the ash disposal area in a manner as directed by the engineer. If the excavated material is suitable and accepted by the Engineer as fill material, the same can be used for filling in other areas where raising by filling is required. Otherwise the same shall be taken and stacked at places(s) within the plant boundary as directed by the Engineer. Filling with rock shall be done only after the written permission of the Engineer in the following manner: Filling with rock shall be done only in areas identified for laydown and preassembly . Original ground after removal of all organic and vegetable matters shall be consolidated by rolling as directed by the engineer subject to a minimum of six passes of 8-10 tonnes roller.		
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	- Excavated rock shall be laid (on original ground or after filling 300 mm thick layers of soil as specified), in layers not exceeding 1000 mm and rolled with with vibratory roller (10-15 tonnes static weight) with minimum six passes. - Over the compacted layer of rock, soil shall be filled in horizontal layers not exceeding 300mm in compacted thickness. The soil shall be compacted as specified elsewhere. - It shall be ensured that the top soil layer is in minimum 3 layers of 300 mm each. To achieve this the thickness and number of rockfill layers below can be suitably adjusted. Contour map and spot levels of the area based on the preliminary survey carried out by Owner is enclosed for the purpose of guidance of Bidder. However, Owner does not lake any responsibility about the accuracy of the survey details furnished and any variation of the said data shall not constitute a valid reason for changing the terms and conditions of the contract. Bidder is requested to carry out his independent assessment of the existing ground levels before furnishing his. bid Detailed survey shall be carried out by Bidder after award of work and all findings as stated earlier shall be submitted for Owner's review. Before commencement of cutting/filling, all organic and vegetable matters like grass. Plants shrubs bushes, weeds, trees (with girth less than 30 cm measured at height of 1m above ground level) etc. in the areas to be filled, shall be completely removed along with their roots and disposed off. .It shall also be ensured that the area to be filled is clear of any water, slush etc. Original ground shall be compacted by rolling as directed by the Engineer subject to a minimum of six passes of 8 to 10 tonne roller The earth shall then be spread in horizontal layers not exceeding 300 mm in compacted thickness. Each layer shall be watered and compacted with proper moisture content and with such equipment as may by required to obtain a compaction of 95% or more of Standard Proctor's maximum dry density. The moisture content of the fill material shall be controlled to obtain near optimum moisture content during compaction. The fill material shall be tested for determining optimum moisture content and maximum dry density by Standard Proctor Test as per IS : 2720 (Part-VII). The fill material shall also be tested for determining moisture content before compaction as per IS:2720 (Part-II) For each of the above tests, one sample for every 10,000 cubic metre of fill material shall be tested. Additional samples shall be tested, whenever there is a change in the source or type of fill material. The compacted soil shall be tested for its dry density as per IS2720 (Part-XXIX) or Part-XXVIII). Samples shall be taken at the rate of one sample for every 10,000 sq.m. area for each compacted layer. In addition random checks shall be carried out in compacted soils by means of Proctor needle penetration. Bidder shall submit to the Engineer, the test results immediately after completion of the tests. A sample shall be deemed to have passed the test when the in-situ dry density is equal to or more than the specified percentage of maximum dry density. If a sample taken from a layer fails to pass the test, the layer shall be further compacted till two samples		
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	taken and tested from this layer pass without any negative deviation. Only after this. spreading of further layers shall be taken up. Before start of filling, the Bidder shall submit to the Owner his proposal for the methodology to be adopted for compaction for each type of fill material. The Bidder shall also carry out compaction trials to establish the proposed methodology. The Bidder shall start the compaction work only after approval of the methodology by the Owner The surface of the cut/filled up areas after reaching final level shall be dressed to the required levels and slopes. The difference in levels shall not be more than +/- 10cm locally. The borrow areas outside the overall plant boundary limits for obtaining suitable fill material which is required over and above the earth available after cutting high grounds within the plant area, for site levelling shall be arranged by the Bidder himself and all expenses in respect of royalties, taxes, duties, etc. for borrow areas/fill material shall be borne by him. He shall also obtain and submit to the Owner the necessary clearances/permission from the concerned authorities for the borrow areas/fill material. Material suitable for filling shall be loaded and transported to the filling site by the Bidder. Any coarse grained or fine grained low plastic soil, free from shingle, salts, organic matter, sod or any other foreign substances, may be used for filling. The Bidder shall test the fill material to establish its suitability and submit its results to the Owner. Fill material shall be approved by the Owner. The following types of materials shall not be used for filling: a) Material from swamps, marshes and bogs. b) Expansive clays c) Peat, logs, stumps, sod and perishable materials. d) Materials susceptible to combustion e) Any material or industrial and domestic produce which will adversely affect other materials in the work. f) Materials from prohibited areas Bidder shall include in his offer any extra filling that may be required on account of subsidence of the original ground due to overburden of filling above and/or compaction works for site levelling.		
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11.00.00	After levelling, the contractor shall establish concrete pillars at the intersection points of the grid lines for future reference. These pillars shall project at least 450 mm above the formation level and shall be labelled permanently with their respective coordinates and reduced levels. Filling upto the specified formation level shall extend at least 2.0m beyond the outside face of boundary wall/fence. Thereafter, it shall be finished at a suitable slope (not steeper than 1 Vertical:2 Horizontal) and provided with good quality dry stone pitching minimum 300mm thick for slope upto level difference of 3m. If the level difference is more than 3m, the stone pitching shall be provided with RCC bands with suitable design and benching. FENCING Fencing with toe wall and steel gates shall be provided around the gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas . Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. All Fence posts shall be of 75 x 75 x 6 MS angles spaced at 2.5 m c/c distance. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions. Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 2. 4) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing. 12.00.00 ROADS All roads shall be of rigid pavements unless otherwise specified. The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. Detailed plate load tests to determine the modulus of sub grade reaction “K” shall be carried out as per the procedure outlined in IS: 1888. The design traffic load shall be a minimum value of 4 million standard axles. The road shall be designed for 30 years of life and considering a minimum traffic growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab. The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standards. IRC: 58 shall be followed for the pavement design and IRC: 15 shall be followed for the construction of the concrete pavement.
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13.00.00	The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete. The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level. The sub grade under all roads and its shoulders shall be compacted to achieve 95 per cent or more of Standard Proctor’s Density MDD using mechanical means. Cutting / extending / rerouting / remaking of existing roads including associated works to maintain continuity of road system / network shall also be carried out. All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed. Unless otherwise specified, all roads shall be double lane roads.		
	GATE ALONG BOUNDARY WALL: The gate shall be complete with fabricated hinges, MS aldrops with locking arrangement, tempered steel pivot, guide track of MS tee, bronze aluminum ball bearing, castor wheel etc. All gates shall be given anti-corrosive treatment in three coats. The structural steel shall confirm to IS: 2062 (latest) and all other relevant IS codes. Beside the each gate one room of size not less than 3m X 3m shall be provided for security guards. The room shall be made of brick/ RCC and with RCC roof. In addition to the room, one toilet block shall also be provided.		
14.00.00	LIME & GYPSUM HANDLING AND ASSOCIATED BUILDINGS STORM WATER DRAINAGE SYSTEM Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. All RCC drains shall be either RCC Cast-in-Situ or RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains. The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 150mm or as per design considerations whichever is higher for drains upto depth of 1m from formation level. For depth of drain more than 1m from formation level, the thickness of side walls and bottom slab		
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15.00.00	of RCC drains shall be minimum 200mm or as per design considerations whichever is higher. The drains shall be provided on both sides of roads .These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings. All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating. The invert levels of the in-plant and plant peripheral drains shall be kept such that water can be discharged by gravity to the main / trunk drains under all conditions. The invert levels of the drains shall be decided in such a way that the water can easily be discharged to the natural water bodies above the high flood. SEWERAGE SYSTEM The connection of sewer pipe line for the associated buildings of FGD and Lime and gypsum handling area to nearest owner’s sewage network is in bidder’s scope. Cement concrete pipes of class NP-3 as per IS:458 shall be used below ground level for sewage disposal in all areas . However, for pressure pipes and under roads spun C.I. pipes conforming to IS:1536 of required class shall be used. RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS:4111. Sewage pump house shall be provided as per IS:4111.			
	16.00.00	LOADING		
	16.01.00	For consideration of loads on structures IS : 875 - ‘Code of practice for structural safety of buildings’ shall be followed. In addition to the dead load, live load, equipment load (including impact / vibration). Temperature loads etc. various loading conditions arising due to operation and maintenance of equipment shall be considered in the design. The structure and equipment shall also be designed for seismic loads as per the “Criteria for Earthquake Resistant Design of Structures and equipment” and the “Criteria for Wind Resistant Design of Structures and equipment” specified in the “Project Information section” of technical specification. Wind and seismic forces shall not be considered to act simultaneously. The following minimum live loads shall be adopted for the design of various structures. If actual expected load is more than the specified load, then actual load is to be considered.		
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	a) Roofs 150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs. In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs & 75 Kgs. / sq. m. on inclined roofs shall also be considered. b) R. C. C. floors 500 Kgs. / Sq. M. c) Stair and balconies 500 Kgs. / Sq. M. d) Toilet rooms 200 Kgs. / Sq. M. e) Chequered plate floors 400 Kgs. / Sq. M. f) Walkways (including walkways in conveyor galleries) 300 Kgs. / Sq. M. g) Conveyor galleries In addition to the live loads, loads due to cable trays, fire fighting / service water pipes shall also be considered @ 125 Kgs. / m (minimum) on each of the longitudinal girder. Roof-truss members are to be checked for supporting fire fighting pipes/ Service water pipes. h) Road Culverts and its allied structures including R. C. C. pipe crossing & road crossing of trenches. For class 'AA' loading and checked for class A loading as per IRC standard. i) Channels / trenches In addition to earth pressure and water pressure, etc. additional earth pressure due to surcharge of 2T / Sq. M. shall also be considered for design. j) Covers for trenches / channels Covers for channels & trenches, shall be designed for a live load of 0.4T Sq. M. and loading as mentioned under clause in trenches, whichever is critical.		
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	k) Sumps and tanks and other underground basement type structures In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge due to Railway loading whichever is critical for Railway load bearing structures etc.) and sub - soil water pressure etc. These are also to be designed for the following conditions : i) Water / liquid inside and no earth outside (applicable only to such structures which are liable to be filled up with water or any liquid). ii) Earth with surcharge outside and no water / liquid inside iii) For underground (basement) structures protection against buoyancy during execution and after execution shall be ensured without superimposed loadings with minimum factor of safety of 1.2 against buoyancy. If the erection load is higher than the specified live loads on any floor or part thereof, then the erection loads are to be considered for the design. Permissible increase in stresses of materials and bearing pressure of soil due to wind load or seismic load shall be as per relevant I. R. S. and I. S. code. 16.02.00 Crane load For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS:875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously. 16.03.00 Temperature load For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation. Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively. 17.00.00 DESIGN CRITERIA 17.01.00 The design of all R. C. C. structures shall be carried out as per 'code of practice for plain and reinforced concrete for general building construction', IS : 456 (latest).
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17.01.00	Design of steel structures shall be done by the Working stress method. Design shall be as per provisions of IS:800 :1984 and other relevant IS standards.		
17.02.00	Minimum size of the angle section to be used as structural members shall be 50 X 50 X 6. Minimum weld size shall be 6 mm. Connections shall be designed for 70 % of shear capacity of the member or the actual shear force, whichever is higher. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. Minimum grade of steel & thickness of Tubular/Hollow sections shall be Yst 240 Mpa & 4.0mm respectively		
17.03.00	The building shall conform to local bye - laws, rules and regulations for industrial buildings and also B. I. S. publications, SP 32 and 41.		
17.04.00	Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports.		
17.05.00	Stresses for all structures shall be checked for the higher of the forces obtained from gust factor method and the peak wind speed method.		
17.06.00	Horizontal bracing system shall be provided at floor levels around the openings.		
17.07.00	Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement.		
17.08.00	For design of liquid retaining structures, IS : 3370 (Part - I to IV) (latest) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. For design of R. C. C. pipes for culverts, latest editions of IS : 458, IS : 783 should be followed.		
17.09.00	For design of all underground structures / foundations, ground water table shall be assumed at the formation level (i. e. the adjoining ground level). For all underground structures like tunnel, underground transfer point and underground hopper etc. crack width shall be limited to 0.2mm.		
17.10.00	Design of masonry walls shall be made as per IS : 1905.		
17.11.00	Civil task drawing indicating various equipment loading and supporting arrangement and floor loads to be submitted along with the design calculation.		
17.12.00	Minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456.		
17.13.00	Foundations for all tanks shall be designed for as per IS: 803.		
17.14.00	Footings shall be so proportioned to as to minimise the differential settlement.		
17.15.00	All gallery supporting trestles shall be so proportioned that the transverse deflection of gallery due to wind / seismic load should not exceed trestle height / 1000 as stipulated in IS: 11592. This deflection condition shall be strictly followed. Peak wind speed method shall be considered for checking the transverse deflection.		
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17.16.00	The crusher and transfer house structures shall be so designed that transverse deflection at places where conveyor galleries meet, should be equal to the respective transverse deflection of conveyor supporting trestles.											
17.17.00	Deflection criteria The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following: <table><tr><th>Sl. No.</th><th>Description</th><th>Maximum value of</th></tr><tr><td>1.</td><td>For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)</td><td>Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)</td></tr><tr><td>2.</td><td>For other Buildings</td><td>Height/325</td></tr></table>			Sl. No.	Description	Maximum value of	1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)	2.	For other Buildings	Height/325
Sl. No.	Description	Maximum value of										
1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)										
2.	For other Buildings	Height/325										
17.18.00	a) Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325. b) The allowable deflection for beams directly supporting drive machinery shall be restricted to span/500 unless specified otherwise in this specification. c) The deflection for manually operated cranes & monorail supporting beams shall not exceed span/500. For electric overhead cranes : 1) upto 50 t capacity : span/750 2) over 50 t capacity : span/1000 d) The vertical deflection of metal deck sheet for roofing and side cladding shall be limited to span/250 e) The permissible vertical deflection for beams supporting drive machinery shall be restricted to span / 500 and for other beams it shall be within span / 325. f) Permissible deflection for all purlins, cladding runners, roofing/cladding sheets and grating / chequered plates shall be span/250. However, the maximum vertical deflection of Grating/ Chequered plate shall be limited to 6 mm.											
17.19.00	a) Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part). b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.											
17.20.00	a) The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever											
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17.21.00		specifically mentioned in this specification.		
	b)	For design and construction of steel-concrete composite members, IS: 11384 shall be followed.		
	c)	For reinforcement detailing, IS: 5525 and SP: 34 shall be followed.		
	d)	Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.		
	a)	All RCC liquid retaining/conveying shall be designed by working stress method as outlined in clause no. 4.5 of IS 3370 (Part-2) 2009 unless specified other wise.		
17.22.00	b)	Water proofing treatment shall be provided for liquid retaining/ carrying structures and basement type structures (requiring dry working condition). Dense and durable concrete with water cement ratio not more than 0.45 shall be used. Plasticiser /super-plasticiser cum water proofing compound shall be added to the concrete. All the construction/expansion joints shall be provided with PVC water bar and/or chemical injection grouting as per IS:6494. As applicable internal/external surface of such structures shall be provided with acrylic based polymer modified cementitious composite coating system for critical structures. For liquid carrying/retaining structures, minimum two coats of such coating shall be applied. For external application wherever the surface is in contact with the earth, fine silica/quartz sand of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5 mm. For non critical structures minimum two coats of bitumen grade 85/25 as per IS:702, mixed with 1% of anti-stripping compound meeting the requirement of IS:6241, shall be applied. The total application of bitumen shall not be less than 1.7 kg/sq.m. Bidder shall submit a comprehensive scheme for water proofing treatment based on above or any other alternative scheme, internationally accepted for Employer's approval prior to commencement of work.		
	c)	All liquid retaining/carrying structures shall be tested for water tightness as per the provisions of IS: 3370 and IS: 6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles.		
		For design of all underground structures, foundations, etc. ground water table shall be assumed at the finished ground level unless specified otherwise.		
17.23.00		Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest or co-efficient of active earth pressure, whichever is applicable, depending upon the structural configuration. However, for the design of substructure of pump houses, earth pressure at rest shall be considered. Co-efficient of passive earth pressure shall be used only in design of shear keys for stability against sliding.		
17.24.00	a)	Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures containing liquid		
	i)	Water pressure from inside and no outside pressure, like earth pressure, ground water and surcharge pressure (applicable only to structures, which are liable to be filled up with water or any other liquid.)		
	ii)	Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.		
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17.25.00 18.00.00	iii) Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves/flap valves, etc., shall not be permitted to counter the buoyancy unless specified otherwise. iv) Base slab and piers of the pump houses shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level. b) Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance. c) All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads. Design of Block Foundation a) Block foundation resting on soil shall be analyzed using elastic half space theory. In case the foundation is supported over piles, Novak's approximation shall be used for determining the spring constant and damping ratio of pile groups. The mass of the RCC block shall be at least three times the mass of machine. Free vibration analysis of the foundation shall be carried out to evaluate the natural frequencies. The fundamental natural frequency shall be kept at least 20% away from the operating frequency (speed). Forced vibration analysis shall be carried out if the dynamic forces are made available by the machine supplier in which case the amplitude limits stipulated by the machine supplier and ISO 10816, whichever is lower, shall be satisfied. Reinforcement design shall be done by working stress method as per IS:456-2000 and IS:2974 (Part-IV). b) For the foundations supporting minor rotating equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably. Coating on RCC water retaining structures (other than drinking water) Epoxy phenolic coating shall be applied on internal surfaces of the RCC water retaining structures, as per details specified below: All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% $\pm$2%) of minimum 50 micron DFT. Surface to be coated shall be absolutely dry, clean and dust free. Sealer coat shall be followed with the application of epoxy phenolic coating (solid by volume minimum 63%) of minimum 400 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.
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19.00.00 20.00.00 20.01.00 20.02.00 20.03.00 20.04.00 20.05.00 20.06.00 20.07.00 20.08.00	Coating on RCC water retaining structures (drinking water) Internal surfaces of RCC water retaining structures shall be provided with minimum 400 micron Food grade epoxy coating complying to FDA Title 21, Part 175.300. Surface to be coated shall be absolutely dry, clean and dust free Fabrication All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections. Chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. For Chimney flue liners, to prevent flue gas leakages, the applicable field joints shall necessarily be welded. Electrodes The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium /high tensile steel and for mild steel plate thickness above 20 mm. All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use. Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage. Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing. Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated. The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started. Edge Preparation for Welding Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded. Pre Heating and Post Heating Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature
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	may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose. Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to atleast 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat and this temperature shall be maintained as minimum inter-pass temperature welding is in progress. TABLE - 1 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MILD STEEL <table><tr><th rowspan="2">Thickness of thicker part at Point of welding</th><th colspan="2">Welding Using</th></tr><tr><th>Low hydrogen electrode or submerged arc welding</th><th>Other than low hydrogen electrode</th></tr><tr><td>Upto and including 20mm</td><td>None</td><td>None</td></tr><tr><td>Over 20mm and up to and including 40mm</td><td>20°C</td><td>Not allowed</td></tr><tr><td>Over 40mm and up to and including 63mm</td><td>66°C</td><td>Not allowed</td></tr><tr><td>Over 63mm</td><td>110°C</td><td>Not allowed</td></tr></table> Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure. TABLE - 2 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MEDIUM / HIGH TENSILE STEEL <table><tr><th rowspan="2">Thickness of thicker part at Point of welding</th><th colspan="2">Welding Using</th></tr><tr><th>Low hydrogen electrode or submerged arc welding</th><th>Other than low hydrogen electrode</th></tr><tr><td>Upto and including 20mm</td><td>None</td><td>Not Allowed</td></tr><tr><td>Over 20mm</td><td>120oC - 140°C</td><td>Not Allowed</td></tr></table> Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.	Thickness of thicker part at Point of welding	Welding Using		Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode	Upto and including 20mm	None	None	Over 20mm and up to and including 40mm	20°C	Not allowed	Over 40mm and up to and including 63mm	66°C	Not allowed	Over 63mm	110°C	Not allowed	Thickness of thicker part at Point of welding	Welding Using		Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode	Upto and including 20mm	None	Not Allowed	Over 20mm	120oC - 140°C	Not Allowed
Thickness of thicker part at Point of welding	Welding Using																												
	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode																											
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Over 40mm and up to and including 63mm	66°C	Not allowed																											
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	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode																											
Upto and including 20mm	None	Not Allowed																											
Over 20mm	120oC - 140°C	Not Allowed																											
20.09.00	Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the																												
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	surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.		
20.10.00	Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.		
20.11.00	All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600oC and rate of application shall be 200oC per hour.		
20.12.00	The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.		
21.00.00	Paving, Drainage and Sewage RCC paving of minimum 150 mm thick with M25 grade concrete, over an underbed as specified herein shall be provided. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick for normal duty paving with 63 mm and down aggregate with interstices filled with selected moorum followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification. 2.5 m wide paving with metallic hardener around periphery of all sumps and underground tanks shall be provided. Suitable drains shall be provided to dispose off storm water as well as floor wash of the FGD area block. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD area to the nearest available manhole of the owner. The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8 m/sec. respectively. However, minimum velocity of 0.6m/sec. for self-cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The open drains shall be open rectangular drains of RCC unless required otherwise due to functional requirement. RC box culverts shall be provided at rail, road or other crossings. Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec.		
22.00.00	Statutory Requirements Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules at Tariff Advisory Committee. Water Act for pollution control, Explosives Act, etc.		
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23.00.00	Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkways along the crane - girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest room etc. Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tariff Advisory Committee. Statutory clearances and norms of State Pollution Control Board shall be followed. Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking up the construction work.		
	INSPECTION, TESTING AND QUALITY CONTROL Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding), piling, sheeting, etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used. The Bidder shall submit and finalise a detailed field Quality Assurance Programme before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer. The Bidder shall furnish the test certificate from the manufacturer's of various materials to be used in the construction.		
24.00.00	CONCRETE All R. C. C. works to the done under this specification, unless specified otherwise shall be design mix concrete. Minimum grade of concrete for various structures shall be as follows: a) M25 - For all underground / sub-structural/ super-structure R. C. C. work. b) M30- For Block Foundation c) M35- For spring supported RCC deck Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations. For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix. Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned.		
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25.00.00	Excavation, Backfilling, Disposal and Stacking of materials Details		
25.01.00	Excavation in Soil Excavation for foundation shall be to the bottom of lean concrete and as shown on drawing or as directed by the Engineer. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels by error, it shall be brought back to the specified level by filling with concrete of nominal mix 1 : 3 : 6 (cement: coarse sand: 40 mm down aggregates), as directed by the Engineer. The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Cofferdams, sheet piling, shoring, bracing to maintain suitable slopes, draining etc. shall be provided and installed by the contractor, to the satisfaction of the Engineer. Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, Backfilling is completed. The Contractor shall remove all slush/muck from the excavated areas to keep the work area dry. The Contractor, if required, shall employ sludge pumps, for this purpose. For other details, excavation clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification, are to be referred.		
25.02.00	Excavation in Rock For the work of excavation in rock, Contractor shall engage specialised agency having experience of excavation in rock involving wedging and blasting. The agency shall be subject to approval of Engineer and the Contractor shall furnish details of relevant experience in support while seeking approval for the agency. Blasting shall be resorted to only with the written permission of the Engineer. All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards etc. pertaining to the acquisition, transport, storage, handling and use of explosives etc. shall be strictly followed. The contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per Explosives Act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive materials. Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, backfilling is completed. For other details for excavation in rock, clauses as given at		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
25.03.00	“Foundation system and Geotechnical Data Chapter” given at “Project Information section” of Technical specification, are to be referred. Backfilling, Disposal and Stacking of materials Backfilled earth shall be compacted as per “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification. However, the backfill under the rail lines and roads shall be compacted to minimum 95 % of the standard proctor density at OMC unless otherwise stated by rail Authorities. The contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer. The disposal / stacking areas for excavated materials shall be indicated by the Engineer. The carriage of excavated materials shall be done by the methods mentioned below: The excavated materials shall be carried beyond the initial lead of 50 m but upto 500 m by manual / animal labour or by mechanical means. If directed by the Engineer this material shall be used directly for filling purposes. For leads exceeding 500 m the Contractor shall transport the excavated materials by mechanical means only and as directed by the Engineer. The Contractor may be allowed to carry materials through Kuccha roads. Providing and maintaining of the Kuccha roads shall be the responsibility of the Contractor. The transported material shall be neatly stacked as directed by the Engineer. Some excavated materials required for filling purposes, may have to be carried upto a lead of 500 m and stacked as per instructions of the Engineer. Excavated materials carried beyond 500 m shall normally be for disposal purpose only. Double handling of materials shall be avoided as far as possible. However, depending on site condition excavated materials carried beyond a lead of 500 m may also be required to be brought back for filling purpose. Materials to be used for filling purpose shall be stone, sand or other inorganic materials and they shall be clean and free from shingle, salts, organic matter, large roots and excessive amount of sod, lumps, concrete or any other foreign substances which could harm or impair the strength of the substances in any manner. All clods shall be suitably broken to small pieces. When the material is mostly rock boulders, these shall be broken into pieces not larger than 150 mm size before backfilling and shall be backfilled in layers of 300mm interstices filled with sand. In case of broken rock boulders used for back filling, the top cover shall be with 1.0m thick soil. The layers of rock boulders, interstices filled with sand shall be compacted by plate vibrators. Sand used for filling shall be clean, medium grained and free from impurities. Fines less than 75 microns shall not be more than 20%. In any case, the materials to be used for filling purposes shall have the prior written approval of the Engineer.		
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26.00.00	In case the materials have to be brought from pits / quarries, then it shall be the Contractor's responsibility for identification of such quarry areas, obtaining approval from their use from concerned authorities, excavation / quarrying loading and carriage of such material, unloading and filling at specified locations. The Contractor shall pay any fees, royalties etc. that may have to be paid for utilisation of borrow areas.			
	GALVANISING All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising. Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 (latest edition). The weight of the zinc coating shall be at least 610 Gms. / m² unless noted otherwise.			
27.00.00	CHEMICAL INJECTION GROUTING Minimum, 12 mm dia (NB) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete. For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using percussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes. After the nozzles are fully set, neat cement slurry admixed with water soluble non - shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / cm². Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises. Plasticizing agent shall be added wherever required. The grouting shall be started at very low pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer.			
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28.00.00	POLYMER MODIFIED CEMENTITIOUS COATING		
28.01.00	Materials Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%). Portland cement based dry powder. Clean, fine specially prepared quartz sand approximately 0.6 mm size.		
28.02.00	Mixing The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same.		
28.03.00	Properties of Coating It must adhere to wet surface. It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm. Co - efficient of permeability shall be about 5×10^{-10} Cm / Sec. Water absorption after continuous soaking shall not be more than 1 %. The materials shall be permeable under water vapour. The material shall be resistant to acids and alkalis present in the soil and underground water with normal pH value between 4 and 14. The co - efficient of thermal expansion of the material shall be close to that of concrete.		
28.04.00	Application The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed. (a) For Slurry Mix A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by rubbing down with a soft dry		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
29.01.02	Flooring of tiles / stone shall be fixed with 18 mm thk cement sand mortar 1:4, above PCC under bed (M 20 (with graded aggregate of nominal size 12.5mm) design mix)		
	Flooring of Concrete hardener topping shall be provided above the PCC underbed (M 20 (with graded aggregate of nominal size 12.5mm) design mix).		
29.02.00	Wherever specified Heavy duty ceramic tiles of size 300x300x7 mm thick (minimum) of reputed manufacturer (Kajaria, Orient, Johnson or equivalent) of approved finish shade and colour to be used. Vitrified ceramic tiles wherever specified shall be 600x600 mm with minimum 9.5 mm thickness and of reputed manufacturer (Kajaria, Johnson, Orient or equivalent).		
	Floor finish & skirting: The nominal thickness of floor finish shall be 50 mm. Floors of toilets, pantries / kitchen shall be finished with Heavy duty (grade-5) dust pressed ceramic tiles 300mmx300mm x7 mm thick as per IS:15622, including pointing the joints with white cement mixed with matching pigment, of approved make, size & colour shade. (1) Floors of Office Room, Labs, Control Rooms, RIO Rooms and all other A/c Room shall be finished with Mirror polished Vitrified ceramic tiles (minimum 9.5 mm thk) with 3 mm groove joints as per approved pattern, pointed neatly with 3X4mm stainless epoxy grout SP- 100 of Laticrete or approved equivalent in approved colour to match colour of tile. (2) Suitable supporting arrangement shall be provided with M.S. angles / channels on cable trenches in MCC and Control rooms for mounting Control panels / MCC. (3) In rest of the areas, IPS (Cement concrete flooring) with Concrete hardener topping shall be 12mm thick with ordinary grey cement using uniformly graded, properly treated iron particles shall be provided. (4) Floors and sides of under ground RCC structures like valve pits, trenches and tanks shall have simultaneous (integral) neat cement finish at the time of concreting. (5) The interconnecting walkway between various structures, buildings and facilities shall be finished with 22 mm chequered concrete tiles at top. 1000 mm wide walkway of 22mm thick chequered concrete tiles shall be provided on terrace for maintenance purpose, in all RCC /Metal deck roof buildings. (6) Skirting in general shall be 150mm high, Dado in toilet, kitchen & pantry shall be up to specified height (up to 2200 mm for toilets, up to 600 mm high above counter top in kitchen and pantry area). The dado height shall be measured from finished floor level. Skirting and Dado shall match with the floor finish. (7) Battery Room shall be provided with Acid resistant tile on horizontal and vertical surfaces, at all levels for all type of works, including One coat of bitumen primer followed by 12 mm thick bituminastic layer, 20 mm thick Acid Resistant tiles, 6 mm thick under-bed by potassium silicate mortar, 6 mm thick pointing of joints of tiles with acid/alkali resistant epoxy/furane mortar up		
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	to a depth of 20 mm and bituminastic end sealing. 1200 mm high dado on wall shall be with 12 mm thk Acid resistant tiles of the similar finish and the joints to be finished as per flooring tiles, with the rest of wall height and ceiling finished in chemical resistant paint (chlorinated rubber based). (8) Well polished 18 mm thick Kota stone jointed with neat cement slurry mixed with pigment to match the shade of the stone including rubbing and cleaning, complete, to be provided in entrance area, entrance steps, Entrance area, staircases (tread, riser, landings, skirting).		
29.03.00	Sunken RCC slab shall be provided in false flooring area and toilet, Kitchen and pantry, so as to keep the finished floor level of these areas same as that of the surrounding area.		
29.04.00	Water proofing treatment to be provided on sunken portion of all vertical and horizontal surfaces of depressed portions of all toilets, W.C., kitchen, Pantry and the like consisting of : (i) Ist course of applying cement slurry @ 4.4 kg/sq.m mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface. (ii) IInd course of 20 mm cement plaster 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface. (iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sq.m of area. (iv) IVth course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sq.m).		
29.05.00	Acid / Alkali Resistant Treatment: Acid / alkali resistant lining treatment shall be provided in different areas as follows: Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick A.R. bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable plasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification. The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R.tile layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted. The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron). Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. : The floor shall be provided with one coat of bitumen primer followed		
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	by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 12 mm thk Acid Resistant tiles up to 1.0M high shall also be provided if applicable in case of walls nearby. Alum/Lime Storage area and first floor of Chemical House : One coat of bitumen primer followed by 12mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick underbed of potassium silicate mortar, 6mm thick pointing of joints of tiles with acid /alkali resistant epoxy /furane mortar up to a depth of 20 mm and bitumastic end sealing. Alum solution preparation tank: The wall shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick underbed by potassium silicate mortar, pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer. Basket of Alum solution preparation tank: 5 mm thick epoxy lining over a coat of epoxy primer. Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks. Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns. Lime tank: Two coats of bitumen paint conforming to IS: 9862, with total DFT 150 microns.		
29.06.00	Walls		
29.06.01	All walls shall be non-load bearing infilled panel walls. All external walls shall be minimum one brick thick masonry wall.		
29.06.02	All external and internal walls shall be with minimum one brick masonry (230 or 250 mm) including toilet walls. Toilet partition low height walls shall be minimum half brick masonry.		
29.06.03	For all air conditioned areas/ rooms, wherever metal cladding is envisaged as cladding material, additional brick masonry wall (230mm thick) shall also be provided in addition to metal cladding for effective air conditioning. This brick wall shall be plastered & painted as specified elsewhere in the specification.		
29.06.04	RCC transoms and mullions of size 115x115mm with suitable reinforcement shall be provided wherever necessary to reinforce the brickwork.		
29.06.05	50 mm thick DPC in Cement concrete (M-20) with water proofing compound followed by two layers of bitumen coating 85/ 25 grade as per IS: 702 @ 1.7 kg/ sq.m. shall be provided at plinth level before starting the masonry work.		
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29.06.06	The bricks shall be laid with cement mortar (1:6) for one brick thick walls and (1:4) for half brick thick walls IS: 1905, IS: 2212 and SP -- 20 shall be followed for brick work design and construction.		
29.07.00	Plastering		
29.07.01	External (rough) surface of walls shall be plastered with 18 mm thick cement plaster, consisting first (base) layer of 12 mm thick plaster in cement sand mortar (1:6) and second (finishing) layer of 6 mm thick plaster in cement sand mortar (1:4). The internal (smooth) surface of walls shall have 12 mm thick plaster in cement sand mortar (1:6). All external / internal RCC surfaces including RCC parapet walls shall be provided with minimum 12mm thick plaster in cement sand mortar (1:4) except walls of underground structures like cable trenches / valve pits etc.		
29.07.02	All exposed faces of R.C.C. walls of structures, buildings and facilities shall have minimum 12 mm thick cement sand plaster 1:6.		
29.07.03	All RCC ceilings (except areas provided with false ceilings and cable vault ceiling) shall be provided with 6 mm thick cement sand plaster 1:4.		
29.07.04	All plastering work shall conform to IS: 1661.		
29.08.00	Painting		
29.08.01	All painting on masonry or concrete surface shall preferably be applied by roller. If Applied by brush then same shall be finished off with roller.		
29.08.02	All paints shall be of approved make including chemical resistant chlorinated rubber paint.		
29.08.03	Minimum two finishing coats of paint shall be applied over a coat of primer.		
29.08.04	The thinner shall not be used with textured paint (Sandtex Matt or equivalent) finish.		
29.09.00	Internal Finish		
	All Air conditioned areas shall have 2mm of polymer based water resistant putty (wall putty) to given an even and smooth surface.		
29.09.01	Acrylic emulsion paint shall be as per IS: 5411 (Part - 1). Acrylic distemper shall be as per IS: 428. Air - conditioned areas shall be applied with minimum 2 coats of acrylic emulsion paint. All other areas shall be applied with minimum 2 coats of Acrylic distemper.		
29.09.02	Toilet, Pantry / Kitchen areas shall have dado with Designer ceramic tiles, 300x200mw (matt finish) upto 2.2 m height and shall match with floor finish. Above dado, Acrylic distemper shall be applied.		
29.09.03	Areas coming in contact with chlorine fumes or acid / alkali shall have two coats of acid / alkali resistant chlorinated rubber paint over suitable primer on walls above dado & ceiling. The paint shall be of approved colour shade and make.		
29.10.00	External Wall Finish		
	One pack, ready mix and ready to use, resin / polymer bonded granular textured coating finish of 2.5 mm (natural coloured graded stone chips), of approved colour, and shade for all types of plastered and / or exposed concrete surface, in all kinds of works, at all levels, including preparation of surface, preparation of working drawing,		
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	labour, material, equipment, handling, transportation, mixing, laying, applying finishing, testing, curing, making grooves, scaffolding, staging, etc., all complete, as per specifications, drawings and instructions of the Engineer-in-charge. Toe wall of chain link fencing shall be provided with two coats of Acrylic Smooth Exterior Paint The finish shall be of approved colour shade and make.		
29.11.00	Ceiling Finish		
	Ceiling shall have min. two (2) coats of Acrylic distemper except AC areas & Battery room.		
29.11.01	For painting on concrete, masonry and plastered & surface, IS: 2395 shall be followed. For painting on steel work and ferrous metals, IS: 1477 shall be followed.		
29.11.02	Fire resistant transparent paint (confirming to IS: 162) shall be provided on all wood work, over French police or flat oil paint. French polish shall confirm to IS : 348. Flat oil paint shall confirm to IS: 1237.		
29.12.00	Doors, Windows, Ventilators, Louvers, Rolling Shutters & Glazing		
29.12.01	Adequate Doors, Windows, Louvers and Ventilators shall be provided for proper lighting and ventilation of all buildings. The area of windows shall be at least 10% of the floor area of the respective building. In addition to the above, wherever room height is more than 3.5 m, a band of ventilators of 600 mm height (minimum) shall be provided at the top.		
29.12.02	Unless specified all doors, of air conditioned areas, entrance lobby of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. Windows, ventilators & partitions of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. All doors of toilet, kitchen, pantry & store areas shall be of factory made pre - laminated solid core flush door shutters, as per IS: 2202 (Part-II) with pressed steel door frame. Control room shall have Aluminium glazed door & partitions. All other doors (unless otherwise specified) shall be of steel.		
29.12.03	All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc.		
29.12.04	Wherever functionally required, rolling shutters of suitable size approved by the Owner, with suitable operating arrangement manual/ electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248.		
29.12.05	All windows and ventilators at ground floor level shall be provided with suitable anodised aluminum grill.		
29.12.06	Fire proof doors with panic devices shall be provided at all fire exit points as per the requirements. However minimum Fire rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation.		
29.12.07	Hollow excluded Section of minimum 2 mm wall thickness as manufactured by INDAL, Jindal, Hindalco or equivalent shall be used for all Aluminium doors, windows, ventilators and Partitions.		
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29.12.08	The doors, Windows & ventilators frame shall be of suitable size & thickness for fixing the glazing. The Glazing thickness shall be minimum 6 mm thk clear toughened glass for all glazed doors, windows, ventilators & partitions. Windows in air conditioned areas shall be provided with 24mm thick hermetically sealed composite double glazing.														
29.12.09	Doors and windows on external walls shall be provided with sunshade over the openings with width 600 mm more than the opening width. The projection from the finished face of the wall for sunshade shall generally be 450 mm over window openings, 750 mm over door openings and 900 over Rolling shutters, or as decided and approved by the Engineer.														
29.12.10	Float glass or flat transparent sheet glass shall conform to IS: 2835.														
29.12.11	All glazing work shall conform to IS: 3548.														
29.12.12	Windows in conveyor gallery shall be provided with welded wire fabric of 1.6mm thick wire as per IS: 4948 and 12mm x 30mm mesh size.														
30.00.00	WATER SUPPLY, DRAINAGE AND SANITATION														
30.01.00	Polyethylene water storage tank conforming to IS: 12701 shall be provided (for the use of toilet, pantry and kitchen) over the roof, with adequate capacity depending on the number of users and 8 hours requirement complete with all fittings including float valve, stop cock etc. The capacity of tank shall be calculated minimum 500 liters, per toilet, pantry and kitchen														
30.02.00	Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal piping works for potable water supply.														
30.03.00	Sand C.I. pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.														
30.04.00	The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall be also be followed.														
30.05.00	Each toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of chromium plated brass (fancy type). The common toilet area shall have finished floor level at 15 mm below the finished floor level of surrounding area. Following minimum fittings & fixtures together with associated plumbing works shall be provided as specified below. <table><tr><th>Sl. No.</th><th>Type of Fitting / Fixtures</th><th>Gents Toilet</th></tr><tr><td>i)</td><td>1 no wall mounted coloured glazed vitreous china European water closet with flush valve.</td><td>1 No.</td></tr><tr><td>ii)</td><td>Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures</td><td>1</td></tr><tr><td>iii)</td><td>Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first</td><td>1 No.</td></tr></table>			Sl. No.	Type of Fitting / Fixtures	Gents Toilet	i)	1 no wall mounted coloured glazed vitreous china European water closet with flush valve.	1 No.	ii)	Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures	1	iii)	Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first	1 No.
Sl. No.	Type of Fitting / Fixtures	Gents Toilet													
i)	1 no wall mounted coloured glazed vitreous china European water closet with flush valve.	1 No.													
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iii)	Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first	1 No.													
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		grade polished granite stone	
	iv)	Wall to wall mirror minimum 450 mm high (minimum 6mm thick float glass) including all fittings	1 No.
	v)	Stainless steel Towel Rail 600mm Long x 20 mm dia.	1 No.
	vi)	Stainless steel Liquid soap holder cum dispenser with requisite fittings.	1 No.
	vii)	Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type.	1
	viii)	Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type	1 No.
	One No. drinking water connection with C.P. brass valve for fixing water cooler by Owner.		
	Required plumbing work from Owner's service water terminal point to the service water tank and from tank to the toilet accessories mentioned above.		
	Required plumbing work from Owner's potable water terminal point to the drinking water tank and from tank up to the water coolers.		
30.06.00	Janitor room. Adequate space shall be provided.		
	Provision for installation of water cooler.		
30.07.00	All structures, buildings, facilities, liquid storage tanks shall be provided with peripheral surface brick drains of all around periphery and suitably connected to nearest Owner's drain. Overflow and drains from storage tanks shall be laid to and suitably connected to Owner's open surface drains.		
30.08.00	The sewerage and waste water disposal system shall consist of providing all associated plumbing and underground pipe works together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers, including connection to Owner's nearest main sewer line or as directed by Engineer. If required, R.C.C. septic tank and soak pit of required capacity shall be provided by the Bidder.		
30.08.00	Miscellaneous Architectural Items		
	(a.)	In all buildings suitable arrangement with provision of floor traps for draining the water collected from leakage, floor washing, fire fighting etc. shall be provided on all floors which shall be connected to rain water down comers.	
	(b.)	Wherever required minimum 1000 high hand railing with 32 NB M.S. pipes medium class as per IS : 1239 shall be provided, with toe & knee rail and toe guard plate, around all floor / roof openings, around periphery of Neutralisation Pit, projections of balconies, walkways, platforms, steel staircase etc.	
	(c.)	However for RCC staircases in structures, buildings and facilities, railings with 20 mm square MS bar balustrades with suitable anti corrosive paint of approved colour MS flats for knee & toe guard with 50mm Ø NB MS pipe hand rail at top shall be provided.	
	(d.)	All air conditioned areas / common corridors shall be provided with false ceiling constructed from 15 mm mineral Fibre Board in tile form of	
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	600x600mm with supporting system as per manufacture guidelines. 50 mm thick mineral wool insulation (conforming to IS : 8183) shall be provided with as under deck insulation). Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, Air conditioning ducts etc. Minimum headroom below false ceiling shall be 3.0 m. (e.) Under - deck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air - conditioned areas depending upon the functional / air - conditioning requirements. The under - deck insulation shall consist of 50 mm thick mineral wool insulation conforming to IS : 8183 backed with 0.05 mm thick aluminium foil & 24 G x 25 mm mesh wire netting and shall be fixed to ceiling with 24 G wire ties and suitable fixing arrangements. (f.) Parapets, chajjas, window / door heads, architectural facias, fins etc., shall be provided with drip course in cement mortar (1 : 3). (g.) 150mm thick fillets at junction of roof slab / chajja slab and parapet / vertical walls shall be provided with cast - in - situ cement concrete 1 : 2 : 4 nominal mix, followed by 12 mm thick cement sand plaster (1 : 4). (h.) Suitable provision shall be made for fixing of ceiling fans in office areas of different structures, buildings and facilities.
31.00.00	CORROSION PROTECTION
31.01.00	GENERAL
	(a) All Steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of Corrosivity category C3 (durability High) as per ISO 12944. Painting system for steel surfaces embedded in Concrete is given separately. (b) All Painting shall be done as per technical specification. Painting scheme shall be submitted by the bidder for approval of employer. (c) All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance of 1.5 mm shall be kept in thickness(over the design thickness) of structural steel members. d) Painting scheme shall be resubmitted by the Bidder for approval of employer.
31.02.00	PAINTING OF STEEL SURFACES EMBEDDED IN CONCRETE:
	a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT). b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.
31.03.00 CONCRETE)	PAINTING OF STEEL SURFACES (OTHER THAN THOSE EMBEDDED IN
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31.04.00	a) All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00. b) Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer. Notes: - For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time. - The most frequent problem associated when top coating Primer is bubbling/pin holing especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required. - In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required. - Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/ emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme.		
	COATING FOR MILD STEEL PARTS IN CONTACT WITH WATER. a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 Gms / Sq. M. for galvanised Structures and shall comply with IS: 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS: 2629.		
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	b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS: 3416, unless otherwise specified.		
31.05.00	Gratings All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 610 Gms / Sq. M.		
31.06.00	Hand Railings and Ladders All Mild steel handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736. However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.0.0.		
31.07.00	Sea Worthiness All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness.		
31.08.00	For Reinforced Concrete Work. i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts. ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion. This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc., Bidder shall furnish the details of corrosion protection measures.		
32.00.00	Miscellaneous		
32.01.00	Ordinary form work shall be used in roofs and floor slabs in transfer houses, footings, pedestals, cable trenches, pits etc., Plywood form work shall be used for all over ground exposed work like columns, beams, floors and ceilings in control room and M. C. C. buildings.		
32.02.00	Monorail girders and fixtures shall be provided for monorails at the locations as required and as described elsewhere in these specifications or drawings. Monorail openings in the walls shall be provided with steel frame doors preferably sliding type or otherwise open able inside, access platforms and ladders.		
32.03.00	Steel frame around openings in roof and on external walls for mounting of exhaust fans shall be provided.		
32.04.00	Ready mix non - shrink cementitious grout of reputed manufacturer as approved by the Employer shall be used for grouting of block outs and foundation bolts, underpinning of base plates and machine bases. Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / mm² unless higher strength requirement is specified by the equipment supplier or the grout manufacturers.		
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32.05.00	The bottom of steel in case of cable / pipe galleries and trestles shall be generally 3m above the ground except for rail / road crossing where it shall be 8m above the rail top / road crest/ground. Further in bunker areas it shall be 8 m above the ground.		
32.06.00	Polysulphide Sealing Compound shall be two-part polysulphide sealant and shall be from approved manufacturer, conforming to IS : 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines.		
33.00.00	SHOTCRETING		
33.01.00	General Requirements		
33.01.01	Generally, shotcreting shall be done in accordance with IS : 9012.		
33.01.02	Reinforcement for shotcreting shall be as detailed below, unless specified otherwise. Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting.		
33.01.03	Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied.		
33.01.04	Clear cover to reinforcement mesh shall not be less than 15 mm.		
33.01.05	Minimum thickness of shotcreting shall be 50 mm. for abrasion resistant work and 25 mm for ordinary surface protection work.		
33.02.00	Material Generally, the materials shall be in accordance with aggregates specification given hereunder.		
33.02.01	Fine aggregate shall consist of natural sand or crushed stone from a known source and shall be strong, hard, coarse, sharp, chemically inert, clean and free from any coating. It shall be free from clay, coal or coal residue, organic or any other impurities that may impair the strength or durability of the concrete and shall conform to IS : 383.		
33.02.02	Fine aggregate (Sand) shall be well graded and particles shall range in size within the following limits. The Engineer, may approved the use of any other grading as per requirement or as per IS : 9012.		
33.02.03	The fineness modulus shall be preferably between 2.5 and 3.3. Any other value can be used, with prior approval of the Engineer.		
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33.03.00	Application		
33.03.01	After the placement of reinforcement and / or welded mesh and not more than six hours prior to the application of shotcrete, the surface shall be thoroughly cleaned of all loose materials and dirt. The Contractor shall properly prepare the surfaces, reinforcement and / or welded mesh to receive the shotcrete. Cleaned surfaces shall be wetted not more than hour prior to shotcreting.		
33.03.02	The mix as placed on surface shall be one part cement to three parts approved sand by mass. Cement and sand shall be dry mixed; not water shall be added after mixing and before using in the gun. The quantity of water when added shall be only that which is sufficient to hydrate the cement. For average atmospheric conditions, the water cement ratio for shotcrete in place shall be between 0.35 and 0.5 by mass. Suitable admixture shall be used wherever required.		
33.03.03	A uniform pressure of not less than 3 Kg/cm ² at the nozzle shall be maintained. Necessary adjustments shall be made to ensure this pressure, taking into account the length of hose and height of the place to be shotcreted, above location of the machine.		
33.03.04	The application shall proceed in an upward direction. Beams, stiffeners and intermediate walls, if any, shall be wrapped with wire fabric and completely covered with shotcreting. All rebound shall be removed from the area of application as the work progresses and such rebound material shall not be reused.		
33.03.05	As soon as the freshly shotcreted surface shows the first dry patches, a fine spray of water shall be applied to keep too moist. After the surface has hardened, it shall be kept continuously moist for minimum seven days. If there is extreme heat, especially when accompanied by hot winds, the shotcreted surface, immediately upon completion, shall be covered with burlap or similar covering, which must be kept continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed 38 ^o C during placing of concrete.		
34.00.00	VIBRATION ISOLATION SYSTEM		
	These specifications are meant for the design, supply and erection of vibration isolation system for supporting crushers.		
34.01.00	Supporting Arrangement		
34.01.01	For Crushers:		
	The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an R. C. C. deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building.		
	The part of the structure consisting of the R. C. C. deck, springs and viscous dampers shall hitherto be referred to as “spring supported foundation”. The part of the structure, which is below the spring shall hitherto be called “supporting structure”.		
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34.01.02	The Contractor should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the crushers. The vibrations isolation system supplied shall be of a proven make. The Contractor or his sub - contractor who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the contractor or his sub - contractor in such machines should have been working satisfactorily for at least five years.		
34.02.00	Scope of Work		
34.02.01	Scope of work shall include the following :		
	(a.) Engineering		
	(1.) Design of the vibration isolation system using steel helical springs and viscous dampers to support an R. C. C. top deck supporting the equipment. This includes the static and dynamic analysis of the vibration isolation system with the R. C. C. top deck and the equipment.		
	(2.) Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc.		
	(3.) Calculation of loads on the structure supporting the springs and viscous dampers, their points of application and the stiffness requirements of the supporting structure.		
	(4.) Drawings showing embedments and their locations and details on the R. C. C. top deck.		
	(5.) Drawings showing blockouts, recesses etc. on the top deck.		
	(6.) Design of the supporting structure, including preparation of detailed drawings and bill of materials.		
	(b.) Supply including packing and transportation to site		
	(1.) Steel helical spring units and viscous dampers, including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads etc.		
	(2.) Frame (s) for pre-stressing of spring elements.		
	(3.) Suitable hydraulic jacks system including electric pumps, high pressure tubes etc. required for the installation, alignment etc. of the spring units, two extra hydraulic jacks, one hand operated pump and spares for the hydraulic jack system as required.		
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	(c.) Erection and Commissioning			
	(1.) Complete erection and commissioning of the vibration isolation system including :			
	(2.) Pre-stressing of spring elements, placing of spring elements in position, checking clearances on the shuttering of the R. C. C. top deck, construction of the supporting structure and the R. C. C. top deck, releasing to pre-stress in spring elements and making final adjustments and alignments after machine installation etc.			
	(3.) The scope of work shall be deemed to include all activities which may not have been explicitly mentioned but are reasonably implied for the successful completion of the work for which these specifications are intended.			
	(4.) This part of the specifications is for vibration isolation system. For the construction of the supporting structure for the crusher and the top deck, the relevant parts of the specification should be referred to.			
	(d.) Documentation			
	(1.) Submission of detailed design calculation, analysis (static and dynamic) and drawings for Employer's acceptance and approval.			
	(2.) Furnishing methodology of providing shuttering and its removal as well as concreting of deck slab, installation of springs and dampers and the sequence of operation.			
	(3.) Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system.			
	(4.) Furnishing a check list for confirming the readiness of the civil fronts for the installation of vibration isolation system and equipment required at each stage installation.			
34.03.00	(5.) Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply.			
	(6.) Detailed specifications of the vibration isolation system and various items included in the supply and the standard (local or international) to which they conform.			
	(7.) Proposed erection strategy of the entire system.			
	Design Requirements for Crusher Foundation			
	34.03.01	Dynamic Analysis		
		Detailed dynamic analysis shall be done for the top deck together with springs and dampers and the natural frequencies and amplitudes of vibration shall be		
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	determined. A mathematical model of the top deck shall be formulated with three - dimensional beam / plate finite elements for the purpose of analysis with the spring idealised with vertical and horizontal stiffnesses. The mass of the machine together with that of the top deck shall be considered for the analysis. Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria. Forced response dynamic analysis shall be carried out for the operating condition unbalance forces using a sinusoidal forcing function. Unbalance forces as given by this specifications shall be used for his purpose. The amplitudes shall be checked against the design criteria. The dynamic forces from this analysis shall be used for structural design with a suitable fatigue factor.		
34.03.02	Isolation Efficiency		
	The vibration isolation system shall be designed for about 90 % isolation efficiency.		
34.03.03	De-coupling		
	A ratio of the least 10 (ten) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in the vertical direction to achieve de-coupling between the two (the stiffness of the spring system being lower). This ensures that dynamic analysis of the supporting structure need not be carried out.		
34.03.04	Frequency Criteria		
	The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required. The first bending mode frequency of the top deck shall be at least 20 % above the operating speed.		
34.03.05	Unbalance Forces for Crushers		
	Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes. (a.) Balance quality grade Q 40 as per VDI 2060 - 1966. (b.) One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher. (c.) Three hammers broken condition. All the three hammers broken shall be assumed to be from the same suspension bar and located at the non - drive end of the crusher.		
34.03.06	Amplitude Criteria for Crushers		
	The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions.		
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	1) Operating speed of 750 RPM (a.) 150 microns for an unbalance force arising out of balance quality grade Q 40 as per VDI 2060 - 1966. (b.) 300 microns in case of a one hammer broken condition. (c.) Amplitudes need not be checked for a three hammer broken condition. 2) Operating speed of 450 RPM (a.) 200 microns for an imbalance force arising out of balance quality grade Q-40 as per VDI -2060-1966. (b.) 400 microns in case of a one hammers broken condition. (c.) Amplitude need not be checked for a three hammer broken condition. For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated. The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the R. C. C. deck. The amplitudes shall be checked for the most unfavorable superposition of modes in any direction. However, phase difference between the maximum amplitude occurring in different directions due to the rotating vetor may be considered while superimposing the modes.		
34.03.07	Unbalance force and Amplitude Criteria The unbalance forces and amplitude criteria shall be as per the equipment manufacturer's recommendations or as per VDI 2060/ VDI 2056, whichever is more stringent.		
34.03.08	Transient Resonance Transient resonance, which may occur during the start - up or coasting down condition of the crusher, shall be checked, and the amplitudes in such a condition should not exceed one - and - half times those at operating speed for each design condition.		
34.04.00	Strength Criteria The following criteria shall apply for the design of top deck : (a.) Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design. (b.) Seismic loads shall be assumed to act together with dynamic loads for a one millimeter eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together		
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	(c.) Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design. (d.) Working stress method shall be used for the design of R. C. C. deck. In survival condition, 10 % overstressing may be permitted. (e.) The R. C. C. top deck shall be at least of M35 grade of concrete as per IS : 456. (f.) Fatigue need not be considered for the three hammer broken condition. (g.) For calculating unbalance forces, the heaviest hammer (plain or toothed) shall be considered.		
34.05.00	Approval of Designs and Drawings All design calculation, drawings and documents shall be in English. All design calculations and drawings shall be submitted to Employer for approval. However, approval of such designs and drawings shall not relieve the contractor of his responsibility regarding the adequacy of the foundation to carry the design forces.		
34.06.00	Standards Latest revisions of the following Codes shall be used for the design of the crusher foundations. (a.) IS : 456 Code of Practice for Plain and Reinforced concrete. (b.) IS : 2974 (Part IV) Code of Practice for Design and Construction of Machine Foundations (Part IV) for rotary type machine of low frequency. (c.) IS : 1893 (Criteria for Earthquake Resistant Design of Structures). (d.) DIN 4024 Machine Foundations : Flexible supporting structures for machines with rotating masses. (e.) DIN 2089 Helical Compression Springs out of round wire and rod; calculation and Design. (f.) DIN 2096 Helical Compression Springs out of round wire and rod; quality requirements for hot formed compression springs. (g.) VDI 2056 - Criteria for assessing mechanical vibrations of machines. (h.) VDI 2060 - Criteria for assessing the state of balance of rotating rigid bodies.not be permitted to exceed 38°C during placing and curing		
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35.00.00	Packaging and Transportation. All the equipment shall be suitably protected coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials the limitations from the point of view of availability of railway wagon sizes in India should be taken into account. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.		
36.00.00	Plant Life The plant shall be designed for a minimum operating life of 30 years under the conditions of operation. Assurance shall be given that plant components are adequate for this lifetime. If there are any exceptional items of the plant on which an assurance of meeting this clause cannot be given, life of such components and the difficulties associated with them shall be stated.		
37.00.00	PTFE (Poly Tetra Fluoroethylene) Bearing The bearing shall be of reputed make and manufacturer as approved by the Engineer, for required vertical load and end displacement/rotation. PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/sq.cm. In order to prevent cold flow in PTFE surface it shall be rigidly bonded by a special high temperature resistance adhesive to the stainless steel substrata. The stainless steel surface that slides against the PTFE is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of stainless steel plate shall be between 1.0 mm to 1.5 mm.		
38.00.00	TESTS FOR MATERIAL / WORKMANSHIP All tests required for all materials, quality of workmanship or any other tests as desired by the Engineer shall be at contractor's cost.		
39.00.00	MATERIALS		
39.01.00	For Civil, Structural and Architectural works Employer will not supply any material. All materials including cement, reinforcement steel and structural steel, whatsoever required for execution and completion of the entire scope of work covered under this specification shall be arranged by the contractor at his own cost. All materials procured by the contractor shall meet the quality requirements specified in this specification. The contractor shall keep sufficient stock of cement and steel at site at any point of time when the work is in progress excluding what has been already incorporated in the works, so that any disruption / delay in availability of these materials during procurement will not affect the progress of work at site. The minimum quantity of such materials in stock at site shall not be less then the Requirement of one (1) month in case of Cement and Requirement of two (2) Consecutive months in case of Steel.		
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39.02.00	Structural steel		
	Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.		
39.02.01	Mild Steel		
	a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/ killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2. b) Pipes shall conform to IS 1161. c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240. d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only.		
39.02.02	Medium and High Tensile Steel		
	Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.		
39.03.00	Fly ash based Portland pozzolona cement conforming to IS: 1489 Part - I shall preferably be used. However, the contractor may use other types of cements conforming to IS: 269, IS: 8112, IS: 12269, & IS: 455.		
39.04.00	Reinforcement steel shall conform to:		
	a) Mild steel bars of grade I of IS: 432 Part – I or grade A of IS: 2062. b) High yield strength deformed TMT steel bars of grade Fe-500 having minimum elongation of 14.5 % or Fe-500D, and conforming to other requirements of IS 1786.		
40.00.00	CODES AND STANDARDS		
	All standards, specifications, acts and code of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. Other Indian, foreign Codes and Standards not listed here but referred to elsewhere within this specification shall also be deemed to be part of this list.		
	In case of conflict between this specification and those (IS standards, codes etc.) referred to herein, the former shall prevail.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Some of the relevant Indian standards, Acts and Codes applicable to this section of the specification are listed below			
	IS : 383	Specification for coarse and fine aggregates from natural sources for Concrete.		
	IS : 432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.		
	IS : 456	Code of practice for plain and reinforced concrete.		
	IS : 458	Specification for concrete pipes.		
	IS : 516	Method of test for strength of concrete.		
	IS : 800	Code of practice for use of structural steel in general building construction.		
	IS : 814	Specification for covered electrodes for metal arc welding for weld steel.		
	IS : 816	Code of practice for use of metal arc welding for general construction.		
	IS : 817	Code of practice for training and testing of metal arc welders.		
	IS : 875 (Pt. I to V)	Code of practice for design loads other than earthquake) for buildings and structures.		
	IS : 1038	Steel doors, windows and ventilators.		
	IS : 1172	Basic requirements for water supply, drainage and sanitation.		
	IS : 1361	Steel windows for industrial buildings.		
	IS : 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.		
	IS : 1892	Code of practice for subsurface investigation for foundation.		
	IS : 1893	Criteria for earthquake resistant design of structures.		
	IS : 1904	Code of practice for design and construction of foundations in soils; general requirements.		
	IS : 1905	Code of practice for structural safety of buildings - Masonry walls.		
	IS : 1948	Specification for aluminium doors, windows and ventilators.		
	IS : 2062	Steel for general structural purposes.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS : 2131 Method of standard penetration test for soils. IS : 2212 Code of practice for brickwork. IS : 2645 Specification for Integral cement water proofing compounds. IS:2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils - determination for water content etc code of practice for earth work on canals. IS : 2911 Code of practice for design and construction of pile foundations. (Part-1/Sec.1) Driven cast in situ concrete piles. (Part-1/Sec.2) Bored cast-in-situ concrete piles. (Part-IV) Load test on piles. IS : 2974 (Part - I TO V) Code of practice for design and construction of machine foundations. IS : 3370 (Part I to IV) Code of practice for concrete structures for the storage of liquids. IS : 3658 Code of practice for liquid penetrant flaw detection. IS : 3664 Code of practice for ultra sonic testing by pulse echo method. IS : 4326 Code of practice for earthquake resistant design and construction of buildings. IS : 4990 Specification for plywood for concrete shuttering work. IS : 5624 Specification for foundation bolts. IS : 7215 Tolerances for fabrication steel structures. IS : 8112 Specification for 43 grade Ordinary Portland Cement. IS : 9103 Specification for admixtures for concrete. IS : 9595 Code of procedure of manual metal arc welding of mild steel. IS : 10262 Recommended guidelines for concrete mix design. IS : 13311 Method of non - destructive testing of concrete. IS : 13755 Dust pressed ceramic tiles with water absorption of 3%, E6% (Group B11a)		
LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-IV-D CIVIL WORKS	PAGE 68 OF 69

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	ASTM 898 -89 Standard guide for use of high solid content, cold liquid-applied elastomeric water proofing membrane for use with separate wearing course. AS/NZS 2728 Pre finished / pre painted sheet metal product for interior / exterior building applications – Performance requirements. AS : 1365 Standards for steel manufacturing. AS : 1397 A steel sheet & strip – hot – dipped-zinc-coated or Aluminium-Zinc coated. AS : 3566 Self drilling screws for building and construction industry. IRC : 37 Guidelines for the design of flexible pavements. - Manual on sewerage and sewage treatment (Published by CPH & EEO) As updated. Indian Explosives Act. 1940 as updated. For “Foundation System and Geotechnical Data” refer “Project Information section” of Technical specification.		
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MW)**

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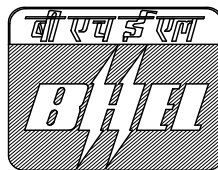
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(4X250 MW)**

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**SPECIFIC TECHNICAL REQUIREMENTS FOR CIVIL,
STRUCTURAL & ARCHITECTURAL WORKS**



Bharat Heavy Electricals Limited

**Project Engineering Management
Power Sector, BHEL**



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PART-I

GENERAL CIVIL REQUIREMENT



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1. GENERAL

Two Volumes-Section C & Section D of this specification cover site survey, soil investigation, site development works, design and construction of Civil, Structural and Architectural works. The scope of works covers complete Civil, Structural and Architectural Works including supply of all materials, labour, tools and plants as required for successful execution of the packages. This Part-I of Section-C Lists Codes and Standards to be adopted and the principal structures of the plant, and briefly describes the basic concept, requirements and features pertinent to each. **If there is any ambiguity and/or contradiction between Section C and Section D, the provisions / requirements laid in Section C shall prevail. In case of ambiguity between BOQ and Part C former shall prevail.**

(Contractor shall read the parts of the specification relevant to the contract and shall ignore the other parts of the specification. Relevant clauses of this section as applicable for respective package to be followed.)

2. CODES AND STANDARDS

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

2.1. 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.
- d) IS-4701: Code of practice for earth work on canals.
- e) IS-9759: Guide lines for dewatering during construction.
- f) IS-10379: Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.

2.2. 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-457: Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
- g) IS-460: Test Sieves (all parts).
- h) IS-516: Methods of test for strength of concrete.
- i) IS-1199: Methods of sampling and analysis of concrete.
- j) IS-1566: Hard drawn steel wire fabric for concrete Reinforcement.
- k) IS-1786: High strength deformed steel bars and wires for concrete Reinforcement.
- l) IS-1791: General requirement for batch type concrete mixers.
- m) IS-1834: Hot applied sealing compounds for joints in concrete.
- n) IS-1838: Preformed fillers for expansion joints in concrete pavement and structures.



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- o) IS-2386: Methods of test for aggregates for concrete (all parts).
(Part I-VIII)
- p) IS-2438: Specification for roller pan mixers.
- q) IS-2502: Code of practice for bending and fixing of bars for concrete Reinforcement.
- r) IS-2505: Concrete vibrators - immersion type.
- s) IS-2506: General requirements for screed board concrete vibrators.
- t) IS-2722: Specification for Portable Swing weigh batchers for concrete (single and double bucket type).
- u) IS-2750: Steel scaffoldings.
- v) IS-2751: Recommended practice for welding of mild steel plain and deformed bars for reinforced construction.
- w) IS-3150: Hexagonal wire netting for general purposes.
- x) IS-3366: Specification for pan vibrators.
- y) IS-3370: Code of practice for concrete structures for storage of liquids (all parts).
(Part I-IV)
- z) IS-3414: Code of practice for design and installation of joints in buildings.
- aa) IS-3558: Code of practice for use of immersion vibrators for consolidating concrete.
- bb) IS-4014: Code of practice for steel tubular scaffolding.
(Part I & II)
- cc) IS-4656: Form vibrators for concrete.
- dd) IS-4925: Concrete batching and mixing plant.
- ee) IS-4948: Welded steel wire fabrics for general use.
- ff) IS-4990: Plywood for concrete shuttering work.
- gg) IS-5256: Code of practice for sealing expansion joints in concrete lining on canals.
- hh) IS-6452: High Alumina Cement for Structural use.
- ii) IS-6461: Glossary of terms relating to cement concrete.
- jj) IS-6494: Code of practice for water proofing of underground reservoir and swimming pools.
- kk) IS-6509: Code of practice for installation of joints in concrete pavements.
- ll) IS-7320: Concrete slump test apparatus.
- mm) IS-7861: Code of practice for extreme weather concreting.
(Part I & II)
- nn) IS-8041: Rapid Hardening Portland Cement.
- oo) IS-8112: High strength ordinary Portland Cement.
- pp) IS-9012: Recommended practice for shotcreting.
- qq) IS-9103: Admixtures for concrete.
- rr) IS-9417: Recommendations for welding cold worked bars for reinforced concrete construction.
- ss) IS-10262: Recommended guidelines for concrete mix design.
- tt) IS-458: Specification for precast concrete pipes.
- uu) IS-3935: Code of practice for composite construction.
- vv) IS-4995: Criteria for design of reinforced concrete bins for storage of granular (all parts) and powdery materials.
- ww) IS-5525: Recommendation for detailing of reinforced concrete works.
- xx) IS-11384: Code of practice for composite construction in structural steel and concrete.
- yy) IS-11682: Criteria for design of RCC staging for overhead water tanks.
- zz) IS-12118: Two parts polysulphide based sealants.
- aaa) IS-12200: Code of practice for provision of water stops at transverse construction joints in masonry and concrete dams.
- bbb) IS-13311: Non-destructive testing of concrete - methods of test.
Part I - Ultrasonic pulse velocity.
Part II - Rebound hammer.
- ccc) IS-13920: Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces.



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- ddd) SP-16: Design codes for reinforced concrete to IS:456-1978.
eee) SP-23: Hand book of concrete mixes.
fff) SP-24: Explanatory handbook on Indian standards code for plain and reinforced concrete.
(IS: 456)
ggg) SP-34: Hand book on concrete reinforcement and detailing.
hhh) ACI-318: American Concrete Institute code for structural concrete.
iii) IS-280: Mild steel wire for general engineering purpose.
jjj) IS-10297: Code of practice for design and construction of floors and roofs using precast
reinforced/prestressed concrete ribbed or cored slab units.
kkk) IS-10505: Code of practice for construction of floors and roofs using pre-cast reinforced
concrete waffle units.
lll) IS-15658: Pre-cast concrete block for paving.

2.3. Foundations

- a) IS-1080: Code of practice for Design and Construction of shallow foundations on soils (other
than raft, ring and shell)
b) IS-1904: Code of practice for Design and Construction of foundations in soils: General
Requirements
c) IS-2314: Steel sheet piling sections.
d) IS-2911: Code of practice for Design and Construction of Pile foundations (all parts).
e) IS-2950: Code of practice for design and construction of raft foundations.
f) IS-2974: Code of practice for design and construction of machine foundations.
g) IS-4091: Code of practice for Design and Construction of foundations for transmission
line towers and poles
h) IS-6403: Code of practice for determination of Bearing capacity of Shallow foundations.
i) IS-8009: Code of practice for calculation of settlement of foundations: (all parts)
j) IS-9556: Code of practice for Design and Construction of diaphragm walls.
k) IS-11089: Code of practice for Design and Construction of ring foundation.
l) IS-12070: Code of practice for design and construction of shallow foundations on rocks.
m) IS-13301: Guidelines for vibration isolation for machine foundation.
n) ISO 10816: Criteria for assessing mechanical vibrations of machines.
o) ISO 1940: Criteria for assessing the st of balance of rotating rigid bodies.
p) DIN: EN13906-1: Helical compression spring made of round wire and rod: calculation and design
of compression.
q) DIN: 2096 Helical compression spring out of round wire and rod: Quality requirements for hot
formed compression spring.
r) DIN: 4024 Flexible supporting structures for machine with rotating machines.

2.4. Loading

- a) IS-875: Code of practice for Structural safety of buildings - loading standards.
b) IS-1911: Schedule of unit weights of building materials.
c) IRC-6: Standard specifications & Code of practice for road bridges.

2.5.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.



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- 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.
- p) IS-1905: Code of practice for structural use of unreinforced masonry.
- q) IS-10440: Code of practice for construction of reinforced brick and reinforced brick concrete floors and roofs.
- r) SP-20: Hand book on masonry design and construction.
- s) IS-1489: Portland-pozzolana cement.
- t) IS-1542: Sand for Plaster.
- u) IS-12269: 53 grade ordinary Portland cement.
- v) IS-12894: Specification for fly ash lime bricks.
- w) IS-13757: Burnt clay fly ash building bricks.

2.6.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 panelled 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.
- r) IS-208: Door Handles.
- s) IS-281: Mild steel sliding door bolts for use with padlocks.
- t) IS-362: Parliament Hinges.
- u) IS-419: Putty, for use on window frames.
- v) IS-451: Technical supply conditions for wood screws.
- w) IS-733: Wrought aluminium and aluminium alloy bars, rods and sections for general engineering purposes.
- x) IS-1285: Wrought aluminium and aluminium alloy extruded round tube & hollow section (for general engineering purposes).
- y) IS-1341: Steel butt hinges.
- z) IS-1823: Floor door stoppers.
- aa) IS-1868: Anodic coatings on Aluminium and its alloys.



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- bb) IS-2209: Mortice locks (vertical type)
- cc) IS-2553: Safety glass.
- dd) IS-3564: Door closers (Hydraulically regulated).
- ee) IS-5187: Flush bolts.
- ff) IS-5437: Figured, rolled and wired glass.
- gg) IS-6315: Specification for floor springs (Hydraulically regulated) for heavy doors.
- hh) IS-7196: Hold fast.
- ii) IS-7452: Hot rolled steel sections for doors, windows and ventilators.
- jj) IS-10019: Mild steel stays and fasteners.
- kk) IS-10451: Steel sliding shutters (top hung type)
- ll) IS-12823: Prelaminated particle boards.

2.7.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.

2.8.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 water proofing and damp proofing.
- h) IS-4365: Code of practice for application of bitumen mastic for waterproofing of roofs.
- i) IS-5318: Code of practice for laying of flexible PVC sheet and tile flooring.
- j) IS-8042: White Portland cement.
- k) IS-13755: Dust pressed ceramic tiles with water absorption of 3%, E 6% (Group B11a).
- l) IS-13801: Chequered cement concrete tiles.

2.9.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).



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2.10. 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.
- hh) IS-554: Pipe threads where pressure tight joints are made on the threads – dimensions, tolerances and designation.
- ii) IS-778: Copper alloy gate, globe and check valves for water works purposes.
- jj) IS-781: Cast copper alloy screw down bib taps & stop valves for water services.
- kk) IS-782: Caulking lead.
- ll) IS-1703: Copper alloy float valve for water supply fitting.
- mm) IS-2326: Automatic flushing cisterns for urinals.
- nn) IS-2556: Vitreous sanitary appliances (vitreous china).
- oo) IS-3311: Waste plug and its accessories for sinks and wash basins.
- pp) IS-3438: Silvered glass mirrors for general purposes.
- qq) IS-3589: Steel pipe for water and sewage (168.3 to 2540mm outside diameter)
- rr) IS-3989: Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
- ss) IS-4111: Code of practice for ancillary structure in sewerage system.
(Part I to V)



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- tt) IS-4733: Methods of sampling and testing sewage effluents.
uu) IS-4764: Tolerance limits for sewage effluents discharged into inland surface waters.
vv) IS-1068: Electroplated coating of nickel plus chromium and copper plus nickel plus chromium.
ww) IS-5382: Rubber sealing rings for gas mains, water mains and sewer
xx) IS-5822: Code of practice for laying of electrically welded steel pipes for water supply.
yy) IS-7740: Code of practice for construction and maintenance of road gullies.
zz) IS-8931: Copper alloy fancy single taps combination tap assembly and stop valves for water services.
aaa) IS-9762: Polyethylene floats for float valves.
bbb) IS-10592: Industrial emergency showers, eye and face fountains and combination units.
ccc) IS-12592: Specification for precast concrete manhole covers and frames.
ddd) IS-12701: Rotational moulded polyethylene water storage tanks.
eee) IS-13983: Stainless steel sinks for domestic purposes.
fff) SP-35: Hand book on water supply and drainage with special emphasis on plumbing.

2.11. Paving and Road works

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

2.12. 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.

2.13. Chimney

- a) IS-4998: Criteria for Design of R.C. Chimneys (all parts).
b) IS-6533: Code of practice for design and construction of steel chimneys
c) ACI-307: Specification for the design and construction of reinforced concrete chimneys
d) BS-4076: Specification for steel chimneys
e) CICIND: Model Code for concrete chimneys / Model code for steel chimneys

2.14. Cooling Tower

- a) BS-4485: Structural design of cooling towers.
(Part 4)

2.15. 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
(All Parts).
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.



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- 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. (Part 1 to 18)
- 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 sub-merged arc welding of structural steels.
- mm) IS-7318: Approval test for welders when welding procedure approval is not required.
(Part-I)
- 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.
- qq) IS-8640: Recommendations for dimensional parameters for industrial building.
- rr) IS-9178: Criteria for design of steel bins for storage of bulk material (all parts).
- ss) IS-12843: Tolerances for erection of steel structures.
- tt) IS-1181: Qualifying tests for Metal Arc welders (engaged in welding structures other than pipes).
- uu) IS-2595: Code of practice for Radiographic testing
- vv) IS-2629: Hot dip galvanising of iron and steel
- ww) IS-3502: Steel chequered plate.



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- xx) IS-3658: Code of practice for liquid penetrant flaw detection.
yy) IS-4353: Sub merged arc welding of mild steel and low alloy steel Recommendation.
zz) IS-5369: General requirements for plain washers and lock washer.
aaa) IS-6623: High strength structural nuts.
bbb) IS-6649: Hardened and tampered washers for high strength structural bolts & nuts.
ccc) IS-6911: Stainless steel plate, sheet and strip.
ddd) IS-7205: Safety code for erection of structural steel.
eee) IS-7307: Approved test for welding procedures
(Part I) Fusion welding of Steel
fff) IS-7310: Approval test for welders working to approval welding procedure.
(Part I) Fusion welding of Steel
ggg) SP-6: IS Handbook for structural engineers.

2.16. 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 in buildings.
(Part I & II)
e) IS-2338: Code of practice for finishing of wood and wood based materials.
(Part I & II)
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.
k) IS-162: Ready mixed paint, brushing fire resisting, silicate type for use on wood, colour as required.
l) IS-1650: Specification for colours for building and decorative materials.
m) IS-2395: Code of practice for painting concrete, masonry and plaster surfaces.
(Part I) Operations and Workmanship.
(Part II) Schedule.
n) IS-2524: Code of practice for painting of nonferrous metals in buildings.
(Part I) Pre-treatment.
(Part II) Painting.
o) IS-15489: Plastic emulsion paint.
p) IS-6278: Code of practice for white washing and Colour washing.
q) IS-10403: Glossary of term related to building finish.
r) IS-12027: Silicone based water repellent.
s) IS-13238: Epoxy based zinc phosphate primer (2 pack).
t) IS-13239: Epoxy surface (2 pack).
u) IS-13467: Chlorinated rubber for paints
v) IS-14209: Epoxy enamel, two component glossy.
w) BS-5493: Code of practice for protective coating of iron and steel structures against corrosion.

2.17. Sheetting

- a) IS-277: Galvanised steel sheets (Plan & corrugated).
b) IS-513: Cold-rolled low carbon steel sheets & strips.
c) IS-730: Hook bolts for corrugated sheet roofing.
d) IS-801: Code of practice for use of cold formed light gauge steel structural members in general building construction.



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- e) IS-7178: Technical supply condition for tapping screw.
- f) IS-8183: Bonded mineral wool.
- g) IS-8869: Washers for corrugated sheet roofing.
- h) IS-12093: Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanized steel sheets.
- i) IS-12436: Preformed rigid Polyurethane (PUR) and Polyisocyanurate (PIR) foams for thermal insulation.
- j) IS-12866: Plastic translucent sheets made from thermosetting polyester resin (glass fiber reinforced).
- k) IS-14246: Continuously pre-painted galvanized steel sheets and coils.
- l) BS-5950: Code of practice for design of light gauge profiled steel sheeting (Part VI)

2.18. Plastering

- a) IS-1661: Code of practice for application of cement and cement lime plaster finishes.
- b) IS-2402: Code of practice for external rendered finishes.
- c) IS-2547: Gypsum building plaster.

2.19. Acid / Alkali Resistant Tiling

- a) IS-158: Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
- b) IS-412: Expanded metal steel sheets for general purpose.
- c) IS-4443: Code of practice for use of resin type chemical resistant mortars.
- d) IS-4456: Method of Test for chemical resistant tiles.
(Part I & II)
- e) IS-4457: Ceramic unglazed vitreous acid resisting tiles.
- f) IS-4832: Specification for chemical resistant mortars.
(Part I) Silicon Type
(Part II) Resin Type
(Part III) Sulphur Type
- g) IS-9510: Bitumastic acid resisting grade.

2.20. Safety

- a) IS-1641: Code of practice for fire safety of buildings - General principles of fire grading and classification.
- b) IS-1642: Code of practice for fire safety of buildings - Details of construction.
- c) IS-3696: Safety code for scaffolds and ladders.
(Part I & II)
- d) IS-4081: Safety code for blasting and related drilling operations.
- e) IS-4130: Demolition of buildings - code of safety.
- f) IS-5121: Safety code for piling and other deep foundations.
- g) IS-5916: Safety code for construction involving use of hot bituminous materials.
- h) IS-7205: Safety code for erection of structural steel work.
- i) IS-7969: Safety code for handling and storage of building materials.



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2.21. Architectural Design of Buildings

- a) SP-7: National Building Code of India.
- b) SP-41: Hand book on functional requirements of buildings (other than industrial buildings).
- c) ECBC: Energy Conservation Building Code
- d) GRIHA: Green Rating for Integrated Habitat Assessment.

2.22. Other

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

3. GENERAL

All the quality standards, tolerances, welding standards and other technical requirements shall be strictly adhered to. The Bidder shall fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications. In case of any conflict between stipulations in various portions of the specification, most stringent stipulation would be applicable for implementation by the Bidder without any extra cost to the Employer.

4. 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 coordinate 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 is 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 opinion 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 works correctly. The Tenderer's shall take into account the cost of these in quoting their price.

5. WORKMANSHIP

Workmanship shall be of the best possible 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 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



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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.

6. TEMPORARY WORK

All scaffoldings, staging, temporary bracing and other necessary temporary work required for proper execution of the Contract shall be provided by the Contractor at his own cost and inclusive 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.

7. INTERFACE WITH STRUCTURES UNDER OTHER'S SCOPE

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

8. SEQUENCE OF WORK AND PROGRESS REPORT

The sequence in which the works 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. 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 up to date progress on all important items of work.

9. CONSTRUCTION METHODOLOGY

Construction and erection activities shall be fully mechanized from the start of the work. All excavation and backfilling work shall be done using excavators, loaders, dumpers, dozers, porcelains, excavator mounted rock breakers, rollers, sprinklers, water tankers, etc. Manual excavation can be done only on isolated places with specific approval of engineer.

Dewatering shall be done using the combination of electrical and standby diesel pumps.

For concreting, weigh batching plants, transit mixers, concrete pumps, hoists, etc. shall be used.

All handling of materials shall be with cranes.

Heavy trailers shall be used for transportation.



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Mechanized modular units of scaffolding and shuttering shall be used.

Grouting shall be carried out using hydraulically controlled grouting equipment.

All finishing items shall be installed using appropriate modern mechanical tools. Manual punching etc. shall not be permitted.

Heavy duty hoists for lifting of construction materials shall be deployed.

Compressors for cleaning of foundations and other surfaces shall be used.

Field laboratory shall be provided with all modern equipment for survey, testing of soil, aggregates, concrete, welding, etc.

All persons working at site shall be provided with necessary safety equipment and all safety aspects shall be duly considered for each construction/ erection activity. Moreover, only the persons who are trained in the respective trade shall be employed for executing that particular work.



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PART-II

SPECIFIC TECHNICAL REQUIREMENT

NTPC Limited

(A Government of India Enterprise)



NABINAGAR THERMAL POWER PROJECT (4x250MW)

PART - A

TECHNICAL SPECIFICATIONS

SECTION – VI

FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

LOT-IA PROJECTS

SECTION - VI

TECHNICAL SPECIFICATION FOR FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

THE TECHNICAL SPECIFICATION, SECTION - VI COMPRISE OF THE FOLLOWING PARTS

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SUB-SECTION-II-A2	PROJECT INFORMATION- LARA-I 2X800 MW
SUB-SECTION-II-A3	PROJECT INFORMATION- GADARWARA-I 2X800 MW
SUB-SECTION-II-A4	PROJECT INFORMATION- DARLIPALLI-I 2X800 MW
SUB-SECTION-II-A5	PROJECT INFORMATION- MOUDA-II 2X660 MW
SUB-SECTION-II-A6	PROJECT INFORMATION- SOLAPUR-II 2X660 MW
SUB-SECTION-II-A7	PROJECT INFORMATION- TANDA-II 2X660 MW
SUB-SECTION-II-A8	PROJECT INFORMATION- NABINAGAR-I 3X660 MW
SUB-SECTION-II-A9	PROJECT INFORMATION- MEJA-I 2X660 MW
SUB-SECTION-II-A10	PROJECT INFORMATION- BARH-I 3X660 MW
SUB-SECTION-II-A11	PROJECT INFORMATION- NABINAGAR 4X250 MW
SUB-SECTION-III	SCOPE OF SUPPLY & SERVICES
SUB-SECTION-III-A	MECHANICAL EQUIPMENTS & SYSTEMS
SUB-SECTION-III-A1	FLUE GAS DESULPHURISATION SYSTEM
SUB-SECTION-III-A2	AIR CONDITIONING, VENTILATION SYSTEM & COMPRESSED AIR SYSTEM
SUB-SECTION-III-A3	FIRE FIGHTING SYSTEM
SUB-SECTION-III-A4	EQUIPMENT COOLING WATER SYSTEM
SUB-SECTION-III-A5	LIME STONE & GYPSUM HANDLING SYSTEM
SUB-SECTION-III-A6	ZERO LIQUID DISCHARGE SYSTEM

LOT-IA PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(1A)-2

SUB-SECTION-III-B	ELECTRICAL SYSTEM/EQUIPMENT
SUB-SECTION-III-C	CONTROL AND INSTRUMENTATION SYSTEM
SUB-SECTION-III-D	CIVIL WORKS
SUB-SECTION-IV	TERMINAL POINTS & EXCLUSIONS
SUB-SECTION-V	SALIENT DESIGN DATA & SIZING
SUB-SECTION-VI	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
SUB-SECTION-VII	MANDATORY SPARES

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SUB-SECTION-I-M3	COMPRESSED AIR SYSTEM
SUB-SECTION-I-M4	FIRE DETECTION & PROTECTION SYSTEM
SUB-SECTION-I-M5	EQUIPMENT COOLING WATER SYSTEM
SUB-SECTION-I-M6	LIME STONE & GYPSUM HANDLING SYSTEM
SUB-SECTION-I-M7	ZERO LIQUID DISCHARGE SYSTEM
SUB-SECTION-I-M8	PIPING
SUB-SECTION-I-M9	MDL

PART – B (DETAILED TECHNICAL SPECIFICATION)

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SUB-SECTION-II-E4	LT POWER CABLES
SUB-SECTION-II-E5	LT CONTROL CABLES
SUB-SECTION-II-E6	CABLING EARTHING & LIGHTNING PROTECTION
SUB-SECTION-II-E7	HT CABLES

SUB-SECTION-II-E8	ELECTRIC ACTUATORS WITH INTEGRAL STARTERS
SUB-SECTION-II-E9	HT SWITCHGEAR
SUB-SECTION-II-E10	LT SWITCHGEAR & LT BUSDUCT
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SUB-SECTION-II-E13	ELEVATOR ELECTRICAL
SUB-SECTION-II-E14	FIRE PROOF CABLE PENETRATION SEALING SYSTEM
SUB-SECTION-II-E15	LIGHTING
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PART – B (DETAILED TECHNICAL SPECIFICATION)

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SUB-SECTION-III-C2	MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)
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SUB-SECTION-III-C6	TYPE TEST REQUIREMENTS
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PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-IV-D (CIVIL WORKS)

SUB-SECTION-IV-D	CIVIL WORKS

PART – B (DETAILED TECHNICAL SPECIFICATION)

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(MECHANICAL)

SUB-SECTION-V-QM1	FLUE GAS DESULPHURISATION SYSTEM
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(ELECTRICAL)

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SUB-SECTION-V-QE14	STATION LIGHTING

(CONTROL & INSTRUMENTATION SYSTEM)

SUB-SECTION-V-QC1	MEASURING INSTRUMENTS (PRIMARY & SECONDARY
SUB-SECTION-V-QC2	PROCESS CONNECTION & PIPING
SUB-SECTION-V-QC3	INSTRUMENTATION CABLES
SUB-SECTION-V-QC4	CONTROL DESK PLC PANEL SMOKE DETECTOR FIRE ALARM & CONTROL SYSTEM
SUB-SECTION-V-QC5	POWER SUPPLY SYSTEM
SUB-SECTION-V-QC6	CONTROL VALVE ACTUATORS AND ACCESSORIES
SUB-SECTION-V-QC7	ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS

(CIVIL WORKS)

SUB-SECTION-V-QD1

SUB-SECTION- VI

(PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND
INITIAL OPERATIONS)

PART - C

GENERAL CONDITIONS OF CONTRACT

PART - D

ERECTION CONDITIONS OF CONTRACTS

PART - E

LIST OF TENDER DRAWINGS

PART - F

ATTACHMENT-12 TO SECTION-VII (TECHNICAL DATA SHEETS)

PART – A

SUB-SECTION-I

INTENT OF SPECIFICATION

CLAUSE NO.	INTENT OF SPECIFICATION			
1.00.00	INTENT OF SPECIFICATION			
1.01.00	Scope of the proposal The scope of the proposal for Engineering, Supply, Construction, Erection, Testing & Commissioning works for each project of Flue Gas Desulphurisation (FGD) System Package for Lot 1A Projects shall be on the basis of a single point responsibility, completely covering the following activities and services in respect of all the equipment specified and covered under the specifications and read in conjunction with “Scope of Supply & Services”, Sub-section-III, Part-A, Section – VI of Technical Specification. a) Basic Engineering of the plant including preparation of Plant Definition Manuals for the Project; b) Detailed design of all the equipment and system(s) including civil, structure steel works included in bidder's scope for the Project. c) Providing engineering drawings, equipment sizing & performance data, instruction manuals, as built drawings and other information; d) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required; e) Complete manufacturing including shop testing/type testing; f) Complete Civil, Structural and Architectural works, including survey, providing construction offices, field laboratory and construction equipments; g) Packing and transportation from the manufacturer's works to the site including customs clearance & port clearance, port charges, if any. h) Receipt, storage, preservation, handling and conservation of equipment at the site; i) Fabrication, pre-assembly, if any, erection, testing, commissioning and completion of facilities including putting into satisfactory operation all the equipment including successful completion of initial operation; j) Reliability tests, performance and guarantee tests after successful completion of facilities; k) Furnishing of spares on FOR site basis; l) Reconciliation with customs authorities, as required.			
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1.02.00	m) Satisfactory conclusion of the contract. n) Insurance and other requirements for the complete FGD package in accordance with the provisions of general conditions of contract (Section-IV) of the bidding document. The requirements, conditions, appendices etc. given in Technical Specifications (Section-VI, Parts A, B, C, D, E & F and shall apply to and shall be considered as a part of this volume as completely as if bound here with. The work to be carried out as per the above scope shall be all in accordance with the requirements, conditions, appendices, etc., stated in Section GCC, which shall be considered as a part of the Technical Specification (Section VI) as completely as if bound herewith. The Contractor shall be responsible for providing all material, equipment and service, which are required to fulfill the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. It is not the intent to specify completely herein, all aspects of design and construction of equipment, nevertheless, the equipment shall conform in all aspects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the Employer, who will interpret the meaning of the specification, drawings and shall have a right to reject or accept any work or material which in his assessment is not complete to meet the requirements of this specification and/or applicable international standards mentioned elsewhere in the specification. Bidders are requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specification. Before, submitting their offer, Bidder is required to visit the Project site for assessing the feasibility & layout for FGD System. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. In the event of conflict between the Technical Specifications and the Conditions of Contract, the requirements as indicated in the technical specification shall govern, unless confirmed otherwise by the Employer in writing before the award of this contract, based on a written request from the Bidder for such a clarification. However, if the Bidder feels that, in his opinion, certain features brought out in his offer are superior to what has been specified, these may be highlighted separately. The Bidder may also make alternate offers provided, such offers are superior in his opinion, to the requirements of these specifications in which case, adequate technical information, operating feed back, etc., are to be enclosed with the offer, to enable the Employer to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumption etc., shall be clearly brought out for the Employer to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications. Under no circumstances the specified equipment and services shall be brought out as an alternative offer.			
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	In case, all the above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.		
1.03.00	The following are the equipment's covered in this specification:		
1.03.01	Wet limestone based Flue gas desulphurization (FGD) for the project, capable of reducing to the specified limits the emissions of Sulphur Dioxide in flue gas produced by specified coal being fired in boiler, complete with all accessories and auxiliary equipment's as per specification requirements including Booster Fans for each unit, Absorber for each unit with Slurry re-circulation pumps & Oxidation blowers, common Limestone Grinding & slurry preparation system, common Gypsum dewatering system, Limestone handling and storage system, Gypsum handling and storage system.		
1.03.02	~~One (1) number of elevator for each absorber and One (1) numbers of elevator for Limestone Grinding System building.~~		
1.03.03	Buildings for Slurry re-circulation pumps/Oxidation blowers, Limestone Grinding System, Gypsum dewatering system & FGD control Room.		
1.03.04	~~All motors, HT & LT Switchgears, DC System, Transformers, Electrical Actuators, HT & LT power & control cables, DG set (if applicable), cabling, lighting etc.~~		
1.03.05	~~ZERO LIQUID DISCHARGE (ZLD) SYSTEM for FGD waste water for Barh-I (3X660 MW) & Nabinagar (4x250 MW).~~		
1.03.06	Low Height Wet Chimney(s) for the project.		
1.03.07	~~Associated Control & Instrumentation (C&I) equipments.~~		
1.03.08	Associated Civil, Structural and Architectural works including foundation as specified in Technical Specification.		
1.04.00	Wherever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific items mentioned shall be understood to be descriptive only and not restrictive. Such description indicates the equipment type, function and quality desired. Other manufacturer's products may be considered provided sufficient information so as to enable the Employer to determine that the products proposed are equivalent to those named.		
2.00.00	Additional Requirements (a) Before submitting his bid, the Bidder should inspect and examine the site and its surroundings and should satisfy himself as to the nature of the ground and subsoil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other		
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3.00.00	circumstances which may influence or affect his offer. No consequent extra claims on any misunderstanding or otherwise shall be allowed by the Employer. (b) Bidder shall take all necessary precautions to protect all the existing equipment, structures, facilities and buildings etc. from damage. In case any damage occurs due to the activities of the contractor on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be immediately made good by the contractor at his own cost to the satisfaction of the Employer. The contractor shall also take all necessary safety measures with specific reference to excavation in rock, at his own cost, to avoid any harm or injury to his workers and staff from the equipment and facilities of the power plant. (c) For his site office and covered store buildings, the contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated or uninsulated roof and wall coverings (fabricated out of permanently color coated metal sheets). Alternatively, contractor can adopt readymade 'Porta cabin' or similar construction. Contractor shall ensure that all such constructions are well engineered, neatly constructed and overall present a pleasing look. (d) In line with Gazette Notification on Ash Utilization issued by MOEF and its amendment thereafter, contractor shall use ash and ash based products in works as specified in these specifications, drawings and as per instructions of the Engineer. He shall also use ash and ash based products in construction of his offices, stores, staff quarters and labour huts etc. He shall furnish a compliance report along with all details of use of ash and ash based products along with each bill. (e) Contractor shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like piling rigs, cranes batching plant, dewatering pumps etc.) In case of piling rigs, cranes, batching plant etc. he will also make arrangements / tie up with equipment manufacturers / suppliers for periodic overhaul/maintenance and for major breakdown, if any. He shall also keep adequate stock of spares at site for various plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Contractor shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.		
	APPLICABLE DRAWINGS The drawings listed below and forming part of the specification (Refer Part-E) shall supplement the requirements specified herein. The scope and terminal points of the equipment to be furnished under this steam generator package shall be as identified in these drawings and read in conjunction with text of the specification:		
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	(A) SCHEMES				
	Sl. No	Drawings Title	Drawings No.	Rev. No.	No. of Sheets
	1)	Scheme of Absorber system	0011-109-POM-A-001	A	2
	2)	Scheme of Limestone Milling system	0011-109-POM-A-002	A	1
	3)	Scheme of Gypsum De-watering system	0011-109-POM-A-003	A	1
	4)	P&ID Diagram for ECW System of FGD	0011-109-POM-A-004	A	1
	5)	Process Flow Diagram for FGD Waste water treatment (FGD WWT) for ZLD	0011-109-POM-A-005	A	3
	(B) CONTROL & INSTRUMENTATION				
	Sl. No.	Drawings Title	Drawings No.	No. of Sheets	
	1.	Standard configuration diagram for PLC	0000-151-POI-A-013	1	
	2.	G.A. of Junction Box	0000-999-POI-A-017	1	
	3.	Instrumentation cabling diagram grounding scheme for cabinets/panels/Power Supply	0000-999-POI-A-019A	2	
	4.	Scheme of 24V DC Power supply system	0000-999-POI-A-019B	1	
	5.	Scheme for Uninterruptible Power Supply System	0000-999-POI-A-019C	1	
	6.	Instrumentation/control/power supply cabling diagram	0000-101/102-POI-A-021	3	
7.	Instrument Source Connection details	0000-999-POI-A-035	14		
8.	Typical GA of Local Instrument	0000-999-POI-A-036	1		
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CLAUSE NO.	INTENT OF SPECIFICATION			एनटीपीसी NTPC
	Sl. No.	Drawings Title	Drawings No.	No. of Sheets
		Enclosure, purging scheme, DP transmitter		
	9.	Interfacing of actuators	0000-999-POI-A-063	1
	10.	Interfacing of field instruments/Electrical interface/PLC Interface	0000-999-POI-A-065	15
	(C) ELECTRICAL			
	(1)	Electrical single line diagram for FGD Package	: Drg No. 0011-109-POE-J-001/A-E	
	Note : All the above drawings are indicative of Employer's requirements to enable the Bidder to make a suitable offer. All variations/alternations shall be clearly brought out in the technical deviation schedule with implications, if any. Such variations may be acceptable after assessment of its implication and shall be subjected to the Employer's approval. However, the flexibility of operation and maintenance desired by the schemes and layouts shall be binding. Electrical drawings (except Electrical single line diagram) are attached with respective Electrical Chapters in Part b, Section VI.			
4.00.00	QUALIFYING REQUIREMENTS FOR EQUIPMENTS/SYSTEMS			
4.01.00	Provenness criteria for critical equipment, auxiliaries, systems and bought out items: The Bidder / Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below:			
4.01.01	Booster Fans, Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, Agitators & Vacuum Belt Filters for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder:			
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	Type and Rating for Qualification				
	Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating
	(a)	Booster Fans	Axial type with variable pitch control	Coal fired power plant	80% of the flow & 100% of the head of the offered Booster Fan with Fan Speed 900 rpm (maximum)
	(b)	Slurry Recirculation Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Recirculation Pump
	(c)	Oxidation Blowers	Centrifugal/ positive displacement type blower	Wet Limestone based FGD application in Coal fired power plant	80% of the flow & 100% of the head of the offered Oxidation Blower
	(d)	Wet limestone Grinding mills	Horizontal Wet Ball mill	Wet Limestone based FGD application in Coal fired power plant	80% of the offered Ball mill capacity with pulverizing fineness not less than 90% thru 325 mesh
	(e)	Slurry Pumps	Centrifugal type	Wet Limestone based FGD application or ash slurry application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Pump(s)
	(f)	Agitators	Vertical/Horizontal	Wet Limestone based FGD application in Coal fired power plant	Agitator rating not less than that supplied for 500 MW or higher size unit for similar application
	(g)	Vacuum Belt filters	Belt type	Wet Limestone based FGD application in Coal fired power plant	80% of the offered Vacuum Belt filter capacity
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	Bidder shall offer and supply only the type of the above equipment(s) for which he himself or the manufacturer proposed by the bidder for the above equipment(s) is qualified. The provenness criteria for equipment (Booster Fans) stipulated at Sl. No. 4.01.01 (a) above shall also be considered acceptable provided the rating parameters (i.e., flow, head and rated rpm) is covered within the operating regime of the respective fan performance curve of the reference plant equipment.			
4.01.02	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Booster Fans as per clause 4.01.01 (a) above but is a manufacturer of such equipment for units of at least 500 MW rating, the Bidder or the proposed sub vendor can manufacture such equipment for 660 MW units also, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (a) above for the Booster Fans.			
4.01.03	A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.01 above in India, can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s). Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later.			
4.01.04	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Oxidation Blowers as per clause 4.01.01 (c) above but is a manufacturer of Blowers/compressors for minimum 50 NM ³ /min capacity, the Bidder or the proposed sub-vendor can also manufacture Oxidation Blowers, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Oxidation Blowers in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (c) above for the Oxidation Blowers. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.			
4.01.05	(i) In case the Bidder or the proposed sub-vendor is not manufacturer of proven Wet limestone Grinding mills as per clause 4.01.01 (d) above but is a manufacturer			
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4.01.06	of dry Grinding mills for power or cement industry of minimum 20 T/h capacity, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding mills, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Wet limestone Grinding mills in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (d) above for the Wet limestone Grinding mills. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments. In addition, the Bidder along with the qualified equipment manufacturer shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed in the bidding document. The DJU shall be submitted prior to the placement of order on the approved sub-vendor for Wet limestone Grinding mills. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 10 Million (Indian Rupees Ten Million only) for each project.			
	OR (ii) In case, the bidder or proposed sub vendor is not a manufacturer of proven Wet Limestone Grinding Mills as per clause 4.01.01 (d) above, but have designed, manufactured & supplied dry Grinding Ball Tube mills for at least 500 MW pulverized coal fired power plant, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding Mills provided it has a licensing agreement with a Wet limestone Grinding mills manufacturer who meet the requirements stipulated at clause 4.01.01 (d) above for the Wet limestone Grinding mills and provides extended warranty of three (3) years for the Wet Limestone Grinding Mills. In such a case Bidder shall provide an additional on demand bank guarantee for INR 10 Million (Indian Rupees Ten Million only) for each project.			
	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 4.01.01 (f) above but is a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry, the Bidder or the proposed sub-vendor can also manufacture Agitators, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Agitators in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (f) above for the Agitators. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.			
	In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.01.01 (e) above, the Bidder or the proposed sub-vendor can also manufacture Slurry Recirculation Pumps,			
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4.01.08 4.01.09 4.01.10 4.02.00 4.02.01 4.02.02	provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (e) above for the Slurry Recirculation Pumps. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. Before taking up the manufacturing of such equipment(s) as per clause 4.01.02, 4.01.03, 4.01.04, 4.01.05(i), 4.01.06 & 4.01.07 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licenser's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licenser shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments. Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licenser(s) proposed by the Bidder for the above equipment(s) is qualified. The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract. Note to clause 4.01.01 (1) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite. Sub QR for Civil Works: Bidder or its agency should have in past executed civil and structural works for 500 MW or higher capacity coal based/Lignite based power plant including earthwork in filling involving mechanical compaction and cutting in hard rock, foundations, Bulk material handling plant involving underground storage hopper and underground tunnels. Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 4.02.01. The agency being engaged for a particular work should have in the past executed such works of 500 MW or higher capacity plant.			
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4.02.03	For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height.			
4.02.04	In case Bidder or its agency do not meet the requirements at 4.02.01and the Bidder proposes to engage agency (ies) for civil & structural works on work volume basis (except for Chimney), Bidder or its agency (ies) should have executed such works in the past and the annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, (structural steel fabrication & erection, RCC, earthwork in filling involving mechanical compaction and cutting in hard rock, RCC in underground storage hopper and underground tunnels) for which it is being engaged.			
	Successful Bidder shall finalize the agency (ies) for each work in consultation with Engineer-in-charge at site before engaging them.			
	Design agency for Civil & Steel Structural Works:			
4.02.05	Bidder or its agency (ies) should have carried out the design and detailed engineering of following works: (i) Civil & Structural works associated with at least one bulk material handling plant for 500 MW or higher capacity coal based/Lignite based power plant. (ii) For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height. (iii) Machine foundations such as Mill foundations/ Block foundations.			
4.02.06	Bidder can engage more than one agency (of repute), in case the Bidder itself is not able to meet the requirement at 4.02.05. The design agency (ies) proposed by the Bidder shall be subject to Employer's approval.			
4.03.00	~~PROVENNESS CRITERIA FOR ELECTRICAL EQUIPMENTS~~			
4.03.01	~~HT MOTORS~~			
4.03.01.01	~~BOOSTER FAN MOTOR~~ The offered Squirrel cage Induction motor shall be from such a Manufacturer who has manufactured and supplied motor of 4MW or above rating, which should have been in successful operation for at least one (1) plant for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
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4.03.02	LT SWITCHGEAR			
4.03.02.01	ROUTE 1			
4.03.02.01	(i) Bidder/ Sub Vendor should have manufactured and supplied at least a total of four hundred & fifty (450) nos. draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for 1 second and 105kA peak under a single order and these panels should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.03.02.01	(ii) Bidder/ Sub Vendor should have manufactured and supplied at least one hundred & fifty (150) nos. of Air Circuit Breakers having fault rating of at least 105kA MAKING and 45kA BREAKING, and their associated draw out type Air circuit breaker panels having fault rating of at least 45kA for 1 Second and 105kA peak, which should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.03.02.02	ROUTE 2			
4.03.02.02	(i) Bidder/Sub-vendor should have manufactured and supplied at least a total of two hundred & twenty five (225) nos. draw out type Air Circuit Breaker Panels and / or draw out type Motor Control Centre Panels with fault rating of at least 45kA for 1 second and 105kA peak under a single order and these panels should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.03.02.02	(ii) Bidder/Sub-vendor should have manufactured and supplied at least seventy five (75) nos. of draw out type Air Circuit Breaker panels having fault rating of at least 45kA for 1 second and 105kA peak, which should have been in successful operation for a period of not less than two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.03.02.02	(iii) Bidder/Sub-vendor shall Associate/Collaborate with a manufacturer who meets the requirements stipulated in Route 1. In such a case, Bidder/Sub-vendor should furnish a Deed of Joint Undertaking executed by Bidder/Sub-vendor and its Associate/Collaborator as per the format enclosed in the bidding document in which the Bidder/Sub-vendor and its Associate/Collaborator are jointly and severally liable to the Employer for successful performance of the LT Switchgears under this package. This Deed of Joint Undertaking should be submitted prior to the placement of order on approved Sub Vendor. In case of award, the Associate or Collaborator of the Bidder / Sub Vendor (as applicable) will be required to			
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4.03.03	furnish an on-demand Bank Guarantee for INR 1 Million (Indian Rupees One Million only) per project. Note: Each Single Front Panel shall be counted as one (1) Panel, Double Front Panel as one (1) Panel and Air Circuit Breaker Panel as one (1) Panel.			
	11 KV / 3.3 KV SWITCHGEARS Route 1			
	4.03.03.01 The Bidder/ Sub Vendor should have manufactured and supplied on an average one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels per annum during the last three years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
	4.03.03.02 The Bidder/ Sub Vendor should have designed, manufactured and supplied at least one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels complete in all respects with fault rating of at least 40kA for one (1) second and 100kA (peak), which should have been in successful operation for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
	4.03.03.03 The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit Breakers for 11kV and /or 6.6kV panels with a rating of 40kA rms BREAKING, 100kA peak MAKING and 40kA withstand for one (1) second, which should have been in successful operation in 6.6kV or higher voltage application for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. Route 2 Bidder/ Sub Vendor based on technological support of its Associate or Collaborator, can also participate provided			
	4.03.03.04 The Bidder/ Sub Vendor should have manufactured and supplied on an average one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels per annum during the last three years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
	4.03.03.05 The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of 11kV and /or 6.6kV Switchgear panels complete in all respects with fault rating of at least 40kA for one (1) second and 100kA (peak). The Bidder/ Sub Vendor should have type tested the offered type of panels as specified.			
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4.03.03.06	The Bidder/ Sub Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit Breakers for 11kV and /or 6.6kV panels with a rating of 40kA rms BREAKING, 100kA peak MAKING and 40kA withstand for one (1) second, reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.03.03.07	Bidder's/ Sub Vendor's Associate or Collaborator meets the qualifying requirement stipulated at 4.03.03.02 & 4.03.03.03 stipulated under Route 1.			
4.03.03.08	Bidder/ Sub Vendor furnishes a Deed of Joint Undertaking jointly executed by it and its Associate/ Collaborator as per format enclosed in the bidding document in which the Bidder/ Sub Vendor and its Associate/ Collaborator are jointly and severally liable to the Employer for successful performance of the MV Switchgears. This Deed of Joint Undertaking should be submitted prior to the placement of order on approved Sub Vendor. In case of award, the Associate or Collaborator of the Bidder / Sub Vendor (as applicable) will be required to furnish an on-demand Bank Guarantee for INR 1 Million (Indian Rupees One Million only) per project. Note: Equipment designed by the Bidder itself or through its Collaborator/Associate for reference plant, shall also be considered meeting the requirement of design.			
4.03.04	NUMERICAL RELAYS & NETWORKING			
4.03.04.01	Numerical Relays shall be offered from a Manufacturer who has manufactured and supplied and successfully configured at least 100 No's of Numerical Relays with IEC 61850 used for application in Feeder Protections/Transformer Protections/Motor Protections. These relays should have been in successful operation for at least one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.03.04.02	The Numerical Relay Network system shall be offered from an Integrator /Manufacturer who has designed and successfully done FAT for a network on IEC 61850 with at least 100 no's of Communicable Numerical Relays reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.03.05	AUXILIARY OIL FILLED TRANSFORMERS			
4.03.05.01	The Bidder/ Sub-Vendor should have manufactured & supplied at least two numbers (one each at two different installations) of 16 MVA, 11KV or higher rating oil filled transformers which should have been in successful operation for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
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	And			
4.03.05.02	Bidder/ Sub-Vendor should have his own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test).			
	And			
4.03.05.03	16 MVA, 11 KV Class or higher rated oil filled transformer manufactured by Bidder/ Sub-Vendor should have been successfully short circuit tested.			
	Note:			
	i) Two different installations mean two different project sites or two different contracts.			
	ii) Equipment designed by the Bidder/Sub-vendor by itself or through its Collaborator/Associate for reference plant, shall also be considered meeting the requirement of design.			
4.04.00	FGD WASTE WATER TREATMENT SYSTEM FOR ZERO LIQUID DISCHARGE (ZLD)			
4.04.01	Route-1			
4.04.01.01	Bidder/Bidder's Sub vendor should have designed, supplied, erected/supervised erection and commissioned/supervised commissioning at least one (1) number of FGD Waste Water Treatment System (essentially comprising of Evaporator (Brine Concentrator) and/or Crystalliser, Vapour Compressor) operating in Coal fired unit(s) of power plant, having inlet feed as FGD waste water of TDS not less than 30,000 ppm and treatment capacity of not less than 10 m³/hr. The above FGD Waste Water Treatment System should have been in successful operation for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.04.02	Route-2			
4.04.02.01	The Bidder/its Sub-vendor who do not meet the qualification requirements stipulated at 4.04.01.01 above, may also participate provided the Bidder/its Sub vendor is a contractor who have designed, supplied, erected/supervised erection and commissioned/supervised commissioning at least one (1) number of Waste Water Treatment System (essentially comprising of Evaporator (Brine Concentrator) and/or Crystalliser) operating in an Industrial unit which should have been in successful operation for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder and associates/collaborates with an Associate/Collaborator who in turn fully meets the requirements stipulated at 4.04.01.01 above.			
4.04.02.02	Bidder/its sub vendor should also have a valid ongoing collaboration and technology transfer agreement with an Associate/Collaborator meeting requirements of clause 4.04.01.01 above, valid minimum up to the end of the defect liability period of the			
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4.04.02.03 4.05.00 4.05.01	contract. In such a case Bidder/Sub vendor can either source the FGD Waste Water Treatment System from such system provider or can itself manufacture/get manufactured, supply and install the FGD Waste Water Treatment System as per the design, manufacturing and installation drawings released by such Associate/Collaborator. The Bidder shall furnish a Deed of Joint Undertaking (DJU) executed by it, its Sub vendor (if applicable) and the Collaborator/Associate and each executant of DJU shall be jointly and severally liable to the Employer for successful performance of FGD waste water treatment system. The Deed of Joint Undertaking(s) (DJU) should be submitted at the time of placement of order on approved Sub vendor. In case of award, the Associate or Collaborator of the Bidder/Sub-vendor (as applicable) shall be required to furnish an on demand bank guarantee for INR 20 Million (Rupees Twenty Million) for each project. Provenness criteria for critical equipment, auxiliaries, systems and bought out items for FGD waste water system: The Bidder/Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below: Evaporator/Brine Concentrator, Crystallizer, Mechanical Vapour Compressor, Evaporator feed Heat exchanger, Crystalliser Heat exchanger for FGD Waste Water System for ZLD offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration/licensing agreement), manufactured/got manufactured the respective equipment(s) of the type, application and minimum equipment rating not less than that supplied in FGD waste water application and such equipment(s) should have been in successful operation in at least one (1) coal fired power station for a period not less than one (1) year reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder. <table border="1"> <thead> <tr> <th>Sl. No</th><th>Name of Equipment</th><th>Type of Equipment</th><th>Application</th><th>Equipment Rating</th></tr> </thead> <tbody> <tr> <td>a)</td><td>Evaporator/ Brine concentrator</td><td>Falling Film</td><td>FGD application in Coal fired power plant</td><td>Evaporator/Brine concentrator of a FGD Waste water treatment system of capacity not less than 10 m³/hr.</td></tr> <tr> <td>b)</td><td>Crystallizer</td><td>Forced circulation</td><td>FGD application in Coal fired power plant</td><td>Crystallizer of a FGD Waste water treatment system of capacity not less than 10 m³/hr.</td></tr> <tr> <td>c)</td><td>Mechanical Vapour Compressor</td><td>Centrifugal</td><td>FGD application in Coal fired power plant</td><td>Mechanical Vapour Compressor of a FGD Waste water treatment system of capacity not less than 10 m³/hr.</td></tr> </tbody> </table>	Sl. No	Name of Equipment	Type of Equipment	Application	Equipment Rating	a)	Evaporator/ Brine concentrator	Falling Film	FGD application in Coal fired power plant	Evaporator/Brine concentrator of a FGD Waste water treatment system of capacity not less than 10 m ³ /hr.	b)	Crystallizer	Forced circulation	FGD application in Coal fired power plant	Crystallizer of a FGD Waste water treatment system of capacity not less than 10 m ³ /hr.	c)	Mechanical Vapour Compressor	Centrifugal	FGD application in Coal fired power plant	Mechanical Vapour Compressor of a FGD Waste water treatment system of capacity not less than 10 m ³ /hr.			
Sl. No	Name of Equipment	Type of Equipment	Application	Equipment Rating																				
a)	Evaporator/ Brine concentrator	Falling Film	FGD application in Coal fired power plant	Evaporator/Brine concentrator of a FGD Waste water treatment system of capacity not less than 10 m ³ /hr.																				
b)	Crystallizer	Forced circulation	FGD application in Coal fired power plant	Crystallizer of a FGD Waste water treatment system of capacity not less than 10 m ³ /hr.																				
c)	Mechanical Vapour Compressor	Centrifugal	FGD application in Coal fired power plant	Mechanical Vapour Compressor of a FGD Waste water treatment system of capacity not less than 10 m ³ /hr.																				
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CLAUSE NO.	INTENT OF SPECIFICATION				
	Sl. No	Name of Equipment	Type of Equipment	Application	Equipment Rating
	d)	Evaporator feed Heat Exchanger	Plate type /Tube & Shell type	FGD application in Coal fired power plant	Evaporator feed Heat Exchanger of a FGD Waste water treatment system of capacity not less than 10 m ³ /hr.
	e)	Crystallizer Heat Exchanger	Plate type/Tube & Shell type	FGD application in Coal fired power plant	Crystallizer Heat Exchanger of a FGD Waste water treatment system of capacity not less than 10 m ³ /hr.
	Bidder shall offer and supply only the type of the above equipment(s) for which he himself or the manufacturer proposed by the Bidder for the above equipment(s) is qualified.				
4.05.02	A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.05.01 above in India can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.05.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/his sub-vendor(s) must create/have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s).				
	Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its Holding company/Subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/Subsidiary or upto the end of defect liability period of the contract, whichever is later.				
4.05.03	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Evaporator/Brine concentrator as per clause 4.05.01 (a) above but is a manufacturer of Evaporator/Brine concentrator for any Industrial unit, the Bidder or the proposed sub-vendor can also manufacture Evaporator/Brine concentrator, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Evaporator/Brine concentrator in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (a) above for the Evaporator/Brine concentrator. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment.				
4.05.04	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Crystallizer as per clause 4.05.01 (b) above but is a manufacturer of Crystallizer for any Industrial unit, the Bidder or the proposed sub-vendor can also manufacture Crystallizer, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Crystallizer in India with such				
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4.05.05 4.05.06 4.05.07 4.05.08	manufacturer who meet the requirements stipulated at clause 4.05.01 (a) above for the Crystallizer. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. In case the Bidder or the proposed sub-vendor is not manufacturer of proven Mechanical Vapour Compressor as per clause 4.05.01 (c) above but is a manufacturer of Compressor, the Bidder or the proposed sub-vendor can also manufacture Mechanical Vapour Compressor, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Mechanical Vapour Compressor in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (c) above for the Mechanical Vapour Compressor. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. In case the Bidder or the proposed sub-vendor is not manufacturer of proven Evaporator feed Heat Exchanger as per clause 4.05.01 (d) above but is a manufacturer of Heat exchanger, the Bidder or the proposed sub-vendor can also manufacture Evaporator feed Heat Exchanger, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Evaporator feed Heat Exchanger in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (d) above for the Evaporator feed Heat Exchanger. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. In case the Bidder or the proposed sub-vendor is not manufacturer of proven Crystallizer Heat Exchanger as per clause 4.05.01 (e) above but is a manufacturer of Heat exchanger, the Bidder or the proposed sub-vendor can also manufacture Crystallizer Heat Exchanger, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Crystallizer Heat Exchanger in India with such manufacturer who meet the requirements stipulated at clause 4.05.01 (e) above for the Crystallizer Heat Exchanger. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment. Before taking up the manufacturing of such equipment(s) as per clause 4.05.03, 4.05.04, 4.05.05, 4.05.06, 4.05.07 above, the Bidder/its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator/licenser's design, manufacturing and quality control system for such equipments duly certified by the Collaborator/licensor. Further, the Collaborator / Licensor shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.			
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4.05.09	Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licenser(s) proposed by the Bidder for the above equipment(s) is qualified.			
4.05.10	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract.			
	Note to clause 4.04.00 & 4.05.00 Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite.			
4.06.00	Agency for Wet Stack Flow Model Study Wet Stack Flow Model Study shall be carried out by an agency which has successfully performed at least two (2) flow model studies, in separate coal fired power plants, of wet stack installed after wet limestone based FGD Absorber (without reheating of cleaned flue gas), and based on the studies developed at least two (2) wet stack liquid collection systems which are in successful operation for a period of at least two (2) years reckoned as on the date of consideration for approval but not later than six months after award date of contract to the Main bidder.			
4.07.00	Balance equipments/ systems The Bidder at his option can source the balance of plant equipment/systems not covered in clause 4.01.00, 4.02.00, 4.03.00, 4.04.00, 4.05.00 & 4.06.00 above. However for such balance of plant equipment/systems, the Employer reserves the rights to satisfy himself on the provenness of the equipment and capability and capacity of the manufacturers.			
4.08.00	Notwithstanding anything stated above, the Employer reserves the right to assess the capabilities and capacity of the Bidder/his collaborators/ licenser/ his sub-contractors to perform the contract, should the circumstances warrant such assessment in the overall interest of the Employer.			
4.09.00	To enable the approval of sub-vendors, the Bidder shall provide all necessary data such as type, design, make, capacity, duty conditions, date of commissioning/ operation etc.			
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SUB-SECTION-II-A11

PROJECT INFORMATION- NABINAGAR 4X250 MW

CLAUSE NO.	PROJECT INFORMATION			
1.00.00	BACKGROUND			
	Details of proposed Stage / Units			
	Project name	:	Nabinagar TPP	
	No. of Units x capacity	:	4 x 250 MW	
	Project setting up by	:	NTPC(FOR BHARTIYA RAIL BIJLEE COMPANY LTD.)	
	The SG with ESP package and TG package of the subject project is being executed by M/s. BHEL.			
1.01.00	LOCATION AND APPROACH			
	Project Location	:	(i) Place	: Nabinagar
		:	(ii) District	: Aurangabad
		:	(iii) State	: Bihar
	Latitude and Longitude of project location	:	North : 24 deg. 42' 30" (N) East : 84 deg. 05' 36" (E)	
	Nearest Railway station	:	Dehri-On-Sone	
	Distance of project location from the Railway station	:	30 KM (Approx.)	
	Nearest MajorTown	:	Aurangabad	
	Distance of the town from the Project site	:	50 KM	
	Nearest CommercialAirport	:	Gaya	
	Distance of airport from the project site	:	100 KM	
	Nearest Highway	:	National Highway-2	
	Distance from nearest highway point to the site	:	25 KM	
	Vicinity plan	:	Vicinity plan of the project enclosed at Annexure-I.	
	Any other information	:	Further to the information given in this sub-section, Bidders are advised to visit the project site and collect data on local site conditions.	
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1.02.00	LAND REQUIREMENT Total area of land acquired for the project : 1700 Acres Any other information : Approximately 1700 acres of land has been identified near Dhundhua village for the Plant, Township and Ash Disposal Area. In principle commitment for the availability of land for Plant, Township and Ash Disposal Area has been obtained from Revenue Department, Govt. of Bihar vide letter dated 29.3.2003. Further, Central Coalfields Ltd., (CCL) vide their letter dated 29.05.03 have indicated that Central Mine Planning & Design Institute Ltd (CMPDI) have confirmed that plant location along with its other allied infrastructure are not coming on coal bearing area.			
1.03.00	WATER Nearest Water Source : The project site is located near the river Sone which is the only source of water for the project. Therefore, the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage, which is about 3 kms from the proposed site. Proposed water requirement for the Stage : 60 Cusec Proposed source / arrangement to the meet the water requirement : The project site is located near the river Sone which is the only source of water for the project. Therefore, the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage, which is about 3 kms. from the proposed site. The make up water requirement for the project operating on cooling towers is about 4300 cubic m/hr with ash water recirculation system and about 5900 cubic m/hr. with once through ash water system. Water Resource Department, Govt. of Bihar, accorded in-principle clearance of 60 cusecs of consumptive water from upstream of Indrapuri Barrage vide their letter dated 06.03.03.			
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CLAUSE NO.	PROJECT INFORMATION 		
1.04.00	COAL and WATER, Utility details: (i) Coal Quality Parameters and Fuel Oil Characteristics Source:Pachra and Pachra south blocks in North Karanpura coalfields Requirement: 5 MTPA The Coal quality parameters and Fuel Oil Characteristics are enclosed at Table-1, & Table-2A & 2B of this Sub-Section. Water data (ii) Process water: Process water quality based on COC in Table-3. (iii) Clarified water: Clarified water quality is indicated in Table-3. (iv) DM water for Equipment cooling water system. DM water quality is indicated in Table-4. 1.05.00 Steam Generator and ESP data: refer Table-5 1.06.00 Drawings are enclosed as per Table-6 for initial overview to the Bidder. 2.00.00 NOT USED 3.00.00 RAILWAY SIDING For bringing the equipment and material to the power house through rail, railway siding is proposed to be constructed from nearest railway station. 4.00.00 METEOROLOGICAL DATA Meteorological data of the nearest observatory Dehri station is enclosed as Annexure-II to this subsection. 5.00.00 CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments. A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for		
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	the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I. Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values. The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4). Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>Steel structures</td><td>2%</td></tr><tr><td>Reinforced Concrete structures</td><td>5%</td></tr><tr><td>Reinforced Concrete Stacks</td><td>3%</td></tr><tr><td>Steel stacks</td><td>2%</td></tr></table> Method of Analysis Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1). In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).				Steel structures	2%	Reinforced Concrete structures	5%	Reinforced Concrete Stacks	3%	Steel stacks	2%
Steel structures	2%											
Reinforced Concrete structures	5%											
Reinforced Concrete Stacks	3%											
Steel stacks	2%											
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	The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve. For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B. For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (A_h) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I. Design/Detailing for Ductility for Structures The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.		
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	APPENDIX – I <u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT</u> The various site specific seismic parameters for the project site shall be as follows: 1) Peak ground horizontal acceleration : 0.16g 2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra a) for ordinary moment resisting steel frames designed and detailed as per IS:800 : 0.04 b) for braced steel frames designed and detailed as per IS:800 : 0.03 c) For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.024 d) for RCC chimney : 0.08 e) for Liquid retaining tanks : 0.048 f) for Steel chimney, Absorber tower : 0.06 g) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below : 0.04 3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.08 Note: g = Acceleration due to gravity The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.		
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APPENDIX – I
HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for New Nabinagar project

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000
0.050	1.750	1.607	1.443
0.100	3.737	3.060	2.374
0.104	3.904	3.174	2.443
0.123	3.904	3.401	2.753
0.150	3.904	3.401	2.753
0.200	3.904	3.401	2.753
0.250	3.904	3.401	2.753
0.300	3.904	3.401	2.753
0.350	3.904	3.401	2.753
0.400	3.904	3.401	2.753
0.450	3.904	3.401	2.753
0.500	3.904	3.401	2.753
0.516	3.904	3.401	2.753
0.550	3.662	3.401	2.753
0.600	3.357	3.142	2.753
0.607	3.320	3.105	2.753
0.670	3.006	2.813	2.493
0.700	2.877	2.693	2.386
0.750	2.685	2.513	2.227
0.800	2.518	2.356	2.088
0.850	2.369	2.218	1.965
0.900	2.238	2.094	1.856
0.950	2.120	1.984	1.758
1.000	2.014	1.885	1.670
1.050	1.918	1.795	1.590
1.100	1.831	1.714	1.518
1.150	1.751	1.639	1.452
1.200	1.678	1.571	1.392
1.250	1.611	1.508	1.336

APPENDIX – I
HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for New Nabinagar project

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
1.300	1.549	1.450	1.285
1.350	1.492	1.396	1.237
1.400	1.439	1.346	1.193
1.450	1.389	1.300	1.152
1.500	1.343	1.257	1.113
1.550	1.299	1.216	1.077
1.600	1.259	1.178	1.044
1.650	1.221	1.142	1.012
1.700	1.185	1.109	0.982
1.750	1.151	1.077	0.954
1.800	1.119	1.047	0.928
1.850	1.089	1.019	0.903
1.900	1.060	0.992	0.879
1.950	1.033	0.967	0.856
2.000	1.007	0.943	0.835
2.050	0.982	0.920	0.815
2.100	0.959	0.898	0.795
2.150	0.937	0.877	0.777
2.200	0.915	0.857	0.759
2.250	0.895	0.838	0.742
2.300	0.876	0.820	0.726
2.350	0.857	0.802	0.711
2.400	0.839	0.785	0.696
2.450	0.822	0.769	0.682
2.500	0.806	0.754	0.668
2.550	0.790	0.739	0.655
2.600	0.775	0.725	0.642
2.650	0.760	0.711	0.630
2.700	0.746	0.698	0.619
2.750	0.732	0.685	0.607
2.800	0.719	0.673	0.596

APPENDIX – I
HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for New Nabinagar project

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
2.850	0.707	0.661	0.586
2.900	0.694	0.650	0.576
2.950	0.683	0.639	0.566
3.000	0.671	0.628	0.557
3.050	0.660	0.618	0.548
3.100	0.650	0.608	0.539
3.150	0.639	0.598	0.530
3.200	0.629	0.589	0.522
3.250	0.620	0.580	0.514
3.300	0.610	0.571	0.506
3.350	0.601	0.563	0.499
3.400	0.592	0.554	0.491
3.450	0.584	0.546	0.484
3.500	0.575	0.539	0.477
3.550	0.567	0.531	0.470
3.600	0.559	0.524	0.464
3.650	0.552	0.516	0.458
3.700	0.544	0.509	0.451
3.750	0.537	0.503	0.445
3.800	0.530	0.496	0.439
3.825	0.527	0.493	0.437
3.850	0.523	0.490	0.434
3.900	0.516	0.483	0.428
3.950	0.510	0.477	0.423
4.000	0.504	0.471	0.418

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6.00.00	<u>CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</u> All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information. Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard. Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz. Susceptibility of structures to across-wind forces, galloping, flutter, ovaling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards. It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects. Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a) Welded steel structures</td><td>: 1.0%</td></tr><tr><td>b) Bolted steel structures</td><td>: 2.0%</td></tr><tr><td>c) Reinforced concrete structures</td><td>: 1.6%</td></tr><tr><td>d) Steel stacks</td><td>: As per IS:6533 & CICIND Model Code whichever is more critical.</td></tr></table>				a) Welded steel structures	: 1.0%	b) Bolted steel structures	: 2.0%	c) Reinforced concrete structures	: 1.6%	d) Steel stacks	: As per IS:6533 & CICIND Model Code whichever is more critical.
a) Welded steel structures	: 1.0%											
b) Bolted steel structures	: 2.0%											
c) Reinforced concrete structures	: 1.6%											
d) Steel stacks	: As per IS:6533 & CICIND Model Code whichever is more critical.											
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	<u>ANNEXURE-B</u> <u>SITE SPECIFIC DESIGN PARAMETERS</u> The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows: a) The basic wind speed “V_b” at ten metres above the mean ground level : 47 metres/second b) The risk coefficient “K₁” : 1.07 c) Category of terrain : Category-2 7.00.0 FOUNDATION SYSTEM AND GEOTECHNICAL DATA 7.00.01 Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV. 7.00.02 The available soil data is of vicinity of proposed structures, therefore, bidder shall carryout his own detailed soil investigation for facilities under this package and shall be as per the scheme approved by owner. The scheme for geotechnical investigation shall be as given at Clause 7.07.00 and shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner's approval prior to commencement of design of foundation. 7.00.03 The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be payable. 7.00.04 Tank Foundations a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any. b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III. c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%. d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.			
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7.02.00 7.02.01	Foundation System The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner. General Requirements a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc. b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M² may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. c) No other foundation (other than as mentioned in (b) above) shall rest on the filled up ground / soil. d) No foundation shall rest on the black cotton soil. e) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost. f) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations. g) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards. h) The water table for design purpose shall be considered at Finished Ground Level. i) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building. j) Foundation for equipments on ground floor For equipments of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m². Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications. For equipment of static weight more than 1.5 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 1. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.	
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7.02.02	Open Foundations In case open foundations are adopted, following shall be adhered to. a) The minimum width of foundation shall be 1.0 m. b) Minimum depth of foundation shall be 1.0m below Ground Level. c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum. d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level.			
7.02.03	Pile Foundations – (a.) In case piles are adopted, following shall be adhered to : i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using Rotary Hydraulic Rigs/conventional tripod rig. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer. If required, temporary or permanent MS liner may be provided for piling. ii) The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be as per approved geotechnical report & as enclosed in relevant annexure: iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m. iv) The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, pile load test arrangement, locations of initial test piles etc.) for Engineer's approval. v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval. vi) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under. Vertical Lateral Minimum of 2 Nos. in each mode. Uplift vii) The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. In case of vertical compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part).			
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	viii) Load test shall be conducted at pile Cut-off Level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter. ix) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under : i) Vertical : 0.5% of the total number of piles provided. ii) Lateral : 0.5% of the total number of piles provided. x) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer. xi) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required. xii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm. xiii) The test load on initial test piles shall be applied by means of reaction from anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge with concrete blocks.			
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	xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency to be approved by Engineering department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM. xv) High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. The procedure to carryout the test shall be submitted to the Engineer. The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner. Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile. xvi) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions. xvii) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles. xviii) Reinforcement for job piles shall be designed as following: (a) Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered. (b) Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package.			
7.03.00	Special Requirements			
7.03.01	Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried			
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	out by contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly.			
7.04.00	Excavation, Filling and Dewatering			
7.04.01	For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.			
7.04.02	Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.			
7.04.03	Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non-cohesive soils			
	Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices.			
7.04.04	Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.			
7.04.05	CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level.			
7.04.06	The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.			
7.05.00	EXCAVATION IN ROCK			
	Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out.			
7.05.01	Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type).			
7.05.02	a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting			
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	operation. All blasting shall be done as per the approved blasting scheme & initial blasting operations shall be done under the supervision & guidance of the representative of the blasting expert. b) All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards, etc. pertaining to the acquisition, transport, storage, handling and use of explosives, etc. shall be strictly followed. c) The Contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per explosives act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive Materials. d) The Contractor shall be responsible and liable for any accident and injury / damage which may occur to any person or property of the project or public on account of any operations connected with the storage, transportation, handling or use of explosive and blasting operations.			
7.06.00	Sheeting & Shoring The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.			
7.07.00	Geotechnical Investigation The Contractor shall carry out detailed geotechnical investigation in the areas under his scope for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements/treatment called for remedial measures for sub-soil/ foundations etc. in view of soft sub-soils, aggressive sub-soils and water, expansive/swelling soils etc. prior to commencement of detailed design/drawings. The Contractor shall obtain the approval for the field testing scheme proposed by him from the Owner before undertaking the geotechnical investigation work.			
7.07.01.00	Scheme of geotechnical Investigation			
7.07.02.01	Field test shall include but not be limited to the following: Boreholes, Standard Penetration Test (SPT), Dynamic Cone Penetration Test (DCPT), collection of disturbed samples (DS) and undisturbed soil samples (UDS), Trial Pits (TP), Plate Load Tests (PLT), Electrical Resistivity Test (ERT), In situ field permeability tests, collection of water samples, etc.			
7.07.02.02	The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. The diameter of UDS sampler shall be 100 mm minimum. Core drilling in rock shall be done by using hydraulically feed rotary drill & double tube core barrel with diamond bit.			
7.07.02.03	The minimum tests are indicated in Clause No. 7.08.00. Adequate number of tests shall be conducted up to sufficient depth for complete determination of subsoil conditions. The depth of boreholes shall be as specified in Appendix A. SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20%, met within a borehole. This test shall be conducted at every 3.0 m interval or at change of strata, up to the final depth. SPT 'N' of 100 and above shall be referred as refusal. UDS shall be collected at every 3.0 m interval or at change of strata up to depth of borehole. UDS may be replaced by additional SPT, if SPT'N' value in the strata is above 50.			
7.07.02.04	Laboratory tests shall be done as per relevant IS codes. The laboratory tests, not be limited to the following shall be conducted on disturbed and undisturbed soil samples, rock samples & water samples collected during field investigations in sufficient numbers.			
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CLAUSE NO.	PROJECT INFORMATION														
7.07.02.05	Laboratory Tests on Soil Samples														
	Laboratory tests shall be carried out on disturbed and undisturbed soil samples for Grain Size Analysis, Hydrometer Analysis, Atterberg Limits, Triaxial Shear Tests (UU), Natural Moisture Content, Specific Gravity and Bulk Unit Weight, Consolidation Tests, Unconfined Compression Test, Free swell Index, Shrinkage Limit, Swell Pressure Test, Chemical Analysis test on soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, organic matter and any other chemicals harmful to concrete and reinforcement steel.														
	Laboratory Tests on Rock Samples														
	Moisture content, porosity & density, Specific Gravity, Hardness, Soundness, Slake durability index, Unconfined compression test (Both at saturated and in-situ water content), Point load strength index and deformability test (Both at saturated and in-situ water content) shall be carried out on rock samples.														
7.07.03.00	Geotechnical investigation (field & laboratory) shall be carried out in accordance with the provisions of relevant Indian Standards.														
7.08.00	On completion of all field & laboratory work, geotechnical investigation report shall be submitted for Owner's review/approval. The Geotechnical investigation report shall contain geological information of the region, procedure adopted for investigation, field & laboratory observations/ data/ records, analysis of results & recommendations on type of foundation for different type of structures envisaged for all areas of work with supporting calculations. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils, etc.														
	Recommendations on foundation system and the net allowable bearing pressures and pile capacity shall be based on the conservative values of geotechnical investigation data.														
	Geotechnical investigation work shall be got executed by the Contractor through the following agencies.														
	1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata 2. CengrsGeotechnica Pvt. Ltd, New Delhi 3. M.K. Soil Testing Laboratory, Ahemdabad 4. SECON Pvt Ltd, Bangalore 5. Soil Engineering Consultants, New Delhi 6. Orbital Infrastructure Consultancy & Research Pvt. Ltd. Cuttack 7. KCT Consultancy Services, Ahemdabad 8. ARKITECHNO Consultants (India) Pvt. Ltd. Bhubaneswar														
7.08.00	Geotechnical Investigation Scheme														
	a) Boreholes (Minimum)														
	<table><tr><th>S.N</th><th>Structure</th><th>Spacing/Number of borehole</th><th>Depth of borehole</th><th>Remarks</th></tr><tr><td>1</td><td>FGD</td><td>Minimum 14 Nos.</td><td>Depth of boreholes shall be 25m to 35m.</td><td>Depth of</td></tr></table>					S.N	Structure	Spacing/Number of borehole	Depth of borehole	Remarks	1	FGD	Minimum 14 Nos.	Depth of boreholes shall be 25m to 35m.	Depth of
S.N	Structure	Spacing/Number of borehole	Depth of borehole	Remarks											
1	FGD	Minimum 14 Nos.	Depth of boreholes shall be 25m to 35m.	Depth of											
LOT-IA PROJECTS FLUE GAS DE-SULPHURIZATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2		SUB-SECTION-II-A11 PROJECT INFORMATION NABINAGAR TPP											
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CLAUSE NO.	PROJECT INFORMATION					एनटीपीसी NTPC
	2	Crusher House	Minimum 2 Nos.	Depth of boreholes shall be 25m to 35m.	boreholes shall be as mentioned in column "Depth of Borehole" or 5m continuous in rock with RQD > 25% whichever is earlier.	
	3	Gypsum and Lime storage area	Minimum 10 Nos.	Depth of boreholes shall be 15m to 25m		
	4	Other Structure/Facility	Minimum 2 Nos. boreholes under each area / facility	15 to 20 m		
	5	Chimney	Minimum 2 Nos.	30 to 35m		
	b) Other Field Tests (Minimum)					
	1	Cyclic Plate Load Test (CPLT)	3nos	Test Depth from 2 to 4 m		
	2	Trial Pit (TP)	5 Nos.	Depth - 3 m		
	3	In Situ Permeability Test In Boreholes	In minimum 3 Nos. of boreholes	Tests shall be conducted at depths of 1.0m, 3.0m, 5.0m, 8.0m and 12.0m.		
	4	ERT	Minimum 10 Nos.			
	• Depth and location of Boreholes and other field tests (PLT, ERT, field permeability tests etc.) shall be approved by Owner before execution of geotechnical investigation work. • Investigation in any other building / structure / facilities / trestles which are not mentioned above shall also be carried out, if required, by the bidder for the facilities under his scope.					
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Annexure-III

SOIL DATA AND FOUNDATION SYSTEM

Employer has carried out geotechnical investigation in the areas near to this package. Logs of representative boreholes to be used for bidder's information in the vicinity of proposed area are enclosed with this Annexure-II. The bidder is required to carry out geotechnical investigation as per the clause no. 7.07.00 and ascertain the pile capacity and bearing capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder. Ground water table is encountered at a depth of about 11.0 to 13.0m below natural ground level (NGL) at the time of investigation. Fluctuation may occur in ground water table due to seasonal variation. The natural ground level is varying as per enclosed contour/spot level drawing.

- a) The foundation system to be adopted for different structures shall be as given in Table – i below

Table – i: Net Allowable Bearing Pressure

STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED
FGD and related structures	Open/Piles

- b) During design the Allowable Bearing Pressure shall be as furnished in Table-ii. Bidder is required to carry out geotechnical investigation in this area. The allowable bearing pressure shall be adopted after approval of geotechnical investigation report by owner. However, the maximum allowable bearing pressure shall be as per the approved geotechnical report and shall be limited to the values as furnished in Table-ii.

Table – ii: Net Allowable Bearing Pressure

Structure	Founding Level in RL	Net Allowable Bearing Pressure T/m ²		
		Isolated / Strip		Rafts (width > 6m) for 75mm settlement
		width upto 6 m for 25mm settlement	Width upto 6m for 40mm settlement	
FGD and related structures	2.5 m below NGL	8.0	9.0	10.0
	3.5 m	10.0	12.0	14.0

CLAUSE NO.	PROJECT INFORMATION					एनटीपीसी NTPC
		below NGL				
		4.5 m below NGL	12.0	15.0	17.0	
	The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.					
	c)	Permissible Settlement of Foundations: For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:				
	Isolated, Strip & Raft (Mill foundations/machine foundation)		25 mm			
	Isolated & Strip (Other than Mill foundations/machine foundation)		40 mm			
	Raft (widths greater than 6 m) (Other than Mill foundations/machine foundation)		75 mm			
	In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with Engineer.					
	d)	The diameter of pile, minimum length and maximum allowable capacity of piles shall be as given below:				
	Area/ Location		Pile Diameter (mm)	Minimum Length of Bored Pile Below Cut-off Level (m)	Safe Load Capacity in	
				Vertical Comp. (MT)	Pullout (MT)	Lateral (MT)
FGD and related structures		600	18.0	140.0	45.0	7.0
		760	19.0	250	75.0	12.5
- Cut off Level (COL) is assumed at 3.0 m below FGL (RL(+) 127.0m). If the COL is shallower than the assumed COL, then the length of the pile shall be increased accordingly.						
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Chemical	SO ₃	Chlorides	pH
Ground Water	18 to 30 ppm	50-82 ppm	7.26 – 7.44
Sub-soil	0.011 to 0.023 %	0.02 to 0.064 %	7.3 – 7.62

CLAUSE NO.	PROJECT INFORMATION						
	एनटीपीसी NTPC						
	TABLE-1						
	COAL CHARACTERISTICS						
	Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal
	1	2	3	4	5	6	7
	A.	PROXIMATE ANALYSIS (As received basis)					
	1.	Total Moisture	%	15.00	17.00	12.00	12.00-17.00
	2.	Ash	%	43.00	47.00	38.00	36.00-49.00
	3.	Volatile matter	%	20.00	18.00	22.00	25.00-15.00
	4.	Fixed carbon	%	22.00	18.00	28.00	37.00-17.00
	B.	ULTIMATE ANALYSIS (As received basis)					
	1.	Carbon	C%	30.77	25.97	39.08	41.11-24.35
	2.	Hydrogen	H2%	3.4	2.85	3.5	3.60-2.87
	3.	Nitrogen	N2%	0.7	0.45	0.55	0.55-0.40
	4.	Oxygen (By difference)	O2%	6.2	5.6	6.07	6.1-5.5
	5.	Sulphur	S%	0.4	0.50	0.36	0.30-0.50
	6.	Carbonates	CO3%	0.50	0.60	0.40	0.30-0.35
	7.	Phosphorous	P2%	0.03	0.03	0.04	0.04-0.03
	8.	Total Moisture	H2O%	15.00	17.00	12.00	12.00-17.00
	9.	Ash	%	43.00	47.00	38.00	36.00-49.00
	10.	Gross Calorific Value	KCal/Kg	3300	2800	4000	4200-2700
	11.	Hard grove index		55	50	60	45-65
	C.	ASH ANALYSIS					
	1.	Silica	(SiO2)%	59.79	61.30	56.70	62-56
	2.	Alumina	(Al2O3)%	25.36	28.00	23.50	28-23
	3.	Iron Oxide	(Fe2O3)%	7.20	6.00	10.00	6-10
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CLAUSE NO.	PROJECT INFORMATION एनटीपीसी NTPC						
	Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal
	1	2	3	4	5	6	7
	4.	Titania	(TiO ₂)%	1.2	1.00	1.50	1-1.7
	5.	Phosphoric Anhydride	(P ₂ O ₅)%	2.6	1.5	3	1-3
	6.	Lime	(CaO)%	0.88	0.5	1.50	0.5-1.7
	7.	Magnesia	(MgO)%	0.55	0.4	1	0.4-1.1
	8.	Sulphuric Anhydride	(SO ₃)%	1.2	0.5	1.4	0.5-1.7
	9.	Alkalies (By Difference)	(Na ₂ O+K ₂ O)%	1.22	0.8	1.4	0.6-0.8
		Note: Na ₂ O content in the above shall not be more than 0.1%					
	D.	ASHFUSIONRANGE (Under reducing atmosphere)					
	a)	Initial Deformation Temperature (IDT)	°C	1150	1200	1100	1100-1200
	b)	Hemispherical temperature	°C	1350	1450	1300	1300-1400
	c)	Flow temperature	°C	1400	1400	1400	1400-1450
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TABLE -2A

FUEL OIL CHARACTERISTICS

Sl. No.	Characteristics	Heavy Furnace Oil grade HV (HFO) IS-1593-1982	Low Sulphur Heavy Stock (LSHS) IS-11489-1985	Heavy Petroleum stock (HPS) IS-11489-1985
1.	Total sulphur content	4.5% Max.	1.0% Max.	4.5% Max.
2.	Gross calorific value (KCal/kg)	of the order of 10,000	of the order of 10,000	of the order of 10,000
3.	Flash Point (Min)	66 deg C	76 deg C	66 deg C
4.	Water content by volume (Max)	1.0%	1.0%	1.0%
5.	Sediment by weight (Max)	0.25%	0.25%	0.25%
6.	Asphaltene content by weight (Max.)	2.5%	2.5%	2.5%
7.	Kinematic viscosity in Centistokes	370 at 50deg C	100 at 100deg C	100 at 100deg C
8.	Ash Content by weight (Max.)	0.1%	0.1%	0.1%
9.	Acidity (inorganic)	Nil	Nil	Nil
10.	Pour Point (Max.)	57 deg C	66 deg C	72 deg C
11.	Sodium content	—	—	100 ppm
12.	Vanadium content	25 ppm	25ppm	25 ppm
13.	Specific heat below pour point (KCal/Kg °C)		0.65	

TABLE -2B

LIGHT DIESEL OIL CHARACTERISTICS

AS PER IS 1460-2000

Characteristics

LDO

1.	Pour Point (max)	21 deg.C & 12°C for Summer and Winter respectively
2.	Kinematic viscosity in centistokes at 40 deg.C	2.5 to 15.7
3.	Sediment percent by mass (max)	0.10
4.	Total sulphur percent by mass (max)	1.8
5.	Ash percentage by mass (max)	0.02
6.	Carbon residue (Rans bottom) percent by pass (max.)	1.50
7.	Acidity in organic	Nil
8.	Flash point(Min.) - Pensky Martens	66 deg.C
9.	Copper strip corrosion for 3 hours at 100°C	Not worse than No. 2
10.	Water content, % by volume(max)	0.25
11.	GCV (Kcal/kg)	10,000

Table-3

DESIGN CLARIFIED WATER ANALYSIS

S.No	Constituent	As	mg/l (except pH & turbidity)
1.	Calcium	CaCO ₃	131
2.	Magnesium	CaCO ₃	52
3.	Sodium + Potassium	CaCO ₃	65
4.	Total Cations	CaCO ₃	248
5.	Chloride	CaCO ₃	20
6.	Sulphate	CaCO ₃	93
7.	Nitrate	CaCO ₃	10
8.	Alkalinity	CaCO ₃	125
9.	Total Anions	CaCO ₃	248
10.	Iron(total)	Fe	0.3
11.	Total Silica	SiO ₂	22
12.	pH value	---	7.0-8.2
13.	Turbidity	NTU	10

Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dosing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.

Table-4

ANALYSIS OF DM WATER

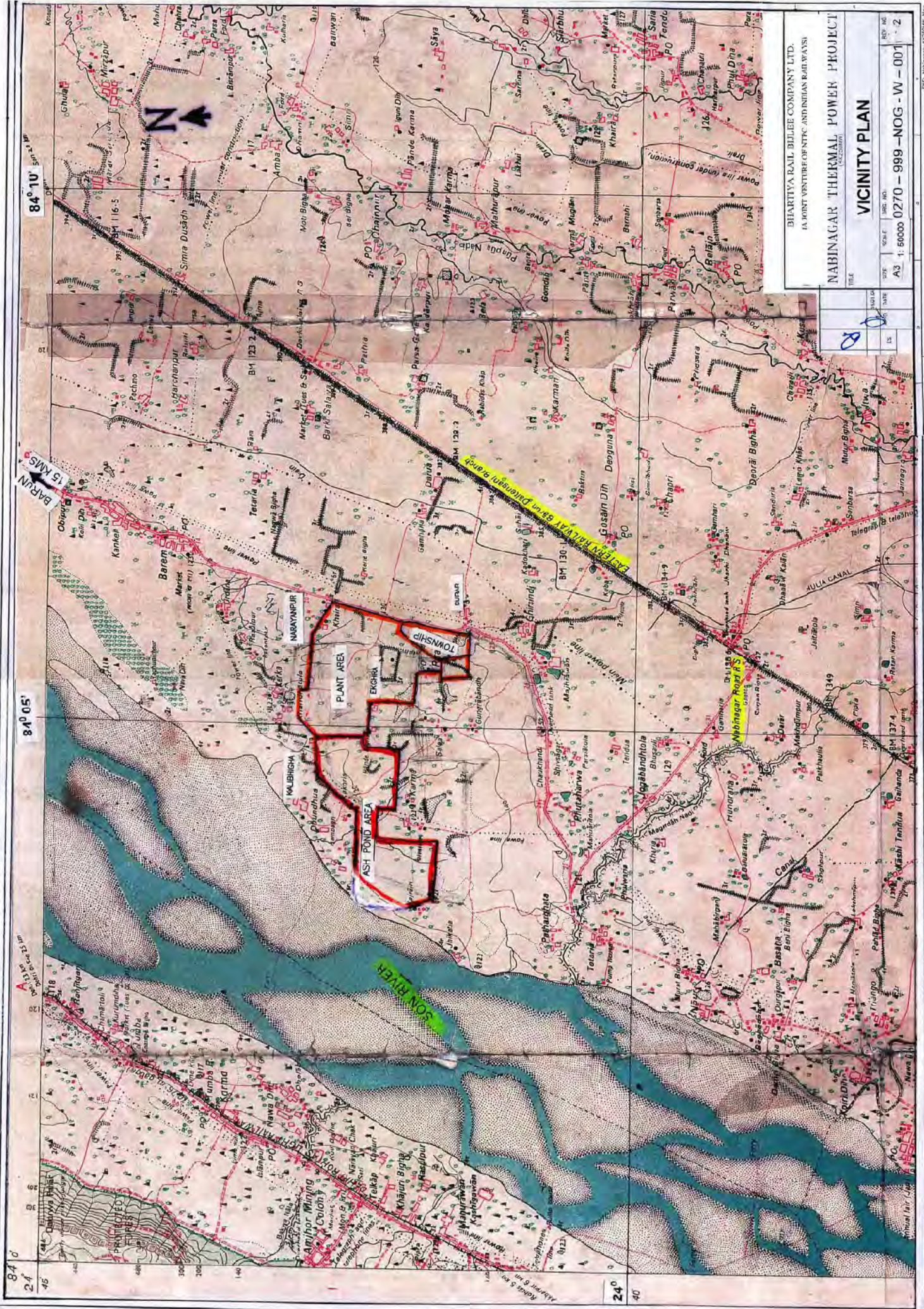
Sl.No.	Characteristics	Value
1.	Silica (Max.)	0.02 ppm as SiO ₂
2.	Iron as Fe	Nil
3.	Total hardness	Nil
4.	pH value	6.8 to 7.2
5.	Conductivity	Not more than 0.1 μ s/cm

CLAUSE NO.	PROJECT INFORMATION		एनटीपीसी NTPC
2.00.00	Table-5		
	STEAM GENERATOR DATA		
	1.	Location	Outdoor
	2.	Operation	Base load
	3.	Type	Pulverised coal fired
	4.	Maximum Continuous Rating	810 Tons/hr.
	5.	Steam pressure at SH outlet	155 Kg/cm ² (a)
	6.	Steam temperature at SH outlet	540°C
	7.	Oil for start up and flame stabilization	Heavy Oil/LSHS/HPS/LDO
	8.	Fuel oil system sizing	30% of Boiler MCR for Heavy oil/LSHS/HPS (7.5% for LDO)
	9.	Pulverised coal size and 99% thru 50 mesh	Minimum 70% through 200 Mesh
	10.	Type of pulveriser	Vertical spindle mills
	11.	Type of oil burners	Steam atomised, (Air atomised for LDO)
	12.	No. of air heaters	Two (2) nos. of Tri-sector type
	13.	No. of ID Fans	Two (Radial type, both working)
	ESP DATA		
	1.	Location:	Downstream side of Air preheaters
	2.	Operation:	Base load
	3.	Type:	Rigid Discharge frame
	4.	Rapping:	Intermittent
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TABLE-6

List of Drawings enclosed in this sub-section:

Sl.No.	Drawing Description			Drawing No.		
1.	General Layout Plan			Enclosed		
2.	Topographical Survey			Enclosed		
3.	Equipment Layout Plan			Enclosed		
4.	ID system-Elevation & Plan			Enclosed		
5.	Pipe Cable Trestle Layout			Not located near FGD area		
6.	Pipe Cable Trestle Foundation			Not located near FGD area		
7.	<u>Chimney foundation details</u>					
		Chimney shell outer diameter at ground level (m)	Chimney foundation outer diameter (m)	Type of foundation	Level of Top of foundation (m)	Level of Bottom of foundation (m)
	Unit #1&2	28	42.1	Raft supported on piles	RL(+) 126.00	RL(+) 122.25
	Unit #3&4	28	42.1	Raft supported on piles	RL(+) 126.00	RL(+) 122.25



84° 10' 50" E

24° 45' 00" N

84° 05'

24° 40'

84° 10' 50" E

24° 45' 00" N

84° 05'

24° 40'

84° 10' 50" E

24° 45' 00" N

84° 05'

24° 40'

84° 10' 50" E

24° 45' 00" N

84° 05'

24° 40'

84° 10' 50" E

24° 45' 00" N

84° 05'

24° 40'

84° 10' 50" E

24° 45' 00" N

84° 05'

24° 40'

BIHARTIYA RAIL BIJLEE COMPANY LTD.
A JOINT VENTURE OF NTPC AND INDIAN RAILWAYS

NABINAGAR THERMAL POWER PROJECT

VICINITY PLAN

DATE	SCALE	SHEET NO.	TITLE
A3	1:50000	0270 - 999	NOG - W - 001

2

Annexure 2

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : देहली
STATION : Dehli

अक्षांश
LAT 24°55' N

देशांतर
LONG 84°11' E

समुद्री तल मध्य से ऊँचाई
HEIGHT ABOVE M. S. L.

मीटर
107 METRES

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

माह	वायु तापमान										वर्षा									
	दैनिक					अधिकतम					अधिकतम					अधिकतम				
	सुबह 5 बजे	दिवस 12 बजे	शाम 5 बजे	रात 9 बजे	दैनिक औसत	सबसे अधिकतम	सबसे कम	सबसे अधिकतम	सबसे कम	दैनिक औसत	सबसे अधिकतम	सबसे कम	सबसे अधिकतम	सबसे कम	दैनिक औसत	सबसे अधिकतम	सबसे कम	सबसे अधिकतम	सबसे कम	दैनिक औसत
MONTH	DRY BULB	WET BULB	DAILY MAX	DAILY MIN	MEAN	HIGHEST IN THE MONTH	LOWEST IN THE MONTH	DATE AND YEAR HIGHEST	DATE AND YEAR LOWEST	EXTREMES	RELATIVE HUMIDITY	ALL CLOUDS	LOW CLOUDS	NO. OF RAINY DAYS	MONTHLY TOTAL	NO. OF RAINY DAYS	MONTHLY TOTAL	NO. OF RAINY DAYS	MONTHLY TOTAL	NO. OF RAINY DAYS
एप्रैल	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. °C	दि.से. °C	प्रतिशत %	एप्रैल	एप्रैल	प्रतिशत %	प्रतिशत %	प्रतिशत %	प्रतिशत %	प्रतिशत %	प्रतिशत %	प्रतिशत %
I	100.9	15.1	12.9	23.6	10.1	27.9	6.1	30.5	28	1958	74	12.7	1.7	0.9	17.5	1.7	94.0	0.0	65.0	27
II	100.1	14.3	12.9	23.6	10.1	27.9	6.1	30.5	28	1958	49	12.5	1.5	1.1	19.0	1.5	19.0	0.0	52.6	05
III	100.2	14.3	12.9	23.6	10.1	27.9	6.1	30.5	28	1958	62	12.9	1.5	0.7	11.2	1.3	103.9	0.0	52.6	05
IV	998.9	25.3	16.8	33.2	17.7	38.5	12.7	41.5	31	1973	40	12.5	1.3	0.7	11.7	1.2	194	0.0	43.7	16
V	998.3	24.5	17.2	33.2	17.7	38.5	12.7	41.5	31	1973	46	13.7	1.5	0.5	11.7	1.2	194	0.0	43.7	16
VI	995.1	31.5	19.0	38.9	23.1	42.7	17.8	44.4	23	1973	35	15.2	1.3	0.3	7.2	0.7	48.3	0.0	43.2	08
VII	990.5	36.9	21.5	41.1	28.2	44.7	21.3	46.7	21	1951	22	13.3	1.3	0.4	16.8	1.2	103.4	0.0	96.0	31
VIII	990.7	33.3	23.2	41.1	28.2	44.7	21.3	46.7	21	1951	27	17.7	1.1	0.3	109.5	6.0	505.4	0.0	220.0	13
IX	987.0	32.2	25.8	38.5	25.7	44.0	22.7	47.2	09	1966	61	28.2	3.9	2.0	315.2	14.5	655.8	55.1	202.4	01
X	983.5	35.5	26.1	38.5	25.7	44.0	22.7	47.2	09	1966	49	26.3	4.3	2.7	277.8	15.0	748.3	78.6	254.5	14
XI	987.2	29.2	26.5	33.4	25.2	37.8	22.4	42.2	01	1953	81	32.5	6.4	4.8	193.7	9.4	771.7	25.1	218.4	12
1	984.3	31.1	27.0	32.3	25.0	35.0	22.7	39.4	03	1972	73	32.5	6.3	4.9	240.3	3.1	240.3	0.0	153.7	06
2	986.6	28.6	26.6	32.3	25.0	35.0	22.7	39.4	03	1972	79	33.4	6.2	5.1	48.0	3.1	240.3	0.0	153.7	06
3	985.4	30.2	27.1	32.3	25.0	35.0	22.7	39.4	03	1972	77	32.0	4.8	3.8	7.7	0.4	105.2	0.0	100.6	19
4	982.7	28.5	25.9	32.2	24.4	34.9	22.0	37.1	12	1976	81	31.4	4.8	3.5	4.9	0.5	19.5	1.0	47.7	21
5	989.0	29.9	26.5	31.9	20.9	34.4	16.7	37.1	14	1974	77	32.0	4.8	3.8	4.9	0.5	19.5	1.0	47.7	21
6	988.8	26.6	23.1	31.9	20.9	34.4	16.7	37.1	14	1974	65	26.1	1.9	1.3	7.7	0.4	105.2	0.0	100.6	19
7	985.2	29.3	24.2	29.2	14.6	31.9	10.7	35.1	07	1977	68	17.3	1.3	0.5	4.9	0.5	19.5	1.0	47.7	21
8	1003.2	21.3	17.5	29.2	14.6	31.9	10.7	35.1	07	1977	53	18.0	1.0	0.5	4.9	0.5	19.5	1.0	47.7	21
9	999.7	26.0	19.6	25.1	10.9	28.2	7.1	31.7	01	1952	74	13.7	1.3	0.4	4.9	0.5	19.5	1.0	47.7	21
10	1005.3	16.2	13.6	25.1	10.9	28.2	7.1	31.7	01	1952	49	13.1	1.2	0.4	4.9	0.5	19.5	1.0	47.7	21
11	1001.7	22.3	16.1	23.6	10.1	27.9	6.1	30.5	28	1958	65	21.4	2.8	1.7	1038.9	55.1	1789.8	530.1	254.5	4.9
12	996.3	25.4	20.6	32.2	19.8	45.1	5.4	47.2	35	1952	51	20.8	2.7	1.8	1961	1966	1961	1966	1961	1966
13	992.5	25.9	21.9	30	30	30	30	36	35	1952	30	30	30	23	28	28	78	78	78	30
14	30	30	30	30	30	30	30	36	35	1952	30	30	30	23	28	28	78	78	78	30
15	30	30	30	30	30	30	30	36	35	1952	30	30	30	23	28	28	78	78	78	30

स्टेशन : देहरी
STATION : Dehri

जलवायवी सारणी
CLIMATOLOGICAL TABLE

मौसम परिचय										दिनांक										दिनांक									
के सम्बन्धित मौसम										मौसम की विशेषता										मौसम की विशेषता									
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ANNEXURE-IV

CLIENT : **NTPC LIMITED**

PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar

BORE HOLE NO. : BH-85

SHEET NO. : 1 OF 3

CO-ORDINATE : N 1553.73, W 958.78

DATE : 30/04/2009 to 07/05/2009

LOCATION : Ash Handling

METHOD : ROTARY DRILLING.

GROUND R. L. : 127.955m.

CASING : 150mm.Ø upto 19.80 m. Below G.L.

GROUND W. T. : 12.85m. Below GL.

DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	C R %	RQD %	CORRECTED SPT 'N'
				DEPTH (m)	TYPE	15	15	15	15				
0.00			Brownish, silty CLAY										
1.00				1.50/									
2.00			Very stiff to hard, yellowish brown, sandy CLAY with gravel	1.95	SPT1	05	07	11	—	18			
3.00				3.00/									
4.00	150 mm Ø			3.50	UDS1								
5.00				4.50									
6.00				4.95	SPT2	07	09	14	—	23			
7.00				6.00/									
8.00				6.40	UDS2								
9.00				7.50/									
10.00				7.95	SPT3	17	19	29	—	48			
				9.00/									
				9.25	UDS3								

SPT N = STANDARD PENETRATION TEST VALUE

RQD = ROCK QUALITY DESIGNATION

UDS = UNDISTURBED SOIL SAMPLE

CR = CORE RECOVERY

DS = DISTURBED SOIL SAMPLE

VST = VANE SHEAR TEST

REMARKS : CONTINUED ON NEXT PAGE.

DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.

SCALE : 1: 50

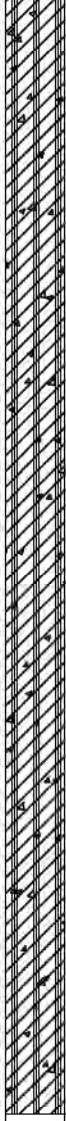
JOB NO. : 2263

Checked By :

Ravi Achari

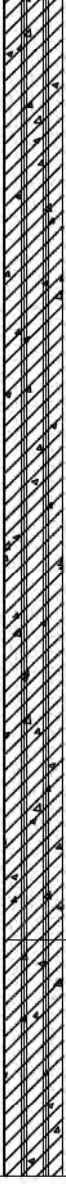
Drawn By:

Sandeep

CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar													
BORE HOLE NO. : BH-85							SHEET NO. : 2 OF 3						
DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	C R %	RQD %	CORRECTED SPT 'N'
				DEPTH (m)	TYPE	15	15	15	15				
11.00	150 mm Ø		Hard, yellowish brown, sandy CLAY with gravel	10.50/									
					SPT4	18	29	37	--	66			
				10.95									
12.00				12.00/									
				12.18	UDS4								
13.00				13.50/									
				13.95	SPT5	21	34	39	--	73			
15.00				15.00/									
				15.10	UDS5								
16.00				16.50/									
				16.95	SPT6	24	26	31	--	57			
18.00				18.00/									
				18.18	UDS6								
19.00			19.50/		15	15	07	--	N				
20.00	NX		Highly weathered reddish brown SANDSTONE	19.87	SPT7	29	46	62	--	R	24	NIL	
21.00													
SPT N =STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST													
REMARKS : CONTINUED ON NEXT PAGE							SCALE : 1: 50		Checked By :		Drawn By:		
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.							JOB NO. : 2263		Ravi Achari		Sandeep		

CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar													
BORE HOLE NO. : BH-85						SHEET NO. : 3 OF 3							
DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	DEPTH (m)	SAMPLE TYPE	BLOWS/15cm				SPT N	CR %	RQD %	CORRECTED SPT 'N'
21.00	NX		Highly weathered reddish brown SANDSTONE	21.00							24	NIL	
22.00										22	14		
23.00										23	NIL		
24.00										27	NIL		
25.00			Highly weathered, brownish, jointed SANDSTONE	24.00									
				25.00									
26.00													
27.00													
28.00													
29.00													
30.00													
31.00													
SPT N = STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST													
REMARKS : BORE HOLE IS TERMINATED AT DEPTH 25.00 m. BELOW G. L.						SCALE : 1: 50		Checked By :		Drawn By :			
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.						JOB NO. : 2263		Ravi Achari		Sandeep			

CLIENT : NTPC LIMITED														
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar														
BORE HOLE NO. : BH-86							SHEET NO. : 1 OF 3							
CO-ORDINATE : N 1557.12,W 868.84							DATE : 16/02/2009 to 25/02/2009							
LOCATION : ASH HANDLING							METHOD : ROTARY DRILLING.							
GROUND R. L. : 129.365m.							CASING : 150mm.Ø upto 21.15 m. Below G.L.							
GROUND W. T. : 12.90 Below G.L.														
DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	C R %	RQD %	CORRECTED SPT 'N'	
				DEPTH (m)	TYPE	15	15	15	15					
0.00	150 mm Ø		Stiff, brownish silty CLAY	0.00										
1.00														
						1.50/		15	05	07	—	N		
2.00							SPT1	03	05	07	—	12		
						1.95								
3.00						3.00/								
						3.50	UDS1							
4.00						4.50								
5.00					Very stiff, yellowish brown, sandy CLAY with gravel		SPT2	06	09	19	--	28		
						4.95								
6.00						6.00/								
						6.50	UDS2							
7.00						7.50/								
8.00						7.95	SPT2	07	10	23	--	33		
9.00			Hard, yellowish brown, sandy CLAY with gravel	9.00/										
				9.47	UDS3									
10.00														
SPT N =STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST														
REMARKS : CONTINUED ON NEXT PAGE.						SCALE : 1: 50 JOB NO. : 2263		Checked By :		Drawn By: Sandeep				
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.														

CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar													
BORE HOLE NO. : BH-86						SHEET NO. : 2 OF 3							
DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE DEPTH (m)	TYPE	BLOWS/15cm 15 15 15 15				SPT N	C R %	RQD %	CORRECTED SPT 'N'
11.00	150 mm Ø		Very stiff to hard, yellowish brown, sandy CLAY with gravel	10.50/									
				10.95	SPT2	08	21	25	--	46			
12.00				12.00/									
				12.40	UDS4								
13.00				13.50/									
				13.95	SPT2	10	26	31		57			
14.00													
15.00			15.00/										
			15.36	UDS5									
16.00			16.50/										
			16.95	SPT6	10	28	34		62				
17.00													
18.00	18.00/												
	18.22	UDS6											
19.00			Dense, yellowish brown, silty SAND with gravel	19.50/									
	19.95	SPT7		16	21	40	--	61					
20.00													
21.00													
SPT N = STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST													
REMARKS : CONTINUED ON NEXT PAGE						SCALE : 1: 50		Checked By :		Drawn By :			
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.						JOB NO. : 2263		Ravi Achari		Sandeep			

CLIENT : NTPC LIMITED														
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar														
BORE HOLE NO. : BH-86						SHEET NO. : 3 OF 3								
DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	CR %	RQD %	CORRECTED SPT 'N'	
				DEPTH (m)	TYPE	15	15	15	15					
21.00	150 mm Ø		Completely weathered, yellowish brown SANDSTONE	21.00/		15	00	--						
	21.15			SPT8	48	52	--	--	R					
22.00			Highly weathered, reddish brown, jointed, SANDSTONE	22.50							20	NIL		
23.00	NX										32	NIL		
24.00				24.00								33	NIL	
25.00				25.00										
26.00														
27.00														
28.00														
29.00														
30.00														
31.00														
SPT N = STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST														
REMARKS : BORE HOLE IS TERMINATED AT DEPTH 25.00 m. BELOW G. L.						SCALE : 1: 50		Checked By :		Drawn By :				
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.						JOB NO. : 2263		Ravi Achari		Sandeep				

CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar													
BORE HOLE NO. : BH-87							SHEET NO. : 1 OF 3						
CO-ORDINATE : N 1555.79,W786.38							DATE : 13/01/2009 to 18/01/2009						
LOCATION : ASH HANDLING							METHOD : ROTARY DRILLING.						
GROUND R. L. : 129.384m.							CASING : 150mm.Ø upto 21.40 m. Below G.L.						
GROUND W. T. : 11.40 Below G.L.													
DEPTH (m.)	DIA. OF BORE HOLE	LOG	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	C R %	RQD %	CORRECTED SPT 'N'
				DEPTH (m)	TYPE	15	15	15	15				
0.00			Stiff, brownish silty CLAY										
1.00				1.50/		15	15	15					
2.00				1.95	SPT1	04	06	08	—	14			
3.00				3.00/									
4.00	150 mm Ø		CH	3.50	UDS1								
5.00			Very stiff yellowish brown silty CLAY with gravel.	4.50		15	15	15					
6.00				4.95	SPT2	05	08	12	--	20			
7.00				6.00/									
8.00				6.45	UDS2								
9.00				7.50/		15	15	15					
10.00			Hard, yellowish brown,sandy silty CLAY with gravel.	7.95	SPT3	08	12	15	—	27			
			CH	9.00/									
				9.45	UDS3								
SPT N =STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST													
REMARKS : CONTINUED ON NEXT PAGE.						SCALE : 1: 50		Checked By :		Drawn By:			
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.						JOB NO. : 2263							

CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar													
BORE HOLE NO. : BH-87						SHEET NO. : 2 OF 3							
DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	C R %	RQD %	CORRECTED SPT 'N'
				DEPTH (m)	TYPE	15	15	15	15				
11.00	150 mm Ø		Hard, yellowish brown, sandy silty CLAY with gravel.	10.50/		15	15	15					
				SPT4	17	19	26	--	45				
12.00				12.00/		15	15	15					
				SPT5	15	21	33	--	54				
13.00				13.50/									
				13.90	UDS4								
15.00				15.00/		15	15	15					
				15.45	SPT6	15	18	30	--	48			
16.00				16.50/									
				16.85	UDS5								
18.00				18.00/		15	15	15					
				18.45	SPT7	24	38	51	--	89			
19.00	19.50/												
20.00	19.82	UDS6											
21.00													
SPT N = STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST													
REMARKS : CONTINUED ON NEXT PAGE								SCALE : 1: 50		Checked By :		Drawn By:	
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.								JOB NO. : 2263		Ravi Achari		Sandeep	

CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar													
BORE HOLE NO. : BH-87						SHEET NO. : 3 OF 3							
DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	CR %	RQD %	CORRECTED SPT 'N'
				DEPTH (m)	TYPE	15	15	15	15				
21.00	150 mm Ø		Completely weathered, reddish brown, SANDSTONE	21.00/		15	15	10					
				21.40	SPT8	34	52	68	-	R			
22.00											20	NIL	
				22.50									
23.00			Highly weathered, reddish brown, SANDSTONE.								22	NIL	
				23.50									
24.00											24	NIL	
25.00				25.00									
26.00													
27.00													
28.00													
29.00													
30.00													
31.00													
SPT N = STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST													
REMARKS : BORE HOLE IS TERMINATED AT DEPTH 25.00 m. BELOW G. L.						SCALE : 1: 50		Checked By :		Drawn By :			
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.						JOB NO. : 2263		Ravi Achari		Sandeep			

CLIENT : NTPC LIMITED														
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar														
BORE HOLE NO. : BH-88							SHEET NO. : 1 OF 3							
CO-ORDINATE : N 1560.83,W 726.63							DATE : 06/01/2009 to 11/01/2009							
LOCATION : ASH HANDLING							METHOD : ROTARY DRILLING.							
GROUND R. L. : 129.408m.							CASING : 150mm.Ø upto 22.60 m. Below G.L.							
GROUND W. T. : 12.70 Below G.L.														
DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	C R %	RQD %	CORRECTED SPT 'N'	
				DEPTH (m)	TYPE	15	15	15	15					
0.00			Very stiff, brownish, silty CLAY											
1.00				1.50/			15	15	15					
2.00			Very stiff to hard, yellowish brown, sandy CLAY with gravel	1.95	SPT1	06	08	10	—	18				
3.00				3.00/										
4.00	150 mm Ø			3.50	UDS1									
5.00				4.50			15	15	15					
6.00				4.95	SPT2	08	16	18	--	34				
7.00				6.00/										
8.00				6.48	UDS2									
9.00				7.50/			15	15	15					
10.00				7.95	SPT3	10	18	21	—	39				
				9.00/										
				9.50	UDS3									
SPT N =STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST														
REMARKS : CONTINUED ON NEXT PAGE.						SCALE : 1: 50		Checked By :		Drawn By:				
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.						JOB NO. : 2263		Ravi Achari		Sandeep				

CLIENT : NTPC LIMITED														
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar														
BORE HOLE NO. : BH-88						SHEET NO. : 2 OF 3								
DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	C R %	RQD %	CORRECTED SPT 'N'	
				DEPTH (m)	TYPE	15	15	15	15					
11.00	150 mm Ø		Hard, yellowish brown, sandy CLAY with gravel.	10.50/		15	15	15						
				SPT4	12	20	24	--	44					
12.00				12.00/										
				12.30	UDS4									
13.00														
				13.50/		15	15	15						
14.00					SPT5	17	21	31	--	52				
				15.00/										
15.00					15.38	UDS5								
16.00														
				16.50/		15	15	15						
17.00					SPT6	18	25	33	--	58				
				16.95										
18.00				18.00/										
	18.45	UDS6												
19.00														
	19.50/		15	15	15									
20.00		SPT7	20	28	35	--	63							
	19.95													
21.00														
SPT N = STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST														
REMARKS : CONTINUED ON NEXT PAGE								SCALE : 1: 50		Checked By :		Drawn By:		
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.								JOB NO. : 2263		Ravi Achari		Sandeep		

CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 4 X 250MW Nabinagar Thermal Power Project at Nabinagar													
BORE HOLE NO. : BH-88						SHEET NO. : 3 OF 3							
DEPTH (m.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	CR %	RQD %	CORRECTED SPT 'N'
				DEPTH (m)	TYPE	15	15	15	15				
21.00	150 mm Ø		Completely weathered, yellowish brown, SANDSTONE	21.00/									
				21.40									
22.00													
	NX		Highly weathered, yellowish brown, jointed SANDSTONE.	22.50/		10	--	--					
				22.60	SPT8	103	--	--	R	20	NIL		
23.00													
				24.00							26	NIL	
24.00													
25.00				25.00									
26.00													
27.00													
28.00													
29.00													
30.00													
31.00													
SPT N =STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST													
REMARKS : BORE HOLE IS TERMINATED AT DEPTH 25.00 m. BELOW G. L.						SCALE : 1: 50		Checked By :		Drawn By:			
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.						JOB NO. : 2263		Ravi Achari		Sandeep			

SUB-SECTION-III-D

CIVIL WORKS

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
1.00.00	SCOPE OF CIVIL WORKS		
1.01.01	Scope of Bidder shall include all Civil, Structural, Architectural works including underground facilities like drainage, sewerage, trenches, earthing mat/ grounding, of all the facilities associated with complete Flue gas desulfurization (FGD) system, Zero Liquid Discharge (ZLD) system & Chimney as specified elsewhere in the technical specification.		
1.02.00	The work to be performed under this specification consists of providing all labour, materials, construction equipment, tools and plant, scaffolding, supplies, transportation, all incidental items not shown or specified, but reasonably implied or necessary for successful completion of the work including Bidder's supervision and in strict accordance with the drawings and specifications. The nature of work shall generally involve earthwork in excavation & deep underground excavation, extensive de-watering, shoring and strutting, sheet piling, back filling around completed structures and plinth protection, paving , disposal of surplus excavated materials, piling, concreting including reinforcement and form work, brick work, fabrication and erection of structural / miscellaneous steel works, inserts, architectural items & finishes such as plastering, painting, flooring, doors, windows & ventilators, glass and glazing, rolling shutters etc., permanently colour coated profiled steel sheeting, anchor bolts, R. C. C. trenches with covers, laying and testing of water pipes, sanitation, water supply, drainage, damp proofing, water proofing and other ancillary items.		
1.03.00	The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, grounding, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, finishes, false ceiling and complete architectural works, etc. The works covered under the scope of the bidder have to be executed in an operating / under construction power station. The bidder shall take all necessary precautions to protect the entire existing equipments, structures, facilities and buildings etc. from damage. In case any damage occurs due to activities of the bidder on account of negligence, ignorance, accidental or any other reason what so ever, the damage shall be made - good by the bidder at his own cost to the satisfaction of the Owner. The bidder shall take all necessary safety measures to avoid any harm, injury to his workers/staff from the equipment / facilities of the power station.		
1.04.00	If during the execution of works it is found that there is interference with the existing facilities / structures, the bidder shall revise his design / detailed drawings to clear the interference and shall provide all necessary measures for the safety of existing structures. In case the details shown in tender drawings are found to be different from actual details at site, bidder shall revise his design/ detailed drawings to suit the constraints at site. No claim in terms of cost or relaxation in time shall be entertained for any redesign, rework and for safety measures provided. If at any stage of work, any dismantling or modification or relocation of any existing facility is required to be done to complete the work in bidder's scope and which has been agreed by the Employer, the same shall be done by the bidder at no extra cost or time implication to the Employer. All such changes will be as per drawings and work plan approved by the employer.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)2	SUB-SECTION-III-D CIVIL WORKS PAGE 1 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES	एनटीपीसी NTPC		
1.05.00	Analysis, design and preparation of construction drawings for all structure/facilities under the scope of this package and getting the same approved from the owner.			
1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.			
2.00.00	CONSTRUCTION FACILITIES The following are also in the Bidder's scope of work: 1. Providing drinking and service water for Bidder's labour, staff and other personnel working for Bidder at the work site and in his staff/ labour colony. He shall install necessary bore wells with associated pumping or water tankers and treatment facilities to supply quality water as per standards. 2. Developing temporary staff colony and labour colony along with fencing etc. Land if required shall be arranged by the Bidder himself. However space required for bidder's office, storage, pre assembly and fabrication areas shall be provided by owner free of charge within the plant premises. The area to be allocated to the Bidder shall be discussed & finalized with the bidder after the award, keeping in view the availability of free space & similar requirement of other agencies. 3. Providing all arrangements for distribution of construction power at various locations as per his requirements from the supply point of Owner. 4. Providing all arrangements for the supply of construction water including bore-wells, water tankers etc. 5. Providing temporary construction office, construction stores (open / covered), workshops, material / field testing laboratory, any other temporary buildings 6. Providing all construction equipment, labour and materials. The Bidder shall provide all the tools and tackles required for the work. 7. Development of the pre-assembly and storage yard with fencing, drainage, internal roads, boulder soling, etc. 8. Approach road to project site is available. Further, Owner intends to construct the roads as per the layout shown in the General Layout plan in a progressive manner. Some of these roads may not be available to the bidder for his use. Similarly the drainage network for the plant site being constructed by the owner may not be available to full extent. The bidder shall plan his work within the plant area considering the above constraints of roads and drains. Access roads to his work sites, offices, stores, preassembly / fabrication yard, etc. as required for providing approach/access for men, materials, equipment, cranes, trailor, construction/erection activities etc., what so ever are required by the bidder, shall be constructed and maintained by the bidder. Bidder shall provide permanent access to all facilities/ structures from the nearby existing roads of the owner. Roads shall be in			
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CLAUSE NO.	SCOPE OF SUPPLY & SERVICES			
	concrete (M-35 grade) as per IRC standards, with minimum thickness of pavement (PQC) as 250mm. Width of all such roads shall be 7.5M concrete pavement. 9. Area lighting at the construction / erection site, pre-assembly and storage yard, office areas and labour / staff colony. 10. Providing all necessary fire-fighting devices / equipment / fire tender etc. required during the project execution stage. He shall maintain all such equipment / devices in proper working conditions throughout the period of work. 11. Providing first aid facilities at the construction / erection sites, workshops, laboratories, pre-assembly and storage yard and other places of work as per the requirement. 12. The Bidder shall arrange skilled / semiskilled / unskilled manpower from local source(s) as far as available in this country. He shall also arrange supervisory staff for quality execution of all works in his scope. 13. Bidder's office, store, workshop, laboratory or any other temporary buildings: The Bidder shall adopt pre-engineered/ pre-fabricated constructions made of steel with single / double skin, insulated for un-insulated roof and wall coverings (fabricated out of permanently color coated metal sheets) for his site office, covered store workshop, laboratory or any other temporary buildings. Alternatively, bidder can adopt readymade `Portacabin' or similar construction. Bidder shall ensure that all such constructions are well-engineered, neatly constructed and overall present a pleasing look. The above requirements shall be applicable to his sub-vendors also and bidder shall be responsible for enforcing the same on his sub-vendors. Any other type of construction if proposed by the bidder shall be subject to approval of the owner. However, such construction shall be based on proper design and shall have aesthetic look. 14. Use of ash and ash based products: In line with Gazette Notification on Ash Utilization issued by MOEF and its amendment thereafter, Bidder shall use ash and ash based products in construction of his offices, stores, staff quarters and labour huts etc. He shall furnish a compliance report along with all details of use of ash and ash based products along with each bill. The above requirements shall be applicable to his sub-vendors also and Bidder shall be responsible for enforcing the same on his sub-vendors. 15. Repair & Maintenance Facilities by the Bidder: Bidder shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like cranes, hydra, forklifts, welding equipments, etc.) He will also make arrangements/tie up with manufacturers/ suppliers of such construction plant, equipment & machinery, for periodic overhaul/maintenance and for major breakdown, if any. He shall also keep			
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	adequate stock of spares at site for various construction plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Bidder shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.		
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SUB-SECTION-IV-D

CIVIL WORKS

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.00	GENERAL		
1.01.00	This section of the bidding document deals mainly with the technical specification for the design and preparation of detailed drawings, getting the design and drawings approved by the Employer, fabrication, erection and construction of the necessary civil, structural and architectural works associated with the FGD package for Lot-1A. The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, silos, sumps, Limestone storage hopper & shed, Crusher House, Transfer points, Conveyor Galleries, Tunnels, Gypsum storage shed, Chimney, Gypsum dewatering building, Ball Mill building, FGD control room building, Tank Foundations, absorber tower foundation, transformer foundation, MCC Building, finishes, complete architectural aspects, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete FGD package.		
1.02.00	The specifications are intended for the general description of the work, quality and workmanship. The specifications are not, however, intended to cover minutest details and the work shall be executed according to the relevant latest Indian Standard Codes / I. R. S. / I. R. C. specifications. In absence of the above, the work shall be executed according to the best prevailing local Public Works Department practices or to the recommendations of relevant American and British Standards or to the instructions of the Engineer. Some of the relevent I. S. Codes to be followed is mentioned in the Technical Specifications. The Contractor is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Employer in respect of interpretation of any portions of this document.		
1.03.00	Bidder or his agencies engaged as detailer for fabrication drawings should have the experience of detailing for power plant structures or steel plant or Industrial structures like Petro/ Chemical/ Refinery/ Cement/FGD Plant/Coal Handling Plant/Ash Handling Plant etc. The designer responsible for preparation of scope drawings shall review and approve the fabrication drawings prepared by the detailer before releasing them for fabrication.		
2.00.00	Sub QR for Civil Works:		
2.01.00	Bidder or its agency should have in past executed civil and structural works for 500 MW or higher capacity coal based/Lignite based power plant including earthwork in filling involving mechanical compaction and cutting in hard rock, foundations, Bulk material handling plant involving underground storage hopper and underground tunnels.		
2.02.00	Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 2.01.00. The agency being engaged for a particular work should have in the past executed such works of 500 MW or higher capacity plant.		
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Ref. sl. no-
36 of
amendment
no.5 of
TS(section-
VI).

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.03.00	For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height.		
2.04.00	In case Bidder or its agency do not meet the requirements at 2.01.00 and the Bidder proposes to engage agency (ies) for civil & structural works on work volume basis (except for Chimney), Bidder or its agency (ies) should have executed such works in the past and the annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, (structural steel fabrication & erection, RCC, earthwork in filling involving mechanical compaction and cutting in hard rock, RCC in underground storage hopper and underground tunnels) for which it is being engaged.		
	Successful Bidder shall finalize the agency (ies) for each work in consultation with Engineer-in-charge at site before engaging them.		
	Design agency for Civil & Steel Structural Works:		
2.05.00	Bidder or its agency (ies) should have carried out the design and detailed engineering of following works:		
	(i) Civil & Structural works associated with at least one bulk material handling plant for 500 MW or higher capacity coal based/Lignite based power plant.		
	(ii) For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height.		
	(iii) Machine foundations such as Mill foundations/ Block foundations.		
2.06.00	Bidder can engage more than one agency (of repute), in case the Bidder itself is not able to meet the requirement at 2.05.00.		
	The design agency (ies) proposed by the Bidder shall be subject to Employer's approval.		
3.00.00	Work Description		
3.01.00	Truck Hopper, Limestone Storage hopper and Underground Tunnel		
	Truck Hopper shall consist of underground portion, which shall be of R. C. C. with structural steel shed covered with permanently Colour coated profiled steel sheets.		
	Limestone storage hopper shall be of RCC with structural steel shed covered with permanently Colour coated profiled steel sheets.		
	The structural arrangement to be adopted for the design and construction of Limestone Storage hopper shall essentially consist of R. C. C. frames spaced at approx. 3.0M centers with R. C. C. wall panels on the sides and R. C. C. raft at the bottom, fixed to the frames. Minimum thickness of R. C. C. raft at bottom shall be 600		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top. The vertical and inclined portion of hopper shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification. Expansion joints shall be provided at a maximum distance of 40m. 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material. Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Side drains and sump shall have removable type steel grating cover. Water proofing / Damp proofing of under ground Truck hopper, Limestone Storage hopper, tunnels and underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments: Chemical injection grouting for inner faces (details as specified elsewhere). Polymer modified cementitious coating on earth side face as per the following : (1) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface. (2) 50 mm thick P. C. C. (1 : 2 : 4 with 10 mm nominal size stone aggregates) shall be provided under the raft i.e. over the lean concrete, followed by polymer modified cementitious coating in two layers (slurry mix application) as per manufacturer's specification. 50 mm thick P. C. C. (1 : 2 : 4) with 10 mm nominal size stone aggregates shall then be laid over the polymer modified cementitious coating before laying the raft. Truck hopper and its gratings shall be designed for movement of front end loader/ bulldozer over them. Bull dozer weight shall be considered as about 35T. The gratings shall be built of min. 200x28mm thick flats in main direction and min.100mm x 20mm thick in secondary direction. No painting/galvanization shall be provided in gratings. However, two coats of Red oxide Primer to be provided immediately after fabrication. Plinth protection along with drains shall be provided along the Hopper complex. However, 5m wide paving shall also be provided around machinery hatches. Earth pressure to be considered for design shall be due to earth pressure at rest (Ko) condition only. Earth pressure due to surcharge intensity of Uniformly Distributed Load (U. D. L) of intensity 2 T / Sq. M. shall be considered in the design. A minimum safety factor of 1.2 against uplift due to ground water shall be ensured during execution and after execution, considering dead weight of the structure to be		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.02.00	0.9 times only, ground water table to be taken at adjoining formation level and soil wedge angle of not more than 15 degrees. Also, FOS against uplift, to be taken as 1.0, considering the dead wt. of structure and soil resting on side projections if any in the vertical plane. Inclined wedge action of soil shall not be considered in this case. Wherever, slope of tunnel exceeds 10°, R. C. C. steps shall be provided for the entire width of each walkway.		
	Overhead / Ground Conveyor Galleries and Trestles		
	Overhead conveyors shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of single rolled steel beam or single channel section (ISMB or ISMC) or plate girder. Horizontal bracings are to be provided at top & bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure. Contractor can also use tubular steel sections for roof truss only of conveyor galleries. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS 1161 and rectangular/square steel sections shall conform to IS 4923. The steel structures using tubular sections shall be designed and fabricated as per IS 806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. The maximum span of overhead gallery shall be limited to 25 meters unless higher span is required due to site conditions, which shall be subject to approval of the Engineer. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made.		
	Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor.		
	The ground conveyors shall be located in suitably enclosed gallery of structural steel consisting of rigid portal frames spaced at regular intervals and suitably braced. Plinth protection along with drains shall be routed along the ground conveyors.		
	For double stream conveyor gallery, two side and one central walkway of width 800 mm and 1100 mm respectively shall be provided. The width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery. Where the slope of walkway is more than 10°, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates and other drainage arrangements as specified elsewhere		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Adequate provision of windows shall be kept on both sides of conveyor gallery as appended in Mechanical Section (Belt conveyor system). Windows shall be provided with wire mesh as specified elsewhere in this specification. Cross - over with chequered plate platform and ladder for crossing over the conveyors shall be provided at approximately every 100 M intervals of conveyor. Crossover shall preferably be located over four-legged rigid trestle location. For railway tracks passing below overhead conveyor gallery and along conveyors, the railway clearances both underground as well as over ground shall have to be adhered to for design, execution and erection of foundations, trestles, galleries etc., so that movement of locomotives and wagons is not hampered in any way during execution and afterwards. However at the location where the overhead conveyor gallery crosses road / rail line, minimum clearance of 8.0m above the road crest / rail top shall be provided. For calculation of material load on moving conveyor, a multiplication factor 1.6 shall be used to take care of inertia force, casual over burden and impact factor etc. Thus material load per unit length of each moving conveyor shall be Rated capacity of conveyor system 1.6 X ----- x F Conveyor Belt Speed Where, F = 1700/1400 for lime & 1250/900 for gypsum It should be noted that for structural design, unit weight of lime shall be assumed as 1700 Kgs. / Cu. M. instead of 1400 Kgs. / Cu. M., unit weight of gypsum shall be assumed as 1250 Kgs. / Cu. M. instead of 900 Kgs. / Cu. M. considered for system sizing purpose. Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously. Conveyor gallery and supporting trestles located between transfer houses / buildings shall be arranged in any one of the following ways. a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS						
3.03.00	b) In between transfer houses / buildings, four legged trestles shall be placed at a maximum interval of 90 metres. The arrangement shall be such so as to ensure that force in the longitudinal direction (i. e. along the conveyor length) of conveyor gallery of length not more than 90 m is transferred to any four legged trestle. In the space between each successive four legged trestles, two legged trestles shall be provided at regular intervals. The end supports resting on the four-legged trestle can have either ends hinged or one hinge and the other on slide type depending on the arrangements. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements. End of conveyor gallery which will be supported over transfer house, shall be so detailed that only vertical reaction is transferred from conveyor gallery and no horizontal force in longitudinal direction is transferred from conveyor gallery to transfer house structure and vice - versa. For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and under ground facilities, location and details of these trestles and foundations shall have to be decided such that there is no interference both underground as well as over ground with existing structures and facilities. Trestle columns / ground conveyor portal column base shall be kept 300 mm higher than the existing ground level.						
	Transfer Houses						
	The over ground portion of the transfer house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding (from lowest working floor level till top) and R. C. C. floors comprising of RCC slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. However, the lower portion of side cladding, at ground, for a minimum height of 0.9 m above the finished floor level shall be one brick thick wall plastered on both side. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Contractor shall have option to use tubular steel sections for roof truss only. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with 0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.						
	Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting.						
	The roof of Transfer points shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.						
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3.04.00	Crusher House			
	The crusher house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding. However, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The lower portion of side cladding, at ground, for a height of minimum 0.9m above the finished floor level shall be of one brick thick wall plastered on both faces. Floors shall be of R. C. C. slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. Within this building cubicles are to be provided for resting room of operators and these shall be constructed with one brick thick brickwork having both sides plastered and roof slab. Adequate steel doors and windows for natural lighting and ventilation shall be provided. Contractor shall have option to use tubular steel sections for roof truss only . Vertical bracings shall be provided only on four sides along the periphery. The roof of Crusher house shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water. Crushers shall be supported on R. C. C. deck, which in turn will rest on suitable vibration isolation system consisting of springs and dampers. This R. C. C. deck shall be isolated from the floor. However, the vibration isolation system consisting of springs and dampers may rest on main building framework. Detailed specification of vibration isolation system including the unbalanced force, frequency and amplitude criteria and other design requirements are appended elsewhere in this specification			
	3.05.00	Control building, M. C. C. Buildings		
These shall be steel or RCC framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams. Cladding shall be of brickwork/concrete blockwork with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations. All air - conditioned areas, shall be provided with the suspended permanently colour coated aluminium false ceiling system (details specified elsewhere) with under deck insulation. Adequate aluminium doors and windows shall be provided for natural lighting, ventilation and view. All windows in air conditioned rooms shall have hermetically sealed double glazing.				
3.06.00		Pent House		
	These shall be of R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof			
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3.07.00	shall be provided with roof water proofing treatment as specified elsewhere. Adequate nos. of steel doors and windows shall be provided for natural lighting and ventilation.			
	Gypsum Storage Shed The Gypsum storage shed shall be RCC framed structure with structural steel work shed with permanently colour coated profiled steel sheet roof and side cladding, grade slab and RCC foundations etc. Roof shall be provided with troughed profile permanently colour coated sheet with adequate slope for quick drainage of rain water.			
	3.08.00 Toilets Toilet with potable water line facilities shall be provided in each of the following locations: (a.) In all M. C. C. Rooms (b.) Control Building			
3.09.00	Staircases, Gratings, Handrails All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. All staircases of Transfer points and crusher house shall be of steel. Cage ladders (min. 450mm wide) shall be provided for access to roof of penthouses, single storey mcc rooms & mumty. All Stairs shall be minimum 1200 mm wide, maximum rise should not be more than 180 mm and minimum tread with 250 mm. Numbers and arrangement (including enclosures etc.) of stair cases shall be such as to meet the fire safety requirement as per guide lines of statutory regulatory bodies. For steel staircases , Stringers shall be of rolled steel channel (minimum ISMC 250) and tread shall be of steel gratings. Out side stairs to transfer points/crusher house shall be open type. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's All gratings shall be electro forged types. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation. However, at entry or road crossing point's minimum thickness of grating shall be 40 mm The opening size shall not be more than 30mmx100mm. The minimum thickness of the main bearing bar shall be 6 mm or as per design requirement whichever is higher. All gratings shall be designed for minimum imposed load of 500Kgs. / Sq. M. If actual expected load is more than the specified load, then actual load is to be considered. All gratings shall be hot dip galvanized at the rate of 610 g. per sq.m. after surface preparation by means of blast cleaning/ acid pickling. Minimum 1000 mm high hand railing shall be provided around all openings, projections / balconies, walkways, platforms, Stairs, etc. All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class) as per IS:1161. Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100			
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3.10.00	mm high and 6 mm thick). All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. M as per IS:4736. Trenches All trenches for cables or any other underground facility as detailed out elsewhere shall be of R. C. C. Cable trenches shall be provided with pre - cast R. C. C. covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Proper drainage arrangement shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers. For cable trenches outside buildings, top level shall be 200 mm above G. L and sand filling shall be overlaid with 50 thk. PCC. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting grating/precast RCC covers, edges of R. C. C. trenches supporting pre - cast covers, supported edges of pre - cast cover 3.11.00 Cable gallery/trestles Cable galleries/trestles shall be made of structural steel. The contractor can use either rolled sections or tubular steel sections. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall confirm to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. 3.12.00 Transformer Foundation 3.12.01 Foundations of transformers shall be designed for seismic and wind loads in addition to other applicable loads. Block foundations shall be provided for the main transformer block. The oil soak pit, if provided, shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store complete oil of the transformer/reactor along with 10 minutes of fire water considering only 40% of the volume as available voids between gravel filling. However, in case a separate oil collection tank is provided for the transformer/reactor, oil soak pit of volume equivalent to one-third (1/3) the oil volume of transformer/reactor shall be provided around transformer/reactor. The oil collection tank, in such cases, shall be designed for an effective capacity of complete oil of the transformer along with 10 minutes of fire water. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit. Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/ reactor foundations.
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3.12.02	RCC Firewall shall also be provided between the transformers wherever required. 300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of gravel filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement. Fencing Fencing with toe wall and steel gates shall be provided around the transformers. Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. Fence posts shall be of pre – cast R. C. C. of minimum M20 grade. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions. Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 1. 5: 3) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing		
	3.13.00	Booster Fan Foundation Booster Fan foundations shall be RCC block foundation directly resting on virgin soil/ pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round.	
	3.14.00	~~CHIMNEY~~	
	3.14.01	~~Salient Features~~ ~~Single-flue or multi-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level.~~ ~~The chimney shell (windshield) shall be constructed using slip form shuttering. Internal platforms of steel structure shall be provided for enabling access to various elevations of the chimney and to provide support to the flue liners. Spacing of internal platforms shall not exceed 45.0 M. The platform beams shall be supported on concrete shell using suitable load bearing arrangement in the recesses provided for the purpose. The platform beams getting supported in the chimney shell shall have complete bearing support within the thickness of shell at that location and shall in no case be supported completely/partially on corbels/ brackets from the shell. "Through openings" in shell if provided to facilitate erection of platform beams shall be closed with cast-in-situ RCC closure wall on the external face of the shell. Necessary dowel~~	
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	bars shall be provided in the shell during construction for this purpose. Openings in the concrete shell for flue duct entry, access door & truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around internal staircase & around the ventilation voids in the internal platform using min. 32 mm nominal bore MS pipes of medium class conforming to IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1200 mm. The handrail shall have three rows of horizontal members between the railing posts including the top member. Kick plate of min. size 100x6 thick shall be provided in the hand railing. The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be bottom supported and shall be profiled into a circular shape to connect to the flue liner. The flue duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic fluoroelastomeric fabric expansion joint. The expansion joint in the flue liner shall comprise of non-metallic fluoroelastomeric material suitable to withstand a temperature of 300 Deg C, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable to withstand a temperature of 300 Deg C and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh. Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell with chequered plate floor panels and pipe handrails, shall be provided for full height of the chimney and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch. The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, mild steel wind strakes (if required), all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects. Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open able from interior of chimney shell) fixed to openings in the chimney shell at locations and levels specified elsewhere. Suitable provision for approach to the AWL shall be provided at the platform level. AWL shall be located at about 1-1.5 metre above the top of platform to enable easy handling for maintenance. The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation & erection of flue segments.		
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3.14.02	Design Concept Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in Indian Standard, reference shall be made to ACI, BS, CICIND and other international standards. In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail. Imposed loading for design of all chimney components shall not be less than 5 kN/Sq.m. An additional 25% of liner load shall be taken as impact loading for liner erection in addition to the liner load. The min. thickness of web for plate girders shall be kept as 12 mm. Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document. Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document. The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings. Design of all chimney components shall be based on working stress method. 3.14.03 Wind Shield The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The load calculation and load combinations shall be as detailed in IS 4998 (Part 1) : 1992. The wind shield shall be analysed for cases with and without flue liner loads. Forces/stresses in the wind shield due to eccentricity effects of local (e.g. corbel) loadings, insulations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered. Seismic response of the chimney shall be computed by the response spectrum method. At least, the first five modes of vibrations shall be used for this analysis. The cross wind analysis of the chimney shall be carried out irrespective of the value of the Scruton Number for the chimney and other empirical considerations which suggest structural immunity to cross wind oscillations. The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm. The stresses for the shell design shall not exceed the limits given in Cl. 7.0 of IS:4998 (PART-I) 1975 for various combinations of loads, excepting the stress in concrete for the case of dead load + wind load which shall not exceed $0.30f_{ck}$ where f_{ck} is the characteristic compressive strength of concrete. The minimum vertical reinforcement shall be 0.3% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 250 mm on each face. The minimum circumferential reinforcement shall be 0.2% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The circumferential reinforcement in the top 3 meters of the windshield		
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3.14.04	shall be twice that required from design forces. The clear cover to reinforcement shall be 50 mm.		
	There shall be a continuous ring of concrete shell without any opening for a height of atleast 5m below the soffit of flue duct openings.		
	There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a sudden change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level.		
	The diameter of the reinforcing bar for the main vertical reinforcement of shell shall not be less than 25mm for a shell height upto the top level of flue duct opening.		
	Shell thickness between any two 10m reference levels shall not vary more than 150mm.		
	The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm.		
	Grade of concrete for chimney shell, and other super structure shall be minimum M 30. Only OPC cement shall be used for Chimney shell and other super structure.		
	The final design shall be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located in the area or in the future expansion stage of the project shall be determined along with the other topographical features of the local area through model test.		
	Flue Liners		
	The flue gas parameters & various operating conditions for selection of flue liner material, material specification for flue liner and the criteria of flue gas exit velocity for sizing the flue liner shall be as specified elsewhere in the specification.		
3.14.05	For flue liner with base metal as mild steel, the thickness of the base metal shall be determined from structural considerations. The thickness of any clad metal/coating/block lining etc. provided on the base metal shall not be considered for computing the structural strength of flue liner. The minimum thickness of the mild steel base metal shall, however, not be less than that specified elsewhere in the specification.		
	Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels.		
	The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.		
	Clean-out door shall be provided below the flue for the removal of ash.		
	Internal Platforms		
	The platforms shall be designed for dead, imposed (live), erection work and other possible loadings and temperatures effects. These platforms shall provide support and lateral restraint to the steel liners and provide access for inspections and maintenance. Forces imposed on the floors due to lateral restraint of flues shall be enhanced aptly for impact effects. These platforms shall also be designed suitably for		
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3.14.06	the liner erection works. The platform shall be made up of chequered floor panels supported on grid of structural steel beams. All beams shall have bolted connections. The maximum permissible deflection in main steel girders supporting flue liner shall be span/1000.		
	Internal Staircase The staircase shall have a clear passage way width of not less than 800 mm and a clear headroom of not less than 2100 mm. The riser height shall not be more than 175 mm and tread width shall not be less than 225 mm.		
	3.14.07	Foundation The chimney foundation shall be designed for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation for any loading condition. Since chimney is a wind sensitive structure no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. No allowance shall be made in the stresses for design of foundation for wind loading. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 25.	
3.14.08		Thermal insulation The insulation shall be semi-rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. The density of insulation shall not be less than 64 kg/cu.m for resin bonded glass wool insulation and 100 kg/cu.m for resin bonded rock wool. The coefficient of thermal conductivity of insulation shall not be more than 0.52mW/cm/oC at a mean temperature of 100oC. The insulation thickness shall be determined based on the maximum/minimum ambient temperature, surface air velocity worked out based on the draught of ventilation air in the annular space between the flue liner and chimney shell, insulation surface emissivity of 0.3 and the insulation cold face maximum temperature not exceeding 55 degree Celsius. The draught of air in the annular space shall be the natural draught created by the heating of air by the flue liner and the air being vented out through the openings in the chimney shell. The increase in the annulus air temperature due to the rising heated air shall be taken into account while calculating the insulation thickness. The insulation thickness shall not be less than 100 mm, in any case, and shall be provided in two layers with the second layer of insulation covering the joints of the first layer. The insulation shall be wrapped on the outer-most surface with galvanised wire mesh using MS galvanised pins and speed washer.	
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3.14.09	Chimney Painting					
	(i) All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) except surfaces of steel wind strakes shall be painted as specified in corrosion protection clause of this specification. (ii) All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT. a) All steel surfaces shall be provided with two component epoxy primer coat (having solid by volume minimum 51% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. b) Primer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied in shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer. (iii) All steel parts embedded in concrete like Strake embedment assembly including bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes. (iv) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab, external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT. a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free. b) Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours <tr><td>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</td><td>SUB-SECTION-IV-D CIVIL WORKS</td><td>PAGE 15 OF 69</td></tr>			LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-IV-D CIVIL WORKS
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3.14.10	exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer. d) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iv) above in alternate bands of 'signal red' and 'bright white' colours.		
	Electrical System 415V, normal and emergency AC power supply for chimney shall be derived from main plant power supply system. Emergency supply shall feed 20% of platform lighting, 50% of staircase lighting, aviation obstruction lighting and elevator load. All other loads shall be connected on normal power supply. Ambient temperature for design of all equipment shall be considered as 55 deg. C which is likely to be encountered inside the chimney. The equipment shall be suitable for installation and render trouble free operation at higher ambient temperature and rigorous weather conditions prevailing at chimney. All equipment supplied shall comply with relevant IS Standards. The distribution boards of chimney shall comprise switch fuse units of appropriate ratings. Emergency board shall have two incomers, one from emergency supply and other from normal AC distribution board itself. Auto changeover scheme shall be provided in emergency board to enable changeover to healthy source on failure of any source. Dry type isolating transformer of Dyn connection shall be provided in emergency board to obtain neutral lead, in case 3 phase 3 wire emergency supply is derived from main plant. Various platforms shall be illuminated by dust tight HPSV well glass lighting fixtures. Average illuminations level of 150 lux shall be maintained on equipment and 70 lux on platforms & 100 lux on staircases (minimum 1 lighting fixture at each landing).Any additional fixture to take care of dark patches/shadows shall also be provided. Lighting system shall be controlled through MCB provided in lighting panel. A lighting and power panel each shall be located at grade level and at other in between levels as required. All distribution boards, aviation lighting controls, etc. shall be located at grade level only. At each platform, 1 No. 63A, 415V welding receptacle and 1 No. 20A, 240V receptacle shall be provided and shall be fed from power panel. Wiring installation for lighting fixture shall be of PVC insulated copper/aluminium wires through galvanised steel conduits. Aviation obstruction lighting system shall conform to the requirements of the latest rules and regulations of the International Civil Aviation Organization (ICAO), National Airports Authority (NAA) and Directorate of Air Routes and Aerodromes (DARA). The type of aviation obstruction lighting system shall be of medium intensity aviation obstruction lights having an effective intensity of 2000 to 20,000 cd depending upon back ground illuminance. Obstacle lights shall have a day time effective intensity of minimum 20000 cd. The intensity of lights shall be 20000 cd ± 25% at twilight and shall reduce automatically to a night time intensity of 2000 cd ± 25% through the use of photo-cell. The obstacle lights shall flash simultaneously at a rate between 20 to 60 per minute. A minimum of three levels will be provided with aviation obstruction		
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3.14.11	lights and there will be four light units per level. The lowest level should not be lower than 45 meters above the ground and vertical spacing of the intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc.. A temporary aviation obstruction lighting system shall be provided during construction of the chimney. Cables from distribution board to lighting panels/power panels/receptacles shall be 1100V grade, multicore FRLS HR-PVC insulated, PVC inner sheathed, armoured, PVC outer sheathed stranded copper/ Aluminum laid on galvanised sheet steel cable trays. Cables shall be terminated using double compression type cable glands and solder less crimping type tinned copper cable lugs. Minimum size of the power cable shall not be less than 2.5 sq.mm copper or 4 sq.mm Aluminum. Minimum size of control cable shall not be less than 1.5 sq.mm. Lightning protection system shall comprise minimum 3 vertical air terminations for each flue liner, horizontal air terminations and minimum 4 Nos. of down conductors spaced 90 degrees apart routed all along chimney height on external surface and connected to the earthing system. Down conductors shall be of minimum 50x6 mm galvanized steel strip. Each down conductor shall be provided with a test link at 1 metre above ground level. Each test link shall be enclosed in a galvanised sheet steel enclosure. Above ground level earthing and lightning protection system shall comprise galvanised steel strips. These materials provided at top 12 meters shall have additional coating of 2 mm thick seamless lead cover and the accessories like nuts, bolts, washers etc. shall be of stainless steel to take care of corrosion. Chimney earthing system shall be interconnected to main plant earthing system. A temporary lightning protection & earthing system shall be provided during construction of the chimney till a permanent lightning protection & earthing system is installed. In no case reinforcement bars of Shell should be used as earthing Down Conductors Communication system comprising of telephone socket at every internal platform level and at grade level, necessary wiring installation, a telephone hand set, junction boxes etc. shall also be provided. Telephone cables shall be of minimum 0.6 mm diameter annealed high conductivity electro copper conductor, PVC insulated, twisted, PVC tape wrapped, screened, rip corded, PVC sheathed, conforming to relevant ITD (Indian Telephones Department) specifications. All equipment to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all type tests as listed below: (A) Distribution boards/panels-Degree of protection tests (B) Aviation lights: (1) Intensity Test (2) Degree of protection test For various equipment, the technical requirements and practices shall conform to the relevant clauses of the main plant electrical specification. Rack and Pinion Elevator A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed		
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	of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual		
4.00.00	Drainage & Water Supply Works		
4.01.00	Drainage System: The drainage arrangements shall be so planned so as to ensure quick disposal of drainage water without stagnation and / or overflow. It is envisaged to clean the facility buildings etc. with water periodically. Minimum 4 nos. down comers shall be provided in each building at corners. For Conveyors, each down comer shall lead the water / slurry to pit (of 2 Cu.M capacity) to allow settling of lime/gypsum. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road. For Ball Mill building, Gypsum dewatering building, FGD control room building, peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / slurry to a local pit (of 2 Cu. M. capacity) near each facility to allow settling. The water from the pit shall overflow into contractor's R.C.C drain, and finally into owner's drain routed alongside the nearby road. In case of Control rooms and M. C. C. buildings Pump houses, etc, water / slurry coming from down comers shall discharge into peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / slurry into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road. Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards and approval of Railway culverts from concern Railway authorities.		
4.02.00	Internal and external water supply, drainage etc. The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc. as required and as described here or elsewhere in the specifications.		
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	The scope for service water supply and dust control water supply shall be as described elsewhere in the specifications. For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be used. All facility buildings shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth all around the periphery. All drains excepting the peripheral drains around facility building shall be of R. C. C. construction. Drains shall have removable steel grating cover and shall be provided with edge protection angles. The scope for foul water from toilets shall include layout and laying of sewers up to the Employer's main sewer line for sewerage system together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers within the building and from the building to the Employer's sewer line. For rain water down comer and those to be used for conveying water / slurry generated from cleaning of buildings floors, Galvanised MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be used for MCC buildings, penthouse, control rooms, ball mill building, gypsum dewatering building, storage sheds. Galvanising shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 400 gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629. All rain water down comers shall be provided with roof drain heads and complete with shoes bends, junctions, sockets, adapters, brackets and finished with anti corrosive painting over a coat or primer. For design of building drainage system IS: 1742 shall be followed. For sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints. For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided. ~~For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch.~~		
5.00.00	COLOUR COATED AND OTHER SHEETING WORK		
5.01.00	Material		
	a) Wall Cladding & Roofing Material		
	Troughed permanently colour coated sheet of approved shade and colour shall be		
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5.02.00	i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254. b) Metal Deck Roof Material Troughed permanently colour coated metal decking sheets shall be i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 ii) or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 iii) or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275. Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254 can also be used for metal decking. Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided.		
	Colour Coating Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 4 of AS/NZ2728.		
	Design Criteria For wall cladding insulated / uninsulated sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm.		
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5.04.00	For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. For metal deck sheets used for roofing (with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition.			
	Fasteners Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self-drilling special coated fasteners confirming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location. Shear anchor studs shall also be provided through troughed permanently colour coated metal decking sheets metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams. The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet. The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet. Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.			
5.05.00	Miscellaneous Details To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing.			
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5.06.00	Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners. Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277 Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer. All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer. Pre-Fabricated Insulated Metal Sandwich Panels For structures where Pre-Fabricated Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently colour coated sheet & bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150. Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254. Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron (nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade.		
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5.07.00	Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below. The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site. Polycarbonate Sheets The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points & pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details			
	6.00.00	Roof Details		
	6.01.00	Roof slab shall be minimum 150 mm thick(above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.		
	6.02.00	900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs of all buildings. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings.		
	6.03.00	Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet.		
6.04.00	Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster.			
6.05.00	Roofs of all control rooms, M. C. C. rooms, penthouse etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as follows:			
6.06.00	1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat. 2) Application of high solid content liquid applied urethane based elastomeric water proofing membrane, over the primer coat, to give uniform joint less dry film thickness of minimum 1.5 mm (as per ASTM C 836 and C 898). 3) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1: 100. This gradient shall be provided by screed concrete M-15 (using 12.5 mm coarse aggregate) and / or cement mortar (1: 4) over the elastomeric water proofing membrane with 25mm thick cement mortar (1:4) topping. 4) Wearing course at top, shall consist of 25 mm thick P. C. C. (M-15) cast in panels of maximum 1.2 x 1.2 m size and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealing compound / elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS : 13801 for a width of 1000 mm in place of P. C. C.			
	For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1:100. This gradient can be provided either in structure or subsequently by			
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6.07.00 6.08.00 6.09.00 6.10.00 7.00.00	screed concrete M-15 (using 12.5 mm coarse aggregate) and/ or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface. Medium class galvanised mild steel pipes conforming to IS: 1239/ IS: 3589 with welded joints shall be provided for rain water down comers to drain off rain water from the roof. These shall be suitably concealed with masonry work, to match with the exterior finish. The number and size of down comers shall be governed by IS: 1742 and IS: 2527. RCC roof shall be provided with 45 x 45 cm size Khurras having minimum thickness of 30 mm with M-15 concrete over PVC sheet of 1mx1mx400micron and finished with 12 mm thick cement sand plaster 1:3. Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through RCC staircase, and roof access to all other buildings all shall be through cage ladder as per requirement. Fillets at junction of roof and vertical walls shall be provided with cast - in - situ cement concrete (M-15) nominal mix followed by 12 mm thick 1:4 cement sand plaster. The rainwater down comers shall be provided with suitable C.I. grating at inlet point. RCC Floors, Paving & Grade Slab details The floor slabs shall be minimum 150 mm thick(above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification. Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates suitably. Chequered plates shall be fixed by staggered welding of suitable size. Floors of trenches shall have integral finish to concrete base. Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided. R. C. C. floors (where no brick masonry walls are provided) shall be provided with handrails all along the periphery. RCC paving of minimum 150 mm thick with M25 grade concrete, over an under bed as specified herein shall be provided for areas mentioned below. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick for normal duty paving and 400mm
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	compacted thick for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. For normal duty paving, reinforcement of the RCC paving shall consist of minimum 8mm dia bars @ 200 mm c / c in both directions at the centre of the slab. For heavy duty paving/ passage, reinforcement of the RCC paving shall consist of minimum 10mm dia bars @ 200 mm c / c in both directions at the centre of the slab. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification. Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the equipment lay down area, unloading & maintenance area with 50 mm thick metallic hardener topping. Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving. All facility buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection. Further, heavy duty paving shall be provided for passages connecting the outer periphery road to have access to the various facilities/buildings. Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level. Suitable open RCC drains shall be provided to dispose off storm water drain. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD block to sewage pump house. GRADE SLAB OF BUILDINGS AT GROUND FLOOR In buildings, the grade slab shall consist of 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm dia. bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at unloading & maintenance area, stone soiling of minimum 400mm thick and grade slab with minimum 10mm dia bars @ 200 mm c/c at top and bottom in both directions shall be provided. Further, top surface of grade slabs shall be finished with 50mm thick metallic hardener topping.		
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8.00.00	Brickwork and allied masonry works		
	All brick walls shall be non - load bearing in-filled panel walls.		
	All brickwork shall be designed as per Indian Standards and shall be plastered on both faces. All external walls shall be minimum one brick thick in 1: 6 cement: sand mortar. Brick walls shall be provided with 12 mm and 18 mm thick 1: 6 cement: sand plaster on smooth and rough face of the brick work respectively.		
	Bricks to be used in brickwork shall be of minimum Class designation 50.		
	Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be suitably encased with plaster or 1: 2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness.		
9.00.00	Parapets, chajjas, windows and door heads, architectural faces, fins etc. shall be provided with drip course in 1 : 4 cement sand mortar.		
	50 mm thick Damp proof course shall be provided at plinth level for all brick wall.		
	All R. C. C. ceilings shall be rendered smooth and finished with whitewash unless otherwise specified. Ceiling of control rooms, M. C. C. rooms (except areas provided with false ceiling) shall be provided with 6 mm thick plaster.		
	Earthing Mat		
	40 mm Dia MS Rods as earthing mat, placed at a distance of 1.0M away and at depths between 0.60M and 1.00M shall be supplied and laid all around the periphery of buildings, structures, and outdoor equipment, as per the approved drawings. Risers of 40 mm Dia MS Rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Contractor, as per the approved drawings. Risers shall be laid up to a height of 300 mm above the local Ground level, at each of the columns of the buildings on outside of the buildings, and minimum 2 (Two) numbers for structures and outdoor equipment. The contractor also supply and lay necessary number of 3.0 M deep vertical 40 mm Dia MS Rods Earthing electrodes and connecting them to the Earthing mat, as per the approved drawings and the supplying and laying of 40 mm Dia MS Rods for connecting the Contractor's earthing mat with the Employer's earthing mat separately at two locations.		
10.00.00	SITE LEVELLING		
	Site leveling of gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing. Bidder shall deploy adequate number of experienced site leveling contracting agency(s) with requisite earth moving and compacting equipment to complete the work as per schedule.		
Bidder shall carry out the topographical survey before he commences detailed design and site leveling. This survey shall cover the entire FGD area including gypsum			
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	storage ,gypsum handling area , lime storage area ,gypsum dewatering area , truck hopper area, limestone grinding and slurry storage area in Bidder's scope of work. Based on field observations the contractor shall prepare and submit for Owners review the survey maps of the surveyed sited on suitable scale, indicating grid lines, contour lines and demarcating all permanent features like roads, railways, waterways, buildings, power lines, natural streams, trees etc. For each area two sets of survey maps shall be prepared and submitted, one showing the spot levels and contours with grid lines and the other showing the grid lines, contours and permanent features Since the construction of roads and drains for the FGD area including gypsum storage ,gypsum handling area , lime storage area ,gypsum dewatering area , truck hopper area, limestone grinding and slurry storage area is included in the scope of Bidder, it shall be the responsibility of the Bidder to ensure that these facilities are also constructed along with site leveling works. Bidder shall ensure that road access and drainage facilities for each block is available when site leveling in that block is completed. Unless otherwise instructed by the Engineers, all roads and drains within a block shall be constructed by the bidder within a month from the date of completion of site leveling of that block. The specified formation level(s) shall be achieved either by excavation where the existing ground levels are higher than the specified formation level or by raising by controlled filling with borrowed earth where the existing ground levels are lower than the specified level All materials arising out of site clearance and excavation shall be the property of owner. They shall be dealt with in the manner specified by the Engineer. Earth / boulders / rock etc. excavated and useful portion (serviceable materials) of trees cut shall be stacked at suitable places within Owner's acquired land for the plant including the reservoir and the ash disposal area in a manner as directed by the engineer. Woods, branches, trunks of trees shall be termed as serviceable material. Other materials like twigs, leaves, roots, vegetable and organic matters etc. shall be termed as unserviceable material and shall be sorted out from the serviceable materials before disposal. They shall be cleared from the area and disposed off at places within Owner's acquired land for the plant including the reservoir and the ash disposal area in a manner as directed by the engineer. If the excavated material is suitable and accepted by the Engineer as fill material, the same can be used for filling in other areas where raising by filling is required. Otherwise the same shall be taken and stacked at places(s) within the plant boundary as directed by the Engineer. Filling with rock shall be done only after the written permission of the Engineer in the following manner: Filling with rock shall be done only in areas identified for laydown and preassembly . Original ground after removal of all organic and vegetable matters shall be consolidated by rolling as directed by the engineer subject to a minimum of six passes of 8-10 tonnes roller.		
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	- Excavated rock shall be laid (on original ground or after filling 300 mm thick layers of soil as specified), in layers not exceeding 1000 mm and rolled with with vibratory roller (10-15 tonnes static weight) with minimum six passes. - Over the compacted layer of rock, soil shall be filled in horizontal layers not exceeding 300mm in compacted thickness. The soil shall be compacted as specified elsewhere. - It shall be ensured that the top soil layer is in minimum 3 layers of 300 mm each. To achieve this the thickness and number of rockfill layers below can be suitably adjusted. Contour map and spot levels of the area based on the preliminary survey carried out by Owner is enclosed for the purpose of guidance of Bidder. However, Owner does not lake any responsibility about the accuracy of the survey details furnished and any variation of the said data shall not constitute a valid reason for changing the terms and conditions of the contract. Bidder is requested to carry out his independent assessment of the existing ground levels before furnishing his. bid Detailed survey shall be carried out by Bidder after award of work and all findings as stated earlier shall be submitted for Owner's review. Before commencement of cutting/filling, all organic and vegetable matters like grass. Plants shrubs bushes, weeds, trees (with girth less than 30 cm measured at height of 1m above ground level) etc. in the areas to be filled, shall be completely removed along with their roots and disposed off. .It shall also be ensured that the area to be filled is clear of any water, slush etc. Original ground shall be compacted by rolling as directed by the Engineer subject to a minimum of six passes of 8 to 10 tonne roller The earth shall then be spread in horizontal layers not exceeding 300 mm in compacted thickness. Each layer shall be watered and compacted with proper moisture content and with such equipment as may by required to obtain a compaction of 95% or more of Standard Proctor's maximum dry density. The moisture content of the fill material shall be controlled to obtain near optimum moisture content during compaction. The fill material shall be tested for determining optimum moisture content and maximum dry density by Standard Proctor Test as per IS : 2720 (Part-VII). The fill material shall also be tested for determining moisture content before compaction as per IS:2720 (Part-II) For each of the above tests, one sample for every 10,000 cubic metre of fill material shall be tested. Additional samples shall be tested, whenever there is a change in the source or type of fill material. The compacted soil shall be tested for its dry density as per IS2720 (Part-XXIX) or Part-XXVIII). Samples shall be taken at the rate of one sample for every 10,000 sq.m. area for each compacted layer. In addition random checks shall be carried out in compacted soils by means of Proctor needle penetration. Bidder shall submit to the Engineer, the test results immediately after completion of the tests. A sample shall be deemed to have passed the test when the in-situ dry density is equal to or more than the specified percentage of maximum dry density. If a sample taken from a layer fails to pass the test, the layer shall be further compacted till two samples		
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	taken and tested from this layer pass without any negative deviation. Only after this. spreading of further layers shall be taken up. Before start of filling, the Bidder shall submit to the Owner his proposal for the methodology to be adopted for compaction for each type of fill material. The Bidder shall also carry out compaction trials to establish the proposed methodology. The Bidder shall start the compaction work only after approval of the methodology by the Owner The surface of the cut/filled up areas after reaching final level shall be dressed to the required levels and slopes. The difference in levels shall not be more than +/- 10cm locally. The borrow areas outside the overall plant boundary limits for obtaining suitable fill material which is required over and above the earth available after cutting high grounds within the plant area, for site levelling shall be arranged by the Bidder himself and all expenses in respect of royalties, taxes, duties, etc. for borrow areas/fill material shall be borne by him. He shall also obtain and submit to the Owner the necessary clearances/permission from the concerned authorities for the borrow areas/fill material. Material suitable for filling shall be loaded and transported to the filling site by the Bidder. Any coarse grained or fine grained low plastic soil, free from shingle, salts, organic matter, sod or any other foreign substances, may be used for filling. The Bidder shall test the fill material to establish its suitability and submit its results to the Owner. Fill material shall be approved by the Owner. The following types of materials shall not be used for filling: a) Material from swamps, marshes and bogs. b) Expansive clays c) Peat, logs, stumps, sod and perishable materials. d) Materials susceptible to combustion e) Any material or industrial and domestic produce which will adversely affect other materials in the work. f) Materials from prohibited areas Bidder shall include in his offer any extra filling that may be required on account of subsidence of the original ground due to overburden of filling above and/or compaction works for site levelling.		
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11.00.00	After levelling, the contractor shall establish concrete pillars at the intersection points of the grid lines for future reference. These pillars shall project at least 450 mm above the formation level and shall be labelled permanently with their respective coordinates and reduced levels. Filling upto the specified formation level shall extend at least 2.0m beyond the outside face of boundary wall/fence. Thereafter, it shall be finished at a suitable slope (not steeper than 1 Vertical:2 Horizontal) and provided with good quality dry stone pitching minimum 300mm thick for slope upto level difference of 3m. If the level difference is more than 3m, the stone pitching shall be provided with RCC bands with suitable design and benching. FENCING Fencing with toe wall and steel gates shall be provided around the gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas . Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. All Fence posts shall be of 75 x 75 x 6 MS angles spaced at 2.5 m c/c distance. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions. Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 2. 4) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing.			
	12.00.00	ROADS All roads shall be of rigid pavements unless otherwise specified. The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. Detailed plate load tests to determine the modulus of sub grade reaction “K” shall be carried out as per the procedure outlined in IS: 1888. The design traffic load shall be a minimum value of 4 million standard axles. The road shall be designed for 30 years of life and considering a minimum traffic growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab. The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standards. IRC: 58 shall be followed for the pavement design and IRC: 15 shall be followed for the construction of the concrete pavement.		
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13.00.00	The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete. The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level. The sub grade under all roads and its shoulders shall be compacted to achieve 95 per cent or more of Standard Proctor’s Density MDD using mechanical means. Cutting / extending / rerouting / remaking of existing roads including associated works to maintain continuity of road system / network shall also be carried out. All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed. Unless otherwise specified, all roads shall be double lane roads.		
	GATE ALONG BOUNDARY WALL: The gate shall be complete with fabricated hinges, MS aldrops with locking arrangement, tempered steel pivot, guide track of MS tee, bronze aluminum ball bearing, castor wheel etc. All gates shall be given anti-corrosive treatment in three coats. The structural steel shall confirm to IS: 2062 (latest) and all other relevant IS codes. Beside the each gate one room of size not less than 3m X 3m shall be provided for security guards. The room shall be made of brick/ RCC and with RCC roof. In addition to the room, one toilet block shall also be provided.		
14.00.00	LIME & GYPSUM HANDLING AND ASSOCIATED BUILDINGS STORM WATER DRAINAGE SYSTEM Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. All RCC drains shall be either RCC Cast-in-Situ or RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains. The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 150mm or as per design considerations whichever is higher for drains upto depth of 1m from formation level. For depth of drain more than 1m from formation level, the thickness of side walls and bottom slab		
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15.00.00	of RCC drains shall be minimum 200mm or as per design considerations whichever is higher. The drains shall be provided on both sides of roads .These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings. All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating. The invert levels of the in-plant and plant peripheral drains shall be kept such that water can be discharged by gravity to the main / trunk drains under all conditions. The invert levels of the drains shall be decided in such a way that the water can easily be discharged to the natural water bodies above the high flood.		
	SEWERAGE SYSTEM The connection of sewer pipe line for the associated buildings of FGD and Lime and gypsum handling area to nearest owner’s sewage network is in bidder’s scope. Cement concrete pipes of class NP-3 as per IS:458 shall be used below ground level for sewage disposal in all areas . However, for pressure pipes and under roads spun C.I. pipes conforming to IS:1536 of required class shall be used. RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS:4111. Sewage pump house shall be provided as per IS:4111.		
	LOADING		
16.01.00	For consideration of loads on structures IS : 875 - ‘Code of practice for structural safety of buildings’ shall be followed. In addition to the dead load, live load, equipment load (including impact / vibration). Temperature loads etc. various loading conditions arising due to operation and maintenance of equipment shall be considered in the design. The structure and equipment shall also be designed for seismic loads as per the “Criteria for Earthquake Resistant Design of Structures and equipment” and the “Criteria for Wind Resistant Design of Structures and equipment” specified in the “Project Information section” of technical specification. Wind and seismic forces shall not be considered to act simultaneously. The following minimum live loads shall be adopted for the design of various structures. If actual expected load is more than the specified load, then actual load is to be considered.		
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	a) Roofs 150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs. In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs & 75 Kgs. / sq. m. on inclined roofs shall also be considered. b) R. C. C. floors 500 Kgs. / Sq. M. c) Stair and balconies 500 Kgs. / Sq. M. d) Toilet rooms 200 Kgs. / Sq. M. e) Chequered plate floors 400 Kgs. / Sq. M. f) Walkways (including walkways in conveyor galleries) 300 Kgs. / Sq. M. g) Conveyor galleries In addition to the live loads, loads due to cable trays, fire fighting / service water pipes shall also be considered @ 125 Kgs. / m (minimum) on each of the longitudinal girder. Roof-truss members are to be checked for supporting fire fighting pipes/ Service water pipes. h) Road Culverts and its allied structures including R. C. C. pipe crossing & road crossing of trenches. For class 'AA' loading and checked for class A loading as per IRC standard. i) Channels / trenches In addition to earth pressure and water pressure, etc. additional earth pressure due to surcharge of 2T / Sq. M. shall also be considered for design. j) Covers for trenches / channels Covers for channels & trenches, shall be designed for a live load of 0.4T Sq. M. and loading as mentioned under clause in trenches, whichever is critical.		
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16.02.00	k) Sumps and underground structures	tanks and basement	other type
	In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge due to Railway loading whichever is critical for Railway load bearing structures etc.) and sub - soil water pressure etc. These are also to be designed for the following conditions :		
	i) Water / liquid inside and no earth outside (applicable only to such structures which are liable to be filled up with water or any liquid).		
	ii) Earth with surcharge outside and no water / liquid inside		
	iii) For underground (basement) structures protection against buoyancy during execution and after execution shall be ensured without superimposed loadings with minimum factor of safety of 1.2 against buoyancy.		
16.02.00	If the erection load is higher than the specified live loads on any floor or part thereof, then the erection loads are to be considered for the design.		
	Permissible increase in stresses of materials and bearing pressure of soil due to wind load or seismic load shall be as per relevant I. R. S. and I. S. code.		
16.02.00	Crane load		
16.03.00	For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS:875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously.		
	Temperature load		
17.00.00	For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.		
	Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.		
17.00.00	DESIGN CRITERIA		
17.01.00	The design of all R. C. C. structures shall be carried out as per 'code of practice for plain and reinforced concrete for general building construction', IS : 456 (latest).		
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17.01.00	Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) and other relevant IS standards.		
17.02.00	Minimum size of the angle section to be used as structural members shall be 50 X 50 X 6. Minimum weld size shall be 6 mm. Connections shall be designed for 70 % of shear capacity of the member or the actual shear force, whichever is higher. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. Minimum grade of steel & thickness of Tubular/Hollow sections shall be Yst 240 Mpa & 4.0mm respectively		
17.03.00	The building shall conform to local bye - laws, rules and regulations for industrial buildings and also B. I. S. publications, SP 32 and 41.		
17.04.00	Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports.		
17.05.00	Stresses for all structures shall be checked for the higher of the forces obtained from gust factor method and the peak wind speed method.		
17.06.00	Horizontal bracing system shall be provided at floor levels around the openings.		
17.07.00	Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement.		
17.08.00	For design of liquid retaining structures, IS : 3370 (Part - I to IV) (latest) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. For design of R. C. C. pipes for culverts, latest editions of IS : 458, IS : 783 should be followed.		
17.09.00	For design of all underground structures / foundations, ground water table shall be assumed at the formation level (i. e. the adjoining ground level). For all underground structures like tunnel, underground transfer point and underground hopper etc. crack width shall be limited to 0.2mm.		
17.10.00	Design of masonry walls shall be made as per IS : 1905.		
17.11.00	Civil task drawing indicating various equipment loading and supporting arrangement and floor loads to be submitted along with the design calculation.		
17.12.00	Minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456.		
17.13.00	Foundations for all tanks shall be designed for as per IS: 803.		
17.14.00	Footings shall be so proportioned to as to minimise the differential settlement.		
17.15.00	All gallery supporting trestles shall be so proportioned that the transverse deflection of gallery due to wind / seismic load should not exceed trestle height / 1000 as stipulated in IS: 11592. This deflection condition shall be strictly followed. Peak wind speed method shall be considered for checking the transverse deflection.		
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17.16.00	The crusher and transfer house structures shall be so designed that transverse deflection at places where conveyor galleries meet, should be equal to the respective transverse deflection of conveyor supporting trestles.											
17.17.00	Deflection criteria The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following: <table><tr><th>Sl. No.</th><th>Description</th><th>Maximum value of</th></tr><tr><td>1.</td><td>For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)</td><td>Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)</td></tr><tr><td>2.</td><td>For other Buildings</td><td>Height/325</td></tr></table>			Sl. No.	Description	Maximum value of	1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)	2.	For other Buildings	Height/325
Sl. No.	Description	Maximum value of										
1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)										
2.	For other Buildings	Height/325										
17.18.00	a) Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325. b) The allowable deflection for beams directly supporting drive machinery shall be restricted to span/500 unless specified otherwise in this specification. c) The deflection for manually operated cranes & monorail supporting beams shall not exceed span/500. For electric overhead cranes : 1) upto 50 t capacity : span/750 2) over 50 t capacity : span/1000 d) The vertical deflection of metal deck sheet for roofing and side cladding shall be limited to span/250 e) The permissible vertical deflection for beams supporting drive machinery shall be restricted to span / 500 and for other beams it shall be within span / 325. f) Permissible deflection for all purlins, cladding runners, roofing/cladding sheets and grating / chequered plates shall be span/250. However, the maximum vertical deflection of Grating/ Chequered plate shall be limited to 6 mm.											
17.19.00	a) Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part). b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.											
17.20.00	a) The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever											
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17.21.00	specifically mentioned in this specification.			
	b)	For design and construction of steel-concrete composite members, IS: 11384 shall be followed.		
	c)	For reinforcement detailing, IS: 5525 and SP: 34 shall be followed.		
	d)	Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.		
17.22.00	a)	All RCC liquid retaining/conveying shall be designed by working stress method as outlined in clause no. 4.5 of IS 3370 (Part-2) 2009 unless specified other wise.		
	b)	Water proofing treatment shall be provided for liquid retaining/ carrying structures and basement type structures (requiring dry working condition). Dense and durable concrete with water cement ratio not more than 0.45 shall be used. Plasticiser /super-plasticiser cum water proofing compound shall be added to the concrete. All the construction/expansion joints shall be provided with PVC water bar and/or chemical injection grouting as per IS:6494. As applicable internal/external surface of such structures shall be provided with acrylic based polymer modified cementitious composite coating system for critical structures. For liquid carrying/retaining structures, minimum two coats of such coating shall be applied. For external application wherever the surface is in contact with the earth, fine silica/quartz sand of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5 mm. For non critical structures minimum two coats of bitumen grade 85/25 as per IS:702, mixed with 1% of anti-stripping compound meeting the requirement of IS:6241, shall be applied. The total application of bitumen shall not be less than 1.7 kg/sq.m.		
		Bidder shall submit a comprehensive scheme for water proofing treatment based on above or any other alternative scheme, internationally accepted for Employer's approval prior to commencement of work.		
	c)	All liquid retaining/carrying structures shall be tested for water tightness as per the provisions of IS: 3370 and IS: 6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles.		
17.23.00	For design of all underground structures, foundations, etc. ground water table shall be assumed at the finished ground level unless specified otherwise.			
17.24.00	Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest or co-efficient of active earth pressure, whichever is applicable, depending upon the structural configuration. However, for the design of substructure of pump houses, earth pressure at rest shall be considered. Co-efficient of passive earth pressure shall be used only in design of shear keys for stability against sliding.			
17.24.00	a)	Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures containing liquid		
	i)	Water pressure from inside and no outside pressure, like earth pressure, ground water and surcharge pressure (applicable only to structures, which are liable to be filled up with water or any other liquid.)		
	ii)	Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.		
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17.25.00 18.00.00	iii) Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves/flap valves, etc., shall not be permitted to counter the buoyancy unless specified otherwise. iv) Base slab and piers of the pump houses shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level. b) Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance. c) All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads. Design of Block Foundation a) Block foundation resting on soil shall be analyzed using elastic half space theory. In case the foundation is supported over piles, Novak's approximation shall be used for determining the spring constant and damping ratio of pile groups. The mass of the RCC block shall be at least three times the mass of machine. Free vibration analysis of the foundation shall be carried out to evaluate the natural frequencies. The fundamental natural frequency shall be kept at least 20% away from the operating frequency (speed). Forced vibration analysis shall be carried out if the dynamic forces are made available by the machine supplier in which case the amplitude limits stipulated by the machine supplier and ISO 10816, whichever is lower, shall be satisfied. Reinforcement design shall be done by working stress method as per IS:456-2000 and IS:2974 (Part-IV). b) For the foundations supporting minor rotating equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably. Coating on RCC water retaining structures (other than drinking water) Epoxy phenolic coating shall be applied on internal surfaces of the RCC water retaining structures, as per details specified below: All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% $\pm$2%) of minimum 50 micron DFT. Surface to be coated shall be absolutely dry, clean and dust free. Sealer coat shall be followed with the application of epoxy phenolic coating (solid by volume minimum 63%) of minimum 400 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.
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19.00.00 20.00.00 20.01.00 20.02.00 20.03.00 20.04.00 20.05.00 20.06.00 20.07.00 20.08.00	Coating on RCC water retaining structures (drinking water) Internal surfaces of RCC water retaining structures shall be provided with minimum 400 micron Food grade epoxy coating complying to FDA Title 21, Part 175.300. Surface to be coated shall be absolutely dry, clean and dust free Fabrication All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections. Chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. For Chimney flue liners, to prevent flue gas leakages, the applicable field joints shall necessarily be welded. Electrodes The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium /high tensile steel and for mild steel plate thickness above 20 mm. All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use. Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage. Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing. Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated. The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started. Edge Preparation for Welding Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded. Pre Heating and Post Heating Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature
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	may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose. Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to atleast 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat and this temperature shall be maintained as minimum inter-pass temperature welding is in progress. TABLE - 1 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MILD STEEL <table><thead><tr><th rowspan="2">Thickness of thicker part at Point of welding</th><th colspan="2">Welding Using</th></tr><tr><th>Low hydrogen electrode or submerged arc welding</th><th>Other than low hydrogen electrode</th></tr></thead><tbody><tr><td>Upto and including 20mm</td><td>None</td><td>None</td></tr><tr><td>Over 20mm and up to and including 40mm</td><td>20°C</td><td>Not allowed</td></tr><tr><td>Over 40mm and up to and including 63mm</td><td>66°C</td><td>Not allowed</td></tr><tr><td>Over 63mm</td><td>110°C</td><td>Not allowed</td></tr></tbody></table> Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure. TABLE - 2 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MEDIUM / HIGH TENSILE STEEL <table><thead><tr><th rowspan="2">Thickness of thicker part at Point of welding</th><th colspan="2">Welding Using</th></tr><tr><th>Low hydrogen electrode or submerged arc welding</th><th>Other than low hydrogen electrode</th></tr></thead><tbody><tr><td>Upto and including 20mm</td><td>None</td><td>Not Allowed</td></tr><tr><td>Over 20mm</td><td>120oC - 140°C</td><td>Not Allowed</td></tr></tbody></table> Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.	Thickness of thicker part at Point of welding	Welding Using		Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode	Upto and including 20mm	None	None	Over 20mm and up to and including 40mm	20°C	Not allowed	Over 40mm and up to and including 63mm	66°C	Not allowed	Over 63mm	110°C	Not allowed	Thickness of thicker part at Point of welding	Welding Using		Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode	Upto and including 20mm	None	Not Allowed	Over 20mm	120oC - 140°C	Not Allowed
Thickness of thicker part at Point of welding	Welding Using																												
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Upto and including 20mm	None	Not Allowed																											
Over 20mm	120oC - 140°C	Not Allowed																											
20.09.00	Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the																												

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	surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.		
20.10.00	Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.		
20.11.00	All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600oC and rate of application shall be 200oC per hour.		
20.12.00	The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.		
21.00.00	Paving, Drainage and Sewage RCC paving of minimum 150 mm thick with M25 grade concrete, over an underbed as specified herein shall be provided. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick for normal duty paving with 63 mm and down aggregate with interstices filled with selected moorum followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification. 2.5 m wide paving with metallic hardener around periphery of all sumps and underground tanks shall be provided. Suitable drains shall be provided to dispose off storm water as well as floor wash of the FGD area block. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD area to the nearest available manhole of the owner. The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8 m/sec. respectively. However, minimum velocity of 0.6m/sec. for self-cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The open drains shall be open rectangular drains of RCC unless required otherwise due to functional requirement. RC box culverts shall be provided at rail, road or other crossings. Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec.		
22.00.00	Statutory Requirements Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules at Tariff Advisory Committee. Water Act for pollution control, Explosives Act, etc.		
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23.00.00	Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkways along the crane - girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest room etc. Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tariff Advisory Committee. Statutory clearances and norms of State Pollution Control Board shall be followed. Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking up the construction work.		
	INSPECTION, TESTING AND QUALITY CONTROL Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding), piling, sheeting, etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used. The Bidder shall submit and finalise a detailed field Quality Assurance Programme before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer. The Bidder shall furnish the test certificate from the manufacturer's of various materials to be used in the construction.		
24.00.00	CONCRETE All R. C. C. works to the done under this specification, unless specified otherwise shall be design mix concrete. Minimum grade of concrete for various structures shall be as follows: a) M25 - For all underground / sub-structural/ super-structure R. C. C. work. b) M30- For Block Foundation c) M35- For spring supported RCC deck and rail load bearing structure (if applicable). Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations. For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix. Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned.		
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25.00.00	Excavation, Backfilling, Disposal and Stacking of materials Details		
25.01.00	Excavation in Soil Excavation for foundation shall be to the bottom of lean concrete and as shown on drawing or as directed by the Engineer. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels by error it shall be brought back to the specified level by filling with concrete of nominal mix 1 : 3 : 6 (cement: coarse sand: 40 mm down aggregates), as directed by the Engineer. The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Cofferdams, sheet piling, shoring, bracing to maintain suitable slopes, draining etc. shall be provided and installed by the contractor, to the satisfaction of the Engineer. Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, Backfilling is completed. The Contractor shall remove all slush/muck from the excavated areas to keep the work area dry. The Contractor, if required, shall employ sludge pumps, for this purpose. For other details, excavation clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification, are to be referred.		
25.02.00	Excavation in Rock For the work of excavation in rock, Contractor shall engage specialised agency having experience of excavation in rock involving wedging and blasting. The agency shall be subject to approval of Engineer and the Contractor shall furnish details of relevant experience in support while seeking approval for the agency. Blasting shall be resorted to only with the written permission of the Engineer. All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards etc. pertaining to the acquisition, transport, storage, handling and use of explosives etc. shall be strictly followed. The contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per Explosives Act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive materials. Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, backfilling is completed. For other details for excavation in rock, clauses as given at		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
25.03.00	“Foundation system and Geotechnical Data Chapter” given at “Project Information section” of Technical specification, are to be referred.		
	Backfilling, Disposal and Stacking of materials		
	Backfilled earth shall be compacted as per “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification.		
	However, the backfill under the rail lines and roads shall be compacted to minimum 95 % of the standard proctor density at OMC unless otherwise stated by rail Authorities.		
	The contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer.		
	The disposal / stacking areas for excavated materials shall be indicated by the Engineer. The carriage of excavated materials shall be done by the methods mentioned below:		
	The excavated materials shall be carried beyond the initial lead of 50 m but upto 500 m by manual / animal labour or by mechanical means. If directed by the Engineer this material shall be used directly for filling purposes.		
	For leads exceeding 500 m the Contractor shall transport the excavated materials by mechanical means only and as directed by the Engineer. The Contractor may be allowed to carry materials through Kuccha roads. Providing and maintaining of the Kuccha roads shall be the responsibility of the Contractor. The transported material shall be neatly stacked as directed by the Engineer.		
	Some excavated materials required for filling purposes, may have to be carried upto a lead of 500 m and stacked as per instructions of the Engineer. Excavated materials carried beyond 500 m shall normally be for disposal purpose only. Double handling of materials shall be avoided as far as possible. However, depending on site condition excavated materials carried beyond a lead of 500 m may also be required to be brought back for filling purpose.		
	Materials to be used for filling purpose shall be stone, sand or other inorganic materials and they shall be clean and free from shingle, salts, organic matter, large roots and excessive amount of sod, lumps, concrete or any other foreign substances which could harm or impair the strength of the substances in any manner. All clods shall be suitably broken to small pieces. When the material is mostly rock boulders, these shall be broken into pieces not larger than 150 mm size before backfilling and shall be backfilled in layers of 300mm interstices filled with sand. In case of broken rock boulders used for back filling, the top cover shall be with 1.0m thick soil. The layers of rock boulders, interstices filled with sand shall be compacted by plate vibrators. Sand used for filling shall be clean, medium grained and free from impurities. Fines less than 75 microns shall not be more than 20%. In any case, the materials to be used for filling purposes shall have the prior written approval of the Engineer.		
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26.00.00	In case the materials have to be brought from pits / quarries, then it shall be the Contractor's responsibility for identification of such quarry areas, obtaining approval from their use from concerned authorities, excavation / quarrying loading and carriage of such material, unloading and filling at specified locations. The Contractor shall pay any fees, royalties etc. that may have to be paid for utilisation of borrow areas.			
	GALVANISING All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising. Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 (latest edition). The weight of the zinc coating shall be at least 610 Gms. / m² unless noted otherwise.			
27.00.00	CHEMICAL INJECTION GROUTING Minimum, 12 mm dia (NB) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete. For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using percussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes. After the nozzles are fully set, neat cement slurry admixed with water soluble non - shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / cm². Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises. Plasticizing agent shall be added wherever required. The grouting shall be started at very low pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer.			
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28.00.00	POLYMER MODIFIED CEMENTITIOUS COATING		
28.01.00	Materials Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%). Portland cement based dry powder. Clean, fine specially prepared quartz sand approximately 0.6 mm size.		
28.02.00	Mixing The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same.		
28.03.00	Properties of Coating It must adhere to wet surface. It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm. Co - efficient of permeability shall be about 5×10^{-10} Cm / Sec. Water absorption after continuous soaking shall not be more than 1 %. The materials shall be permeable under water vapour. The material shall be resistant to acids and alkalis present in the soil and underground water with normal pH value between 4 and 14. The co - efficient of thermal expansion of the material shall be close to that of concrete.		
28.04.00	Application The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed. (a) For Slurry Mix A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by rubbing down with a soft dry		
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29.01.02	Flooring of tiles / stone shall be fixed with 18 mm thk cement sand mortar 1:4, above PCC under bed (M 20 (with graded aggregate of nominal size 12.5mm) design mix)			
	Flooring of Concrete hardener topping shall be provided above the PCC underbed (M 20 (with graded aggregate of nominal size 12.5mm) design mix).			
29.02.00	Wherever specified Heavy duty ceramic tiles of size 300x300x7 mm thick (minimum) of reputed manufacturer (Kajaria, Orient, Johnson or equivalent) of approved finish shade and colour to be used. Vitrified ceramic tiles wherever specified shall be 600x600 mm with minimum 9.5 mm thickness and of reputed manufacturer (Kajaria, Johnson, Orient or equivalent).			
	Floor finish & skirting:			
	The nominal thickness of floor finish shall be 50 mm.			
	Floors of toilets, pantries / kitchen shall be finished with Heavy duty (grade-5) dust pressed ceramic tiles 300mmx300mm x7 mm thick as per IS:15622, including pointing the joints with white cement mixed with matching pigment, of approved make, size & colour shade.			
	(1) Floors of Office Room, Labs, Control Rooms, RIO Rooms and all other A/c Room shall be finished with Mirror polished Vitrified ceramic tiles (minimum 9.5 mm thk) with 3 mm groove joints as per approved pattern, pointed neatly with 3X4mm stainless epoxy grout SP- 100 of Laticrete or approved equivalent in approved colour to match colour of tile. (2) Suitable supporting arrangement shall be provided with M.S. angles / channels on cable trenches in MCC and Control rooms for mounting Control panels / MCC. (3) In rest of the areas, IPS (Cement concrete flooring) with Concrete hardener topping shall be 12mm thick with ordinary grey cement using uniformly graded, properly treated iron particles shall be provided. (4) Floors and sides of under ground RCC structures like valve pits, trenches and tanks shall have simultaneous (integral) neat cement finish at the time of concreting. (5) The interconnecting walkway between various structures, buildings and facilities shall be finished with 22 mm chequered concrete tiles at top. 1000 mm wide walkway of 22mm thick chequered concrete tiles shall be provided on terrace for maintenance purpose, in all RCC /Metal deck roof buildings. (6) Skirting in general shall be 150mm high, Dado in toilet, kitchen & pantry shall be up to specified height (up to 2200 mm for toilets, up to 600 mm high above counter top in kitchen and pantry area). The dado height shall be measured from finished floor level. Skirting and Dado shall match with the floor finish. (7) Battery Room shall be provided with Acid resistant tile on horizontal and vertical surfaces, at all levels for all type of works, including One coat of bitumen primer followed by 12 mm thick bituminastic layer, 20 mm thick Acid Resistant tiles, 6 mm thick under-bed by potassium silicate mortar, 6 mm thick pointing of joints of tiles with acid/alkali resistant epoxy/furane mortar up			
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	to a depth of 20 mm and bituminastic end sealing. 1200 mm high dado on wall shall be with 12 mm thk Acid resistant tiles of the similar finish and the joints to be finished as per flooring tiles, with the rest of wall height and ceiling finished in chemical resistant paint (chlorinated rubber based). (8) Well polished 18 mm thick Kota stone jointed with neat cement slurry mixed with pigment to match the shade of the stone including rubbing and cleaning, complete, to be provided in entrance area, entrance steps, Entrance area, staircases (tread, riser, landings, skirting).		
29.03.00	Sunken RCC slab shall be provided in false flooring area and toilet, Kitchen and pantry, so as to keep the finished floor level of these areas same as that of the surrounding area.		
29.04.00	Water proofing treatment to be provided on sunken portion of all vertical and horizontal surfaces of depressed portions of all toilets, W.C., kitchen, Pantry and the like consisting of : (i) Ist course of applying cement slurry @ 4.4 kg/sq.m mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface. (ii) IInd course of 20 mm cement plaster 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface. (iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sq.m of area. (iv) IVth course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sq.m).		
29.05.00	Acid / Alkali Resistant Treatment: Acid / alkali resistant lining treatment shall be provided in different areas as follows: Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick A.R. bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable plasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification. The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R.tile layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted. The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron). Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. : The floor shall be provided with one coat of bitumen primer followed		
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	by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 12 mm thk Acid Resistant tiles up to 1.0M high shall also be provided if applicable in case of walls nearby. Alum/Lime Storage area and first floor of Chemical House : One coat of bitumen primer followed by 12mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick underbed of potassium silicate mortar, 6mm thick pointing of joints of tiles with acid /alkali resistant epoxy /furane mortar up to a depth of 20 mm and bitumastic end sealing. Alum solution preparation tank: The wall shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick underbed by potassium silicate mortar, pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer. Basket of Alum solution preparation tank: 5 mm thick epoxy lining over a coat of epoxy primer. Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks. Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns. Lime tank: Two coats of bitumen paint conforming to IS: 9862, with total DFT 150 microns.		
29.06.00	Walls		
29.06.01	All walls shall be non-load bearing infilled panel walls. All external walls shall be minimum one brick thick masonry wall.		
29.06.02	All external and internal walls shall be with minimum one brick masonry (230 or 250 mm) including toilet walls. Toilet partition low height walls shall be minimum half brick masonry.		
29.06.03	For all air conditioned areas/ rooms, wherever metal cladding is envisaged as cladding material, additional brick masonry wall (230mm thick) shall also be provided in addition to metal cladding for effective air conditioning. This brick wall shall be plastered & painted as specified elsewhere in the specification.		
29.06.04	RCC transoms and mullions of size 115x115mm with suitable reinforcement shall be provided wherever necessary to reinforce the brickwork.		
29.06.05	50 mm thick DPC in Cement concrete (M-20) with water proofing compound followed by two layers of bitumen coating 85/ 25 grade as per IS: 702 @ 1.7 kg/ sq.m. shall be provided at plinth level before starting the masonry work.		
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29.06.06	The bricks shall be laid with cement mortar (1:6) for one brick thick walls and (1:4) for half brick thick walls IS: 1905, IS: 2212 and SP -- 20 shall be followed for brick work design and construction.		
29.07.00	Plastering		
29.07.01	External (rough) surface of walls shall be plastered with 18 mm thick cement plaster, consisting first (base) layer of 12 mm thick plaster in cement sand mortar (1:6) and second (finishing) layer of 6 mm thick plaster in cement sand mortar (1:4). The internal (smooth) surface of walls shall have 12 mm thick plaster in cement sand mortar (1:6). All external / internal RCC surfaces including RCC parapet walls shall be provided with minimum 12mm thick plaster in cement sand mortar (1:4) except walls of underground structures like cable trenches / valve pits etc.		
29.07.02	All exposed faces of R.C.C. walls of structures, buildings and facilities shall have minimum 12 mm thick cement sand plaster 1:6.		
29.07.03	All RCC ceilings (except areas provided with false ceilings and cable vault ceiling) shall be provided with 6 mm thick cement sand plaster 1:4.		
29.07.04	All plastering work shall conform to IS: 1661.		
29.08.00	Painting		
29.08.01	All painting on masonry or concrete surface shall preferably be applied by roller. If Applied by brush then same shall be finished off with roller.		
29.08.02	All paints shall be of approved make including chemical resistant chlorinated rubber paint.		
29.08.03	Minimum two finishing coats of paint shall be applied over a coat of primer.		
29.08.04	The thinner shall not be used with textured paint (Sandtex Matt or equivalent) finish.		
29.09.00	Internal Finish		
	All Air conditioned areas shall have 2mm of polymer based water resistant putty (wall putty) to given an even and smooth surface.		
29.09.01	Acrylic emulsion paint shall be as per IS: 5411 (Part - 1). Acrylic distemper shall be as per IS: 428. Air - conditioned areas shall be applied with minimum 2 coats of acrylic emulsion paint. All other areas shall be applied with minimum 2 coats of Acrylic distemper.		
29.09.02	Toilet, Pantry / Kitchen areas shall have dado with Designer ceramic tiles, 300x200mw (matt finish) upto 2.2 m height and shall match with floor finish. Above dado, Acrylic distemper shall be applied.		
29.09.03	Areas coming in contact with chlorine fumes or acid / alkali shall have two coats of acid / alkali resistant chlorinated rubber paint over suitable primer on walls above dado & ceiling. The paint shall be of approved colour shade and make.		
29.10.00	External Wall Finish		
	One pack, ready mix and ready to use, resin / polymer bonded granular textured coating finish of 2.5 mm (natural coloured graded stone chips), of approved colour, and shade for all types of plastered and / or exposed concrete surface, in all kinds of works, at all levels, including preparation of surface, preparation of working drawing,		
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	labour, material, equipment, handling, transportation, mixing, laying, applying finishing, testing, curing, making grooves, scaffolding, staging, etc., all complete, as per specifications, drawings and instructions of the Engineer-in-charge. Toe wall of chain link fencing shall be provided with two coats of Acrylic Smooth Exterior Paint The finish shall be of approved colour shade and make.		
29.11.00	Ceiling Finish		
	Ceiling shall have min. two (2) coats of Acrylic distemper except AC areas & Battery room.		
29.11.01	For painting on concrete, masonry and plastered & surface, IS: 2395 shall be followed. For painting on steel work and ferrous metals, IS: 1477 shall be followed.		
29.11.02	Fire resistant transparent paint (confirming to IS: 162) shall be provided on all wood work, over French police or flat oil paint. French polish shall confirm to IS : 348. Flat oil paint shall confirm to IS: 1237.		
29.12.00	Doors, Windows, Ventilators, Louvers, Rolling Shutters & Glazing		
29.12.01	Adequate Doors, Windows, Louvers and Ventilators shall be provided for proper lighting and ventilation of all buildings. The area of windows shall be at least 10% of the floor area of the respective building. In addition to the above, wherever room height is more than 3.5 m, a band of ventilators of 600 mm height (minimum) shall be provided at the top.		
29.12.02	Unless specified all doors, of air conditioned areas, entrance lobby of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. Windows, ventilators & partitions of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. All doors of toilet, kitchen, pantry & store areas shall be of factory made pre - laminated solid core flush door shutters, as per IS: 2202 (Part-II) with pressed steel door frame. Control room shall have Aluminium glazed door & partitions. All other doors (unless otherwise specified) shall be of steel.		
29.12.03	All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc.		
29.12.04	Wherever functionally required, rolling shutters of suitable size approved by the Owner, with suitable operating arrangement manual/ electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248.		
29.12.05	All windows and ventilators at ground floor level shall be provided with suitable anodised aluminum grill.		
29.12.06	Fire proof doors with panic devices shall be provided at all fire exit points as per the requirements. However minimum Fire rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation.		
29.12.07	Hollow excluded Section of minimum 2 mm wall thickness as manufactured by INDAL, Jindal, Hindalco or equivalent shall be used for all Aluminium doors, windows, ventilators and Partitions.		
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29.12.08	The doors, Windows & ventilators frame shall be of suitable size & thickness for fixing the glazing. The Glazing thickness shall be minimum 6 mm thk clear toughened glass for all glazed doors, windows, ventilators & partitions. Windows in air conditioned areas shall be provided with 24mm thick hermetically sealed composite double glazing.														
29.12.09	Doors and windows on external walls shall be provided with sunshade over the openings with width 600 mm more than the opening width. The projection from the finished face of the wall for sunshade shall generally be 450 mm over window openings, 750 mm over door openings and 900 over Rolling shutters, or as decided and approved by the Engineer.														
29.12.10	Float glass or flat transparent sheet glass shall conform to IS: 2835.														
29.12.11	All glazing work shall conform to IS: 3548.														
29.12.12	Windows in conveyor gallery shall be provided with welded wire fabric of 1.6mm thick wire as per IS: 4948 and 12mm x 30mm mesh size.														
30.00.00	WATER SUPPLY, DRAINAGE AND SANITATION														
30.01.00	Polyethylene water storage tank conforming to IS: 12701 shall be provided (for the use of toilet, pantry and kitchen) over the roof, with adequate capacity depending on the number of users and 8 hours requirement complete with all fittings including float valve, stop cock etc. The capacity of tank shall be calculated minimum 500 liters, per toilet, pantry and kitchen														
30.02.00	Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal piping works for potable water supply.														
30.03.00	Sand C.I. pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.														
30.04.00	The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall be also be followed.														
30.05.00	Each toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of chromium plated brass (fancy type). The common toilet area shall have finished floor level at 15 mm below the finished floor level of surrounding area. Following minimum fittings & fixtures together with associated plumbing works shall be provided as specified below. <table><tr><th>Sl. No.</th><th>Type of Fitting / Fixtures</th><th>Gents Toilet</th></tr><tr><td>i)</td><td>1 no wall mounted coloured glazed vitreous china European water closet with flush valve.</td><td>1 No.</td></tr><tr><td>ii)</td><td>Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures</td><td>1</td></tr><tr><td>iii)</td><td>Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first</td><td>1 No.</td></tr></table>			Sl. No.	Type of Fitting / Fixtures	Gents Toilet	i)	1 no wall mounted coloured glazed vitreous china European water closet with flush valve.	1 No.	ii)	Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures	1	iii)	Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first	1 No.
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		grade polished granite stone	
	iv)	Wall to wall mirror minimum 450 mm high (minimum 6mm thick float glass) including all fittings	1 No.
	v)	Stainless steel Towel Rail 600mm Long x 20 mm dia.	1 No.
	vi)	Stainless steel Liquid soap holder cum dispenser with requisite fittings.	1 No.
	vii)	Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type.	1
	viii)	Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type	1 No.
	One No. drinking water connection with C.P. brass valve for fixing water cooler by Owner.		
	Required plumbing work from Owner's service water terminal point to the service water tank and from tank to the toilet accessories mentioned above.		
	Required plumbing work from Owner's potable water terminal point to the drinking water tank and from tank up to the water coolers.		
30.06.00	Janitor room. Adequate space shall be provided.		
	Provision for installation of water cooler.		
30.06.00	All structures, buildings, facilities, liquid storage tanks shall be provided with peripheral surface brick drains of all around periphery and suitably connected to nearest Owner's drain. Overflow and drains from storage tanks shall be laid to and suitably connected to Owner's open surface drains.		
30.07.00	The sewerage and waste water disposal system shall consist of providing all associated plumbing and underground pipe works together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers, including connection to Owner's nearest main sewer line or as directed by Engineer. If required, R.C.C. septic tank and soak pit of required capacity shall be provided by the Bidder.		
30.08.00	Miscellaneous Architectural Items (a.) In all buildings suitable arrangement with provision of floor traps for draining the water collected from leakage, floor washing, fire fighting etc. shall be provided on all floors which shall be connected to rain water down comers. (b.) Wherever required minimum 1000 high hand railing with 32 NB M.S. pipes medium class as per IS : 1239 shall be provided, with toe & knee rail and toe guard plate, around all floor / roof openings, around periphery of Neutralisation Pit, projections of balconies, walkways, platforms, steel staircase etc. (c.) However for RCC staircases in structures, buildings and facilities, railings with 20 mm square MS bar balustrades with suitable anti corrosive paint of approved colour MS flats for knee & toe guard with 50mm Ø NB MS pipe hand rail at top shall be provided. (d.) All air conditioned areas / common corridors shall be provided with false ceiling constructed from 15 mm mineral Fibre Board in tile form of		
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	600x600mm with supporting system as per manufacture guidelines. 50 mm thick mineral wool insulation (conforming to IS : 8183) shall be provided with as under deck insulation). Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, Air conditioning ducts etc. Minimum headroom below false ceiling shall be 3.0 m. (e.) Under - deck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air - conditioned areas depending upon the functional / air - conditioning requirements. The under - deck insulation shall consist of 50 mm thick mineral wool insulation conforming to IS : 8183 backed with 0.05 mm thick aluminium foil & 24 G x 25 mm mesh wire netting and shall be fixed to ceiling with 24 G wire ties and suitable fixing arrangements. (f.) Parapets, chajjas, window / door heads, architectural facias, fins etc., shall be provided with drip course in cement mortar (1 : 3). (g.) 150mm thick fillets at junction of roof slab / chajja slab and parapet / vertical walls shall be provided with cast - in - situ cement concrete 1 : 2 : 4 nominal mix, followed by 12 mm thick cement sand plaster (1 : 4). (h.) Suitable provision shall be made for fixing of ceiling fans in office areas of different structures, buildings and facilities.		
31.00.00	CORROSION PROTECTION		
31.01.00	GENERAL		
	(a) All Steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of Corrosivity category C3 (durability High) as per ISO 12944. Painting system for steel surfaces embedded in Concrete is given separately. (b) All Painting shall be done as per technical specification. Painting scheme shall be submitted by the bidder for approval of employer. (c) All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance of 1.5 mm shall be kept in thickness(over the design thickness) of structural steel members. d) Painting scheme shall be resubmitted by the Bidder for approval of employer.		
31.02.00	PAINTING OF STEEL SURFACES EMBEDDED IN CONCRETE:		
	a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT). b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.		
31.03.00	PAINTING OF STEEL SURFACES (OTHER THAN THOSE EMBEDDED IN CONCRETE)		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
31.04.00	a) All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00. b) Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer. Notes: 1. For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time. 2. The most frequent problem associated when top coating Primer is bubbling/pin holing especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required. 3. In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required. 4. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/ emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme.		
	COATING FOR MILD STEEL PARTS IN CONTACT WITH WATER. a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 Gms / Sq. M. for galvanised Structures and shall comply with IS: 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS: 2629.		
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	b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS: 3416, unless otherwise specified.		
31.05.00	Gratings All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 610 Gms / Sq. M.		
31.06.00	Hand Railings and Ladders All Mild steel handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736. However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.0.0.		
31.07.00	Sea Worthiness All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness.		
31.08.00	For Reinforced Concrete Work. i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts. ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion. This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc., Bidder shall furnish the details of corrosion protection measures.		
32.00.00	Miscellaneous		
32.01.00	Ordinary form work shall be used in roofs and floor slabs in transfer houses, footings, pedestals, cable trenches, pits etc., Plywood form work shall be used for all over ground exposed work like columns, beams, floors and ceilings in control room and M. C. C. buildings.		
32.02.00	Monorail girders and fixtures shall be provided for monorails at the locations as required and as described elsewhere in these specifications or drawings. Monorail openings in the walls shall be provided with steel frame doors preferably sliding type or otherwise open able inside, access platforms and ladders.		
32.03.00	Steel frame around openings in roof and on external walls for mounting of exhaust fans shall be provided.		
32.04.00	Ready mix non - shrink cementitious grout of reputed manufacturer as approved by the Employer shall be used for grouting of block outs and foundation bolts, underpinning of base plates and machine bases. Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / mm² unless higher strength requirement is specified by the equipment supplier or the grout manufacturers.		
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32.05.00	The bottom of steel in case of cable / pipe galleries and trestles shall be generally 3m above the ground except for rail / road crossing where it shall be 8m above the rail top / road crest/ground. Further in bunker areas it shall be 8 m above the ground.		
32.06.00	Polysulphide Sealing Compound shall be two-part polysulphide sealant and shall be from approved manufacturer, conforming to IS : 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines.		
33.00.00	SHOTCRETING		
33.01.00	General Requirements		
33.01.01	Generally, shotcreting shall be done in accordance with IS : 9012.		
33.01.02	Reinforcement for shotcreting shall be as detailed below, unless specified otherwise. Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting.		
33.01.03	Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied.		
33.01.04	Clear cover to reinforcement mesh shall not be less than 15 mm.		
33.01.05	Minimum thickness of shotcreting shall be 50 mm. for abrasion resistant work and 25 mm for ordinary surface protection work.		
33.02.00	Material Generally, the materials shall be in accordance with aggregates specification given hereunder.		
33.02.01	Fine aggregate shall consist of natural sand or crushed stone from a known source and shall be strong, hard, coarse, sharp, chemically inert, clean and free from any coating. It shall be free from clay, coal or coal residue, organic or any other impurities that may impair the strength or durability of the concrete and shall conform to IS : 383.		
33.02.02	Fine aggregate (Sand) shall be well graded and particles shall range in size within the following limits. The Engineer, may approved the use of any other grading as per requirement or as per IS : 9012.		
33.02.03	The fineness modulus shall be preferably between 2.5 and 3.3. Any other value can be used, with prior approval of the Engineer.		
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33.03.00	Application		
33.03.01	After the placement of reinforcement and / or welded mesh and not more than six hours prior to the application of shotcrete, the surface shall be thoroughly cleaned of all loose materials and dirt. The Contractor shall properly prepare the surfaces, reinforcement and / or welded mesh to receive the shotcrete. Cleaned surfaces shall be wetted not more than hour prior to shotcreting.		
33.03.02	The mix as placed on surface shall be one part cement to three parts approved sand by mass. Cement and sand shall be dry mixed; not water shall be added after mixing and before using in the gun. The quantity of water when added shall be only that which is sufficient to hydrate the cement. For average atmospheric conditions, the water cement ratio for shotcrete in place shall be between 0.35 and 0.5 by mass. Suitable admixture shall be used wherever required.		
33.03.03	A uniform pressure of not less than 3 Kg/cm ² at the nozzle shall be maintained. Necessary adjustments shall be made to ensure this pressure, taking into account the length of hose and height of the place to be shotcreted, above location of the machine.		
33.03.04	The application shall proceed in an upward direction. Beams, stiffeners and intermediate walls, if any, shall be wrapped with wire fabric and completely covered with shotcreting. All rebound shall be removed from the area of application as the work progresses and such rebound material shall not be reused.		
33.03.05	As soon as the freshly shotcreted surface shows the first dry patches, a fine spray of water shall be applied to keep too moist. After the surface has hardened, it shall be kept continuously moist for minimum seven days. If there is extreme heat, especially when accompanied by hot winds, the shotcreted surface, immediately upon completion, shall be covered with burlap or similar covering, which must be kept continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed 38 ^o C during placing of concrete.		
34.00.00	VIBRATION ISOLATION SYSTEM		
	These specifications are meant for the design, supply and erection of vibration isolation system for supporting crushers.		
34.01.00	Supporting Arrangement		
34.01.01	For Crushers:		
	The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an R. C. C. deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building.		
	The part of the structure consisting of the R. C. C. deck, springs and viscous dampers shall hitherto be referred to as “spring supported foundation”. The part of the structure, which is below the spring shall hitherto be called “supporting structure”.		
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34.01.02	~~The Contractor should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the crushers. The vibrations isolation system supplied shall be of a proven make. The Contractor or his sub - contractor who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the contractor or his sub - contractor in such machines should have been working satisfactorily for at least five years.~~		
34.02.00	Scope of Work		
34.02.01	Scope of work shall include the following :		
	(a.) Engineering		
	(1.) Design of the vibration isolation system using steel helical springs and viscous dampers to support an R. C. C. top deck supporting the equipment. This includes the static and dynamic analysis of the vibration isolation system with the R. C. C. top deck and the equipment.		
	(2.) Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc.		
	(3.) Calculation of loads on the structure supporting the springs and viscous dampers, their points of application and the stiffness requirements of the supporting structure.		
	(4.) Drawings showing embedments and their locations and details on the R. C. C. top deck.		
	(5.) Drawings showing blockouts, recesses etc. on the top deck.		
	(6.) Design of the supporting structure, including preparation of detailed drawings and bill of materials.		
	(b.) Supply including packing and transportation to site		
	(1.) Steel helical spring units and viscous dampers, including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads etc.		
	(2.) Frame (s) for pre-stressing of spring elements.		
	(3.) Suitable hydraulic jacks system including electric pumps, high pressure tubes etc. required for the installation, alignment etc. of the spring units, two extra hydraulic jacks, one hand operated pump and spares for the hydraulic jack system as required.		
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	(c.) Erection and Commissioning (1.) Complete erection and commissioning of the vibration isolation system including : (2.) Pre-stressing of spring elements, placing of spring elements in position, checking clearances on the shuttering of the R. C. C. top deck, construction of the supporting structure and the R. C. C. top deck, releasing to pre-stress in spring elements and making final adjustments and alignments after machine installation etc. (3.) The scope of work shall be deemed to include all activities which may not have been explicitly mentioned but are reasonably implied for the successful completion of the work for which these specifications are intended. (4.) This part of the specifications is for vibration isolation system. For the construction of the supporting structure for the crusher and the top deck, the relevant parts of the specification should be referred to. (d.) Documentation (1.) Submission of detailed design calculation, analysis (static and dynamic) and drawings for Employer's acceptance and approval. (2.) Furnishing methodology of providing shuttering and its removal as well as concreting of deck slab, installation of springs and dampers and the sequence of operation. (3.) Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system. (4.) Furnishing a check list for confirming the readiness of the civil fronts for the installation of vibration isolation system and equipment required at each stage installation. (5.) Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply. (6.) Detailed specifications of the vibration isolation system and various items included in the supply and the standard (local or international) to which they conform. (7.) Proposed erection strategy of the entire system.		
34.03.00	~~Design Requirements for Crusher Foundation~~		
34.03.01	~~Dynamic Analysis~~		
	~~Detailed dynamic analysis shall be done for the top deck together with springs and dampers and the natural frequencies and amplitudes of vibration shall be~~		
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	determined. A mathematical model of the top deck shall be formulated with three - dimensional beam / plate finite elements for the purpose of analysis with the spring idealised with vertical and horizontal stiffnesses. The mass of the machine together with that of the top deck shall be considered for the analysis. Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria. Forced response dynamic analysis shall be carried out for the operating condition unbalance forces using a sinusoidal forcing function. Unbalance forces as given by this specifications shall be used for his purpose. The amplitudes shall be checked against the design criteria. The dynamic forces from this analysis shall be used for structural design with a suitable fatigue factor. 34.03.02 Isolation Efficiency The vibration isolation system shall be designed for about 90 % isolation efficiency. 34.03.03 De-coupling A ratio of the least 10 (ten) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in the vertical direction to achieve de-coupling between the two (the stiffness of the spring system being lower). This ensures that dynamic analysis of the supporting structure need not be carried out. 34.03.04 Frequency Criteria The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required. The first bending mode frequency of the top deck shall be at least 20 % above the operating speed. 34.03.05 Unbalance Forces for Crushers Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes. (a.) Balance quality grade Q 40 as per VDI 2060 - 1966. (b.) One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher. (c.) Three hammers broken condition. All the three hammers broken shall be assumed to be from the same suspension bar and located at the non - drive end of the crusher. 34.03.06 Amplitude Criteria for Crushers The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions.
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	1) Operating speed of 750 RPM (a.) 150 microns for an unbalance force arising out of balance quality grade Q 40 as per VDI 2060 - 1966. (b.) 300 microns in case of a one hammer broken condition. (c.) Amplitudes need not be checked for a three hammer broken condition. 2) Operating speed of 450 RPM (a.) 200 microns for an imbalance force arising out of balance quality grade Q-40 as per VDI -2060-1966. (b.) 400 microns in case of a one hammers broken condition. (c.) Amplitude need not be checked for a three hammer broken condition. For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated. The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the R. C. C. deck. The amplitudes shall be checked for the most unfavorable superposition of modes in any direction. However, phase difference between the maximum amplitude occurring in different directions due to the rotating vetor may be considered while superimposing the modes.		
34.03.07	Unbalance force and Amplitude Criteria The unbalance forces and amplitude criteria shall be as per the equipment manufacturer's recommendations or as per VDI 2060/ VDI 2056, whichever is more stringent.		
34.03.08	Transient Resonance Transient resonance, which may occur during the start - up or coasting down condition of the crusher, shall be checked, and the amplitudes in such a condition should not exceed one - and - half times those at operating speed for each design condition.		
34.04.00	Strength Criteria The following criteria shall apply for the design of top deck : (a.) Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design. (b.) Seismic loads shall be assumed to act together with dynamic loads for a one millimeter eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	(c.) Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design. (d.) Working stress method shall be used for the design of R. C. C. deck. In survival condition, 10 % overstressing may be permitted. (e.) The R. C. C. top deck shall be at least of M35 grade of concrete as per IS : 456. (f.) Fatigue need not be considered for the three hammer broken condition. (g.) For calculating unbalance forces, the heaviest hammer (plain or toothed) shall be considered.		
34.05.00	Approval of Designs and Drawings All design calculation, drawings and documents shall be in English. All design calculations and drawings shall be submitted to Employer for approval. However, approval of such designs and drawings shall not relieve the contractor of his responsibility regarding the adequacy of the foundation to carry the design forces.		
34.06.00	Standards Latest revisions of the following Codes shall be used for the design of the crusher foundations. (a.) IS : 456 Code of Practice for Plain and Reinforced concrete. (b.) IS : 2974 (Part IV) Code of Practice for Design and Construction of Machine Foundations (Part IV) for rotary type machine of low frequency. (c.) IS : 1893 (Criteria for Earthquake Resistant Design of Structures). (d.) DIN 4024 Machine Foundations : Flexible supporting structures for machines with rotating masses. (e.) DIN 2089 Helical Compression Springs out of round wire and rod; calculation and Design. (f.) DIN 2096 Helical Compression Springs out of round wire and rod; quality requirements for hot formed compression springs. (g.) VDI 2056 - Criteria for assessing mechanical vibrations of machines. (h.) VDI 2060 - Criteria for assessing the state of balance of rotating rigid bodies.not be permitted to exceed 38°C during placing and curing		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
35.00.00	Packaging and Transportation. All the equipment shall be suitably protected coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials the limitations from the point of view of availability of railway wagon sizes in India should be taken into account. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.		
36.00.00	Plant Life The plant shall be designed for a minimum operating life of 30 years under the conditions of operation. Assurance shall be given that plant components are adequate for this lifetime. If there are any exceptional items of the plant on which an assurance of meeting this clause cannot be given, life of such components and the difficulties associated with them shall be stated.		
37.00.00	PTFE (Poly Tetra Fluoroethylene) Bearing The bearing shall be of reputed make and manufacturer as approved by the Engineer, for required vertical load and end displacement/rotation. PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/sq.cm. In order to prevent cold flow in PTFE surface it shall be rigidly bonded by a special high temperature resistance adhesive to the stainless steel substrata. The stainless steel surface that slides against the PTFE is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of stainless steel plate shall be between 1.0 mm to 1.5 mm.		
38.00.00	TESTS FOR MATERIAL / WORKMANSHIP All tests required for all materials, quality of workmanship or any other tests as desired by the Engineer shall be at contractor's cost.		
39.00.00	MATERIALS		
39.01.00	For Civil, Structural and Architectural works Employer will not supply any material. All materials including cement, reinforcement steel and structural steel, whatsoever required for execution and completion of the entire scope of work covered under this specification shall be arranged by the contractor at his own cost. All materials procured by the contractor shall meet the quality requirements specified in this specification. The contractor shall keep sufficient stock of cement and steel at site at any point of time when the work is in progress excluding what has been already incorporated in the works, so that any disruption / delay in availability of these materials during procurement will not affect the progress of work at site. The minimum quantity of such materials in stock at site shall not be less then the Requirement of one (1) month in case of Cement and Requirement of two (2) Consecutive months in case of Steel.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
39.02.00	Structural steel		
	Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.		
39.02.01	Mild Steel		
	a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/ killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2. b) Pipes shall conform to IS 1161. c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240. d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only.		
39.02.02	Medium and High Tensile Steel		
	Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.		
39.03.00	Fly ash based Portland pozzolona cement conforming to IS: 1489 Part - I shall preferably be used. However, the contractor may use other types of cements conforming to IS: 269, IS: 8112, IS: 12269, & IS: 455.		
39.04.00	Reinforcement steel shall conform to:		
	a) Mild steel bars of grade I of IS: 432 Part – I or grade A of IS: 2062. b) High yield strength deformed TMT steel bars of grade Fe-500 having minimum elongation of 14.5 % or Fe-500D, and conforming to other requirements of IS 1786.		
40.00.00	CODES AND STANDARDS		
	All standards, specifications, acts and code of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. Other Indian, foreign Codes and Standards not listed here but referred to elsewhere within this specification shall also be deemed to be part of this list.		
	In case of conflict between this specification and those (IS standards, codes etc.) referred to herein, the former shall prevail.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Some of the relevant Indian standards, Acts and Codes applicable to this section of the specification are listed below		
	IS : 383	Specification for coarse and fine aggregates from natural sources for Concrete.	
	IS : 432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.	
	IS : 456	Code of practice for plain and reinforced concrete.	
	IS : 458	Specification for concrete pipes.	
	IS : 516	Method of test for strength of concrete.	
	IS : 800	Code of practice for use of structural steel in general building construction.	
	IS : 814	Specification for covered electrodes for metal arc welding for weld steel.	
	IS : 816	Code of practice for use of metal arc welding for general construction.	
	IS : 817	Code of practice for training and testing of metal arc welders.	
	IS : 875 (Pt. I to V)	Code of practice for design loads other than earthquake) for buildings and structures.	
	IS : 1038	Steel doors, windows and ventilators.	
	IS : 1172	Basic requirements for water supply, drainage and sanitation.	
	IS : 1361	Steel windows for industrial buildings.	
	IS : 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.	
	IS : 1892	Code of practice for subsurface investigation for foundation.	
	IS : 1893	Criteria for earthquake resistant design of structures.	
	IS : 1904	Code of practice for design and construction of foundations in soils; general requirements.	
	IS : 1905	Code of practice for structural safety of buildings - Masonry walls.	
	IS : 1948	Specification for aluminium doors, windows and ventilators.	
	IS : 2062	Steel for general structural purposes.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS : 2131 Method of standard penetration test for soils. IS : 2212 Code of practice for brickwork. IS : 2645 Specification for Integral cement water proofing compounds. IS:2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils - determination for water content etc code of practice for earth work on canals. IS : 2911 Code of practice for design and construction of pile foundations. (Part-1/Sec.1) Driven cast in situ concrete piles. (Part-1/Sec.2) Bored cast-in-situ concrete piles. (Part-IV) Load test on piles. IS : 2974 (Part - I TO V) Code of practice for design and construction of machine foundations. IS : 3370 (Part I to IV) Code of practice for concrete structures for the storage of liquids. IS : 3658 Code of practice for liquid penetrant flaw detection. IS : 3664 Code of practice for ultra sonic testing by pulse echo method. IS : 4326 Code of practice for earthquake resistant design and construction of buildings. IS : 4990 Specification for plywood for concrete shuttering work. IS : 5624 Specification for foundation bolts. IS : 7215 Tolerances for fabrication steel structures. IS : 8112 Specification for 43 grade Ordinary Portland Cement. IS : 9103 Specification for admixtures for concrete. IS : 9595 Code of procedure of manual metal arc welding of mild steel. IS : 10262 Recommended guidelines for concrete mix design. IS : 13311 Method of non - destructive testing of concrete. IS : 13755 Dust pressed ceramic tiles with water absorption of 3%, E6% (Group B11a)		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	ASTM 898 -89 Standard guide for use of high solid content, cold liquid-applied elastomeric water proofing membrane for use with separate wearing course. AS/NZS 2728 Pre finished / pre painted sheet metal product for interior / exterior building applications – Performance requirements. AS : 1365 Standards for steel manufacturing. AS : 1397 A steel sheet & strip – hot – dipped-zinc-coated or Aluminium-Zinc coated. AS : 3566 Self drilling screws for building and construction industry. IRC : 37 Guidelines for the design of flexible pavements. - Manual on sewerage and sewage treatment (Published by CPH & EEO) As updated. Indian Explosives Act. 1940 as updated. For “Foundation System and Geotechnical Data” refer “Project Information section” of Technical specification.		
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(CIVIL WORKS)
SUB-SECTION-V-QD1

Clause No	QUALITY ASSURANCE PROGRAMME		
	SAMPLING, TESTING AND QUALITY ASSURANCE FOR CIVIL WORKS		
1.0.0	INTRODUCTION		
1.1.0	This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification including excavation and filling, cast in situ concrete and allied works, fabrication and erection of structural steel works, masonry / sheeting and allied works, finishing items etc.		
1.2.0	This part of the technical specification shall be read in conjunction with other Parts of the technical specifications, general technical requirements & erection conditions of the contract. Wherever IS code or standards have been referred they shall be the latest revisions.		
1.3.0	All tests required for all materials (bought by Contractor) and workmanship shall be done / got done by the contractor at his own cost. The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part.		
1.4.0	The Contractor shall provide the facilities whatsoever required and also bear the cost for all sampling, testing and quality assurance in the field and in the laboratory. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian standards and / or international standards and this technical specification. Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer. All sampling shall be done in the presence of the Engineer or his authorised representative. The Contractor shall establish the QA&QC laboratory at site and all field tests shall be done in the presence of the Engineer and / or his authorised representative. The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute such as CSMRS, NCBM, IITs, National Test House, Kolkata etc. as agreed by the Engineer. The test samples for such test shall be jointly selected and sealed by the engineer and thereafter these shall be sent to the concerned laboratory through the covering letter signed by FQA representative of the engineer. The cost of transportation and other associative cost including the test charges shall be borne by the contractor. These cost shall deemed to be included in the respective item of work in the contract. If the Engineer desires to witness such tests at laboratory, Contractor shall arrange to conduct the test in his presence.		
1.5.0	The recommendations and suitability of material for concreting and other building materials like brick, cement, aggregates etc., shall be ascertained by contractor prior to start of work. Preliminary evaluation of aggregate and its evaluation for potential alkali-aggregate reactivity as per following scope of work shall be done:- <u>A. Evaluation of Aggregates:</u> I. To carry out different tests on coarse aggregate sample i.e. specific gravity,		
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Clause No	QUALITY ASSURANCE PROGRAMME
	water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386. II. To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis soundness, deleterious material, silt content, clay content and organic impurities as per IS: 2386. III. To prepare evaluation report based on test results of I) and ii) above and to advise regarding suitability of fine and coarse aggregates. B. Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity: Evaluation for Potential Alkali-Aggregate reactivity as per following scope of work: I. To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test. II. To prepare a report based on test results of I) above and to advise regarding suitability of aggregates and further testing required if any. The contractor shall initiate the action with regard to the above mentioned evaluation of aggregates and other building material, so as to ensure timely completion of these tests thereby not affecting any project work. All records shall be submitted, unless specified otherwise, as per the format developed by the Contractor and approved by the Engineer. 1.6.0 The Contractor shall enclose a comprehensive list of bought out items (BOIs) envisaged in the contract for carrying out fabrication/ manufacturing/ erection/ construction/ commissioning activities, procurement of forged, cast, semi-finished and finished components/equipment etc and shall indicate the names of reputed manufacturers for each of them in their bid proposal. The items envisaged by the Contractor to be procured from these manufacturers shall meet the specification requirement. An indicative list of major bought out items (not exhaustive) for civil works is enclosed at Annexure-I, for which the contractor shall submit the requisite details / lists of manufacturer's in their bid proposal. 1.7.0 The list of manufacturers / sub-vendors of each of the BOIs identified / indicated by the Contractor shall be discussed / reviewed by the NTPC during post bid discussions and the list of proposed manufacturers / sub-vendors for each of the BOI shall be agreed/ approved. The list of manufacturers for all the BOIs envisaged in contract shall be included in the bid proposal and the same shall be discussed for finalization during the post bid discussions before placement of award. Where the manufacturers are placed in "DR" (Details required) category, the details of the manufacturers / sub-vendors placed in the "DR" category shall be submitted to the NTPC for approval within the period agreed at the time of post bid discussions. The Contractor's proposal shall include vendor's site facilities, expertise, facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Contractors proposed. The formats for furnishing above details shall be given to the Contractor at post bid discussion stage. Monthly progress reports on sub-Contractor detail submission / approval shall be furnished on format no. QS-01-QAI-P-02/F1. The NTPC shall furnish other relevant formats for information/ clarification for manufacturers / sub-vendors approval to the Contractor at the time of post bid discussions (Main supplier's evaluation report Format No:
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	QA-01-QAI-P-04/F1-R0 and Sub supplier questionnaire Format no: QA-01-QAI-P-04/F2-R0). Such manufacturers / sub-vendors approval shall not relieve the Contractor from any obligation, duty or responsibility under the contract.		
1.8.0	Structural steel and Reinforcement steel supply if in the scope of the contractor shall be procured from Main Steel Producers enlisted by NTPC from time to time. Currently, Main Steel Producers enlisted by NTPC are SAIL, JSW Steel Ltd, Jindal Steel & Power, Tata steel Ltd. (for Reinforcement steel/TMT bars), RINL (for long products/Rolled sections and Reinforcement steel/TMT bars), Essar Steel India Ltd. (for Flat products/ Steel Plates), Electosteel steel Ltd. (for Reinforcement steel/TMT bars) and Monnet Ispat and Energy Ltd. (for long products/Rolled sections and Reinforcement steel/TMT bars). Subsequent, if any new Main Steel Producer/s are enlisted, they may also be considered for procurement during execution of the contract if proposed by the Contractor.		
1.9.0	The Field Quality Plans shall detail out all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site. The contractor shall furnish complete QA & QC programme (QAP) for the work envisaged which may include the following:- • The organisation structure for the management and implementation of the proposed Quality Assurance Programme. • Documentation Control System • The procedure for procurement of materials and source inspection. • System for site controls including process controls. • Control of non-conforming items and systems for corrective action • Inspection and test procedures for site activities • System for indication and appraisal of inspection status • System for maintenance of records • System for handling, storage and delivery. • Quality Plan detailing out quality practices and procedures, relevant standards and acceptance levels for all types of work under the scope of this contract. The Contractor shall appoint a dedicated, experienced and competent quality management representative on site, preferably directly reporting to the Project Manager, supported by experienced personnel, to ensure the effective implementation of the approved quality assurance programme. The onsite quality management representative shall have the organisational freedom and authority to implement the requirements of these quality assurance arrangements, free from commercial and programme restraints. The QA & QC setup of the contractor shall consist of qualified and experienced engineers, with their supporting staff. The QA&QC set up in addition to requisite mechanical & electrical engineers shall consist sufficient graduate civil engineers & supervisors to take care of quality assurance activities of both site & laboratory. An		
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	indicative QA & QC organization chart is attached at Annexure-III. The deployment of man power for QA & QC set up shall be affected on the basis of agreed manpower deployment schedule, which shall be prepared by the contractor based on the L-2 network and the same shall be submitted to the Engineer-in-charge for acceptance. Based on the schedule of work agreed with the Engineer-in-charge and the approved FQP, the Contractor shall prepare a schedule of tests and submit them to the Engineer-in-charge and organise to carry out the tests as scheduled/ agreed. The QA&QC laboratory shall have all necessary equipment, instruments and shall be managed by a qualified / experienced person. An indicative list of test equipment is attached at Annexure-II. All these testing equipment shall be provided by the contractor at his own cost. The contractor shall maintain the equipment in good working condition along with valid calibration certificates, for the duration of the contract. Any other equipment though required for testing but not listed in the equipment list shall be provided / arranged by the contractor at his own cost. QA&QC laboratory building shall be constructed by the Contractor at their own cost. The laboratory building shall be constructed and installed with the appropriate facilities. Temperature and humidity controls shall be available wherever necessary during testing of samples.		
1.10.0	The contractor shall prepare and obtain approval of the Owner of the Field Quality Plan (FQP) well before the start of the work. This FQP shall cover for all the items / activities covered in the contract/schedule of items and required for completion of the work.		
1.11.0	All materials / components and equipment covered under the scope of work which are to be manufactured at shop/ factory of the vendor/subvendor shall be covered under a comprehensive quality assurance programme. The detailed quality plan for manufacturing shall be drawn up by the contractor and will be submitted to the owner for approval in the prescribed format for manufacturing quality plan. Manufacturing Quality Plan (MQP) shall detail out all the components and equipment, various test/inspection, to be carried out as per the requirements of this specification and standards mentioned therein. The quality practices and procedures followed by Bidder's/Sub-Bidder's/ sub-supplier's Quality Control Organization shall include , the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of material procurement, manufacture, assembly and final testing / performance testing . The quality plan shall be submitted in electronic media e.g. CD or E-mail in addition to hard copy, for review and approval. After approval the same shall be finally submitted in compiled form on CD.		
1.12.0	The contractor shall store and handle the materials as per the requirements of the relevant standards at his own cost.		
1.13.0	All the equipment shall be duly calibrated by NABL/ NPL accredited laboratories/accreditation agencies.		
1.14.0	The Contractor shall submit to the NTPC Field Welding Schedule for field welding activities in the format No.: QS-01-CQA-W11/F1, this format shall be furnished to the Contractor at pre-award stage. The field-welding schedule shall be submitted		
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1.15.0	to the NTPC along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site. The Contractor shall submit Welding Procedure Specification (WPS) in the format No: QS-01-QAI-W-06/F1 for NTPC approval/ acceptance, this format shall be furnished to the Contractor during post bid discussion stage. All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the NTPC. All welding/brazing procedures shall be submitted to the NTPC or its authorized representative for approval prior to carrying out the welding/brazing. All brazers, welders and welding operators employed on any part of the contract either in the Contractor's/ sub-Contractor's works or at site or elsewhere shall be qualified as per AWS D1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the NTPC. Welding procedure qualification and Welder qualification test results shall be furnished to the NTPC for approval. However, where required by the NTPC, tests shall be conducted in presence of NTPC/authorized representative. No welding shall be carried out on cast iron components for repair. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes. All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification; The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NTPC.		
	The Contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (Man-In-Charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the Contractor. The Contractor shall install and operate equipments (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with		
LOT-1A PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-0011-109(1A)-2	SUB-SECTION-V-QD1 QA CIVIL WORKS	Page 5 of 37

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1.16.0	the Technical Specification requirements in association with the specialized blasting agency. The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NTPC, highlighting the scope of services/ work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at site.		
	ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME: i. Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 ii. Indicative list of Field Quality Laboratory and Survey equipment list (Annexure-II) iii. Indicative QA&QC Manpower requirements (Annexure-III) iv. Indicative Field Quality Plan for Civil Works (Annexure-IV) v. Indicative Field Quality Plan for Structural Steel Works (Annexure-V) vi. Manufacturing Quality Plan Format No.: QS-01-QAI-P-09/F1-R1 vii. Status of items requiring Quality Plan and sub supplier approval. Format No.: QS-01-QAI-P-02/F1-R0 viii. List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 ix. Field Welding Schedule Format No.: QS-01-CQA-W-11/F1-R0 x. Welding Procedure Specification (WPS) Format No.: QS-01-QAI-W-06/F1-R0 xi. Main supplier's evaluation report Format No: QA-01-QAI-P-04/F1-R2 xii. Sub supplier questionnaire Format no: QA-01-QAI-P-04/F2-R1 (Note: The field quality plan attached is indicative and the contractor shall prepare the field Quality plan covering the entire scope of work in the contract and submit the same to corporate QA for acceptance/approval. However any addition or deletion in the scope of work, during detailed engineering shall be accordingly added/ deducted from the Field Quality Plan)		
	2.0.0 GENERAL QA REQUIREMENTS		
	2.1.0 STORAGE AND HANDLING OF COMMON BUILDING MATERIALS All materials shall be stacked and stored by the Contractor as per IS-4082 and as per the requirements specified in NTPC Technical Specification.		
2.2.0	EXCAVATION AND FILLING WORKS The contractor shall submit a work methodology covering various items of works for all stages of excavation and filling works. This methodology shall broadly include the quantity wise and classification wise identification of source of excavation and filling, suitability tests as per specification requirements, method of stockpiling, transportation, placement, spreading , compaction, equipment, list of protocols, in-situ tests, third party lab test if required, acceptance checks for final clearance. For blasting work at site if required, the contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at		
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Clause No	QUALITY ASSURANCE PROGRAMME											
2.3.0	site. The contractor shall install and operate equipment (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with the technical specification requirements in association with the specialized blasting agency. The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NTPC, highlighting the scope of services / work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (man-in-charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the contractor. Tolerance for finished surface level shall be within 20 mm of the level shown in the drawing. For an unimportant area, tolerance up to +75mm shall be acceptable at the discretion of the engineer. However, these tolerances shall be applicable for localized areas only. Acceptance criteria shall be a) When only one set of sample is tested, then all individual samples collected and tested should pass without any deviation b) For retest of any sample two additional samples shall be collected and tested, and both should pass without any deviation. c) Where a large number of samples are tested for a particular test then 9 samples out of every 10 consecutive samples tested shall meet the specification requirement.											
	MASONRY AND ALLIED WORKS The execution, finishing, testing and acceptance of masonry related works shall be as per the provisions of technical specifications / relevant practices IS code. Local depressions on account of faulty workmanship, broken / chipped edges shall not be acceptable. All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpends properly aligned. Unless specified otherwise the tolerances in construction of masonry works shall be as below:											
	<table><tr><th>Sl. No.</th><th>Type of Check</th><th>Tolerance</th></tr><tr><td></td><td>Deviation in verticality in total height of any wall of a building</td><td>Shall not exceed ± 12.5mm (more than one storey) ± 6mm per 3m height (within a storey)</td></tr><tr><td></td><td>Deviation from the position shown on the plan of any brickwork</td><td>Shall not exceed 12.5mm (more than one storey)</td></tr></table>			Sl. No.	Type of Check	Tolerance		Deviation in verticality in total height of any wall of a building	Shall not exceed ± 12.5mm (more than one storey) ± 6mm per 3m height (within a storey)		Deviation from the position shown on the plan of any brickwork	Shall not exceed 12.5mm (more than one storey)
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		Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	Shall not exceed 6mm	
		Deviation of bed joint from horizontal in any length, and it	Shall not exceed 6mm (upto 12m) Shall not exceed 12.5mm total (in any length over 12m)	
		Deviation from the specified thickness of bed-joints, cross-joints or perpends	Shall not exceed ± 3mm	
		Finished plastered surface	Deviation not more than 4 mm when checked with a straight edge of 2 m length placed against the surface	
		The average thickness of plaster	Not be less than the specified thickness	
		The minimum thickness over any portion of the surface	Not less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster	
2.4.0	CONCRETE WORKS			
	For concreting works provisions of technical specifications and IS: 456 shall apply. A detailed methodology for concrete works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.			
	The methodology for concrete works shall broadly contain the suitability of source of aggregates, cement, admixture, water and reinforcement steel, etc. The available concrete mix design recommended from a specialist institute, results of trial mix carried out at site, method / control of batching, mixing, transportation, layer wise placement, compaction, fixing / removal of form work, staging, fixing of water stops at appropriate locations along with specials, expansion joints, contraction joints and construction joints, cover blocks and method of curing, methodology of repair of newly placed hardened concrete, testing and sampling of concrete during production and placement and acceptance checks for final clearance.			
	The equipment, deployment of manpower and machinery shall arranged by the contractor to ensure the continuous rate of placement of specified grade of concrete so as to prevent segregation, bleeding, formation of cold joints, temperature control for concreting in extreme weather conditions and for mass concreting works.			
	Exposed surfaces of concrete shall be kept continuously in a damp or wet condition for at least seven days from the date of placing concrete in case of ordinary Portland cement, not be less than 10 days for concrete exposed to dry and hot weather conditions, at least 10 days or period may be extended to 14 days where mineral admixtures or blended cements are used. Approved curing compounds may be used in lieu of moist curing with the permission of engineer-in-charge.			
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	Reinforcement steel shall conform to relevant IS codes. Lapping / spacing of reinforcement shall be so staggered that under no circumstances more than 50% of bars at any cross section shall be lapped. Corrosion resistance Steel shall be used for the foundations wherever specified in the technical specification. Sample test for 3% of the number of mechanical bars grips subject to a minimum of three, shall be carried out up to the yield strength of reinforcement of bars. Test shall be conducted for the water tightness of the liquid retaining structures as per technical specifications, IS 3370 and IS 6494. All the materials, equipments, processes used in pre cast concrete work shall conform to the requirements for the cast-in-situ concrete. If fly ash is used in concrete, source of supply shall be checked for suitability as per IS 3812 (Part-I). Routine tests for retention of particles on 45µ sieve and loss on ignition shall be carried out on each lot of fly ash before its use. The storage of fly ash shall be similar to that of cement. Separate Silo for fly ash shall be provided in the batching plant. Validation of Mix design using fly ash shall be carried out by an approved specialist agency, before start of concrete production. The acceptance criteria of concrete shall be in accordance with clause no.16 of IS 456. However in exceptional circumstances and that too in non-critical areas, the engineer may accept concrete work which is marginally unacceptable as per the criteria laid down in IS 456. For such accepted work, payment shall be made at a reduced rate pro rata to the concrete cube strength obtained, against that stipulated. All records of concreting, reinforcement, testing of materials, as-built dimensions, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to owner for their record and future reference. i. Testing data / report of aggregates including petrographic examination & potential reactivity of aggregate and repeated temperature cycle tests wherever specified ii. Mix design details and record of trial mixes carried out at site iii. Testing records of admixture as per IS-9103 / ASTM C494 including third party test reports. iv. Approved scheme for concreting v. Hourly records of concreting including pour card vi. Protocol indicating the dimensional tolerance and details of inserts vii. Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used viii. Bar bending schedule ix. Location and details of mechanical anchoring used for reinforcement x. Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings xi. Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification xii. Temperature control record of concrete at the time of placement if applicable.		
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	xiii. Details of curing, staging and fixing / removal of formwork, checklist for formwork as per Clause 9.9 and Annexure-C of IS 14687 including all machine foundations xiv. Batching Plant shall be calibrated regularly at least once in a 3 months. Computerized output shall be taken for each batch of production of concrete. For concreting works of ash pipe pedestals, mixer with weight batcher may be used. Production and supply of concrete from batching plant shall conform to the provisions of IS 4926 xv. Dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances for pre cast members as per NTPC Technical Specification. Load test on Pre cast members (except pre- cast tiles to be laid in the reservoir) shall be carried out @ 1% up to 1000 nos., @0.5% from more than 1000 nos. precast members of one type. The load test shall be carried out as per the provisions of IS-456 and relevant IS code.																																																																																										
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	report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NTPC. Low hydrogen electrode (AWS E-7018) for welding of High/Medium tensile steel, for M.S (IS 2062 Gr. A/Gr. B, IS 8500) sections thickness above 20mm shall be used. Preheating and Post weld heat treatment requirements shall be complied as specified in the technical specification / approved WPS. The requirements of pre-heating shall be			
	Thickness of thickest part at the area of welding / heat affected zone	Welding using other than low hydrogen welding electrodes IS 2062	Welding using low hydrogen welding electrodes or submerged arc welding IS 2062	
	Upto 20 mm (including)	None	None	
	Over 20 mm to 40 mm (including)	Not allowed	200 C	
	Over 40 mm to 63 mm (including)	Not allowed	660 C	
	Over 63 mm	Not allowed	1100 C	
	The following tests / checks shall be carried out for structural steel works			
	SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD	
		Physical and chemical properties of material if supply in the scope of contractor	As per relevant codes, review of correlated mill test certificates or check testing in absence of MTC	
		Ultrasonic test on plates above 40mm	As per ASTM A435	
		Welding procedure & welders qualification test	AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards	
	Fillet Weld			
		Macro-etch examination on production test coupons for main fillet welds	Minimum one joint per built up beams, columns and crane girder etc.	
		Tension member of crane girder	Dye penetration test on 25% weld length	
		All other fillet welds	DPT on 5% of weld length with minimum 300mm at each location	
Butt Weld				
	DPT	100% after back gouging on all butt welds		
	Mechanical testing of production test coupons	Minimum one joint per built up beam, column and crane girder.		
	Radiography test on butt welds (In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the	100% RT on butt welds of tension flange (bottom flange) of crane girders 10% RT weld length of each welder on butt welds,		
LOT-1A PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-0011-109(1A)-2	SUB-SECTION-V-QD1 QA CIVIL WORKS	Page 12 of 37

Clause No	QUALITY ASSURANCE PROGRAMME		
	SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
		engineer)	
		Ultrasonic testing on full penetration welds (other than butt welds)	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints
		Control assembly check in shop before erection	1st and further every 10th set of identical structure
		Dimensional tolerances during fabrication and erection	as per IS-7215 and IS-12843
		Surface Preparation and Paint thickness	SA 2 1/2 , By elcometer random after each coat, each member
2.6.0	PAINTING WORKS Painting works shall be carried out as per the provisions of technical specifications. A detailed methodology for painting works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted. The methodology for painting works shall broadly contain the source of approved brand of paints, shot / sand blasting as specified, minimum acceptable size of shot used for blasting, application of primer, intermediate coat and final coat, experience of applicator, etc. testing of painting work and acceptance checks for final clearance.		
2.7.0	SHEETING WORKS All bought out items shall be procured from the manufacturer's approved by engineer and tested as per relevant IS Codes/ Specification. Raw material of colour coated sheets shall meet the chemical & physical properties as per relevant standards / codes referred in the approved data sheet. It shall be tested for colour match, bare metal thickness, weight of Z/AZ coating, thickness of painting system, reverse impact, T-Bend adhesion, scratch resistance, salt spray test for 1000 Hrs and any other test / properties as specified in the technical specifications. Colour coated sheets shall be marked with video jet printing at the interval not more than 2m bearing manufacturer's name, date and time of manufacturing. Fasteners shall also be tested for 1000 hrs salt spray test as per the requirement of technical specifications. Bonded Mineral Wool Insulation shall meet the requirements of thickness, density, thermal Conductivity, all other tests as per the technical specifications and IS-8183. For sheet installation no gas cut opening shall be allowed at the site, whenever opening is specified these shall be properly cut in the factory and shall be filled with lipping / flashing for true shape / dimension etc. The sheets/ packets shall be stacked neatly clear off the ground at an angle to the ground, over a base pallet to provide drainage. Water / moisture should not be allowed to stagnate on surface, or in between layers. This can damage the coating, and cause corrosion.		
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Clause No	QUALITY ASSURANCE PROGRAMME			
2.8.0	TILE WORKS			
	The contractor shall submit the work methodology which shall include the type, grade and make of materials along with their technical data sheets, details, etc, clearance from E-I-C regarding leak proofness and damp proofness of parent concrete surface, surface preparation, the procedure of application, curing, testing and acceptance. The agencies having adequate experience to execute the acid / alkali resistant lining works shall be engaged for executing the acid / alkali resistant lining works after obtaining the approval from the E-I-C. The execution, finishing, testing and acceptance of tile works shall be as per the provisions of technical specifications. The material for tile works shall be procured from the NTPC approved brand / source. Local depressions on account of faulty workmanship, tiles / natural stones with cracked or broken / chipped edges shall not be acceptable. The tests shall be carried out on acid resistant bricks / tile- water absorption, compressive strength, resistance to acid, flexural strength, dimensions and all other tests as per IS 4860 and IS 4457, bitumastic ready mixed paint as per IS 158, bitumastic as per IS 9510, potassium silicate, resin type and sulphur type mortars as per IS 4832, part I, II and III, surface preparation for painting as per IS 2395, epoxy painting shall be carried for required coating thickness and dry film thickness.			
	2.9.0	FIRE PROOF DOORS		
		Fire Proof doors shall be tested for the requirements mentioned in the Technical Specification. The type test of the doors shall be carried out at CBRI Roorkee for minimum 2 hours fire rating and its Fabrication drawing shall also be approved by CBRI, Roorkee. DFT of paint of Fire Proof Doors and its fittings and fixtures as per BOQ shall be checked. The doors shall be finished with suitable fire retardant painting system		
2.10.0	WATER PROOFING			
	The execution, finishing, testing and acceptance of water proofing works shall be as per the provisions of technical specifications. The material for the works shall be procured from the NTPC approved brand / source and the works shall be executed by the authorized applicator of the supplier. Water proofing shall be tested for water tightness by creating a pond of water minimum 25 mm height on area of 6 m x 6 m, for the period of 48 hrs on fully dried elastomeric membrane surfaces. Minimum 5% area of the roof shall be subjected to water tightness test. Such test necessarily be conducted on vulnerable areas like drain channel / drain head. No dampness shall be visible on the underneath side of roof (i.e. ceiling), parapet and well junctions etc. which have been subjected for testing. The above testing shall be carried out prior to application of wearing course.			
2.11.0	PILING WORK (If Applicable)			
	For piling works provisions of technical specifications, approved drawings, BOQs and relevant IS codes / standards shall apply. The piling works shall be executed by the agency meeting the qualifying requirements as specified. A detailed			
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	methodology for piling works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted. The methodology for piling works shall broadly contain the method of boring, stability of bore hole, termination criteria, tests / checks for termination level, fabrication of cage, cage lowering, concrete batching / mixing, transportation, placing, recording of the time of construction operations, method of conducting initial and routine load tests, testing and sampling of concrete during production and placement and acceptance checks on piles for final clearance. The equipment, deployment of manpower and machinery shall be arranged by the contractor to prevent the collapse of bore hole and to ensure continuous rate of placement of specified grade of concrete. The piling works shall be executed as per the technical specifications, approved drawings, relevant codes / standards, FQP and BOQ. In addition to the requirements of technical specifications, the following shall also be ensured while execution of piling works: a) Time gap between completion of pile boring and start of concreting should be kept to the minimum. However the maximum time gap shall not be more than 6 hours. b) Muck Debris should be removed from the pile bore by air lift technique(by keeping the tremie & air pipe as close as to bottom of pile bore) i.e. after completion of boring, after completion of SPT(whenever applicable), after lowering reinforcement cage, but before start of concreting. c) Density of bentonite slurry shall be checked from the sample taken from the bottom of pile bore(not at 1.0 m above the bottom of the pile bore) d) Minimum two welding sets shall be kept ready to join the two cages of reinforcement by engaging 3 or more welders. This will ensure the lowering of R/F cage in minimum time. e) While lowering the R/F cage into the pile bore, two hooks shall always be used to ensure balanced/symmetrical insertion of cage into the pile bore. f) Concrete cover blocks at the junction of two R/F cage shall be ensured before lowering the second segment. g) Surge concreting of about 1.0 cum shall be ensured at the start of concreting (i.e. in the first pour), by suddenly allowing to fall through the tremie pipe from the funnel. This will help in displacing left out muck/debris in the pile bore (by the impact). h) Continuous feeding of concrete shall be ensured by deploying at least two transit concrete mixers (if required to be deployed) and mixing done through concrete batching plant (if deployed). Cold joints in the pile shall be avoided. i) In a pile group, SPT shall be carried out at termination level in the pile, taken up first. j) Bentonite slurry circulation to be ensured from start of boring to start of concreting. Flushing of bentonite slurry will only ensure maintaining of density of bentonite slurry uniformly and will not allow bentonite jelly to settle at the bottom, whereas air lift technique with bentonite circulation will ensure removal of muck debris from the bottom of pile bore.		
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2.12.0	k) Properties of drilling mud shall be checked prior to commencement of the piling work and thereafter, minimum once per week or as found necessary by the engineer. One sample consisting of 3 specimens shall be tested for the above. l) Low strain pile integrity test on all job piles and test piles shall be conducted as specified in the Technical Specification. This test shall be suitably used to identify the piles for routine tests. High Strain dynamic test shall be done as per the technical specification. The frequency of the test shall be as per the BOQ m) For Working Piles: Minimum one sample consisting of 6 test cubes shall be made for first ten piles. Out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength. Minimum one sample of 6 test cubes for every 25 nos. of piles shall be tested, out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength PILE LOAD TEST Pile load testing shall conform to the requirements of IS-2911 (Part IV) and the technical specification. Initial load tests as specified in the contract documents shall be conducted to assess the safe load carrying capacity of pile before start of work. To verify the load carrying capacity of the working piles, routine load test shall be conducted. Pile load-testing procedure and the test setup / scheme shall be submitted for approval of NTPC. The contractor shall use the test setup having arrangement for anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge for both vertical compression and uplift (tension) Load test (initial) on piles. The cost of reaction system / piles shall deem to be included in the cost of test piles All the gauges and instruments shall be calibrated before the start of the tests on test piles and working piles and the calibration record shall be verified before start of execution of the test. WATER SUPPLY, DRAINAGE & SANITATION Material used for sanitary and plumbing fittings and fixtures shall conform to and be tested as per the requirements of relevant IS Codes specified in NTPC technical specification. The obstructions in sewer lines shall be checked by inserting a smooth ball, of diameter 13 mm less than the pipe bore at the high end of the sewer or drain. If absence of any obstructions, such as yarn or mortar projecting through the joints, ball shall roll down the invert of the pipe and emerge at the lower end. The straightness shall be checked by means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of the light may be observed. The mirror will also indicate obstruction in the barrel, if the pipeline is not straight. The service pipes shall be slowly and carefully charged with water, allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under test / working condition of pressure and flow, when all draw-off taps		
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2.13.0	are closed. The service pipes shall be checked for satisfactory support and protection from damage, corrosion and frost. ARCHITECTURAL & MISC. WORKS Material used for sanitary and plumbing fittings and fixtures, floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in NTPC technical specification. Fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. shall be checked for correctness of locations and smoothness of operation and fixtures. All controls and locking devices shall give fault free performance. Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 2.5 mm. Materials used in glass and glazing shall be procured from source approved by NTPC and shall conform to the requirements of the Technical Specification and IS Codes. False ceiling panels shall be best quality material in thickness and properties called for in the specification / schedule of items. Material Test Certificate to be submitted before bulk supply. All bought items covered in the scope of contract shall be procured from sources approved by NTPC and shall conform to the requirements of the technical specifications and referred standards /codes.		
	2.14.0	PRE CAST CONCRETE WORKS 1. All the materials used in Pre cast Concrete work shall be tested and conform to the requirements of IS codes and NTPC Tech. Specification. 2. Concrete mix for Pre cast members shall conform to IS-456-2000. 3. All relevant QA requirements pertaining to cast insitu concrete shall be applicable. 4. Pre Cast Concrete member shall be checked for dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances shall be as per NTPC Technical Specification.	
		2.15.0	FABRIC EXPANSION COMPENSATOR: Each layer of fabric Compensator shall be checked for thickness, unit weight, tensile strength & elongation, composite layer of the expansion joint shall be tested for temperature withstandability test. Thermal Insulation shall be checked for thickness, density, thermal conductivity test and all other tests as per IS:8183. Tests and checks on all other items shall be carried out as per relevant codes.
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2.16.0	SLIPFORM SHUTTERING		
	1. The monitoring of the leveling of the yoke and the platform of the slip form shuttering to be done in each shift to avoid tilt during the casting of the chimney shell. 2. Manning of each shift shall be done by at least two experienced operators and a foreman particularly in night shift. 3. Suitable removal/ reduction of overhung / excess yoke beam length shall be affected with the decrease in the diameter of Chimney shell, as per the approved plan. 4. The laser centering method to be deployed for chimney alignment and Monitoring of chimney centre should be done by laser instruments at least two points. Monitoring/Recording of the same shall be done in each shift of 8 hours 5. Shuttering plates to be used for slip form shall be new and the grade of steel shall conform to the specification requirements. 6. The outage of the alignment of chimney centre shall be prevented by creating a counterbalance for alignment purpose to avoid differential loading, arising out of placement of reinforcement bars at one side or unloading of concrete in a hopper at one side of the platform for slip form shuttering.		
LOT-1A PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-0011-109(1A)-2	SUB-SECTION-V-QD1 QA CIVIL WORKS	Page 18 of 37

	PROJECT:	LIST AND STATUS OF ITEM REQUIRING QP AND SUB-SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: FLUE GAS DESULPHURISATION SYSTEM PACKAGE					REV. NO.	0
	MAIN SUPPLIER:					DATE	
	CONTRACT NO.:						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS
1	CEMENT						
2	CONSTRUCTION CHEMICALS - ADMIXTURES, PLASTISIZERS, RETARDERS, WATER PROOFING COMPOUNDS, GROUTS, RESINS, EPOXY ETC.						
3	COLOUR COATED SHEET(FOR COIL)						
4	PROFILERS FOR DECKING/CLADDING SHEETS						
5	ELECTROFORGED GRATING						
6	PAINT AND PAINTING SYSTEM						
7	GI PIPES						
8	INSULATION WOOL						
10	PVC WATER STOP						
11	PLASTIC/ PVC PIPES						
12	FLOOR TILES						
13	FIRE PROOF DOORS						
14	PARTICLE BOARDS, PLYWOOD, MDF						
15	ROOF WATER PROOFING						
16	RCC PIPES						
17	FALSE CEILING - GLASS REINFORCED GYPSUM						
18	BITUMEN ASPHALT						
19	BITUMEN IMPREGNATED FIBER BOARD JOINT						
20	SANITARY ITEMS						
21	CP BRASS TAP AND OTHER SANITARY FITTINGS						
22	POLYTHENE WATER STORAGE TANKS - IS 12701						
23	CHIMNEY ELEVATOR						
24	PTFE BEARING / ELASTOMERIC BEARING						
25	FOUNDATION BOLTS						

LEGENDS:

1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list along with the condition of approval, if any.

DR – For these items "Details required" for NTPC review. To be identified with letter "DR" in the list.

'N' NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with 'NOTED.'

2. QP/INSPN CATEGORY:

CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.

CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved

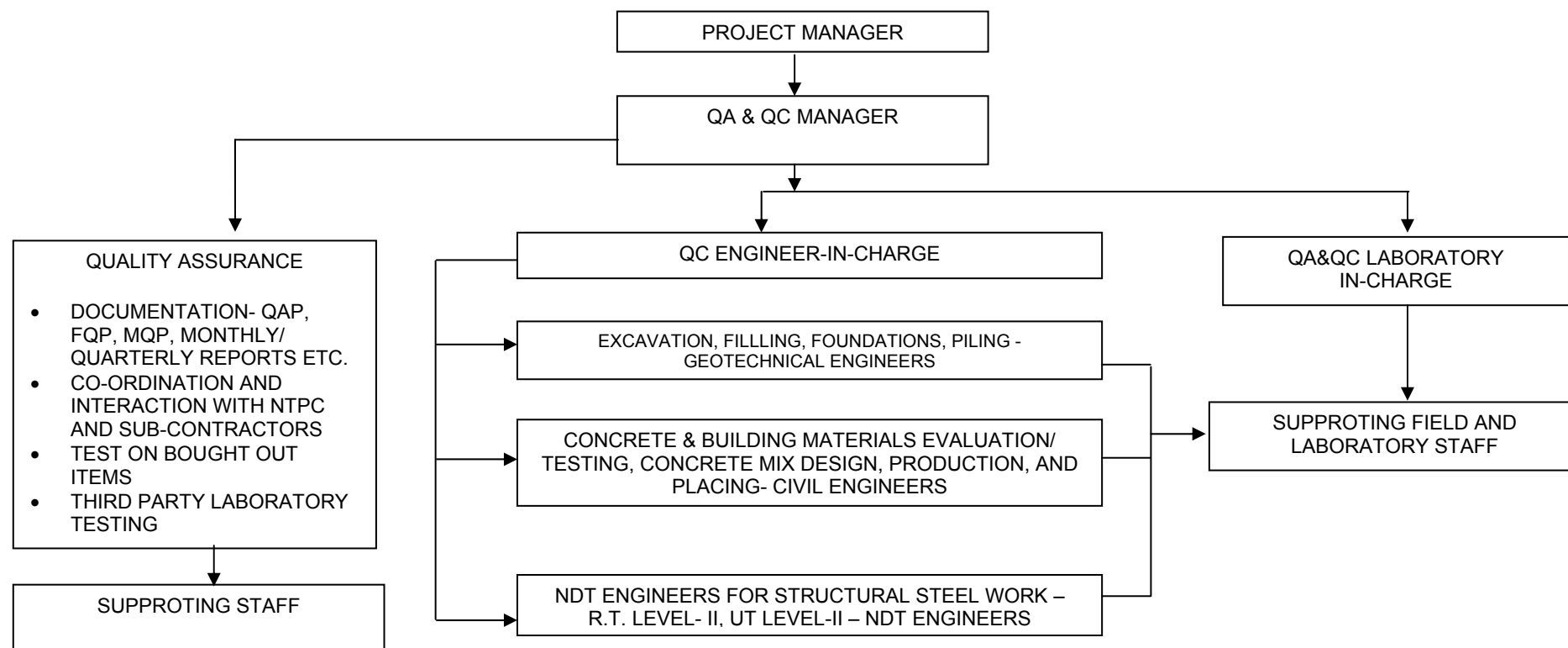
CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.

UNITS/ WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

NOTE: For the items placed in CAT-III for Civil Works, the review and final acceptance shall be done by NTPC-EIC/ FQA on the basis of certificate of conformance submitted by the main supplier/ main contractor.

Clause No	QUALITY ASSURANCE PROGRAMME																																																																																																																							
	Annexure – II INDICATIVE FIELD QA&QC LABORATORY SET-UP <table><tr><th>S.No</th><th>Equipment</th><th>Nos.</th></tr><tr><td>1</td><td>Vicat Apparatus with deskpot</td><td>2</td></tr><tr><td>2</td><td>Le Chatelier flask</td><td>2</td></tr><tr><td>3</td><td>Le Chatelier Mould</td><td>2</td></tr><tr><td>4</td><td>Cube Moulds for cement testing</td><td>12</td></tr><tr><td>5</td><td>Vibration Machine</td><td>1</td></tr><tr><td>6</td><td>Length comparator</td><td>2</td></tr><tr><td>7</td><td>Shrinkage Bar mould</td><td>2</td></tr><tr><td>8</td><td>Sieve shaker</td><td>1</td></tr><tr><td>9</td><td>Sieves for sand, coarse & fine aggregate</td><td>1 set for each</td></tr><tr><td>10</td><td>Sieves for coarse aggregate for Road</td><td>1 set</td></tr><tr><td>11</td><td>Proctor testing equipment</td><td>2 sets + 18 cores</td></tr><tr><td>12</td><td>Slump testing equipment</td><td>6 sets</td></tr><tr><td>13</td><td>Oven</td><td>2</td></tr><tr><td>14</td><td>Physical balance</td><td>1</td></tr><tr><td>15</td><td>Rapid moisture meter</td><td>2</td></tr><tr><td>16</td><td>Thermometer</td><td>4</td></tr><tr><td>17</td><td>Burret</td><td>2</td></tr><tr><td>18</td><td>Measuring cylinders</td><td>9</td></tr><tr><td>19</td><td>Measuring flasks</td><td>3</td></tr><tr><td>20</td><td>Compression testing machine</td><td>2 sets</td></tr><tr><td>21</td><td>Cube moulds</td><td>30</td></tr><tr><td>22</td><td>Electronic balance</td><td>2 (12 kg capacity), 2 (200 mg capacity)</td></tr><tr><td>23</td><td>pH balance</td><td>As per requirement</td></tr><tr><td>24</td><td>Radiographic facilities</td><td>As per requirement, Party should deploy BARC approved agency for carrying out RT</td></tr><tr><td>25</td><td>Mechanical weighing machine</td><td>1 (100 kg capacity)</td></tr><tr><td>26</td><td>Ultrasonic testing machine</td><td>As per requirement</td></tr><tr><td>27</td><td>D.P. Test kit</td><td>10</td></tr><tr><td>28</td><td>Vernier 300 mm, 600 mm</td><td>2</td></tr><tr><td>29</td><td>Micrometer (0.25 mm) out side (25.00)</td><td>2</td></tr><tr><td>30</td><td>Radiography film viewer</td><td>2</td></tr><tr><td>31</td><td>Inside Micrometer 25-750 dia</td><td>2</td></tr><tr><td>32</td><td>Digital elcometer for paint thickness</td><td>2</td></tr><tr><td>33</td><td>Baking oven for electrode</td><td>3</td></tr><tr><td>34</td><td>Portable ovens</td><td>2</td></tr><tr><td>35</td><td>Rebar detector to locate the reinforcement before core cutting operation</td><td>1</td></tr><tr><td>36</td><td>Concrete coring machine (55mm, 60mm upto 150 mm dia core bit)</td><td>1</td></tr><tr><td>37</td><td>Rebound hammer</td><td>1</td></tr><tr><td>38</td><td>Ultrasonic pulse velocity tester</td><td>May be arranged from specialist laboratory.</td></tr></table>			S.No	Equipment	Nos.	1	Vicat Apparatus with deskpot	2	2	Le Chatelier flask	2	3	Le Chatelier Mould	2	4	Cube Moulds for cement testing	12	5	Vibration Machine	1	6	Length comparator	2	7	Shrinkage Bar mould	2	8	Sieve shaker	1	9	Sieves for sand, coarse & fine aggregate	1 set for each	10	Sieves for coarse aggregate for Road	1 set	11	Proctor testing equipment	2 sets + 18 cores	12	Slump testing equipment	6 sets	13	Oven	2	14	Physical balance	1	15	Rapid moisture meter	2	16	Thermometer	4	17	Burret	2	18	Measuring cylinders	9	19	Measuring flasks	3	20	Compression testing machine	2 sets	21	Cube moulds	30	22	Electronic balance	2 (12 kg capacity), 2 (200 mg capacity)	23	pH balance	As per requirement	24	Radiographic facilities	As per requirement, Party should deploy BARC approved agency for carrying out RT	25	Mechanical weighing machine	1 (100 kg capacity)	26	Ultrasonic testing machine	As per requirement	27	D.P. Test kit	10	28	Vernier 300 mm, 600 mm	2	29	Micrometer (0.25 mm) out side (25.00)	2	30	Radiography film viewer	2	31	Inside Micrometer 25-750 dia	2	32	Digital elcometer for paint thickness	2	33	Baking oven for electrode	3	34	Portable ovens	2	35	Rebar detector to locate the reinforcement before core cutting operation	1	36	Concrete coring machine (55mm, 60mm upto 150 mm dia core bit)	1	37	Rebound hammer	1	38	Ultrasonic pulse velocity tester	May be arranged from specialist laboratory.
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	Note : 1. The equipments listed above are indicative and required to be mobilised as minimum requirement. additional equipment if any ,required for successful completion of work shall be provided /arranged by the contractor. 2. All test reports/ inspection reports have to be computerized and maintained on LAN with an access to the owner 3. Computers - 2 Nos shall be deployed with Windows operating system and connected to the NTPC server 4. Based on the schedule (L2/L3 Network), Quality control & Quality Assurance work plan shall be finalized by the contractor and the same shall be submitted to the engineer-in-charge for acceptance/approval. The Finalized work plan shall be maintained on the computer to be accessed by the owner for database and day to day monitoring.		
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INDICATIVE FIELD QA & QC MANPOWER STRUCTURE**NOTE:**

1. The above organization setup is minimum, however their deployment shall be as per the agreed deployment schedule. The contractor shall prepare a manpower deployment schedule in line with the finalized work plan and the same shall be submitted to the engineer-in charge for acceptance/ approval.
2. The contractor shall mobilize the QA& QC manpower in line with the finalized manpower deployment schedule and shall ensure their availability well in advance (15 days approx.) of the beginning of the concerned activity/ work.
3. The contractor shall further mobilize required number of skilled & supporting staff and additional resources, if any to meet the work schedule.

LOT-1A PROJECTS FLUE GAS DESULPHURISATION SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC NO: CS-0011-109(1A)-2	SUB-SECTION- V-QD1 QA Civil Works	PAGE 22 of 37

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE- IV			
		ITEM : CIVIL WORK SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc.	QP NO. : REV. NO. : DATE : PAGE :		1 0	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
Sl. No	Activity and operation	Characteristics / instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3	4	5	6	7	8	9	D*	10
1.00	GENERAL REQUIREMENTS									
A	Setting up of Field QA&QC laboratory		As agreed / required	A	Physical	Once prior to start of work	Tech Specs and Const. Drawings	SR	√	Functioning of laboratory equipment in proper working condition to be verified on monthly basis
B	Avialability of requisite laboratory set up and equipment in good working condition well before commencement of concerned activity		As agreed / required	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	√	
C	Submission of QA & QC manpower deployment schedule based on agreed L-2 network .	-	A	Physical	Once prior to start of work	Tech Specs and Const. Drawings		√		
D	Availability of QA& QC manpower based on deployment schedule .	-	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	√		
E	Sampling for testing of building materials, concrete mix design etc.	As agreed / required	A	Physical	Once per each source prior to start of concern work	Tech Specs and Const. Drawings	SR	√		Test report along with the recommendations from specialist agency to be submitted to NTPC.
F	Submission of schedule of tests to be done monthly / quaterly and maintenace of the same on a computer connected to LAN of NTPC for monitoring	-	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	√		
2.00	EXCAVATION AND FILLING IN FOUNDATION WORKS									
	Excavations-									
1		Check for the Nature, type of soil/rock before and during excavations	As agreed / required	B	Visual	Random in eah shift	Tech Specs and Const. Drawings	SR		
2		Check for the Initial ground level before start of excavations	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR		
3		Check for the final shape and Dimensions of excavations.	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR		
4		Check for the Final excavation levels	As agreed / required	B	Measuement	100%	Tech Specs and Const. Drawings	SR		
5		Check for the Side slope of final excavation	As agreed / required	B	Measurement	Random in eah shift	Tech Specs and Const. Drawings	SR		
6		Excavation in Hard Rock.								
i		Receipt, Storage, accountability of Explosive	As agreed / required	B	Physical	Random in each week	Indian Explosive Act 1940/all statutory norms, Tech Specs and Const. Drawings	SR	√	NTPC approved specialist blasting agency such as CMRI, NIRM shall be deployed at site for trial blasts, design blasts, blast vibration monitoring etc. Seismographs shall be deployed at site for monitoring of blast operation vibrations.
ii		Execution of Blasting Operation	As agreed / required	B	Physical	Random in eah shift	IS:4081, Tech Specs and Const. Drawings	SR	√	
iii		Submission of Blasting report to EIC	As agreed / required	C	Physical	Each blast	Tech Specs and Const. Drawings		√	
7		Excavation in Hard Rock (Blasting Prohibited)	As agreed / required	B	Physical	100%	As per approved drawing/ scheme, Tech Specs and Const. Drawings	SR	√	
	Fill/ Backfill -									
8	Suitability of fill material									
i		Grain size analysis	As required/ agreed	B	Physical	One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV), Tech Specs and Const. Drawings	SR/TR	√	
ii		Liquid & plastic limit	As required/ agreed	B	Physical	One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV) , Tech Specs and Const. Drawings	SR/TR	√	
iii		Shrinkage limit	As required/ agreed	B	Physical	One in every 5000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV), Tech Specs and Const. Drawings	SR/TR	√	
iv		Free Swell Index	As required/ agreed	B	Physical	One in every 5000 cum for each type and source of fill materials	IS:2720 (Pt.XI), Tech Specs and Const. Drawings	SR/TR	√	
9	Standard proctor Test	Optimum moisture content and max. dry density before fill	As required/ agreed	A	Physical	One in every 2000 cum for each type and source of fill materials	IS 2720 (Pt.VII), Tech Specs and Const. Drawings	SR/TR	√	
10	Moisture content	Moisture content of fill before compaction	As required/ agreed	A	Physical	One in every 2000 cum for each type and source of fill materials	IS 2720 (Pt.II), Tech Specs and Const. Drawings	SR/TR	√	
11	Degree Of Compaction Of Fill / Backfill									
i		Dry density by core cutter method ---- OR ---- Dry density in place by sand displacement method	As required/ agreed	A	Physical	i) For foundation fill/ backfill one for every 10 foundations for each compacted layer. ii) For area filling, one every 1000 SQM area for each compacted layer.	IS 2720 (Pt. XXIX), Tech Specs and Const. Drawings IS 2720 (Pt. XXVIII), Tech Specs and Const. Drawings	SR/TR	√	
ii		Relative density (Density Index)	As required/ agreed	A	Physical	----do----- (i) & (ii) above	IS 2720 (Pt. XIV), Tech Specs and Const. Drawings	SR/TR	√	

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1	2	3		4	5	6	7	8	9	D* 10	
iii		Dry Density by proctor needle penetration	As required/ agreed	B	Physical	Random checks to be carried out for each compacted layer	Tech Specs and Const. Drawings		SR/TR	√	
3.00	CAST-IN-SITU CONCRETE										
	MATERIALS										
1	Cement										
i		Initial & Final Setting Time	as per IS:4031	A	Physical	Each Lot	IS:4031	As per relevant IS Codes	SR/LB/ Test Report	√	
ii		Compressive strength @ 3, 7 & 28 days	as per IS:4031	A	Physical	Each Lot	IS:4031	As per relevant IS Codes	SR/LB/ Test Report	√	
2	Coarse Aggregate										
i		Moisture content		B	Physical	Once for each stack of 100 Cum. or part there of Except during monsoon when this has to be done every day before start of concreting	IS:2386 Part-III, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings		SR/LB		
ii		Specific gravity, bulk density, voids, water absorption,	As required/ agreed	B	Physical	Once for each source & for every change of source	IS:2386 Part-III, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings		SR/TR		
iii		Particle, size & Shape-(Sieve analysis, determination of material finer than 75 micron, flakiness index, elongation index, angularity number)	As required/ agreed	B	Physical	One per 100 cum., or part thereof/change of source whichever is earlier	IS:2386 Part-I, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings		SR/LB	-do-	
iv		Deleterious materials & organic impurities (determination of clay lumps, fine silt, fine dust , light weight pieces , soft particle & estimation of organic impurities.)	As required/ agreed	B	Physical	Once per source/ on every change of source	IS:2386 Part-II, IS : 456, IS : 383/Tech Spec, Tech Specs and Const. Drawings		SR/TR		
v		Soundness	As required/ agreed	B	Physical	Once per source/ on every change of source	IS: 2386 Part-V, IS:383 , Tech Specs and Const. Drawings		SR/TR		
vi		Alkali aggregate reactivity	As required/ agreed	A	Physical	Once per source/ on every change of source	ASTM C 1260 , Tech Specs and Const. Drawings		SR/TR	√	
vii		Petrographic examination	As required/ agreed	A	Physical	Once per source/ on every change of source	IS: 2386 Part-VIII, IS:383 , Tech Specs and Const. Drawings		SR/TR	√	
viii		Crushing value abrasion value and impact value	As required/ agreed	A	Physical	Once per source/ on every change of source	IS:383, IS-2386 Part IV/, Tech Specs and Const. Drawings		SR/TR		
3	Fine Aggregate										
i		Moisture content	As agreed / required	B	Physical	To be done every day before start of work	IS: 2386 Part-III and Const. Drawings	IS:383 , Tech Specs	SR/TR		
ii		Silt, Clay content and organic impurities	As agreed / required	B	Physical	Once per source& for on every change of source	IS: 2386 Part-II, IS:383 , Tech Specs and Const. Drawings		SR/TR		
iii		All other tests similar to coarse aggregates as mentioned above.	As agreed / required	B	As above	Refer S.No. 2.01.02	IS-2386, IS-383, Tech Specs and Const. Drawings		SR/TR		
4	Water										
i		Test for sulphates and chlorides	As required/ agreed	B	Testing	Once per each source thereof yearly.	IS:3025 part 22 and 23 (for test procedure), IS:456(for acceptance criteria) , Tech Specs and		SR/TR		
ii		Tests for ascertaining limit of solids	As required/ agreed	B	Physical	Once per each source thereof yearly.	IS:3025 part 18 (organic),IS:456 , Tech Specs and Const. Drawings		SR/TR		
iii		Tests for pH Value	As required/ agreed	B	Testing	Once per each source thereof yearly.	IS:3025, IS:456, Tech Specs and Const. Drawings		SR/TR		
iv	Check for initial set time for used water and distilled water	vicat appratus		A	Physical	See Remarks	See Remarks, Tech Specs and Const. Drawings		See Remarks	√	
										Initial set time with used water should not be less than that with distilled water. This check is to be carried out only if the results of the tests mentioned at sl. no. 3.00, .4 i),ii)& iii) mentioned above	

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v	Check for Concrete compressive strength with used water and distilled water	standard sand and compression testing machine	As agreed / required	A	Physical	See Remarks	See Remarks, Tech Specs and Const. Drawings	See Remarks	√		This check is to be carried out only if the results of the tests mentioned at sl. no. 3.00, .4 i),ii)& iii) mentioned above
5	CONCRETE PRODUCTION										
i		Check for the proportions of materials for nominal mix concrete as per Table-9 of IS 456	As agreed / required	B	Physical	Random in each shift	IS:456, Tech Specs and Const. Drawings	SR/TR			
ii		Trial mix (Cubes compressive strength) as per Mix Design	As agreed / required	A	Physical	Min. 4 Trial Mixes with admixtures and Without admixtures With fly ash.	IS: 516 & IS:456, IS:10262, Tech Specs and Const. Drawings	SR/TR	√		For trial mix min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength. Mix design shall carried out at agency finalised during pre award)
iii		Crushing strength (works Tests cubes)	As agreed / required	A	Physical	One set of 6 cubes per 50 M3 or part thereof for each grade of concrete per shift whichever is earlier.	IS:516, IS:456, Tech Specs and Const. Drawings	SR/TR	√		Min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength.
iv		Workability - slump test	As required/ agreed	B	Physical	One sample every 2 hrs. from every mixing plant	IS:456, Tech Specs and Const. Drawings	SR/TR			Slump test for medium and high workability, Compaction factor test for medium and low workability, V.B. test for low to Very low workability
v		Cement content	As agreed / required	B	Physical	At random at the time of batching.	IS:1199 , Tech Specs and Const. Drawings	SR/TR			
vi		Admixtures for Concrete from approved sources	As agreed / required	A	Review of MTC	Random in each shift	IS:456 , Tech Specs and Const. Drawings	SR/TR	√		Admixture of appd. Brand and tested quality shall be used.
vii		Water Tightness Test for Water Retaining Structures	As agreed / required	B	Physical	100%	IS:3370 (Tanks and Revision) , Tech Specs and Const. Drawings	SR	√		
viii		Dimensions and visual exa-mination of finished structure	As agreed / required	B	Physical/ visual	100%	As per Tech. Specification/Appd. Drg./IS-456	SR			
6	CONCRETE CONVEYING, PLACING& COMPACTION										
i	Mixing of concrete	mixing of concrete shall be done in a approved mixer such as to produce a homogenous mix	As required/ agreed			To be calibrated at the time of starting and subsequently once in three months, and shall confirm to IS:4925	Review of calibration chart/ Certificate, IS 457, Tech Specs and Const. Drawings				time of mixing will be as given in IS 457
ii		Calibration of Batching Plant	As required/ agreed	A	Physical	To be calibrated at the time of starting and subsequently once in three months, and shall confirm to IS:4925	Review of calibration chart/ Certificate, Tech Specs and Const. Drawings	SR/TR	√		Cement consumption at batching plant shall also be obtained through comp. Output.Provision of online printer is manadatory
iii		Handling and Transportation of concrete	As required/ agreed	B	Physical	Random in each shift	IS:456, Tech Specs and Const. Drawings	SR			Free fall or drop shall be limited to 150 cm unless permitted concrete should be placed within 30 min of its removal from mixture . Construction methodology to be approved one week prior to start of work.
iv		Placement of concrete	As required/ agreed	B	Physical	Random in each shift	IS:456, Tech Specs and Const. Drawings	SR			No concrete shall be placed until the place of deposit has been thoroughly inspected and approved, the concrete shall be deposited in such a manner to maintain, until completion of unit, a plastic horizontal surface throughout
v		Check for compaction and Curing	As required/ agreed	B	Physical	Random in each shift	Check for period of curing as per IS 456 , Tech Specs and Const. Drawings	SR			Exposed concrete surface shall be protected against heating and drying for atleast 72 hrs after placement, curing compound may be used
vi		Cleanliness, provision of chute and arrangement for transportation & placement of concrete.	As agreed / required	C	Visual	100%	IS:456, Tech Specs and Const. Drawings	SR			
x		check for segregation	As agreed / required	C	Visual	100%	IS:456, Tech Specs and Const. Drawings				
7	TEST/CHECK ON RCC STRUCTURE IN HARDENED CONDITIONS										
i		Core Test	As agreed / required	A	Physical	As required by NTPC Engineer.	As per IS:456, IS 516, Tech Specs and Const. Drawings	SR/LB/ Test Report	√		Acceptable if average equivalent cube strength of the cores is equal to at least 85% of the cube strength of the grade of concrete specified for the corresponding age and no individual conc has result less than 75%
ii		Dimensional check on finished structures & Dimensional tolerances	As agreed / required	B	Measurement	Approved Drawing	As per IS:456, Tech Specs and Const. Drawings	SR/LB			
iii		Rebound Hammer test	As agreed / required	A	physical	As required by the NTPC engineer	Tech Specs and Const. Drawings	SR/LB	√		
8	REINFORCEMENT STEEL										
i		Physical and Chemical Properties for each lot as per relevant IS codes	As required/ agreed	A	Review of MTC	Each batch of delivery	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	MTC	√		Applicable if steel is procured by Contractor
ii		Cutting tolerance	As agreed / required	B	Measurement	Random in each shift	IS : 1852, IS: 432, IS:1786, Tech Specs and Const. Drawings	SR/LB			Tolerance as per specifications

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iii		Freedom from cracks surface flaws, Lamination.	As agreed / required	B	Visual	Random in each shift	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	SR/LB		To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs.
9	PLACEMENT OF REINFORCEMENT STEEL									
i		Check for bar bending schedule with necessary laps. Spacers & Chairs	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	SR		
ii		Check for cover, spacing of bars	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	SR		
iii		Check for bending of bars	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	SR		
iv		Check for spacers and chairs after the reinforcement cage is put inside the formwork	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	SR		
v		Acceptance of placement of reinforcement before start of concreting	As agreed / required	B	Visual & Measurement	before start of each concreting	IS : 456/ Drawings & approved bar bending, Tech Specs and Const. Drawings schedule	SR		
10	STAGING AND FORMS									
i		Materials and accessories	As agreed / required	B	Visual	Once before start of work	As per relevant IS, Tech Specs and Const. Drawings	SR		Proper care should be taken in order to combat corrosion. Proper care should be taken while cleaning, moving and stacking the scaffolds
ii		Soundness of staging, shuttering and scaffolding	As agreed / required	B	Visual	Once before start of work	As per manufacturer's spec.and as per 3696,4014, 4990, Tech Specs and Const.	SR		
iii		Acceptance of formwork before start concreting		B	Physical / visual	before start of each concreting	As per provisions and tolerances, Tech Specs	SR		
11	EMBEDDED PART (INCLUDING LAYING OF RAILS & ANCHOR FASTENERS)									
i		Position and levels of embedded parts	As agreed / required	B	Physical/ measurement	100%	As per drawing, Tech Specs and Const. Drawings	SR		Exposed surface of the embedded parts other than holding down bolts are to be painted with primer ,chlorinated , rubber based zinc phosphate
ii		Position depth and size of bolt hole	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings	SR		
iii		Location verticality of pipe sleeve/opening of bolt hold	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings	SR		
iv		Laying of rails under supervision of NTPCs specialised agency.	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings	SR		
v		Welding / tying of embedment to reinforcement	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings	SR		
12	PRE-CAST CONCRETE									
i		Crushing strength	As required/ agreed	A	Physical	one sample of six cubes per 50 cum or part thereof	IS:516&IS; 456, Tech Specs and Const. Drawings	SR/LB	√	a minimum of three specimen shall be tested for 28 days comp. strength
ii		Workmanship free from visual defects	As required/ agreed	B	Physical	100%	Tech Specs and Const. Drawings	SR		The precast units shall be free from defects like honeycombing, reinforcement exposure and should have good finish. All relevant tests like workability, cube test shall be carried out as per IS 456-2000 Same as applicable to cast in situ concrete.
iii		Dimension of finish structure	As required/ agreed	B	Measurement	100%	As per IS:456, Tech Specs and Const. Drawings	SR		If the material already tested of the cast-in-situ concrete and part of the same is used for precast concrete, further testing is not required, otherwise testing is required for every 50 Cum. Of Concrete.
iv		Workability	slump test apparatus	B	Physical	one sample every two hrs from mixing plant	IS:1199 &IS:456, Tech Specs and Const. Drawings	SR/LB		According to the mix design
v		Water cement ratio	As agreed / required	B	Physical	At random at the time of batching	IS:1199 , Tech Specs and Const. Drawings	SR/LB		According to the mix design
vi		Cement content	As agreed / required	B	Physical	At random at the time of batching	IS:1199 /tech spec, Tech Specs and Const. Drawings	SR		According to the mix design
vii		Load Test	As agreed / required	A	Physical	5% or as desired by EIC	IS:456/ As decided by NTPC Site Engr. Incharge., Tech Specs and Const. Drawings	SR	√	These tests shall also be carried out, in case of doubt regarding grade of concrete and poor quality.
13	JOINTS IN CONCRETE									
i		Check for the joint material - bitumen impregnated fibre board, PVC water stops, Sealing compound, Expanded polystyrene board, Hydrophilic strip, Acrylic polymer etc.	As per manufacturer Standards	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings, IS 1838, IS 1834, IS12200	MTC	√	
ii		Acceptance of installation of materials for Joints in concrete	As agreed / required	B	Acceptance	Each installation randomly	As per technical specifications and construction drawings			
14	DAMP PROOF COURSE									
i		Check for the material - Hot bitumen and water proofing materials etc	As agreed / required	A	Review of MTC	Each batch of delivery at site	Tech Specs and Const. Drawings, IS 702	SR	√	
ii		Acceptance of damp proof course	As agreed / required	B	Acceptance	100%	As per technical specifications and construction drawings	SR		

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15	GROUTING										
i		Check for the material	As agreed / required	A	Review of MTC	Each batch of delivery	As per technical specifications and construction drawings	SR	√	Check for chemical, epoxy, resin grouts etc	
ii		Check for the type of mix - fluid mix, plastic mix, stiff mix etc.	As agreed / required	B	Physical	Prior to start of work	As per technical specifications and construction drawings				
iii		Check for the mixing, placement, application and grout pressure	As agreed / required	B	Physical	Random in each shift	As per technical specifications and construction drawings	SR			
iv		Check for the compressive strength	As agreed / required	A	Physical	Each batch of delivery	As per technical specifications and construction drawings	SR	√		
v		Acceptance of the grouts	As agreed / required	B	Physical	Each grout section	As per technical specifications and construction drawings	SR			
16	SLIPFORM SHUTTERING										
i		Submission of Slipform Work system to be used	-	B	Submission	Before Comencement of work	As per specifications	SR			
ii		Check for the Slipform shutters	As required	B	Physical	Before Comencement of work	As per specifications	SR		Check for water level system, Controls, Walkways etc.	
iii		Details Positions and arrangement of Jack rods	-	B	Approval	Before Comencement of work	As per specifications	SR		Submitted to Engineer for approval	
iv		Details of Proposed arrangement for continuous readings	-	B	Approval	Before Comencement of work	As per specifications	SR		Submitted to Engineer for approval	
v		Check for All type of openings, Chases, Fixing of Blocks and similar built-up features	As required	B	Physical	100% during execution	Construction Drawings and specifications	SR		No any type of openings ,chases , blocks other than shown in the construction drawings or approved by Engineer shall be executed in the concrete.	
vi		Details of proposed method for concrete curing and protection	-	B	Approval	Before Comencement of work	Construction Drawings and specifications	SR		Submitted to Engineer for approval	
vii		Check of Concrete Curing and Protection	As required	B	Physical	At Random	Construction Drawings and specifications	SR		Concrete shall not remain uncured for period longer than 12 hours	
viii		Check for Sliding Operation	As required	B	Physical	Each Sliding	As per specifications	SR		Rate of Sliding, Delays in sliding, Discontinuity or stop strat sliding to be checked	
ix		Monitoring of Sliding Portion Progress Height	As required	B	Physical	Six hourly intervals	As per specifications	SR		To be recorded in tabular form and on graphs immediately after each monitoring	
x		Centre line in relation to the centers at the base	As required	A	Physical	Six hourly intervals	As per specifications	SR	✓	To be recorded in tabular form and on graphs immediately after each monitoring	
xi		Internal wall faces in relation to the concrete at the base	As required	B	Physical	Six hourly intervals	As per specifications	SR		To be recorded in tabular form and on graphs immediately after each monitoring	
xii		Wall thickness	As required	B	Physical	Six hourly intervals	As per specifications	SR	✓	To be recorded in tabular form and on graphs immediately after each monitoring	
xiii		Twist	As required	B	Physical	Six hourly intervals	As per specifications	SR	✓	To be recorded in tabular form and on graphs immediately after each monitoring	
xiv		Verticality of the structure	Optical Theodolight	B	Physical	Every day in morning	As per specifications	SR		To be recorded in tabular form and on graphs immediately after each monitoring	
xv		Check for Tolerances for chimney construction	As required	B	Physical	For every day monitoring	As per specifications	SR			
4.00	BRICK MASONARY										
1	Test on Bricks										
i		Check for Dimensions , shape	As required/ agreed	A	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 Nos. or part thereof	IS: 1077, Tech Specs and Const. Drawings	Inspection Report	√	Efflorescence shall be checked at each source.	
ii		compressive strength, water absorption, warpage efflorescence.	As required/ agreed	B	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 Nos. or part thereof	IS: 1077, IS:3495 part I (Compressive Strength) Part II (Water Absorbition) Part III(Efflorescence) Part IV (War page), Tech Specs and Const.		√	Preconditioning of brick shall be done as per IS. For compersive strength, warpage and water absorption	
2	Test on Mortar	Compressive strength, consistency and water retentivity for each portion of walls, plasters and ceilings.	As required/ agreed	B	Test	At random	IS 2250-1981, Tech Specs and Const. Drawings	LB		Cement used in mortar shall confirm to either IS 269: 1976 or IS 455- 1976 sand shall confirm to IS 2116 -1980	
3	Masonry construction	Acceptance of Workmanship, verticality and alignment	As agreed / required	B	Visual/ Physical	100%	IS 2212, IS 1905 , Tech Specs and Const. Drawings	SR/LB			
5.00	FINISHING AND ALLIED WORKS										
1	MATERIALS- FINE SAND, SAND FOR PLASTERING										
i		Deleterious Material	As agreed / required	B	Physical	Once per source	IS : 2386 (Part-I &II) & IS :2116, Tech Specs and Const. Drawings	SR			
ii		Grading	As agreed / required	B	Physical	50 Cum./or part thereof	IS:3150,1542& Apprd. drgs, Tech Specs and Const. Drawings	SR		Table –I of IS:2116	

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		ITEM : CIVIL WORK SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc.	QP NO. : REV. NO. : DATE : PAGE :	1 0	PROJECT : PACKAGE: CONTRACT NO. MAIN CONTRACTOR	FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
Sl. No	Activity and operation	Characteristics / Instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3	4	5	6	7	8	9	10
iii		Galvanized hexagonal wire netting for lath plastering	As agreed / required	B	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR	
iv		Check for the thickness and finishing of plaster	As agreed / required	B	Visual/ Measurement	Random in each shift	As per IS 1661 , Tech Specs and Const. Drawings	SR/LB	
2	PLASTERING								
i		Check for defects and the remedial measure for bond filler , blistering , cracking and crazing , efflorescence and irregularity of surface texture	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings, IS: 1661	SR	
ii		Truness of plastering system	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR	finished plaster surface shall not show any deviation more than 4 mm when checked with straight edge of 2 m length
iii		Acceptance of Grooves and finishing	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR	
3	STONE GRIT PLASTER/ GRANULAR TEXTURED COAT FINISH								
i		Check for Preparation of surface	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR	
ii		Check for material - Size of chips	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR	
iii		Acceptance of Grooves and finishing	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR	
4	WATER PROOFING SYSTEM								
i		Check for the material	As agreed / required	A	Physical and Review of MTC	Each lot of delivery	Tech Specs and Const. Drawings,	SR/ MTC	✓
ii		Acceptance of water proofing system - Application, fixing, laying	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR	Water pounding test shall be done
5	FALSE CEILING								
i)		Check for the Materials - Glass Reinforced Gypsum (GRG), Pre-painted coil coated steel false ceiling system etc.	As agreed / required	A	Physical and MTC Review	Each batch of delivery	As per relevant IS and Tech. Specs / Manufacturer's TC	-do-	✓
ii)		Acceptance of installation	As agreed / required	B	Physical / measurements	Each installation	-do-	-do-	All supports , hangers , accessories shall be as per Tech. Specifications/ approved manufacturer's recommendations
6.00	PAINTING SYSTEM - All surfaces								
1	Check for the Materials and accessories	White wash, Distemper and all types of Primer and Paints - Check for Shade, type from brand and manufacturer as approved by NTPC EIC	As agreed / required	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	✓ Mfr.'s T.C. shall be correlated with the consignment received.
2	Check for Surface prepration		As agreed / required	B	Physical /visual	Random in each shift	Tech Specs and Const. Drawings	SR	
3	Check for DFT of painted surfaces		As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR	
4	Acceptance of painted surfaces		As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR	
6.10	CHIMNEY PAINTING								
i		Requirements for Steel Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR	No of Coats applied and DFT/WFT to be checked as per specified
ii		Requirements for Cast Iron Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR	No of Coats applied and DFT/WFT to be checked as per specified
iii		Requirements for Concrete Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR	No of Coats applied and DFT/WFT to be checked as per specified
iv		Material Requirements	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR	Requirement of DFT to be checked as per Specifications. Procurement to be done from approved/acceptable manufacturer/source
v		Preparation of Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const.	SR	
vi		Application of Paint	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR	AS per recommendations by Manufacturer along with Relevant IS Codes and Specification requirements
7.00	DOORS , WINDOWS VENTILATORS & GRILL								

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		ITEM : CIVIL WORK SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc.	QP NO. : REV. NO. : DATE : PAGE :	1 0	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	FLUE GAS DESULPHURISATION SYSTEM PACKAGE				
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	D* 10
1	Check for the material/ items for all type of timber, flush doors, Particle doors, wire guage, Aluminium doors, Fire proof doors, window s fittings, Anodized aluminium works, Mortice locks, Automatic operating system etc received at site	Review of MTC / make or/and Physical checks, tests report (if MTC is not available)	As agreed / required	A	Review of MTC/ Physical	for each batch of delivery	Tech Specs and Const. Drawings		SR	√
2	Wood work in frames	Wood work in frames - Check for dimensions, surface finish and rebating etc.	As agreed / required	B	Physical	Random for each installation	Tech Specs and Const. Drawings		SR	
3	Wardrobe shutter and show cases									
i		Check for material as per IS 3087 and 3097 - from NTPC approved source	As agreed / required	B	Physical	one sample for each section for each lot of delivery	Tech Specs and Const. Drawings, IS 3087 and 3097		SR	
ii		Acceptance of fixing after completion	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings, IS 3087 and 3098		SR	
4	Pelmets									
i		Check for material as per IS 3087/ 3097 - from NTPC approved source	As agreed / required	B	Physical	one sample for each section for each lot of delivery	Tech Specs and Const. Drawings, IS 3087/ 3097		SR	
ii		Acceptance of fixing after completion	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings, IS 3087/ 3098		SR	
5	MS Grills									
i		Check for the material for section and weight from NTPC approved source	As agreed / required	A	Physical	one sample for each section for each lot of delivery	Tech Specs and Const. Drawings		SR	√
ii		Check for fabrication done at approved workshop	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings		SR	
		Acceptance of fixing of MS Grills	As agreed / required	B	Acceptance	Random	Tech Specs and Const. Drawings		SR	
6	Fitting and fixtures - MS sliding door bolts, tower bolts, pull bolt lock, MS handles, Safety Chains, brass locks, brass latch, hydraulic floor springs & door closers, etc	Check for fitting items as per relavent IS codes, tech specifications and BOQ- from NTPC approved source	As agreed / required	B	Physical and acceptance	Five samples for each item for each lot of delivery	Tech Specs and Const. Drawings		SR	
7	Fitting and fixtures - Aluminium sliding door bolts, tower bolts, pull bolt locks, handles, door stoppers etc.	Check for fitting items as per relavent IS codes, tech specifications and BOQ- from NTPC approved source	As agreed / required	B	Physical and acceptance	Five samples for each item for each lot of delivery	Tech Specs and Const. Drawings		SR	
8	Fire proof doors									
i		a) Check for the Fire Proof Doors	As required/ agreed	A	Review of MTC	Each lot	As per Technical Specifications and approved drawings, IS 3614 Part (I &II), TAC		MTC	√
ii		b) Check for DFT and Fire Retardency of Paint	As required/ agreed	B	Physical	Each Door	As per Technical Specifications and approved drawings, IS 3614 Part (I &II)		SR/LB	
9	Acceptance of all type fittings after fixing	Acceptance of fittings after completion	As agreed / required	B	Physical and acceptance	Random for each type of fitting	Tech Specs and Const. Drawings		SR	
8.00	GENERAL STEEL WORK									
1	Check for Material	Review of MTC/ make / Physical checks, tests (if MTC is not available)	As agreed / required	A	Review of MTC for each delivery	For each batch of delivery	Tech Specs and Const. Drawings		SR	√
2	Rolling shutters									
i		Check for surface finish and thickness of plate of rolling shutters of approved make and DFT	As agreed / required	B	Physical	Random for each batch of delivery	Tech Specs and Const. Drawings		SR	
ii		Acceptance of roling shutters after fixing	As agreed / required	B	Physical and acceptance	Random	Tech Specs and Const. Drawings		SR	
3	Steel Glazed doors and T-iron frames sections									
i		Check for shape, tolerances, thickness, welding and finishing of sections (Check MTC wherever applicable)	As agreed / required	A	Review of MTC for each delivery	Random for each delivery	Tech Specs and Const. Drawings		SR	√
ii		Acceptance of Steel Glazed doors and T-iron frames sections after fixing	As agreed / required	B	Physical and acceptance	Random for each installation	Tech Specs and Const. Drawings		SR	
4	Pressed steel pressed frames/ doors									
i		Check for shape, tolerances, thickness, welding and finishing (Check MTC wherever applicable)	As agreed / required	A	Review of MTC for each delivery	Random for each delivery	Tech Specs and Const. Drawings, IS4351, IS2202		SR	√
ii		Acceptance of Pressed steel pressed doors after fixing	As agreed / required	B	Physical and acceptance	Random for each installation	Tech Specs and Const. Drawings		SR	
5	Fencing and Gates									

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Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D* 10	
	i) Check for Materials for fencing and gates	PVC coated chain link fencing (IS 2720), Welded wire mesh (IS 1566), Reinforced barbed tape galvanised (IS 2629) etc.	As agreed / required	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	Mfr.'s T.C. shall be correlated with the consignment received.	
	ii) Check for alignments, erection painting, DFT etc.		As agreed / required	B	Physical / measurements	Each installation	Tech Specs and Const. Drawings	SR		Erection shall be as per NTPC Tech. Specs.	
	ii) Acceptance of the installation and working		As agreed / required	B	Physical / measurements	Each installation	Tech Specs and Const. Drawings	SR		Erection shall be as per NTPC Tech. Specs.	
6	Galvanised Chicken Wire Mesh	Check for Guage and Dimensions from NTPC approved Source	As agreed / required	B	Acceptance	Random for each delivery	Tech Specs and Const. Drawings	SR			
9.00	FLOOR FINISHES AND ALIED WORKS										
1	Cement Concrete Flooring										
	i	Check for execution of concreting	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR			
	ii	Check for providing and fixing glass/ PVC strips in joints	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR			
	iii	Check for laying, polishing, curing, finishing for terrazzo, marble chip flooring	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR			
	iv	Acceptance of lines, levels and finishing	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
10.00	SANITORY INSTALLATIONS										
1		Check for size and surface finish of all sanitary items and fixtures from NTPC approved sources, (Check MTC wherever applicable)	As agreed / required	A	Physical / review of MTC	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓	To be procured from NTPC approved source	
2		Acceptance of installations of all sanitary items and fixtures	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
3	SCI, CI, S&S Pipes & Fittings etc										
	i	Check for Work man ship and finish	As agreed / required	B	Visual	Random	Tech Specs and Const. Drawings	SR			
	ii	Check for Unit weight and Dimensions	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR			
	iii	Hydrostatic test	As agreed / required	A	Review of MTC for each delivery	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓		
11.00	WATER SUPPLY AND ALL TYPES OF FITTINGS										
1		Check for size and surface finish of all water supply, GI/ MS pipes and fittings, Photo Voltaic Control System etc from NTPC approved sources (Check MTC wherever applicable)	As agreed / required	A	Physical / review of MTC	each delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓	To be procured from NTPC approved source	
2		Acceptance of installations of all water supply, GI pipes and fittings	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
3	CI, S&S Pipes & Fittings										
	i	Check for Work man ship and finish	As agreed / required	B	Visual	Random as per Specifications	Tech Specs and Const. Drawings	SR			
	ii	Check for Unit weight and Dimensions	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR			
	iii	Hydrostatic test	As agreed / required	A	Physical / review of MTC	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓		
4	Polyethylene Water Storage Tanks										
	i	Check for material of tanks from NTPC approved sources	As agreed / required	A	Physical / review of MTC	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓		
	ii	Acceptance for instillation and fitting (IS 12701)	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
12.00	DRAINAGE AND SANITATION										
1	Sanitary appliances										
	i	Check for Viterous China, Glazed, ceramic sanitary appliances (Water closets, Wash basins, urinals) etc.	As agreed / required	A	Physical / review of MTC	each delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓	To be procured from NTPC approved source	
	ii	Acceptance of installation of Viterous China, Glazed, ceramic sanitary appliances (Water closets, Wash basins, urinals) etc.	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
2	SW Pipes and RCC Pipes										
	i	Check for size and surface finish of Pipes from NTPC approved sources	As agreed / required	A	Physical	100% after delivery	Tech Specs and Const. Drawings, IS458, IS 1536	SR	✓		
	ii	Testing of Joints	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR			

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Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	D* 10
i		Acceptance of installations of Pipes	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR		Acceptance tests shall be done as per specifications
3	CI Pipes, Covers and Frames									
i		Check for CI and SFRC covers and frames as per IS 1726 and IS 12592 from NTPC approved sources (Check MTC wherever applicable)	As agreed / required	A	Physical / review of MTC	Each lot of delivery	Tech Specs and Const. Drawings, IS 1536, IS 12592	SR	√	
ii		Acceptance of installations of CI Pipes, Covers and Frames	As agreed / required	B	Acceptance	1	Tech Specs and Const. Drawings	SR		
4	RCC manholes	Acceptance of RCC manholes after completion	As agreed / required	B	Acceptance	1	Tech Specs and Const. Drawings , IS 4111	SR		
13.00	FOUNDATION SYSTEM									
1	SHALLOW FOUNDATIONS									
i		Check for the foundation excavation - Location, Layout, size, depth etc	As required / agreed	B	Physical	Each location	As per technical specifications and construction drawings	SR	√	lines and levels to be checked
ii		Check for the foundation casting - Layout, Shape, dimensions, Reinforcement, concreting, curing etc	As required / agreed	B	Physical	Each foundation	As per technical specifications and construction drawings	SR		lines and levels to be checked. Concrete Grade to be checked as per Mix Design
14.00	SHEETING AND OTHER WORKS									
1		Check for Material like modular areated panel, permanently colour coated sheets , metal decking , pre-engineered buildings, AC sheeting, Fire proof doors and insulations (all tests as per tehcnical Specifications)	As per manufacturer Standards	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	MTC	√	1)FQP for structural steel shall also be applicable.2) For aluminium door/windows, check for anodisation as per Tech. Spec. 3) Fire proof doors shall be procured from TAC Approved parties as per relevant IS/Tech. 4) For aluminium cladding grade of alminium to be checked.
2		Check for Storage at Site	As agreed / required	B	Visual	Random in each shift	Tech Specs and Const. Drawings	SR		
3		Installation, lap alignment & workmanship.	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR		No gas cutting of sheets acceptable . Profile sheets will be kept covered in weather proof storage
4		Installation of lining &insulation &check thermal insulationfor wall cladding for thickness , density , thermal conductivityn at 50 deg c and all other tests as per IS:8183	As agreed / required	B	Testing	100%	Tech Specs and Const. Drawings	SR	√	&stored at accurate height to avoid any exposure of actual water . Principle of first in and first out shall be apply for erecting the sheets.
5		Check for the installation, alignments, finishing etc	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR/LB		
6		Fasteners for sheeting work	As agreed / required	B	Review of TC including 1000 hrs salt spray test	100%	Tech Specs and Const. Drawings	SR/LB		
7		Acceptance of each type of installation	As agreed / required	B	Visual/ Physical	Each installation	Tech Specs and Const. Drawings	SR/LB		
15.0	PILING WORK (IF APPLICABLE)									
15.1	Execution									
i		100 mm Dia Borehole	As required	A	Physical	100%	NTPC Tech. Specs	SR/LB	√	If carried out by the contractor
ii		Pile layout	Total station	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	√	
iii		Recording ground level	As required	B	Measurement	Random	IS:2911, as per appd. Drawings and technical	SR/LB	√	
iv		Cleaning/Flushing of pile bore	As required	B	Visual	Random	As per appd. Drawings and technical specification	SR/LB	√	
v		Size of bore and During boring of pile record commencement of SPT/ core recovery to ensure socketing length equivalent in terms of the Diameter of the pile below the socketing horizon.	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	√	
vi		Trial mix to ascertain the workability and cube strength	After receiving the recommended mix design from specialist agency,	B	Physical	One for each mix proportion	NTPC tech specification	SR/LB	√	Necessary correction for moisture content and water absorption according to mix design recommendation may be carried out during the trial mix
vii		Cement content	As required	B	Physical	Once per shift	As per approved design mix.	SR/LB	√	At batching plant
viii		Pouring of concrete to project above cutoff level.	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	√	
ix		Pile termination level	SPT & core recovery	A	Soil data	As per NTPC specifications	As per appd. Drawings and technical specification	SR	√	
15.2	Testing									
i		Bentonite	IS:2720	A	Physical / testing	Once per source	As per IS:2720 / tech. Specs.	SR/LB	√	Review of test report
ii		Density check on sample of mud collected from pile bore bottom	Sample collection	A	Physical	As per Tech. Spec.	As per NTPC Tech Spec.	SR/LB	√	Tests to be done before placing concrete. Samples to be collected from pile bore bottom.

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Sl. No	Activity and operation	Characteristics / Instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3	4	5	6	7	8	9	D*	10
iii		Slump test of concrete	IS:1199	B	Physical	Every 2 hrs at pouring point of concrete	IS:2911, As per appd. Drawings and technical specification	SR/LB	√	
iv		Cube sampling for works cube test	IS:456	B	Physical	One set of 6 cubes per 50 CuM or part thereof for each grade of concrete per shift whichever is earlier.	IS:2911, As per appd. Drawings and technical specification	SR/LB	√	
v		Initial pile load test, Vertical (Compression), Lateral (horizontal) and pullout (tension).	IS:2911 / as required	A	Testing	100% for 3 nos. for each type or as specified in BOQ / Tech. Spec.	IS:2911, As per appd. Drawings and technical specification	SR/LB	√	In case of compression test method the loading shall be cyclic.
vi		Routine pile tests, compression and horizontal	Calibrated dial gauges etc. as required.	A	Testing	100% for 0.5% of the total number of piles provided for each type of test/Tech. Spec.	IS:2911, As per appd. Drawings and technical specification	SR/LB	√	Routine Test shall be conducted by direct loading method.
vii		Integrity Tests	PEM	A	Testing	100%	IS:2911, As per appd. Drawings and technical specification and suppliers manual	Test Report	√	CHP
16.0 SPECIAL ITEMS										
16.1 Earthing Mat (Grounding System)										
i	Material	Earthing mat	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs / Manufacturer's, IS 3043	SR/MTC	√	
ii		Weld sizes & length	Visual/Tape	B	Visual/ Measurement	1	Tech Specs and Const. Drawings			NTPC approved electrodes shall be used
iii		D P test	DP test Kit	A	Physical	10% at random of the offered lot	Tech Specs and Const. Drawings	TR	√	
iv		Earth test	Earthing test kit	A	Physical	1	Tech Specs and Const. Drawings,	SR	√	
16.2 Bitumen layer for tank foundation										
i	Material	Grade of bitumen	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs /MTC	SR/MTC	√	
ii	Acceptance and workmanship	Application / workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR		
16.3 Composite Aluminium Panels and structural glazing										
i	Material	Type of aluminium panels / structural glazing / fasteners and fixtures / silicon sealant	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Technical specifications / drawings	SR/MTC	√	MTC shall cover all the properties / parameters as per technical specifications
ii	Acceptance and workmanship	Installation / workmanship	As agreed / required	B	Physical	Random	Technical specifications / drawings	SR		
LEGEND: D * Records, identified with "Tick" (✓) shall be essentially included by supplier in QA documentation.							DOC. NO.: CS-4140-109-2 REV:			
Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR, TR, MTC, LB										
Manufacturer/ Sub-supplier	Main-supplier	Categorization Witnessing & Accepting (As per NTPC QA&I System) Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report, MTC = Manufacturer's Test Certificate				For NTPC USE				
Signature		This document shall be read in conjunction with NTPC Tech. Specifications, BOQ, Drawings					REVIEWED BY	APPROVED BY	APPROVAL SEAL	

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		ITEM : STRUCTURAL STEEL WORK		QP NO. : 2		PROJECT:	FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. : 0		PACKAGE:				
				DATE :		CONTRACT NO.				
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	MAIN CONTRACTOR Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	D* 10
1.00	MATERIALS									
i		Structural steel procured from NTPC approved sources-Mechanical (YS, UTS, Elg, UT if specified),,and Chemical properties (CE as per IS)		A	Review	For each batch of each section delivered at site	Technical Specification and Construction Drawings, IS 2062	SR	√	Correlated MTC shall be verified. In the event of non submission of MTC , sample shall be selected by FQA for testing
2.00	FIT-UP									
2.01		Marking and Cutting	As agreed / required	B	Visual & Measurement	Each plate/ Section	Tech Specs and Const. Drawings/ Approved cutting plan	SR		
2.02		Match markings for trial assembled components	As agreed / required	B	Physical	Each fit-up	Tech Specs and Const. Drawings	SR		
2.03		Weld Fit Up	As agreed / required	B	Physical	Each fit-up	Tech Specs and Const. Drawings	SR	√	Edge Preparation/ Gap/ Alignment
3.00	PRE HEATING (wherever applicable)									
3.01		Pre-Heating Temperature	As agreed / required	B	Measurement	Each pre-heating	Tech Specs and Const. Drawings, Approved WPS	SR	√	
3.02		Post Weld Heat Treatment (PWHT), if required	As agreed / required	A	Time & Temperature	Each PWHT	Tech Specs and Const. Drawings, Approved WPS	SR	√	
4.00	WELDING REQUIREMENTS									
4.01		PQR and Welder's Qualification	As agreed / required	A	Physical	Each welder	Approved WPS/ PQR, AWS-D1.1/ASME IX, Tech Specs and Const. Drawings	Test Report	√	
4.02		Welding consumables	As agreed / required	B	Physical	Random in each shift	Approved WPS/ Owner Rationalized list of Electrodes.	SR	√	
4.03		Sequence of welding	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings, Agreed scheme	SR		
4.04		Removal/ grinding of temporary attachments	As agreed / required	B	Measurement	All cleats/ attachments	Tech Specs and Const. Drawings, IS-7215/Approved Drq.	SR		
4.05		Completeness after welding-Dimensions/ distortion	As agreed / required	B	Visual	Each structure component	Tech Specs and Const. Drawings	SR		
5.00	NON DESTRUCTIVE AND DESTRUCTIVE TESTING									
5.01	Fillet Welds									
5.01.01		Visual	As required/ agreed	B	Visual/ Measurement	Each welded joint	As per technical specifications and construction drawings	SR		As per requirement of Owner Engineer
5.01.02		Macro-Etch Examination	As required/ agreed	B	Physical	Main fillet weld with min one joint per built up beam, columns and crane girders	As per technical specifications and construction drawings	SR	√	

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE- V				
		ITEM : STRUCTURAL STEEL WORK		QP NO. : 2		PROJECT:	FLUE GAS DESULPHURISATION SYSTEM PACKAGE				
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO .: 0		PACKAGE:					
				DATE :		CONTRACT NO.					
				PAGE :		MAIN CONTRACTOR					
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
5.01.03		Dye Penetration Test (DPT)	As required/ agreed	B	Physical	25% weld length of tension member of crane girder- For crane girder 5% of Weld length with min. 300mm at each location - Except Crane Girder, for all other Fillet Welds	As per technical specifications and construction drawings	SR		√	
5.02	Butt Welds										
5.02.01		Visual	As required/ agreed	B	Visual	Random in each shift	As per technical specifications and construction drawings	SR			
5.02.02		Dye Penetration Test	As required/ agreed	B	Physical	100% DPT after back gouging on all butt welds except for coal bunker bins 10% DPT after back gouging-For coal bunker bins	As per technical specifications and construction drawings	SR			All butt welds to be back gouged before DPT
5.02.03		Mechanical testing on production test coupons	As required/ agreed	A	Physical	Min. one joint per built up beams, coloums and crane girder.	As per technical specifications and construction drawings	SR		√	Test on production test coupons
5.02.04		Radiography Test (RT)	As required/ agreed	A	Physical	100% RT on butt welds of tension flange (bottom flange) of crane girders 5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins 10% RT weld length of each welder on butt welds, except for crane girders and coal bunk	As per technical specifications and construction drawings	SR		√	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the Engineer
5.03	Full Penetration Welds (Other than butt welds)										
5.03.01		Ultrasonic Testing (UT)	As required/ agreed	A	Physical	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints	As per technical specifications and construction drawings	IR		√	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular loaction. Acceptance criteria of NDT on welds shall be as per AWS D1.1.

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE- V				
		ITEM : STRUCTURAL STEEL WORK SUB-SYSTEM : FABRICATION & ERECTION		QP NO. : REV. NO. :		2 0	PROJECT: PACKAGE:	FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
				DATE :		CONTRACT NO.					
				PAGE :		MAIN CONTRACTOR					
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
5.04	NON DESTRUCTIVE AND DESTRUCTIVE TESTING FOR CHIMNEY STEEL LINER										
i		Visual examination	As required/ agreed	B	Visual	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1	SR		√	As per requirement of NTPC Engineer
ii		DPT	As required/ agreed	B	Physical	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1	IR		√	
iii		RT	As required/ agreed	A	Physical	10% FOR SHOP BUTT WELD AND 15% FOR SITE BUTT WELDS	As per technical specifications and construction drawings, IS 822, AWS D 1.1				
6.00	FOUNDATION CHECKS										
6.01		Dimensions and levels	As agreed / required	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings	SR		√	Shape, lines (including diagonal checks)
6.02		Foundation Bolts and Embedments	As agreed / required	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings	SR		√	Measurement of Verticality, Levels, pitch distance
7.00	PRE-ASSEMBLY CHECKS										
7.01		Punch Erection marks and match marks on members	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings				Markings for - Assembly designation, Part number, Weight, Any other important identifications.
7.02		Pre-assembly as per match mark	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings				
7.03		Camber, sweep and total length after trial assembly of structure.	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings	SR		√	
7.04		Control assembly check at shop	As agreed / required	B	Visual/ Physical	Every first and tenth set of identical structure	Tech Specs and Const. Drawings				
8.00	ERECTION CHECKS										
8.01		Alignment, slopes, level, tolerances of erected member	As agreed / required	B	Measurement	Each structural member	Tech Specs and Const. Drawings	SR		√	
8.02		Tightening of bolts including foundation bolts with lock nuts	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings	SR		√	
8.03		Acceptance of erected structure	As agreed / required	B	Visual/ Physical	Each erected structure	Tech Specs and Const. Drawings, IS 7215 and IS 12843	SR		√	
9.00	INSTALLATION AND ALIGNMENT OF STEEL LINER										
i		Submission of Installation/ Erection Scheme/ methodology for all structures	-	B	Approval	Once prior to erection of each structure	Approved drawings and Technical Specifications	SR		√	
ii		Check for Erection Marks	-	B	Visual	100%	Approved drawings and Technical Specifications	SR			
iii		Check for Installation of Steel Liners	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR			
iv		Check for Site Joints	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR			
v		Check for Installation of Inlet Transition Ducts	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR			

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		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. : 0		PACKAGE:					
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		PAGE :				MAIN CONTRACTOR					
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
vi		Check for Installation of Insulations and Expansion Compensators	As required	B	Visual, Physical, Acceptance	100%	Approved drawings and Technical Specifications	SR			Each layer of expansion Compensator to be checked at shop for thickness, unit weight, tensile strength & elongation along with temp. withstandability for composite joints
vii		Ensure the Erection of all steel structures along with permissible tolerances and their acceptance	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR			
viii		Check and approval for Dismantling, Modification and Re-erection, if required for any reason	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR			
10.00	PAINTING SYSTEM										
10.01		Paining Materials and accessories	As agreed / required	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√		Mfr.'s T.C. shall be correlated with the consignment received.
10.02		Surface prepration	As agreed / required	B	Physical /visual	Random in each shift	Tech Specs and Const. Drawings, Relevant code/ standards	SR	√		
10.03		DFT of paint - Over steel surface	As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR	√		
10.04		Acceptance of painted surfaces	As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR			
11.00	PERMANENT BOLTS AND NUTS AND WASHERS										
11.01		Material	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√		Permanent mild steel Bolts, mild steel Nuts, Mild steel Washers, High strength structural Bolts, Washers-Dimensions, properties, storage along with MTC
11.02		Contact surfaces before bolting	As agreed / required	B	Physical	Random before assembly for bolting	Tech Specs and Const. Drawings, IS 4000	SR			
11.03		Inspection of the assembled bolts	As agreed / required	B	Physical	Randomly in each shift for assembeled bolts	Tech Specs and Const. Drawings, IS 4000	SR			
11.04		Tensioning	As agreed / required	B	Physical	Randomly during snug tight test and after full tensinoning	Tech Specs and Const. Drawings, IS 4000	SR	√		
11.05		Acceptance of installed bolts	As agreed / required	B	Physical	Each bolt	Tech Specs and Const. Drawings	SR			
12.00	STAINLESS STEEL HAND RAILS										
12.01		Material	As agreed / required	A	Physical/MTC Review(In case procured by contractor)	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√		Also check grade of steel
12.02		DPT for welding	As agreed / required	A	Physical	Random for each fabrication	AWS D1.1 / Tech Specs and Const. Drawings	SR/LB	√		WPS shall be submitted for Owner approval , electrodes used shall be as specified in WPS

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		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:				
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Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	D* 10
12.03		Acceptance of stainless steel hand rails	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings	SR		
13.00	PTFE SLIDING BEARINGS AND ELASTOMERIC BEARINGS									
13.01		Material from approved source	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	
13.02		Acceptance of installation of bearings	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings	SR		
		LEGEND: D * Records, identified with "Tick" (√) shall be essentially included by supplier in QA					For Owner USE	DOC. NO.: REV: 0		
		Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR, TR, MTC, LB								
Manufacturer/ Sub-supplier	Main-supplier	Categorization Witnessing & Accepting (As per Owner QA&I System) Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report,MfrTC = Manufacturer's Test Certificate								
	Signature	This document shall be read in conjunction with Owner Tech. Specifications, BOQ, Drawings						REVIEWED BY APPROVED BY APPROVAL SEAL		

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	LIST OF CODES AND STANDARDS			
	Indian Standards	Title	International and Internationally recognised standards	
	IS:277	Galvanised steel sheets (plain or corrugated)		
	IS:655	Specification for metal air duct		
	IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952	
	IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev	
	IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 47 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963	
	IS:3354	Outline dimensions for electric lifts.		
	IS:3401	Silica gel		
	IS:3588	Specification for electrical axial flow fans		
	IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)		
	IS:3677	Unbonded rock and slag wool for thermal insulation		
	IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)	
	IS:3895	Specification for monocry-stallines semiconductor rectifier cells and stacks		
	IS:3963	Roof extractor unit		
	IS:3975	Mild steel wires, strips and tapes for armouring cables		
	IS:4503	Shell and tube type heat Exchanger		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 49 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:4540	Specification for monory-stallines rectifire assembly equipment		
	IS:4671	Expanded polystyrene for thermal insulation purpose		
	IS:4736	Hot dip zinc coating on steel tubes		
	IS:4894	Centrifugal fans		
	IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)		
	IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958	
	IS:6392	Steel pipe flanges	BS 4504 : 1969	
	IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956	
	IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524	
	IS:7373	Specification for wrought aluminium and aluminium sheet and strips		
	IS:7938	Air receivers for compressed air installation		
	ISO:1217	Displacement compressor-Acceptance test		
	ASHRAE-33 and air heating coils.	Methods of testing for rating of forced circulation air cooling		
	ASHRAE-52-76	Air cleaning device used in general ventilation for removing particle matter.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 50 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	ASHRAE-22-72 Method of testing for rating of water cooled refrigerant condensers. ASHRAE 23-67 Methods of testing for rating of positive displacement refrigerant compressors. ARI-450-6 Standard for water cooled refrigerant condensers. ARI-550 Standard for centrifugal water chilling packages. ARI-410 Standard for forced circulation air cooling and air heating coils ARI-430/435 Central station AHU/Application of Central Station AHU BS:848 Fans (Part-1,2) BS:400 Low carbon steel cylinders for the storage & transport of permanent gases. BS:401 Low carbon steel cylinders for the storage & transport of liquified gases. CTI Code Acceptance test code for Water Cooling Tower. ACT-105 ANSI-31.5 Refrigerant piping ASME-PTC- Atmospheric Water Cooling Equipment 23-1958 AMCA A-21C Test Code for air moving devices API:618 Reciprocating Compressor for general refinery services. HYDRAULIC INSTITUTE STANDARDS. HYDRANT SYSTEM MANUALS OF TAC. TAC MANUALS OF SPRAY SYSTEM NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS. INDIAN EXPLOSIVES ACT. INDIAN FACTORIES ACT. STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 51 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	CODE AND STANDARD FOR CIVIL WORKS Some of the applicable Standards, Codes and references are as follows: Excavation & Filling IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc. IS: 4701 Code of practice for earth work on canals. IS: 9758 Guide lines for Dewatering during construction. IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade. Properties, Storage and Handling of Common Building Materials IS: 269 Specification for ordinary Portland cement, 33 grade. IS: 383 Specification for coarse and fine aggregates from natural sources for concrete. IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement. IS: 455 Specification for Portland slag cement. IS: 702 Specification for Industrial bitumen. IS: 712 Specification for building limes. IS: 808 Rolled steel Beam channel and angle sections. IS: 1077 Specification for common burnt clay building bricks. IS: 1161 Specification of steel tubes for structural purposes. IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C. IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B. IS: 1367 Technical supply conditions for Threaded fasteners. IS: 1489 Specification for Portland-pozzolana cement: (Part-I) Fly ash based.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 52 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	(Part-II) Calcined clay based. IS: 1542 Specification for sand for plaster. IS: 1566 Specification for hard-drawn steel wire fabric for concrete reinforcement. IS: 1786 Specification for high strength deformed bars for concrete reinforcement. IS: 2062 Specification for steel for general structural purposes. IS: 2116 Specification for sand for masonry mortars. IS: 2386 Testing of aggregates for concrete. (Parts-I to VIII) IS: 3150 Hexagonal wire netting for general purpose. IS: 3495 Methods of tests of burnt clay building bricks. (Parts-I to IV) IS: 3812 Specification for fly ash, for use as pozzolana and admixture. IS: 4031 Methods of physical tests for hydraulic cement. IS: 4032 Methods of chemical analysis of hydraulic cement. IS: 4082 Recommendations on stacking and storage of construction materials at site. IS: 8112 Specification for 43 grade ordinary portland cement. IS: 8500 Medium and high strength structural steel. IS: 12269 53 grade ordinary portland cement. IS: 12894 Specification for Fly ash lime bricks. Cast-In-Situ Concrete and Allied Works IS: 280 Specification for mild steel wire for general engineering purposes. IS: 456 Code of practice for plain and reinforced concrete.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS PAGE 53 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.		
	IS: 516	Method of test for strength of concrete.		
	IS: 650	Specification for standard sand for testing of cement.		
	IS: 1199	Methods of sampling and analysis of concrete.		
	IS: 1791	General requirements for batch type concrete mixers.		
	IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).		
	IS: 2204	Code of practice for construction of reinforced concrete shell roof.		
	IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.		
	IS: 2438	Specification for roller pan mixer.		
	IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.		
	IS: 2505	General requirements for concrete vibrators, immersion type.		
	IS: 2506	General requirements for concrete vibrators, screed board type.		
	IS: 2514	Specification for concrete vibrating tables.		
	IS: 2645	Specification for Integral cement water proofing compounds.		
	IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)		
	IS: 2750	Specification for Steel scaffolding.		
	IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.		
	IS: 3025	Methods of sampling and test waste water.		
	IS: 3366	Specification for Pan vibrators.		
	IS: 3370	Code of practice for concrete structures for the storage of		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 54 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	(Part I to IV) IS: 3414 IS: 3550 IS: 3558 concrete. IS: 4014 (Parts I & II) IS: 4326 of buildings. IS: 4461 IS: 4656 IS: 4925 IS: 4990 IS: 4995 (Parts I & II) IS: 5256 IS: 5525 concrete work. IS: 5624 IS: 6461 IS: 6494 IS: 6509 IS: 7861 IS: 9012 IS: 9103	liquids. Code of practice for design and installation of joints in buildings. Methods of test for routine control for water used in industry. Code of practice for use of immersion vibrators for consolidating concrete. Code of practice for steel tubular scaffolding. Code of practice for earthquake resistant design and construction of buildings. Code of practice for joints in surface hydro-electric power stations. Specification for form vibrators for concrete. Specification for batching and mixing plant. Specification for plywood for concrete shuttering work. Criteria for design of reinforced concrete bins for the storage of granular and powdery materials. Code or practice for sealing joints in concrete lining on canals. Recommendations for detailing of reinforcement in reinforced concrete work. Specification for foundation bolts. Glossary of terms relating to cement concrete. Code of practice for water proofing of underground water reservoirs and swimming pools. Code of practice for installation of joints in concrete pavements. Code of practice for extreme weather concreting. (Parts I & II) Recommended practice for shot concreting. Specification for admixtures for concrete.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 55 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		IS: 9417 Recommendations for welding cold worked steel bars for reinforced concrete construction. IS: 10262 Recommended guidelines for concrete mix design. IS: 11384 Code of practice for composite construction in structural steel and concrete. IS: 11504 Criteria for structural design of reinforced concrete natural draught cooling towers. IS: 12118 Specification for two-parts poly sulphide. IS: 12200 Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams. IS: 13311 Method of non-destructive testing of concrete. Part-1 Ultrasonic pulse velocity. Part-2 Rebound hammer. SP:23 Handbook of concrete mixes SP: 24 Explanatory Handbook on IS: 456-1978 SP: 34 Handbook on concrete reinforcement and detailing. Precast Concrete Works SP: 7(PartVI/ National Building Code- Structural design of prefabrication and Sec.7) systems building. IS: 10297 Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units. IS: 10505 Code of practice for construction of floors and roofs using pre-cast reinforced concrete units. Masonry and Allied Works IS: 1905 Code of Practice for Structural Safety of Buildings-Masonry walls. IS: 2212 Code of Practice for Brickwork.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 56 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	IS: 2250 Code of Practice for Preparation and use of Masonry Mortar. SP: 20 Explanatory hand book on masonry code. Sheeting Works IS:277 Galvanised steel sheets (plain or corrugated). IS: 459 Unreinforced corrugated and semi-corrugated asbestos cement sheets. IS: 513 Cold-rolled carbon steel sheets. IS: 730 Specification for fixing accessories for corrugated sheet roofing. IS: 1626 Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings. IS: 2527 Code of practice for fixing rain water gutters and down pipe for roof drainage. IS: 3007 Code of practice for laying of asbestos cement sheets. IS: 5913 Methods of test for asbestos cement products. IS: 7178 Technical supply conditions for tapping screw. IS: 8183 Bonded mineral wool. IS: 8869 Washers for corrugated sheet roofing. IS: 12093 Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets. IS: 12866 Plastic translucent sheets made from thermosetting polyster resin (glass fibre reinforced). IS: 14246 Specification for continuously pre-painted galvanised steel sheets and coils. Fabrication and Erection of Structural Steel Work IS: 2016 Specification for plain washers.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS PAGE 57 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS: 814 IS: 1852 IS: 3502 IS: 6911 IS: 3757 IS: 6623 IS: 6649 IS: 800 IS: 816 IS: 4000 IS: 9595 IS: 817 IS: 1811 IS: 9178 IS: 9006 IS: 7215 IS: 12843 IS: 4353 SP: 6 (Part 1 to 7)	Specification for covered Electrodes for Metal Arc Welding for weld steel. Specification for Rolling and Cutting Tolerances for Hot rolled steel products. Specifications for chequered plate. Specification for stainless steel plate, sheet and strip. Specification for high strength structural bolts Specification for high strength structural nuts. High Tensile friction grip washers. Code of practice for use of structural steel in general building construction. Code of practice for use of Metal Arc Welding for General Construction. Code of practice for assembly of structural joints using high tensile friction grip fasteners. Code of procedure of Manual Metal Arc Welding of Mild Steel. Code of practice for Training and Testing of Metal Arc Welders. Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes). Criteria for Design of steel bins for storage of Bulk Materials. Recommended Practice for Welding of Clad Steel. Tolerances for fabrication steel structures. Tolerance for erection of structural steel. Recommendations for submerged arc welding of mild steel and low alloy steels. ISI Hand book for structural Engineers.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 58 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS: 1608 IS: 1599 IS : 228 IS : 2595 IS : 1182 IS : 3664 IS : 3613 IS : 3658 IS : 5334 Plastering and Allied Works IS : 1635 IS : 1661 IS : 2333 IS : 2402 IS : 2547 IS : 3150 Acid and Alkali Resistant Lining IS : 158 IS : 412	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube. Method of Bend Tests for Steel products other than sheet, strip, wire and tube Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel. Code of Practice for Radio graphic testing. Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates. Code of practice for Ultra sonic Testing by pulse echo method. Acceptance tests for wire flux combination for submerged Arc Welding. Code of practice for Liquid penetrant Flaw Detection. Code of practice for Magnetic Particle Flaw Detection of Welds. Code of practice for field slaking of Building lime and preparation of putty. Application of cement and cement lime plaster finishes. Plaster-of-paris. Code of practice for external rendered finishes. Gypsum building plaster. Hexagonal wire netting for general purpose. Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting. Specification for expanded metal steel sheets for general purpose.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 59 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS : 4441	Code of practice for use of silicate type chemical resistant mortars.		
	IS : 4443	Code of practice for use of resin type chemical resistant mortars.		
	IS : 4456	Method of test for chemical resistant tiles. (Part I & II)		
	IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.		
	IS : 4832	Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type		
	IS : 4860	Specification for acid resistant bricks.		
	IS : 9510	Specification for bitumasitc, Acid resisting grade.		
	Water Supply, Drainage and Sanitation			
	IS : 458	Specification for concrete pipes.		
	IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.		
	IS : 651	Specification for salt glazed stoneware pipes.		
	IS : 774	Flushing cisterns for water closets and urinals.		
	IS : 775	Cast iron brackets and supports for wash basins and sinks.		
	IS : 778	Copper alloy gate, globe and check valves for water works purposes.		
	IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.		
	IS : 782	Caulking lead.		
	IS : 783	Code of practice for laying of concrete pipes.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 60 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	IS : 1172 Basic requirements for water supply, drainage and sanitation. IS : 1230 Cast iron rain water pipes and fittings. IS : 1239 Mild steel tubes, tubulars and other wrought steel fittings. IS : 1536 Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage. IS : 1537 Vertically cast iron pressure pipes for water, gas and sewage. IS : 1538 Cast iron fittings for pressure pipe for water, gas and sewage. IS : 1703 Ball valves (horizontal plunger type) including float for water supply purposes. IS : 1726 Cast iron manhole covers and frames. IS : 1729 Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories. IS : 1742 Code of practice for building drainage. IS : 1795 Pillar taps for water supply purposes. IS : 1879 Malleable cast iron pipe fittings. IS : 2064 Code of practice for selection, installation and maintenance of sanitary appliances. IS : 2065 Code of practice for water supply in building. IS : 2326 Automatic flushing cisterns for urinals. IS : 2470 (Part-I & II) Code of practice for installation of septic tanks. IS : 2501 Copper tubes for general engineering purposes. IS : 2548 Plastic seat and cover for water-closets. IS : 2556 (Part 1 to 15) Vitreous sanitary appliances (vitreous china). IS : 2963 Non-ferrous waste fittings for wash basins and sinks.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS PAGE 61 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	IS : 3114 Code of practice for laying of cast iron pipes. IS : 3311 Waste plug and its accessories for sinks and wash basins. IS : 3438 Silvered glass mirrors for general purposes. IS : 3486 Cast iron spigot and socket drain pipes. IS : 3589 Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter). IS : 3989 Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories. IS : 4111 (Part I to IV) Code of practice for ancillary structure in sewerage system. IS : 4127 Code of practice for laying of glazed stone-ware pipes. IS : 4764 Tolerance limits for sewage effluents discharged into inland-surface waters. IS : 4827 Electro plated coating of nickel and chromium on copper and copper alloys. IS : 5329 Code of practice for sanitary pipe work above ground for buildings. IS : 5382 Rubber sealing rings for gas mains, water mains and sewers. IS : 5822 Code of practice for laying of welded steel pipes for water supply. IS : 5961 Cast iron grating for drainage purpose. IS : 7740 Code of practice for road gullies. IS : 8931 Cast copper alloy fancy bib taps and stop valves for water services. IS : 8934 Cast copper alloy fancy pillar taps for water services. IS : 9762 Polyethylene floats for ball valves. IS : 10446 Glossary of terms for water supply and sanitation.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS PAGE 62 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS : 10592	Industrial emergency showers, eye and face fountains and combination units.		
	IS : 12592	Specification for precast concrete manhole covers and frames.		
	IS : 12701	Rotational moulded polyethylene water storage tanks.		
	SP: 35	Hand book on water supply and drainage.		
	-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.		
	Doors, Windows and Allied Works			
	IS : 204	Tower Bolts		
	Part-I	Ferrous metals.		
	Part-II	Nonferrous metals.		
	IS : 208	Door Handles.		
	IS : 281	Mild steel sliding door bolts for use with padlocks.		
	IS : 362	Parliament Hinges.		
	IS : 420	Specification for putty, for use on metal frames.		
	IS : 1003	Specification for timber panelled and glazed shutters-		
	Part-I door	(Part-I) shutters.		
	IS : 1038	Steel doors, windows and ventilators.		
	IS : 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.		
	IS : 1341	Steel butt hinges.		
	IS : 1361	Steel windows for industrial buildings.		
	IS : 1823	Floor door stoppers.		
	IS : 1868	Anodic coatings on Aluminium and its alloys.		
	IS : 2202	Specification for wooden flush door shutters (solid core type);		
	(Part-II)	particle board face panels and hard board face panels		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	IS:2209	Mortice locks (vertical type).		
	IS:2553	Safety glass		
	IS:2835	Flat transparent sheet glass.		
	IS:3548	Code of practice for glazing in buildings.		
	IS:3564	Door closers (Hydraulically regulated).		
	IS : 3614	Fire check doors; plate, metal covered and rolling type.		
	IS:4351	Steel door frames.		
	IS:5187	Flush bolts.		
	IS:5437	Wired and figured glass		
	IS:6248	Metal rolling shutters and rolling grills.		
	IS:6315	Floor springs (hydraulically regulated) for heavy doors.		
	IS:7196	Hold fasts.		
	IS:7452	Hot rolled steel sections for doors, windows and ventilators.		
	IS:10019	Mild steel stays and fasteners.		
	IS:10451	Steel sliding shutters (top hung type).		
	IS:10521	Collapsible gates.		
	R oof Water Proofing and AlliedWorks			
	IS:1203	Methods of testing tar and bitumen.		
	IS:1322	Specification for bitumen felts for water proofing and damp proofing.		
	IS:1346	Code of practice for water proofing of roofs with bitumen felts.		
	IS:1580	Specification for bituminous compound for water proofing and caulking purposes.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.		
	IS:3384	Specification for bitumen primer for use in water proofing and damp proofing.		
	Floor Finishes and Allied Works			
	IS:1237	Specification for 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 finish.		
	IS:2571	Code of practice for laying in-situ cement concrete flooring.		
	IS:3462	Specification for unbacked flexible PVC flooring.		
	IS:4971	Recommendations for selection of industrial floor finishes.		
	IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.		
	IS:8042	Specification for white portland cement.		
	IS:13801	Specification for chequered cement concrete flooring tiles.		
	Painting and Allied Works			
	IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.		
	IS:1477	Code of practice for painting of ferrous metals in buildings.		
	Part-I	Pretreatment.		
	Part-II	Painting.		
	IS:1650	Specification for colours for building and decorative finishes.		
	IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.		
	IS:2338	Code of practice for finishing of wood and wood based materials.		
	Part-I	Operations and workmanship		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	Part-II	Schedules		
	IS:2395	Code of practice for painting concrete, masonry and plaster surfaces.		
	Part-I	Operations and workmanship.		
	Part-II	Schedule.		
	IS:2524	Code of practice for painting of nonferrous metals in buildings.		
	Part-I	Pretreatment.		
	Part-II	Painting.		
	IS:2932	Specification of synthetic enamel paint, exterior, under-coating and finishing.		
	IS:2933	Specification enamel paint, under coating and finishing.		
	IS:4759	Code of practice for hot dip zinc coating on structural steel and other allied products.		
	IS:5410	Specification for cement paint		
	IS:5411 (Part-I)	Specification for plastic emulsion paint-for exterior use		
	IS:6278	Code of practices for white washing and colour washing.		
	IS:10403	Glossary of terms relating to building finishes.		
	Piling and Foundation			
	IS:1080	Code of practice for design and construction of simple spread foundations.		
	IS:1904	Code of practice for design and construction of foundations in Soils; General Requirements.		
	IS:2911	Code of practice for designs and construction of Pile foundations (Relevant Parts).		
	IS:2950	Code of practice for designs and construction of Raft (Part-I) foundation.		
	IS:2974 (Part-I TO V)	Code of practice for design and construction of machine foundations.		
	IS:6403	Code of practice for determination of Allowable Bearing pressure on Shallow foundation.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	IS:8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.		
	Part-I	Shallow foundations.		
	Part-II	Deep foundations.		
	IS:12070	Code of practice for design and construction of shallow foundations on rocks.		
	DIN:4024	Flexible supporting structures for machines with rotating machines.		
	VDI:2056	Criteria for assessing mechanical vibrations of machines.		
	VDI:2060	Criteria for assessing rotating imbalances in machines.		
	Stop Log and Trash Rack			
	IS:4622	Recommendations for fixed - wheel gates structural design.		
	IS:5620	Recommendations for structural design criteria for low head slide gates.		
	IS:11388	Recommendations for design of trash rack for intakes.		
	IS:11855	General requirements for rubber seals for hydraulic gates.		
	Roads			
	IRC:5	Standard specifications and Code of practice for road bridges, section-I general Features of Design.		
	IRC:14	Recommended practice of 2cm thick bitumen and tar carpets.		
	IRC:16	Specification for priming of base course with bituminous primers.		
	IRC:19	Standard specifications and code of practice for water bound macadam.		
	IRC:21	Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced).		
	IRC:34	Recommendations for road construction in waterlogged areas.		
	IRC:36	Recommended practice for the construction of earth embankments for road works.		
	IRC:37	Guidelines for the Design of flexible pavements.		
	IRC:56	Recommended practice for treatment of embankment slopes for erosion control.		
	IRC:73	Geometric design standards for rural (non-urban) highways.		
	IRC:86	Geometric Design standards for urban roads in plains.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 67 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	IRC:SP:13 Guidelines for the design of small bridges & culverts. IRC - Public- Ministry of Surface Transport (Roads Wing), Specifications ation for road and bridge works. IS:73 Specification for paving bitumen Loadings IS:875 Code of practice for design loads other than earthquake) for (Pt. I to V) buildings and structures. IS:1893 Criteria for earthquake resistant design of structures. IS:4091 Code of Practice for design and construction of foundation for transmission line towers & poles. IRC:6 Standard specifications & code of practice for road bridges, Section-II Loads and stresses. M.O.T. Deptt. of railways Bridge Rules. Safety IS:3696 Safety code for scaffolds and ladders. (Part I & II) IS:3764 Safety code for excavation work. IS:4081 Safety code for blasting and related drilling operations. IS:4130 Safety code for demolition of buildings. IS:5121 Safety code for piling and other deep foundations. IS:5916 Safety code for construction involving use of hot bituminous materials. IS:7205 Safety code for erection on structural steelwork. IS:7293 Safety code for working with construction machinery. IS:7969 Safety code for handling and storage of building materials IS:11769 Guidelines for safe use of products containing asbestos. - Indian Explosives Act. 1940 as updated. Architectural design of buildings SP:7 National Building Code of India SP:41 Hand book on functional requirements of buildings (other than industrial buildings)	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS PAGE 68 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	Miscellaneous IS:802 Code of practice for use of structural steel in (Relevant parts) overhead transmission line towers. IS:803 Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks. IS:10430 Criteria for design of lined canals and liner for selection of type of lining. IS:11592 Code of practice for selection and design of belt conveyors. IS:12867 PVC handrails covers. CIRIA Design and construction of buried thin-wall pipes. Publication REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents. Temperature Measurements - Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). - Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. - Temperature measurement by electrical Resistance thermometers - IS:2806. - Thermometer - element - Platinum resistance - IS:2848. Pressure Measurements - Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964). - Electronic transmitters BS:6447. - Bourdon tube pressure and vacuum gauges - IS:3624 - 1966. - Process operated switch devices (Pr. Switch) BS-6134.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS PAGE 69 OF 83

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
1.	PAR T-B	IV-D	3.07.00	8 OF 69	Gypsum Storage Shed The Gypsum storage shed shall be RCC framed structure with structural steel work shed with permanently colour coated profiled steel sheet roof and side cladding and RCC foundations etc. Roof shall be provided with troughed profile permanently colour coated sheet of 1 in 5 for quick drainage of rain water	Gypsum Storage Shed The Gypsum storage shed shall be RCC framed structure with RCC/ Brick infill wall (upto Tripper floor) and structural steel shed with permanently colour coated profiled steel sheet roof and side cladding (above tripper floor). Roof shall be provided with troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water. At grade level Heavy duty paving as detailed elsewhere in the specification shall be provided inside the shed.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
2.	V/B	IV-D	3.14.01, Para 1	10 of 69	Single-flue or multi-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level.	Single-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level. The centre to centre distance between the proposed chimney(s) and the existing chimney(s) in any direction shall not be less than 150 metres.
3.	V/B	IV-D	3.14.08	14 of 69	Thermal insulation The insulation shall be semi rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. pins and speed washer.	Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner) The insulation shall be semi rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. pins and speed washer.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
4.	VI/B	IV-D	3.14.09,	15 of 69	(iv) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab, external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT.	(iv) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab etc shall be painted with epoxy phenolic coating system having total 220 microns DFT.
5.	VI/A	II-A8	6.00.00, Annexur e-B	8 of 31	a) The basic wind speed “V _b ” at ten metres above the mean ground level	a) The basic wind speed “V _b ” at ten metres/second

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
6.	VII/A	II-A10	7.02.00	10 OF 30	For excavation 6 metres below FGL, sheet piling shall be provided.	Excavation may be carried out by using either sheet piling/ diaphragm wall/ secant piling/ contiguous piling or their combination.
7.	VII/A	II-A7/A8/A3/A5/A11	7.02.03 (xv)	14 OF 33/ 13 OF 31/ 14 OF 31/ 14 OF 40/ 15 OF 29	High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail.	Either of Static routine load test or High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
					load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.	Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.
8.	VII/A	II-A10 Project Information Barh STPP Stage-I	7.00.00	10 to 13 of 30	SOIL DATA AND FOUNDATION SYSTEM	“SOIL DATA AND FOUNDATION SYSTEM” given in “Annexure-1” to this amendment shall replace the contents of Clause 7.00.00, Page 10 to 13 of 30, Sub-section-II-A10, Part-A Sec-VI, of Tech. Specification.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
9.	VII/A	II-A6 Project Information Solapur	7.00.00	9 to 21 of 31	Foundation system & Geotechnical data	“Foundation system & Geotechnical data” given in “Annexure-2” to this amendment shall replace the contents of Clause 7.00.00, Page 9 to 21 of 31 , Sub-section- II-A6, Part-A Sec- VI, of Tech. Specification.
10.	VII/A	II-A4 Project Information Darlipali	Annexur e-IV of clause 7.00.00	-	-	“Annexure-IV BORE LOGS” at “Annexure-3” to this amendment added with clause 7.00.00, II-A4, Part-A Sec-VI, of Tech. Specification.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
11.	VII/A	II-A9 Project Information Meja TPP-I	Annexur e-IV of clause 7.00.00		Annexure-IV Borelog	“Bore Log ” given in “Annexure-4” to this amendment shall replace the contents of Page 26 to 28 of 36 , Clause 7.00.00 , Sub-section-II-A9, Part-A Sec-VI, of Tech. Specification.
12..	VII/A	II- A1/A2//A4/ A5/ A6/A8/A11	-	-	-	Electrical Resistivity Test (ERT) Data at “Annexure-5”.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
13.	VII/A	IIA2 Project Information Lara STPP Stage-I	5.00.00	3 to 10 of 48	“CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT”	“CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT” given in “Annexure-6” to this amendment shall replace the contents of Clause 5.00.00, Sub-section- II-A2, Part-A Sec-VI, of Tech. Specification.
14.	VII/A	II-A10 Project Information Barh STPP Stage-I	5.00.00	2 to 7 of 30	“CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT”	“CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT” given in “Annexure-7” to this amendment shall replace the contents of Clause 5.00.00, Sub-section- II-A10, Part-A Sec-VI, of Tech. Specification.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Secti on / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
15.	Secti on VI / Part A	Sub- Section III D	1.06.00	2 of 4	Uniform Finished Ground Level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	Uniform Finished Ground Level (FGL) in FGD areas shall be made available by the owner at a level specified in tender drawing.
16.	Secti on VI / Part A	Sub-section IIID	2.00.00	2 of 4	 r shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be in concrete (M 35) as per IRC standards, with minimum thickness of pavement (PQC) as 250mm (in concrete (M 35) as per IRC standards, with minimum thickness of pavement (PQC) as 250mm (in M 10 grade). Double lane road (width 12m having 7.5m wide pavement & 2.25m wide shoulders on both sides) shall be provided.	 Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be in concrete as per IRC standards, with minimum thickness of pavement (PQC) as 250mm (in M 35 grade) and DLC of 150 thick (in M 10 grade). Double lane road (width 12m having 7.5m wide pavement & 2.25m wide shoulders on both sides) shall be provided.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
17.	Secti on VI / Part B	Sub-section IVD	15.00.00	32 of 69	 Sewage pump house shall be provided as per IS:4111.	 Sewage pumping stations shall be provided as per IS:4111.
18.	Secti on VI / Part B	Sub-section IVD	14.00.00	31 of 69	These values shall be based on rainfall intensity of 90mm/hr	Th ese values shall be based on rainfall intensity of 75mm/hr

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
19.	Secti on VI / Part A	Sub Section IIA10 Project information, BARH STPP STAGE-1 (3X660MW)	2.00.00	30 of 30		The topographical survey drawing no: 9562-999-POC-F-002 is attached with this amendment as Annexure-8
20.	Secti on VI / Part A	Sub Section IIA8 Project information, NABINAGA STPP STAGE-1 (3X660MW)	10.00.00	31 of 31		The topographical survey drawing no: 0370-999-POC-F-002 is attached with this amendment as Annexure-9

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
21.	Secti on VI / Part A	Sub Section IIA2 Project information, LARA STPP STAGE-1 (2X800MW)	-	48 of 48		The topographical survey drawing no: 9548-999-POC-F-002 is attached with this amendment as Annexure-10
22.	Secti on VI / Part B	Sub-Section-IV- D Civil Works	4.02.00	18 to 19 of 69	The scope for potable water supply includes all distribution conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided. For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch.	The scope for potable water supply includes all distribution conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
23.	Secti on VI / Part B	Sub-Section-IV-D Civil Works	7.00.00, Para-2	24 of 69	In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification.	In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.6mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
24.	Secti on VI / Part B	Sub- Section-IV- D Civil Works	3.03.00, Para-1	6 of 69	The over ground portion of the transfer house shall be framed structure..... ...Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Contractor shall have option to use tubular steel sections for roof truss only. Vertical bracing shall be provided only on four sides along the periphery. Grade slab with 0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.	The over ground portion of the transfer house shall be framed structure.....Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Vertical bracing shall be provided only on four sides along the periphery. Grade slab with 0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
25.	Secti on VI / Part B	Sub-Section-IV-D Civil Works	3.04.00, Para-1	7 of 69	The crusher house shall be framed structure..... Adequate steel doors and windows for natural lighting and ventilation shall be provided. Contractor shall have option to use tubular steel sections for roof truss only. Vertical bracings shall be provided only on four sides along the periphery.	The crusher house shall be framed structure..... Adequate steel doors and windows for natural lighting and ventilation shall be provided. Vertical bracings shall be provided only on four sides along the periphery.
26.	Secti on VI / Part B	Sub-Section-IV-D Civil Works	3.09.00, Para-1	8 of 69	All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. For steel staircases, Stringers shall be of rolled steel channel (minimum SMC 250) and tread shall be of steel gratings. Out side stairs to transfer points/crusher house shall be open type. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's.	All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. For steel staircases, Stringers shall be of rolled steel channel (minimum SMC 250) and tread shall be of steel gratings. Out side stairs to transfer points/crusher house shall be open type. However sheeting shall be provided at the top. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
27.	Secti on VI / Part B	Sub- Section-IV- D Civil Works	3.01.00, Para-11	3 of 69	Plinth protection along with drains shall be provided along the Hopper complex. However, 5m wide paving shall also be provided around machinery hatches.	Plinth protection along with drains shall be provided along the Hopper complex. However, minimum 5m wide paving shall also be provided around machinery hatches and Truck hopper.
28.	Secti on VI / Part B	Sub- Section-IV- D Civil Works	24.00.00 ,	42 of 69	CONCRETE c) M35- For spring supported RCC deck	CONCRETE c) M35- For spring supported RCC deck and rail load bearing structure (if applicable).

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
29.	Secti on VI / Part B	Sub-Section-IV-D Civil Works	39.03.00 ,	66 of 69	Fly ash based Portland pozzolana cement conforming to IS: 1489 Part - I shall preferably be used. However, the contractor may use other types of cements conforming to IS: 269, IS: 8112, IS: 12269, & IS: 455.	Cement Fly ash based portland pozzolana cement conforming to IS:1489 (Part-1) shall be used for all areas other than for the critical structures identified below. Other properties shall be as per IS code. Ordinary Portland Cement (OPC) shall necessarily be used for the following structures. a) Spring supported decks of limestone crusher b) RCC for Chimney shell. The grade of cement shall be Grade 43 for OPC conforming to IS:8112. In place of fly ash based portland pozzolana cement, OPC mixed with Fly Ash can be used. Batching plant shall have facility for mixing fly ash. Fly ash shall conform to IS:3812(Part I & Part II). Percentage of fly ash to be mixed in concrete shall be based

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
						on trial mix. Mix design shall be done with varying percentage of fly ash mix with cement.
30.	Secti on VI / Part B	Sub- Section-IV- D Civil Works	39.05.00 ,	66 of 69	-	Aggregates a) Coarse Aggregate Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383. b) Fine Aggregate Fine aggregate shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or
LOT 1A PROJECTS FLUE GAS DESULPHURISATION (FGD)SYSTEM PACKAGE BIDDING DOCUMENT NO.: CS-0011-109(1A)-2					AMENDMENT NO. CS-0011-109(1A)-2-AMDT-03(T)	Page 18 of 117

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
						pellets. Fine aggregate in concrete shall conform to IS : 383. For plaster, it shall conform to IS : 1542 and for masonry work to IS : 2116. c) Petrographic examination of aggregate shall be carried out by the contractor at National Council for Cement and Building Materials (NCB), Ballabgarh, or any other approved laboratory to ascertain the structure and rock type including presence of strained quartz and other reactive minerals. In case, the coarse aggregate sample is of composite nature, the proportions (by weight) of different rock types in the composite sample and petrographic evaluation of each rock should also be ascertained. While determining the rock type, special emphasis should be given on identification of known reactive rocks like

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
						chaledony, opal etc. The procedure laid down in IS 2430 for sampling of aggregates may be followed. The laboratory shall determine potential reactivity of the aggregate, which may lead to reaction of silica in aggregate with the alkalis of cement and / or potential of some aggregates like limestone to cause residual expansion due to repeated temperature cycle. If the same is established, the contractor shall further carry out alkali aggregates reactivity test as per IS 2386 (Pt.VII) and / or repeated temperature cycle test to establish the suitability of the aggregates for the concrete work. The test results, with the final recommendations of the laboratory, as to a suitability of the aggregate, for use in the concrete work for various structures and suggested measures, in case of results

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
						are not satisfactory, shall be submitted to the Engineer for his review, in a report form. In case in the report, it is established, that the aggregates contain reactive silica, which would react with alkalis of the cement, the contractor shall change the source of supply of the aggregate or use low alkali cement as per recommendation or take measures as recommended in the report as instructed by Engineer. In case aggregates indicate residual expansion, under repeated temperature cycle test (from 10° Celsius to 65° Celsius and for 60 temperature cycles) the material shall not be used for concreting of Lime stone crusher decks, Mills, Fans and other equipment foundations which are likely to be subjected to repeated
LOT 1A PROJECTS FLUE GAS DESULPHURISATION (FGD)SYSTEM PACKAGE BIDDING DOCUMENT NO.: CS-0011-109(1A)-2					AMENDMENT NO. CS-0011-109(1A)-2-AMDT-03(T)	Page 21 of 117

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
						temperature cycle. The contractor shall use aggregates free from residual expansion under repeated temperatures cycle test.
31.	Secti on VI / Part B	Sub- Section-IV- D Civil Works	8.00.00, Para-3	26 of 69	Bricks to be used in brickwork shall be of minimum Class designation 50.	Only fly ash bricks shall be used in all construction. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm ² . Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS 13757 and IS 12894 respectively. Minimum fly ash content in fly ash based bricks shall be 25%.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
32.	SECTION - VI, PART-B	SUB-SECTION-III-C5 PLC BASED CONTROL SYSTEM	9.05.00	19 of 27	Bidder shall clearly bring out in the proposal the redundancy feature along with configuration diagram, single line diagram and datasheets etc. & this shall be finalized subject to approval during detail engineering. Configuration B : UPS system shall consist of 1 x 100% charger and inverter with input isolation transformer, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories. Scheme of UPS system Configuration-B Drg. no. 0000-999-POI-A-019C	Bidder shall clearly bring out in the proposal the configuration diagram, single line diagram and datasheets etc. & this shall be finalized subject to employer's approval during detail engineering. Configuration B : UPS system shall consist of 1 x 100% charger and inverter with input isolation transformer, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories. UPS Configuration-B drawing 0000-999-POI-A-019C updated.
	SECTION - VI, PART-T-E	Tender drawing C&I		18 of 53 (of PDF)		

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
33.	SECTION – VI, PART-A	SUB-SECTION- IIIC C&I	New clause 1.00.00 e)	1 of 8		1.00.00 e) Scope defined in PART-A read in conjunction with PART-B has to be provided for each station (i.e. 11 sets for 11 stations) under LOT-1A package. The scope detailed hereunder in the following clauses is for one set.
34.	SECTION – VI, PART-T-E	Tender drawing C&I		13 of 53 (of PDF)	Standard configuration drawing for PLC based offsite control system. Tender drawing no. 0000-151-POI-A-013 (Rev no. A).	Standard configuration drawing for PLC based offsite control system. Tender drawing no. 0000-151-POI-A-013 (Rev no. B).
35.	SECTION – VI, PART-A	SUB-SECTION- IIIC C&I	New clause 2.07.00	4 of 8	-	2.07.00 Contractor shall provide one no. of Hand held HART calibrator per generating unit.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
36.	SECTION – VI, PAR T-A	SUB-SECTION- III C&I	New clause 6.08.00	7 of 8	-	6.08.00 Binary and modulating controls of complete Flue gas desulphurization system, associated material handling systems etc. and other systems being provided under the contract shall be implemented in PLC. The PLC based Control System shall have separate process blocks for unitised system and one process block for common system including material handling system. For example in KUDGL-I (3x800MW), the PLC based control system shall have following process blocks: (i) Unit-1 FGD and associated system (ii) Unit-2 FGD and associated system (iii) Unit-3 FGD and associated system (iv) Common system including material handling systems.
37.	SECTION – VI, PAR T-B	SUB-SECTION-III- C2, MEASURING INSTRUMEN TS	8.00.00	16 OF 34	Coriolis Flow Transmitter: Viscosity range of Fluid 0-500cst for HFO.	Coriolis Flow Transmitter: Viscosity range of Fluid 0-500cst for HFO.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
38.	SECTION – VI, PART-A	SUB-SECTION- III C&I	6.01.00	7 of 8	6.01.00 on as required basis (to be decided during detail Engineering) for controlling and monitoring of the FGD and associated system being provided under the contract located in FGD control room. One OWS shall also be provided with capabilities of programming station of PLC and Human Machine Interface system (EWS cum OWS). The PLC configuration drawing.....	6.01.00 on as required basis (to be decided during detail Engineering) for controlling and monitoring of the FGD and associated system being provided under the contract located in FGD control room. One OWS shall also be provided with capabilities of programming station of PLC and Human Machine Interface system (EWS cum OWS). However, bidder to consider minimum quantity of OWS and OWS cum EWS as follows: a) OWS (placed in FGD control room)-(N+1) where N is the total number of generating units per project under this package. b) OWS cum EWS (placed in FGD control room)-ONE (1) c) OWS (placed in central control room of each generating unit)-TWO (2). The PLC configuration drawing.....

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
39.	SECTION – VI, PAR T-A	SUB-SECTION- III C&I	New clause 6.09.00	7 of 8	-----	6.09.00 The Bidder shall provide maintenance services of complete control System under a comprehensive Annual Maintenance Contract (AMC) for period of three year after Warranty period.
	SECTION – VI, PAR T-B	SUB-SECTION- III-C5 PLC BASED CONTROL SYSTEM	16.01.00	26 of 27	16.01.00 The Bidder shall provide maintenance services of complete control System under a comprehensive Annual Maintenance Contract (AMC) for period of one year after Warranty period and thereafter AMC for only hardware support for next two years.	16.01.00 The Bidder shall provide maintenance services of complete control System under a comprehensive Annual Maintenance Contract (AMC) for period of three year after Warranty period.
40.	SECTION – VI, PAR T-E	Tender drawing C&I		19 and 20 of 53 (of PDF)	Instrumentation/control/power supply cabling diagram Drg No. 0000-101/102-POI-A-021 Sheet 1 of 3 and sheet 2 of 3	Instrumentation/control/power supply cabling diagram Drg No. 0000-101/102-POI-A-021 Sheet 1 of 3 and sheet 2 of 3 updated.

AMENDMENT NO. 3 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. No.	Sect ion / Part	SUB SECTION	Clause No.	Page No.	EXISTING	READ AS
41.	SECTION – VI, PART-A	SUB-SECTION- III C&I	7 of 8	New clause 6.10.00	-	6.10.00 Contractor shall provide control desk placed in FGD control room, meeting specification requirements stipulated in clause 10.04.00, PART-B, Sub Section III-C5 of technical specification. Contractor shall also provide a control desk for each generating unit, of length 2 meter aesthetically matching with the existing control desk of main plant Central Control Room (CCR) for placing FGD OWS in main plant CCR.
42.	SECTION – VI, PART-E	Tender drawing		5 of 53 (of PDF) 6 of 53 (of PDF)	Tender drawing no. 0011-109-POM-A-001(a): Scheme of FGD Absorber system (Single unit) Tender drawing no. 0011-109-POM-A-001: Scheme of FGD Absorber system (For two units)	NOTE 13 and 17 deleted NOTE 13 and 17 deleted

AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc.	lowest level should not be lower than 45 meters above the ground and vertical spacing of the intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc.
35.	Section VI / Part B	Sub-Section -IV-D Civil Works	2.00.00	1 of 69	"Sub QR for civil works:"	" Clause Deleted"
36.	VI/B	Sub-section IVD Civil Works	1.02.00	01 of 69	The specifications are intended for the general description of the work.....in writing with the Employer in respect of interpretation of any portions of this document.	The specifications are intended for the general description of the work, quality and workmanship. The specifications are not, however, intended to cover minutest details and the work shall be executed according to the relevant latest Indian Standard Codes / I. R. S. / I. R. C. specifications. Where provisions are not covered in Indian Standards, reference shall be made to ACI, AISC, ASCE, EN, CICIND and other international standards or to the best prevailing local Public Works Department practices or to the instructions of the Engineer. Some of the relevant I. S. Codes to be followed

FLUE GAS DESULPHURISATION (FGD)SYSTEM PACKAGE FOR LOT 1A PROJECTS BIDDING DOCUMENT NO.: CS-0011-109(1A)-2	AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T)	Page 13 of 60

AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
						are mentioned in the Technical Specifications. The Contractor is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Employer in respect of interpretation of any portions of this document.
37.	VI/A	II- A1/A3/ A4/A5/ A6/A7/ A9/A11 Project Informa tion	5.00.00		SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT	“SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT” given in “Civil Annexure-1” to this amendment shall replace the “SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT” at Clause 5.00.00, Sub-section-II- A1/ A3/A4/A5/A6/A7/A9/A11, Part-A, Sec-VI, of Tech. Specification.
38.	Amendment No.03. to Technical specification (Section-VI) (Amendment No. CS-0011-109(1A)-2-AMDT-03(T)) Sl.No. 13, Page-8 of 102				“SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT” of Lara STPP Project	“SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT” of Lara STPP Project given in “Civil Annexure-2” to this amendment shall replace the “SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT” Amendment No.03. to Technical specification (Section-VI) (Amendment No. CS-0011-109(1A)-2-AMDT-03(T)), Sl.No. 13, Page-8 of 102

FLUE GAS DESULPHURISATION (FGD)SYSTEM PACKAGE FOR LOT 1A PROJECTS BIDDING DOCUMENT NO.: CS-0011-109(1A)-2	AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T)	Page 14 of 60

AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
39.	Amendment No.03. to Technical specification (Section-VI) (Amendment No. CS-0011-109(1A)-2-AMDT-03(T)) Sl.No. 14, Page-8 of 102				“SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT” of Barh STPP Project	“SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT” of Barh STPP Project given in “ Civil Annexure-3 ” to this amendment shall replace the “ SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT ” at Amendment No.03. to Technical specification (Section-VI) (Amendment No. CS-0011-109(1A)-2-AMDT-03(T)), Sl.No. 14, Page-8 of 102
40.	Errata No.01 to Technical specifications, Section-VI (Doc. No.:CS-0011-109(1A)-2-ERRATA-01)				“SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT” of Nabinagar STPP Project (3x660MW)	“SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT” of Nabinagar STPP (3x660MW) Project given in “ Civil Annexure-4 ” to this amendment shall replace the “ SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT ” at Errata No.01 to Technical specification (Doc. No.:CS-0011-109(1A)-2-ERRATA-01).

FLUE GAS DESULPHURISATION (FGD)SYSTEM PACKAGE FOR LOT 1A PROJECTS BIDDING DOCUMENT NO.: CS-0011-109(1A)-2	AMENDMENT NO. CS-0011-109(1A)-2-AMDT-05(T)	Page 15 of 60

AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
41.	Section VI / Part B	Sub-Section -IV-D Civil Works	17.01.00	35 of 69	Design of steel structures shall be done by working stress method. Design shall be as per provisions of IS:800:1984.	Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) and other relevant IS standards.
42.	Section VI / Part B	Sub-Section -IV-D Civil Works	17.26.00	38 of 69	-	For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015 for Earthquake loads.
43.	Section VI / Part B	Sub-Section -IV-D Civil Works	17.27.00	38 of 69	-	Design drawings of steel structures shall include the connection, joint & fastener details for Main columns, Beams & Bracings.
44.	VI/A	IIA2	BORE LOG	Page:23 to 39 of 48	BH No.53,54,55,57,58,60,163,164	“Bore Logs” given in “Civil Annexure-5” to this amendment shall replace the contents of Bore Logs, Page 23 to 39 of 48 , Sub-section- II-A2, Part-A Sec-VI, of Tech. Specification.
45.	VI/B	IV-D	3.01.00(a)	4 of 69	-----	New Clause: Limestone Storage Silo The supporting structure for silo shall be of structural steel. Independent supporting structure shall be provided for each silo.
46.	Amendment No. 03 to technical specification (Section-VI) Sl. No. 02, Page 2 of 102				Single-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for	Single-flue chimney(s) shall be provided, except for Tanda TPP (2X660MW) and Meja TPP (2X660MW) where twin-flue

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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					each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level. The centre to centre distance between the proposed chimney(s) and the existing chimney(s) in any direction shall not be less than 150 metres.	Chimney shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point for single flue chimney shall be minimum 150 meters above the plant grade level and for twin flue chimney flue gas emission point shall be minimum 220m above the plant grade level. The centre to centre distance between the proposed chimney(s) and the existing chimney(s) in any direction shall not be less than 150 metres. For Barh-I (3X660MW) already existing 275m high chimneys shall be utilized with modifications as specified elsewhere in mechanical specification and hence, new chimney is not to be provided under FGD package. General Arrangement Drawing of already existing Chimneys at Barh-I are provided in Sub Section-II -A10, Part A, Section-VI for reference.
47.	VI/B	IV-D	3.14.01 Para 3	11 of 69	The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be bottom supported and shall be profiled into a circular shape to connect to the	The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be profiled into a circular shape to connect to the flue liner. The flue

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					flue liner. The flue duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic fluoroelastomeric fabric expansion joint.	duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic expansion joint.
48.	VI/B	IV-D	3.14.01 Para 4	11 of 69	The expansion joint in the flue liner shall comprise of non-metallic fluoroelastomeric material suitable to withstand a temperature of 300 Deg C , shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable to withstand a temperature of 300 Deg C and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh.	The expansion joint in the flue liner shall comprise of non-metallic material suitable for wet stack operations , shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable for wet stack operations and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh. Design of expansion joint shall comply EPRI guideline to avoid contact of condensate with expansion joint material and to ensure drainage of condensate.
49.	VI/B	IV-D	3.14.01 Para 5	11 of 69	Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell	Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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					with chequered plate floor panels and pipe handrails, shall be provided for full height of the chimney and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch.	chimney shell with chequered plate floor panels and pipe handrails, shall be provided upto the platform just below roof platform and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch.
50.	VI/B	IV-D	3.14.01 Para 6	11 of 69	The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, mild steel wind strakes (if required) , all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects.	The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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						reasonably implied and necessary to complete the job in all respects.
51.	VI/B	IV-D	3.14.02 Para 7	12 of 69	The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings. Design of all chimney components shall be based on working stress method.	The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings.
52.	VI/B	IV-D	3.14.03 Para 1	12 of 69	The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The load calculation and load combinations shall be as detailed in IS 4998 (Part 1) : 1992. The wind shield shall be analysed for cases with and without flue liner loads.	The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The analysis and design of wind shield shall be carried out as per IS 4998. The wind shield shall be analysed for cases with and without flue liner loads.
53.	VI/B	IV-D	3.14.03 Para 2	12 of 69	Forces/stresses in the wind shield due to eccentricity effects of local (e.g. corbel) loadings, insulations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered.	Forces/stresses in the wind shield due to eccentricity effects of local loadings, insulations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered.
54.	VI/B	IV-D	3.14.03 Para 6	12 of 69	The stresses for the shell design shall not exceed the limits given in Cl. 7.0 of IS:4998 (PART-I) 1975 for various combinations of loads, excepting the stress in concrete for the case of dead load + wind load which shall not	DELETED

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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					exceed 0.30fck where fck is the characteristic compressive strength of concrete.	
55.	VI/B	IV-D	3.14.03 Para 9	13 of 69	There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a sudden change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level.	There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level.
56.	VI/B	IV-D	3.14.03 Para 14	13 of 69	The final design shall be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located in the area or in the future expansion stage of the project shall be determined along with the other topographical features of the local area through model test.	The final design shall be checked & verified by 'Wind Tunnel Test' conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located upto distance of 20 times diameter at 2/3rd height of subject chimney , in the area or in the future expansion stage of the project, as envisaged by the owner at the time testing , shall be determined along with the other topographical features of the local area through model test.
57.	VI/B	IV-D	3.14.04 Para 5	13 of 69	Clean-out door shall be provided below the flue for the removal of ash.	DELETED

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
58.	VI/B	IV-D	3.14.07 Para 5	14 of 69	The chimney foundation shall be designed for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation for any loading condition. Since chimney is a wind sensitive structure no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. No allowance shall be made in the stresses for design of foundation for wind loading. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 25 .	The chimney foundation shall be designed as per limit state method as per IS 4998 for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation/ piles for any loading condition. Since chimney is a wind sensitive structure, no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 30 .
59.	VI/B	IV-D	3.14.08 Para 2	14 of 69	The insulation thickness shall be determined based on the maximum/minimum ambient	DELETED

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					temperature, surface air velocity worked out based on the draught of ventilation air in the annular space between the flue liner and chimney shell, insulation surface emissivity of 0.3 and the insulation cold face maximum temperature not exceeding 55 degree Celsius. The draught of air in the annular space shall be the natural draught created by the heating of air by the flue liner and the air being vented out through the openings in the chimney shell. The increase in the annulus air temperature due to the rising heated air shall be taken into account while calculating the insulation thickness.	
60.	VI/B	IV-D	3.14.09 (i)	15 of 69	All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) except surfaces of steel wind strakes shall be painted as specified in corrosion protection clause of this specification.	All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) shall be painted as specified in corrosion protection clause of this specification.
61.	VI/B	IV-D	3.14.09 (ii)	15 of 69	All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT. a) All steel surfaces shall be provided with two component epoxy primer coat (having solid by volume minimum 51% $\pm$ 2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer	DELETED

AMENDMENT NO. 5 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					coat shall be applied in shop immediately after blast cleaning by airless spray technique. b) Primer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique. c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% $\pm$ 2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 Δ E) and minimum 70 micron DFT. This coat shall be applied in shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.	
62.	VI/B	IV-D	3.14.09 (iii)	15 of 69	All steel parts embedded in concrete like Strake embedment assembly including bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes.	All steel parts embedded in concrete like bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes.

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SL. NO.	SPECIFICATION REFERENCE				EXISTING		READ AS	
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.				
							(iv)	
129.	VI	I-M1	8 of 51	4.01.01 3(iii)	Pressure at Booster Fan suction	0 mmWc	Pressure at terminal point before Booster Fan suction	0 mmWc
130.	VI/B	I-M1	27 of 51	7.07.05	The secondary wastewater underflow shall be taken to the adequately sized filtrate tank, while the overflow shall be taken to a wastewater tank.		The secondary wastewater underflow shall be taken to the adequately sized filtrate tank while the overflow shall be taken to a wastewater tank. In case Bidder opts to provide additionally Lamella separator before the waste water tank and after the secondary hydro cyclone for removing impurities from the system, the solids concentration in waste water up to max 10% can be acceptable .However, the required moisture content in Gypsum & required Gypsum quality shall be complied.	
131.					ZLD envisaged for Barh (3x660 MW) & BRBCL (4x250MW)		ZLD stands deleted for both these projects (Barh-I (3x660 MW) & BRBCL (4x250MW)). Accordingly, all clauses and Drgs indicated in the specification pertaining to ZLD will not be applicable and clauses and drgs indicated in the	

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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						specification related Wastewater treatment system shall be applicable to these two projects also.
132.	VI/A	IV	2 of 3	1.08.00	Waste Water FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank , and 300 mm above FFL in HCSD Silo Area. Pressure at terminal point shall be 3.0 kg/cm2(g) , pH shall be 7.0 (approx.) and temperature shall be <50°C.	Waste Water FGD waste water pipes shall terminate along with isolation valve at 5 Meters near HCSD Mixing Tank , and 300 mm above FFL in HCSD Silo Area. Pressure at terminal point shall be 3.0 kg/cm2(g) , pH shall be 7.0 (approx.) and temperature shall be <50-60°C. For (Barh-I (3x660 MW) & BRBCL (4x250MW):- FGD waste water pipes shall terminate along with isolation valve ash slurry sump. PH shall be 7.0 (approx.) and temperature shall be <50-60°C at terminal point.
133.	VI/A	VII	1 of 61	1.01.00 a)	The list of mandatory spares considered essential by the Employer is indicated in the list enclosed to this Sub-Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the price of any spare item, the cost of such spares	The list of mandatory spares considered essential by the Employer is indicated in the list enclosed to this Sub-Section. The bidder shall indicate the prices for each and every item (except for items not applicable to the bidders design) in the 'Schedule of Mandatory Spares' whether or not he considers it necessary for the Employer to have such spares. If the bidder fails to comply with the above or fails to quote the

FLUE GAS DESULPHURISATION (FGD)SYSTEM PACKAGE FOR LOT 1A PROJECTS

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CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
13.	PART-A	III-A5	1 OF 6	1.01.00	Based on site visit, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid. Bidder shall bring out all necessary modification and relocation of existing facilities, if required, along with proposed Layout submitted with the bid	We understand any modification and relocation is not in the scope of this package. Please confirm	All required modification and demolition work of existing facilities shall be in the bidder's scope. However if any relocation of existing facility is required, the same shall be done by the employer.
14.	PART-A	III-A5	2 OF 6	2.01.01	Based on site visit, bidder shall submit layout for Limestone handling plant & Gypsum handling facilities along with their techno-commercial bid. Bidder shall bring out all necessary modification and relocation of existing facilities, if required, along with proposed Layout submitted with the bid	Request customer to furnish the drawings of the existing facilities to study the modification required in the existing facility.	Bidder shall refer the GLP drawing attached with the tender documents and shall also visit the site to study existing facilities that require modification.
15.	PART-B	IV-D	23 OF 69	5.07.00	Polycarbonate sheet of 3 mm thick....	We propose to use 2 mm thick polycarbonate sheets. Please confirm.	Bidder shall comply with technical specification requirement

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
16.	PART-B	IV-D	30 OF 69	11.00.00	Fencing around lime storage/ gypsum storage area.	We do not understand the requirement of any fencing in these areas. Kindly review the requirement and confirm.	Refer Scope of work. Refer clause 2.00.00, Section-VI, Part-A of technical specification.
17.	PART-B	IV-D	8 OF 69	3.07.00	Gypsum storage shed- Gypsum storage shed shall be of RCC –framed structure with steel structure framed structure----	Details specified for gypsum storage shed is not clear. Please furnish the detail specification for the gypsum storage shed. We propose to use space frame structure with bolted joints. Please confirm.	Bidder to refer amendment in this regard.
18.	PART-A	III-A5	3 OF 6	2.01.07	Crushed limestone reclaim hopper(RH silo)Machinery hatch---	Please furnish the detail specification for the lime stone storage shed. We propose to use space frame structure with bolted joints. Please confirm.	Bidder to refer necessary amendment in this regard.
19.	PART-A	III-A5	3 OF 6	2.01.10	Suitable no. of motorized travelling tripper /flow diverter----feeding the crushed limestone to limestone shed	We understand that intermediate supporting trestle can be provided for the supporting of tripper conveyor gallery inside lime stone shed. Please confirm.	Confirmed. However adequate space for movement of dozer/payloader shall be provided.
20.	PART-A	III-A5	6 OF 6	3.06.00	Suitable no. of motorized travelling tripper /flow diverter-	We understand that intermediate supporting trestle can be provided	Confirmed. However adequate space for movement of doz-

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
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					er---feeding the gypsum to gypsum shed.	for the supporting of tripper conveyor gallery inside gypsum shed. Please confirm.	er/payloader shall be provided.
21.	PART-B	IV-D	8 OF 69	3.07.00	Gypsum storage shed- Gypsum storage shed shall be of RCC –framed structure with steel structure framed structure-----	We understand that for the gypsum stock pile area no PCC/RCC paving is required. Only leveling and grading of gypsum stockpile area is needed.	Bidder to refer amendment in this regard.
22.	PART-A	III-A5	3 OF 6	2.01.07	Crushed limestone reclaim hopper(RH silo)Machinery hatch---	We understand that no retaining wall and peripheral drain needed around lime stone stock pile and gypsum stock pile please confirm.	Bidder's understanding is not correct. Retaining wall and peripheral drain around lime stone stock pile and gypsum stock pile along with suitable entry point for dozer entry with ramp need to be provided by the successful bidder.
BARH							
23.	VI/PART-A	II-A10	1 OF 30	1.05.00	Railway siding.	We understand that work of railway siding is not in the scope of bidder. Kindly confirm our understanding is correct.	Bidders understanding is correct.
24.	VI/PART-A	II-A10	10 OF 30	7.01.00	FGL generally corresponds to RL 46.20M-----to achieve the FGL as indicated above.	Please furnish the topographical survey drawing and contour drawings of the site.	Bidder to refer amendment in this regard.

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Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
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25.	VI/PART-A	II-A10	10 OF 30	7.01.00	FGL generally corresponds to RL 46.20M-----to achieve the FGL as indicated above.	We understand that FGD area marked in plot plan is already levelled and graded and now no further leveling and grading is needed. Please confirm.	Site levelling shall be done by Owner as per the levels specified in GLP in tender document. Only site clearance and minor grading is in bidder's scope.
26.	VI/PART-A	II-A10	10 OF 30	7.03.00	The foundation system to be adopted for different structures shall be as given below---	Please furnish the bore log details and drawings showing the locations of various bore logs.	Borelog have already furnished in the tender document. For, location of boreholes, co-ordinates indicated in borelog may be referred.
27.	Plot plan	-	-	9558/956 0-999- POC-F-001/Rev. No.8-D0	ROAD AND DRAINS	Since FGD facilities are to be incorporated in the existing layout .Kindly furnish the road and drain layout for the present scope of work.	Kindly refer GLP of Barh project furnished with the tender document.
GADARWARA II							
28.	-	-	-	-	General layout plan	Kindly furnish the FGL to be adopted for the different systems/areas of FGD	FGL is indicated in GLP.
MOUDA II							
29.	-	-	-	-	General layout plan	Kindly furnish the FGL to be adopted for the different systems/areas of FGD	FGL is indicated in GLP.
NABINAGAR II							
30.	-	-	-	-	General layout plan	Kindly furnish the FGL to be adopted for the different systems/areas of FGD	FGL is indicated in GLP.

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Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIRE- MENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
SOLAPUR							
31.	-	-	-	-	Geo- technical investigation Report	Kindly furnish geo technical report along with the Recommended SBC and foundation system to be adopted.	The geotechnical investigation report for the vicinity area will be made available for the Bidder's study at the Owner's office. However, for borelog data, bidder may refer Amendment .
32.	-	-	-	-	General layout plan	Kindly furnish the FGL to be adopted for the different systems/areas of FGD	FGL is indicated in GLP.
BRBCL							
33.	VI/PART-A	II-A11	3 OF 29	3.00.00	Railway siding.	We understand that work of railway siding is not in the scope of bidder. Kindly confirm our understanding is correct.	Bidders understanding is correct.
34.	VI/PART-A	II-A10	12 OF 29	7.02.01	General Requirement	Please furnish FGL to be considered in FGD area.	FGL is indicated in GLP.
35.	VI/PART-A	II-A10	11 OF 29	7.03.00	Geo technical data and foundation system for the respective project are enclosed at Annexure-III .The corresponding bore logs are enclosed at at Annexure-IV.	Bore log details furnished in Annexure-IV are of ash handling area. Kindly furnish the bore log details of FGD area also.	Bidder may refer Clause No.7.00.02, as mentioned in Clause No. 7.00.02, the available borelog data is of vicinity to proposed structure and the same has already been furnished in the tender document for bidder's guidance. Detailed Geotechnical Investigation shall be carried out by contractor.

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
36.	Plot plan		0270-999-POC-F-001(Rev.No .6)		ROAD AND DRAINS	Since FGD facilities are to be incorporated in the existing layout .Kindly furnish the road and drain layout for the present scope of work.	Refer General Layout Plan. Road and drain drawing shall be provided after award.
DARLIPALLI							
37.	VI/PART-A	II-A4	1 OF 30	1.02.00	The main plant---railway siding---	We understand that work of railway siding is not in the scope of bidder. Kindly confirm our understanding is correct.	Confirmed.
38.	VI/PART-A	Annexure-III	19 OF 30		Natural ground level is varying as per enclosed contour/spot level	Please furnish FGL to be considered in FGD area.	FGL is indicated in GLP.
39.	VI/PART-A	II-A10	10 OF 30	7.00.01	Geo technical data and foundation system for the respective project are enclosed at Annexure-III .The corresponding bore logs are enclosed at at Annexure-IV.	Kindly furnish annexure- IV as the same is not available with tender document.	Bidder to refer amendment in this regard.
40.	Plot plan		9549-999-POC-F-001		ROAD AND DRAINS	Since FGD facilities are to be incorporated in the existing layout .Kindly furnish the road and drain layout for the present scope of work.	Refer General Layout Plan. Road and drain drawing shall be provided after award.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
71.					Gypsum/ Byproduct : Gypsum Storage Yard for Wet FGD	Kindly furnish angle of repose for limestone & gypsum.	Angle of repose shall be considered as 38 deg for limestone and 35 deg for gypsum.
72.	SECTION-VI, PART-B,	SUB-SECTION-IM6, LIME-STONE HANDLING PLANT	3.1.0	128 OF 274	A mechanised system shall be.....before limestone crusher.	Bidder is considering over ground truck tippler and dedicated limestone handling conveyor of capacity 150 TPH till limestone crusher. Please confirm.	Confirmed. However for unloading through existing WT/Track Hopper, the minimum stream capacity shall be 1200 MTPH.
73.	SECTION-VI, PART-B,	SUB-SECTION-IM6, LIME-STONE HANDLING PLANT	3.2.0	128 OF 274	"As received" limestone shall be up to limestone bunkers.	Bidder understands that the uncrushed limestone received from wagon tippler will be conveyed through existing coal conveyors and will be re-routed through new limestone conveyors till limestone crushers. After crushing, crushed limestone shall be conveyed to limestone storage shed. Please confirm.	Confirmed.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
74.	SECTION-VI, PART-B,	SUB-SECTION-I-M6, LIME-STONE HANDLING PLANT	3.3.0 & 4.12.3	129 OF 274 144 of 274	Crushing: "In limestone crusher house, limestone from each conveyor shall pass through 2 nos crushers 7 screens..... from either stream. Primary samplers rated conveyor capacity.	Bidder is considering 1X100% crusher in crusher house for each incoming stream. Please confirm. Based on our experience, screens are not required below the crushers. Crusher is designed to have final product size (-) 20mm. Hence we are not considering any screen equipment below the crushers. Please check and confirm.	Bidder shall comply the technical specifications.
75.	SECTION-VI, PART-B,	SUB-SECTION-I-M6, LIME-STONE HANDLING PLANT	3.4.0	129 OF 274	Crushed limestone shall be stored in covered..... junction towers and ploughs/fixed trippers.	Bidder understand that the crushed limestone (-20mm) shall be stored in a covered storage yard. However, use of travelling tripper and paddle feeders not understood. Please elaborate and review the requirement.	Travelling tripper has been envisaged to distribute crushed limestone along the length of limestone storage shed. Paddle feeders are provided to reclaim the stored crushed limestone and feed it to the outgoing limestone conveyors to store limestone FGD usage point.

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
76.	SECTION-VI, PART-B,	SUB-SECTION-I-M6, LIME-STONE HANDLING PLANT				Bidder request customer to specify the maximum lime stone and gypsum pile height to be considered to arrive the size of storage area and shed to make all the bidders at par.	Maximum pile height shall be decided considering the availability of space during detailed engineering.

CIVIL-MOUDA

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUB-SEC.	PAGE NO.	CLAUSE NO.			
77.	VI/A	III-D	2 of 4	1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan



CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAU E NO.			
78.	VI/B	IV-D	26 of 69	10.00.00	Site levelling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing...	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Lay-out plan
79.	VI/B	IV-D	31 of 69	14.00.00	Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr.	The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain.	The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.
80.	VI/B	IV-D	41 of 69	21.00.00	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr.		The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.			
81.	VI/B	IV-D	24 of 69	7.00.00	In case Bidder opts for steel super-structure with RCC floors/roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering...	In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding).	Type of cladding system if not specified in the technical Specification shall be decided by the bidder considering the functional requirement, schedule of construction and site constraints (if any).
82.	VI/B	IV-D	25 of 69	7.00.00	Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings... All facility buildings shall be provided with 750 mm wide plinth protection all around... An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection...	(1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved. (2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted.	Extent and type of paving in FGD block shall be in accordance with Technical specification. However, any functional requirement of paving for FGD facilities not specifically mentioned in technical specification is also in the scope of bidder.
83.	VI/B	IV-D	25 of 69	7.00.00	The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.		

CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.			
84.	VI/A	II-A5	22 OF 40	Annexure-III, e)	The minimum pile length for each group of piles shall be determined based on the nearest bore log. A minimum embedment of 5.0 m and 6.0 m into strata with SPT 'N' greater than 50 for 600 mm dia pile and 760 mm dia pile respectively before termination and at pile termination minimum SPT 'N' shall be 60, while deciding the minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby bore log data.	The minimum length of pile shall be as per approved geotechnical investigation report during detailed engineering. Please confirm.	Bidder shall comply the provisions of technical specification.

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Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAU S E NO.			
85.	VI/A	II-A5	14 OF 40	7.02.0 3 xv	High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.	High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm.	Bidder to refer amendment in this regard.
86.	General	-	-	-	-	Lab test results of geotechnical investigation may please be furnished.	Bidder to refer amendment in this regard.



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CIVIL-SOLAPUR

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAU SE NO.			
87.	VI/A	III-D	2 of 4	1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
88.	VI/B	IV-D	26 of 69	10.00.00	Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing...	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAU SE NO.			
89.	VI/B	IV-D	31 of 69	14.0 0.00	Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr.		The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.
90.	VI/B	IV-D	41 of 69	21.0 0.00	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr.	The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain.	The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately
91.	VI/B	IV-D	24 of 69	7.00. 00	In case Bidder opts for steel superstructure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering...	In case Bidder opts for steel superstructure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding).	Refer Sl. No.81



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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAU SE NO.			
92.	VI/B	IV-D	25 of 69	7.00.00	Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings... All facility buildings shall be provided with 750 mm wide plinth protection all around... An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection...	(1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved. (2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted.	Refer Sl. No.82
93.	VI/B	IV-D	25 of 69	7.00.00	The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.		
94.	VI/A	II-A6	9 of 31	7.00.01	Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV.	Annexure-IV is not available in the specification. Please provide the same.	Bidder to refer amendment in this regard.

CIVIL-MEJA

SL.	ENQUIRY SPECIFICATION	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS

CLARIFICATION No.01 (TECHNICAL)
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NO	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
95.	VI/A	III-D	2 of 4	1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
96.	VI/B	IV-D	26 of 69	10.00.00	Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing...	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
97.	VI/B	IV-D	31 of 69	14.00.00	Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr.	The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain.	The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.
98.	VI/B	IV-D	41 of 69	21.00.00	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr.		The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.

CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
99.	VI/B	IV-D	24 of 69	7.00.00	In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering...	In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding).	Refer Sl. No. 81
100.	VI/B	IV-D	25 of 69	7.00.00	Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings... All facility buildings shall be provided with 750 mm wide plinth protection all around... An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection...	(1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved. (2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted.	Refer Sl.No.82
101.	VI/B	IV-D	25 of 69	7.00.00	The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.		Refer Sl.No.82

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
102.	VI/A	III-D	2 of 4	1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
103.	VI/B	IV-D	26 of 69	10.00.00	Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing...	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
104.	VI/B	IV-D	31 of 69	14.00.00	Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr.		The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.
105.	VI/B	IV-D	41 of 69	21.00.00	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr.	The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain.	The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.
106.	VI/B	IV-D	24 of 69	7.00.00	In case Bidder opts for steel superstructure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering...	In case Bidder opts for steel superstructure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding).	Refer SI.No.81

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
107.	VI/B	IV-D	25 of 69	7.00.00	Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings... All facility buildings shall be provided with 750 mm wide plinth protection all around... An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection...	(1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved. (2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted.	Refer Sl.No.82
108.	VI/B	IV-D	25 of 69	7.00.00	The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.		
109.	VI/A	II-A10	10 OF 30	7.02.00	For excavation 6 metres below FGL, sheet piling shall be provided.	Any suitable slope protection works can be provided. Please confirm	Excavation may be carried out by using either sheet piling/ diaphragm wall/ secant piling/ contiguous piling or their combination. Bidder to refer amendment in this regard.
110.	General	-	-	-	-	Topographical survey details is not available in the specification. Please furnish the same.	Bidder to refer amendment in this regard.

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CIVIL TANDA

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
111.	VI/A	III-D	2 of 4	1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
112.	VI/B	IV-D	26 of 69	10.00.00	Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing...	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
113.	VI/B	IV-D	31 of 69	14.00.00	Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr.	The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain.	The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.

CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
114.	VI/B	IV-D	41 of 69	21.00.00	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr.		The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.
115.	VI/B	IV-D	24 of 69	7.00.00	In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering...	In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding).	Refer Sl.No.81
116.	VI/B	IV-D	25 of 69	7.00.00	Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings... All facility buildings shall be provided with 750 mm wide plinth protection all around... An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection...	(1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth	Refer Sl.No.82

CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
117.	VI/B	IV-D	25 of 69	7.00.00	The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.	protection, etc.) is to be paved or left unpaved. (2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted.	
118.	VI/A	II-A7	22 OF 33	Annex-ure-III, e)	The minimum pile length for each group of piles shall be determined based on the nearest bore log. A minimum embedment of 4.0m into the very dense sand strata with SPT 'N' value greater than 50 as observed in such bore log shall be ensured, while deciding the minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby bore log data.	The minimum length of pile shall be as per approved geotechnical investigation report during detailed engineering. Please confirm.	Bidder shall comply the provisions of technical specification.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
119.	VI/A	II-A7	14 OF 33	7.02.03 xv	High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.	High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm.	Bidder may conduct either static routine load test or high strain dynamic load test. Bidder to refer amendment in this regard.
120.	General	-	-	-	-	Lab test results of geotechnical investigation may please be furnished.	Bidder to refer amendment in this regard.



CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

CIVIL NPGCPL NABINAGAR

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.			
121.	VI/A	III-D	2 of 4	1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
122.	VI/B	IV-D	26 of 69	10.00.00	Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing...	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
123.	VI/B	IV-D	31 of 69	14.00.00	Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr.	The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain.	The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.			
124.	VI/B	IV-D	41 of 69	21.00.00	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr.		The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.
125.	VI/B	IV-D	24 of 69	7.00.00	In case Bidder opts for steel super-structure with RCC floors/roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering...	In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding).	Refer Sl.No.81

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.			
126.	VI/B	IV-D	25 of 69	7.00.00	Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings... All facility buildings shall be provided with 750 mm wide plinth protection all around... An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection...	(1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved. (2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted.	Refer Sl.No.82
127.	VI/B	IV-D	25 of 69	7.00.00	The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.		
128.	VI/A	II-A8	9 OF 31	ANNEX-URE-B	a) The basic wind speed "Vb" at ten	Kindly specify the basic wind speed.	The basic wind speed "Vb" at 10m height above the mean ground level for "NABINAGAR-I 3X660 MW" project shall be 47 metres/second. Also refer Amendment issued separately in this regard.

CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/PART	SUB-SEC.	PAGE NO.	CLAUSE NO.			
129.	VI/A	II-A8	21 OF 31	Annex-ure-III, e)	The minimum pile length for each group of piles shall be determined based on the nearest bore log. A minimum embedment of 4.0m into the very dense sand strata with SPT 'N' value greater than 40 as observed in such bore log shall be ensured, while deciding the minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby bore log data.	The minimum length of pile shall be as per approved geotechnical investigation report during detailed engineering. Please confirm.	Bidder shall comply the provisions of technical specification.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.			
130.	VI/A	II-A8	13 OF 31	7.02.03 xv	High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.	High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm.	Bidder may conduct either static routine load test or high strain dynamic load test. Bidder to refer amendment in this regard.
131.	General	-	-	-	-	Lab test results of geotechnical investigation may please be furnished.	Bidder to refer amendment in this regard.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUB- SEC.	PAGE NO.	CLAUSE NO.			
132.	General	-	-	-	-	Topographical survey details is not available in the specification. Please furnish the same.	Bidder to refer amendment in this regard.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



CIVIL BRBCL NABINAGAR

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
133.	VI/A	III-D	2 of 4	1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Lay-out plan
134.	VI/B	IV-D	26 of 69	10.00.00	Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing...	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Lay-out plan
135.	VI/B	IV-D	31 of 69	14.00.00	Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr.	The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain.	The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
136.	VI/B	IV-D	41 of 69	21.00.00	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr.		
137.	VI/B	IV-D	24 of 69	7.00.00	In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering...	In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding).	Refer Sl.No.81

CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
138.	VI/B	IV-D	25 of 69	7.00.00	Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings... All facility buildings shall be provided with 750 mm wide plinth protection all around... An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection...	(1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved. (2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted.	Refer Sl.No.82
139.	VI/B	IV-D	25 of 69	7.00.00	The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.		
140.	VI/A	II-A11	22 OF 29	Annexure-III, e)	The minimum pile length for each group of piles shall be determined based on the nearest bore log. Pile shall be socketed into yellowish weathered sand stone. A socketing length of four (4) times the diameter of the pile into rock with rock core recovery $\geq 20\%$ shall be ensured for 600 mm & 760 mm dia piles.	The minimum length of pile shall be as per approved geotechnical investigation report during detailed engineering. Please confirm.	Bidder shall comply the provisions of technical specification.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
141.	VI/A	II-A11	15 OF 29	7.02.03 xv	High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.	High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm.	Bidder may conduct either static routine load test or high strain dynamic load test. Bidder to refer amendment in this regard.
142.	General	-	-	-	-	Lab test results of geotechnical investigation may please be furnished.	Bidder to refer amendment in this regard.



CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects

CIVIL BRBCL (MOUDA, SOLAPUR, MEJA, BARH, TANDA, NPGCPL NABINAGAR & BRBCL NABINAGAR)

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
143.	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
144.	VI / A	V	8 OF 26	5.01.00	A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor...	The location of new Wet Chimney shall be near to Existing Chimney in the space provided clearing foundation interface. The design of Wet Chimney shall be done considering interface factor of existing chimney as determined by wind tunnel study. However, no design check or validation shall be done for existing chimney/structures/buildings. Kindly confirm.	It is confirmed that no design check or validation shall be done by the bidder for existing chimney(s).

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
212.	Section-VI, PART-A	Sub-Section-VII	39 OF 61	K	Mandatory Spares of Limestone & Gypsum Handling: ELECTRIC HOISTS	fied in referred clause. In case the same has to be considered, then kindly inform about applicable list of mandatory spares to be followed. 4) Further, no spares are mentioned for chain pulley blocks. We understand that no spares shall be provided for chain pulley blocks. Please confirm.	Confirmed.
CIVIL							
213.	VI/A	III-D	2 of 4	1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan

CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
214.	VI/B	IV-D	26 of 69	10.00.00	Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing...	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
215.	VI/B	IV-D	31 of 69	14.00.00	Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr.	The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain.	The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.

CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
216.	VI/B	IV-D	41 of 69	21.00.00	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr.		The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
217.	VI/B	IV-D	24 of 69	7.00.00	In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering...	In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding).	Refer Sl.No.81

CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
218.	VI/B	IV-D	25 of 69	7.00.00	Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings... All facility buildings shall be provided with 750 mm wide plinth protection all around... An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection...	(1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved. (2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted.	Refer Sl.No.82
219.	VI/B	IV-D	25 of 69	7.00.00	The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.		

CLARIFICATION No.01 (TECHNICAL)
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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
220.	VI/A	II-A4	10 of 30	7.00.01	Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV.	Annexure-IV is not available in the specification. Please provide the same.	Bidder to refer amendment
221.	SEC VI / PART B	I M1	6 OF 51	3.02.07	External surface of the chimney flue liner projecting over the chimney roof shall be wrapped with 2mm thick titanium/ C276 sheet over insulation.	These clauses are contradictory. Bidder understands that if 2mm thick titanium/ C276 sheet wrapping over insulation is provided then no painting is required on external surface of the chimney flue liner projecting over the chimney roof. Please confirm.	No painting is required on external surface of chimney flue liner projecting above chimney roof. Also refer Amendment in this regard.
222.	SEC VI / PART B	IV D	15 OF 69	3.14.09 (iv)	, external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT.		

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
223.	SEC VI / PART A	V	8 OF 26	5.01.00	External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation.		
224.	SEC VI / PART A	V	8 OF 26	5.01.00	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	Bidder understands that cladding can be done with explosion bonding or hot rolling or combination of both to achieve the required quality as per ASTM B 898-11. Please confirm.	Bidder shall provide the proposed cladding methods as per the NTPC approved fabrication procedures, tests and Quality plan such that it meets the plant operation requirements.

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
225.	SEC VI / PART B	I M1	6 OF 51	3.02.07	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.		
226.	SEC VI / PART B	IV D	39 OF 69	20.00.00	Electrodes	Please provide the detail/type of electrodes to be used in welding of titanium/C276.	Type of electrode will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval.
227.	SEC VI / PART B	IV D	39 OF 69	20.07.00	Edge Preparation for Welding	Please provide edge preparation detail for titanium/C276 material.	Edge Preparation detail will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval.

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
228.	SEC VI / PART A	V	8 OF 26	5.01.00	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	Please provide the material code to be followed for alloy C-276.	Specification requirement is clear. Bidder shall comply with the specification requirements.
229.	SEC VI / PART B	I M1	6 OF 51	3.02.07	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.		

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
230.	SEC VI / PART A	V	8 OF 26	5.01.00	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	Kindly furnish the following specifications for chimney liners. 1. Permissible tolerances on thickness of clad sheet and base material. 2. Permissible tolerances on flatness for clad sheet and base material. 3. Specify the quality tests which will be conducted on the clad sheet for assessing mechanical and chemical properties and on the chimney cans after fabrication. 4. Indicate any special requirements applicable for welding and fabrication of chimney at site.	Specification requirement is clear. Bidder shall comply with the specification requirements.
231.	SEC VI / PART B	I M1	6 OF 51	3.02.07	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	5. Indicate any restriction in size of base metal and clad plate to be used for fabrication of flue cans. 6. Mention tensile and yield strength of the clad material to be achieved.	

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
232.	SEC VI / PART A	I	10 OF 19	4.02.03	For Chimney, Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height.	Bidder understands that, there is no other prequalification requirements related to fabrication and erection of titanium/c276 clad steel flue liner in chimney. Please confirm.	Bidder's understanding is Correct.
233.	SEC VI / PART B	IV D	2 OF 69	2.03.00	Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height.		
234.	VI / A	V	8 OF 26	5.01.00	A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor...	The location of new Wet Chimney shall be near to Existing Chimney in the space provided clearing foundation interface. The design of Wet Chimney shall be done considering interface factor of existing chimney as determined by wind tunnel study. However, no design check or validation shall be done for existing chimney/structures/buildings. Kindly confirm.	It is confirmed that no design check or validation shall be done by the bidder for existing chimney(s).

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
268.	VI/A	III-D	2 of 4	1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
269.	VI/B	IV-D	26 of 69	10.00.00	Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing...	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Layout plan
270.	VI/B	IV-D	31 of 69	14.00.00	Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr.	The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain.	The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.

CLARIFICATION No.01 (TECHNICAL)
Flue Gas Desulphurization (FGD) System Package for Lot 1A Projects



SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
271.	VI/B	IV-D	41 of 69	21.00.00	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr.		The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.
272.	VI/B	IV-D	24 of 69	7.00.00	In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering...	In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding).	Refer Sl.No.81

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
273.	VI/B	IV-D	25 of 69	7.00.00	Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings... All facility buildings shall be provided with 750 mm wide plinth protection all around... An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection...	(1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved. (2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted.	Refer Sl.No.82
274.	VI/B	IV-D	25 of 69	7.00.00	The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.		

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	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
275.	VI/A	II-A3	22 OF 31	Annexure-IV, e)	The minimum pile length for each group of piles shall be determined based on the nearest bore log. A minimum embedment of 2.0m into pebbles/cobbles/boulder strata (river Bed material) as observed in such bore log shall be ensured, while deciding the minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby bore log data.	The minimum length of pile shall be as per approved geotechnical investigation report during detailed engineering. Please confirm.	Bidder shall comply the provisions of technical specification.

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	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
276.	VI/A	II-A3	14 OF 31	7.02.03 xv	High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.	High strain dynamic load test is not required as static routine load test are being carried out in the piles. Please confirm.	Bidder may conduct either static routine load test or high strain dynamic load test. Refer amendment .

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	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
277.	General	-	-	-	-	Lab test results of geotechnical investigation may please be furnished.	Bidder to refer amendment.
278.	SEC VI / PART B	I M1	6 OF 51	3.02.07	External surface of the chimney flue liner projecting over the chimney roof shall be wrapped with 2mm thick titanium/ C276 sheet over insulation.	These clauses are contradictory. Bidder understands that if 2mm thick titanium/ C276 sheet wrapping over insulation is provided then no painting is required on external surface of the chimney flue liner projecting over the chimney roof. Please confirm.	No painting is required on external surface of chimney flue liner projecting above chimney roof. Also refer Amendment in this regard.
279.	SEC VI / PART B	IV D	15 OF 69	3.14.09 (iv)	, external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT.		
280.	SEC VI / PART A	V	8 OF 26	5.01.00	External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation.		

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
281.	SEC VI / PART A	V	8 OF 26	5.01.00	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	Bidder understands that cladding can be done with explosion bonding or hot rolling or combination of both to achieve the required quality as per ASTM B 898-11. Please confirm.	Bidder shall provide the proposed cladding methods as per the NTPC approved fabrication procedures, tests and Quality plan such that it meets the plant operation requirements.
282.	SEC VI / PART B	I M1	6 OF 51	3.02.07	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.		Bidder shall provide the proposed cladding methods as per the NTPC approved fabrication procedures, tests and Quality plan such that it meets the plant operation requirements.
283.	SEC VI / PART B	IV D	39 OF 69	20.00.00	Electrodes	Please provide the detail/type of electrodes to be used in welding of titanium/C276.	Type of electrode will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval.

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
284.	SEC VI / PART B	IV D	39 OF 69	20.07.00	Edge Preparation for Welding	Please provide edge preparation detail for titanium/C276 material.	Edge Preparation detail will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval.
285.	SEC VI / PART A	V	8 OF 26	5.01.00	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	Please provide the material code to be followed for alloy C-276.	Specification requirement is clear. Bidder shall comply with the specification requirements.
286.	SEC VI / PART B	I M1	6 OF 51	3.02.07	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.		

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
287.	SEC VI / PART A	V	8 OF 26	5.01.00	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	Kindly furnish the following specifications for chimney liners. 1. Permissible tolerances on thickness of clad sheet and base material. 2. Permissible tolerances on flatness for clad sheet and base material. 3. Specify the quality tests which will be conducted on the clad sheet for assessing mechanical and chemical properties and on the chimney cans after fabrication.	Specification requirement is clear. Bidder shall comply with the specification requirements.
288.	SEC VI / PART B	I M1	6 OF 51	3.02.07	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	4. Indicate any special requirements applicable for welding and fabrication of chimney at site. 5. Indicate any restriction in size of base metal and clad plate to be used for fabrication of flue cans. 6. Mention tensile and yield strength of the clad material to be achieved.	Bidder's understanding is Correct.
289.	SEC VI / PART A	I	10 OF 19	4.02.03	For Chimney, Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height.	Bidder understands that, there is no other prequalification requirements related to fabrication and erection of titanium/ c276 clad steel flue liner in chimney. Please confirm.	Bidder's understanding is Correct.

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	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
328.	VI/A	III-D	2 of 4	1.06.00	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Lay-out plan
329.	VI/B	IV-D	26 of 69	10.00.00	Site leveling of gypsum storage area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing...	In tender drawings only space for FGD area is marked. No FGL is mentioned for FGD area blocks. Kindly clarify and furnish the same.	FGL is indicated in General Lay-out plan
330.	VI/B	IV-D	31 of 69	14.00.00	Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr.	The referred clauses are contradictory. Kindly clarify the rainfall intensity to be considered for designing the plant storm water drain.	The value of minimum rainfall intensity shall be taken as 75mm/hr. Refer amendment issued separately.

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	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
331.	VI/B	IV-D	41 of 69	21.00.00	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr.		
332.	VI/B	IV-D	24 of 69	7.00.00	In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering...	In case Bidder opts for steel super-structure with RCC floors/roof, kindly specify the cladding system to be adopted (Brick Cladding / Metal Sheet Cladding).	Refer Sl.No.81

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
333.	VI/B	IV-D	25 of 69	7.00.00	Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings... All facility buildings shall be provided with 750 mm wide plinth protection all around... An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection...	(1) Within the FGD blocks, kindly specify whether the balance area (i.e. area excluding various facilities/buildings, passage areas, plinth protection to facility buildings, additional paving of 5m width all around the tank foundations and other facility buildings beyond the extent of plinth protection, etc.) is to be paved or left unpaved. (2) In case paving is required for the balance area, kindly specify the type of paving (Normal Duty paving/Heavy Duty paving) to be adopted.	Refer Sl.No.82
334.	VI/B	IV-D	25 of 69	7.00.00	The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.		
335.	VI-A	II-A2	23-39 of 48	Annexure-II	BORE LOG	Geotechnical investigation report is not readable. Please provide the report in readable format.	Bidder to refer amendment.
336.	SEC VI / PART B	I M1	6 OF 51	3.02.07	External surface of the chimney flue liner projecting over the chimney roof shall be wrapped with 2mm thick titanium/ C276 sheet over insulation.	These clauses are contradictory. Bidder understands that if 2mm thick titanium/ C276 sheet wrapping over insulation is provided then no painting is required on	No painting is required on external surface of chimney flue liner projecting above chimney roof. Also refer Amendment in this regard.

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
337.	SEC VI / PART B	IV D	15 OF 69	3.14.09 (iv)	, external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT.	external surface of the chimney flue liner projecting over the chimney roof. Please confirm.	
338.	SEC VI / PART A	V	8 OF 26	5.01.00	External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet over insulation.		
339.	SEC VI / PART A	V	8 OF 26	5.01.00	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	Bidder understands that cladding can be done with explosion bonding or hot rolling or combination of both to achieve the required quality as per ASTM B 898-11. Please confirm.	Bidder shall provide the proposed cladding methods as per the NTPC approved fabrication procedures, tests and Quality plan such that it meets the plant operation requirements.

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	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
340.	SEC VI / PART B	I M1	6 OF 51	3.02.07	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.		
341.	SEC VI / PART B	IV D	39 OF 69	20.00.00	Electrodes	Please provide the detail/type of electrodes to be used in welding of titanium/C276.	Type of electrode will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval.
342.	SEC VI / PART B	IV D	39 OF 69	20.07.00	Edge Preparation for Welding	Please provide edge preparation detail for titanium/C276 material.	Edge Preparation detail will be as per Qualified WPS. This qualified WPS needs to be submitted for NTPC approval.

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
343.	SEC VI / PART A	V	8 OF 26	5.01.00	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	Please provide the material code to be followed for alloy C-276.	Specification requirement is clear. Bidder shall comply with the specification requirements.
344.	SEC VI / PART B	I M1	6 OF 51	3.02.07	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.		
345.	SEC VI / PART A	V	8 OF 26	5.01.00	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	Kindly furnish the following specifications for chimney liners. 1. Permissible tolerances on thickness of clad sheet and base material. 2. Permissible tolerances on flatness for clad sheet and base material. 3. Specify the quality tests which	Specification requirement is clear. Bidder shall comply with the specification requirements.

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / QUERIES	NTPC CLARIFICATIONS
	SEC/PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
346.	SEC VI / PART B	I M1	6 OF 51	3.02.07	The chimney flue liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8 mm thick (minimum) mild steel base metal of flue liner. Cladding shall be done to achieve the required quality as per ASTM B 898-11.	will be conducted on the clad sheet for assessing mechanical and chemical properties and on the chimney cans after fabrication. 4. Indicate any special requirements applicable for welding and fabrication of chimney at site. 5. Indicate any restriction in size of base metal and clad plate to be used for fabrication of flue cans. 6. Mention tensile and yield strength of the cladded material to be achieved.	
347.	SEC VI / PART A	I	10 OF 19	4.02.03	For Chimney, Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height.	Bidder understands that, there is no other prequalification requirements related to fabrication and erection of titanium/ c276 cladded steel flue liner in chimney. Please confirm.	Bidder's understanding is Correct.
348.	SEC VI / PART B	IV D	2 OF 69	2.03.00	Bidder or its agency should have in the past built at least one (1) Reinforced concrete chimney of minimum 100m height.		

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	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
349.	VI / A	V	8 OF 26	5.01.00	A "wet Chimney" shall be installed downstream of Wet Flue Gas Desulfurization (FGD) system by the Contractor...	The location of new Wet Chimney shall be near to Existing Chimney in the space provided clearing foundation interface. The design of Wet Chimney shall be done considering interface factor of existing chimney as determined by wind tunnel study. However, no design check or validation shall be done for existing chimney/structures/buildings. Kindly confirm.	It is confirmed that no design check or validation shall be done by the bidder for existing chimney(s).

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Sl. No.	Vol No	Clause No.	Page No.	Issues	Comments / Clarifications	NTPC reply
350.	Sec-VI Part-D ,ECC	Clause no. 28.04.00	Page no. 12	Site laboratory for Civil Work	Bidder through its civil work sub-contractors will set up a temporary field quality Lab to conduct normal civil work tests at site. However, customer to allow bidder/it's subcontractors to take back those field quality lab equipment after completion of work at site. Please confirm.	We understand that after completion of work at site, contractor may be allowed to take back their lab equipments.

SL.	ENQUIRY SPECIFICATION	SPECIFICATION REQUIRE-	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
384.	VI-PART-B	VI-D CIVIL WORKS	24 of 69	6.08.00	Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, ball Mill building shall be through RCC staircase and roof access to all other buildings all shall be through cage ladder as per requirement	It is proposed to provide steel staircases for access to operating floors of all buildings except FGD Control room/MCC building. RCC staircase will be provided for FGD Control room/MCC building. Cage ladder may be allowed for access to roofs of all buildings with roof sheeting. Kindly accept	Bidder shall comply with technical specification requirement.
385.	VI-PART-B	VI-D CIVIL WORKS	-	-	Ball Mill Building:	Type of construction of Ball Mill building is not mentioned in the technical specification. Bidder proposes to use structural steel building with roof sheeting and side cladding (sheeting and cladding with permanently colour coated sheeting). Kindly confirm.	Type of building structure (Steel/RCC) and cladding system shall be decided by the bidder considering the functional requirement, schedule of construction and site constraints (if any). However, roof shall be of RCC as per technical specification requirement.

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SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	NTPC CLARIFICATIONS
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
386.	VI-PART-B	VI-D CIVIL WORKS	-	-	Gypsum dewatering building:	Type of construction of Gypsum Dewatering building is not mentioned in the technical specification. Bidder proposes to use structural steel building with roof sheeting and side cladding (sheeting and cladding with permanently colour coated sheeting). Floor of Vacuum belt filter will be RCC over metal deck sheeting. Kindly confirm.	Bidder shall comply with technical specification requirement.

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	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
387.	VI-PART-B	VI-D CIVIL WORKS	-	-	Recirculation & Oxidation Blower house:	Type of construction of the building to house recirculation pumps and oxidation blowers is not mentioned in the technical specification. Bidder proposes to use structural steel building with roof sheeting and side cladding (sheeting and cladding with permanently colour coated sheeting). Kindly confirm.	Type of building structure (Steel/RCC) and cladding system shall be decided by the bidder considering the functional requirement, schedule of construction and site constraints (if any). However, roof shall be of RCC as per technical specification requirement.

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Sl. No.	Section/Part/Chapter	Clause No.	Page No.	Bid Specification	Clarification sought by the bidder	NTPC CLARIFICATIONS
538.	Section-VI (TS) Part-B Sub-section-II E15 Station Light- ning	4.00.00.10 (I)	8 of 16	Lighting Panels shall be of following types:	Please clarify the purpose of 3kVA transformer located inside of LP-3 type lighting panel itself.	LP-3 shall be used for feeding of RC receptacle as mentioned in technical specification. Kindly refer clause no:- 4.00.00.10.h
539.	Section-VI (TS) Part-B Sub-section-II E15 Station Light- ning	Annexure - A.	15 of 16	Annexure - A.	Please clarify average illumination Lux levels (or ratio (%) of fixture) to be adopted in certain area where Emergency AC, Normal DC, Emergency DC Lightings are installed.	Refer to Annexure-B in Station Lighting chapter. Amendment-1 issued
540.	Section-VI (TS) Part-B Sub-Section IV-D Civil Works	3.14.00	10 of 69	Single flue or multiple flue chimneys to be provided	Bidder suggests that this chimney might not be necessary. Please confirm.	Bidder shall comply to the requirements of technical specification.
541.	Section-VI (TS) Part-B Sub-Section IV-D Civil Works	12.00.00 (Roads)	30 of 69	Concrete pavement for roads shall be min. 250mm thick slab	Please clarify which particular specification about roads needs to be followed.	Query is not clear

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Sl. No.	Section/Part/Chapter	Clause No.	Page No.	Bid Specification	Clarification sought by the bidder	NTPC CLARIFICATIONS
542.	Section-VI (TS) Part-B Sub-Section IV-D Civil Works	12.00.00	31 of 69	Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete.	Please clarify which particular specification about roads needs to be followed.	Query is not clear
543.	Section-VI (TS) Part-B Sub-Section IV-D Civil Works	21.00.00	41 of 69	RCC paving of min. 150mm thick with M25 grade concrete	Please clarify which particular specification about roads needs to be followed.	Query is not clear
544.	Section-VI (TS) Part-B Sub-Section IV-D Civil Works	29.02.00	48 of 69	Interconnecting walkway between various structures, buildings & facilities shall be finished with 22mm chequered concrete tiles	Please confirm - between which structures / buildings are interconnecting walkways required? Further, if the interconnecting walkways (if any) are steel structures, can we use steel chequered plate / gratings in place of chequered concrete tiles?	As the layout of FGD system is in Bidder's scope, ascertaining the requirement of Interconnecting walkway between various structures, buildings & facilities is in the scope of Bidder. For finishing schedule, Bidder shall comply with technical specification requirement.
545.	Section-VI (TS) Part-B Sub-Section	31.03.00	56 of 69	All steel surfaces should be provided with two component moisture curing zinc silicate primer	What separate paint is required other than the primer, intermediate & final coat already provided in the shop?	For steel sections and structures which are to be transported on sea, anti-corrosive paint before shipment shall be provided to take care of sea worthiness.

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Sl. No.	Section/Part/Chapter	Clause No.	Page No.	Bid Specification	Clarification sought by the bidder	NTPC CLARIFICATIONS
	IV-D Civil Works			coat, followed by polyamide curved epoxy (with MIO content) intermediate & aliphatic isocyanate curved acrylic final coat, all in shop	Please clarify.	
546.	Section-VI (TS) Part-B Sub-Section IV-D Civil Works	31.07.00	57 of 69	All steel sections & fabricated structures, which are required to be transported by sea, shall be provided with anti-corrosive paint before shipment to take care of sea worthiness	Same with above.	For steel sections and structures which are to be transported on sea, anti-corrosive paint before shipment shall be provided to take care of sea worthiness.
547.	Section-VI (TS) Part-E List of Tender Drawings	ELECTRICAL SINGLE LINE DIAGRAM FOR FGD PACAKGE	53 of 53	GENERAL NOTE 11. Panel being used for feeding of CHP	Bidder understands scope of supply for cabling from 11kV FGD TIE SWGR to 11/3.45kV Exiting CHP/AHP TR as below. Please confirm. - Power Cable: Supplied by FGD Supplier's - Cable raceway: Supplied by employer. (up to employer's trestle : Supplied by FGD Supplier's)	Refer amended tender SLD. -Bidder shall comply with technical specification requirement clause no: - 1.08.00.2.However bidder may visit the project in order to get itself acquainted with existing electrical of plant. GLP of respective plants has already been attached.

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Sl. No.	Specification Reference				Employer (NTPC) Specification	Bidder Requested Clarification	NTPC CLARIFICATIONS
	Part	Sub-section	Clause no.	Page			
678.	SECTION – VI, PART-D	Erection Condition of contract	44.22.00	33 of 53	Hydra shall not be used for material transport	Bidder understanding is that Farna shall be used in place of Hydra.	Specification requirement is clear. Bidder shall comply with the specification requirements.
679.	SECTION – VI, PART-A	Scope of supply and Services	2.00.00 (10)	3 of 4	Providing all necessary fire fighting devices/ Equipment/Fire tender etc. required during the project execution.....	Bidder shall provide all fire fighting devices / Equipment during the entire Project Execution period for its scope of work. However Bidder requested Employer to provide the Fire Tender of the existing Plant during emergency if required	Bidders understanding/request is not correct.
680.	SECTION – VI, PART-B	SUB-SECTION-VI-D Civil Works	4.01.00	18 of 69	Drainage System	Bidder clarifies that Employers existing drain invert level shall be necessary to plan the RCC drain(in the scope of Bidder) on which water from the pit in FGD area shall be diverted. So Bidder request Employer furnish the above information.	Refer General Layout Plan. Road and drain drawing shall be provided after award.
681.	SECTION – VI, PART-A	SUB-SECTION-II-A2-Project Information-Lara-I 2X800 MW	Annexure-II	23 to 39 of 48	Borelog Data Sheet	The Location and Coordinates of various borelogs marked in the data sheet does not match with the location indicated in GLP.	Bidder may refer Clause No.7.00.02, as mentioned in Clause No. 7.00.02, the available borelog data is of vicinity to proposed structure and the

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Sl. No.	Specification Reference				Employer (NTPC) Specification	Bidder Requested Clarification	NTPC CLARIFICATIONS
	Part	Sub-section	Clause no.	Page			
						So Bidder request Employer to furnish the corrected documents.	same has already been furnished in the tender document. Detailed Geotechnical Investigation shall be carried out by contractor.
682.	SECTION – VI, PART-A	SUB-SECTION-II-A4-Project Information-Darlipalli-I 2X800 MW	-	-	Borelog Data	No borelog data is available in the tender. Bidder request Employer to furnish the nearest vicinity borelogs if not available for FGD area.	Bidder to refer necessary amendment in this regard.
683.	SECTION – VI, PART-A	SUB-SECTION-II-A6-Project Information-Solapur-II 2X800 MW	-	-	Borelog Data	No borelog data is available in the tender. Bidder request Employer to furnish the nearest vicinity borelogs if not available for FGD area.	Bidder to refer necessary amendment in this regard.
684.	SECTION – VI, PART-A	SUB-SECTION-II-A6-Project Information-Solapur-II 2X800 MW	Annexure-III Soil Data and Foundation System	20 of 31	Net Allowable Bearing Pressure	Bidder understands that in case of soil for depths greater than 1.5m, net allowable bearing pressure value available as per detailed geotechnical investigation during that stage can be utilised for foundation design. Employer is requested to confirm on Bidders understanding.	Bidder to refer necessary amendment in this regard.

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Sl. No.	Specification Reference				Employer (NTPC) Specification	Bidder Requested Clarification	NTPC CLARIFICATIONS
	Part	Sub-section	Clause no.	Page			
685.	SECTION – VI, PART-A	SUB-SECTION-III-A6 ZLD	1.01.00	1 of 3	Pre treatment system shall consist of FGD waste water storage tank (2x50%) to store FGD waste water, GGH washing water, etc.	Bidder proposes 1x100% tank sized for 30 m3/h inflow (Barh-I) and 20 m3/h inflow (Nabinagar) instead of 2x50% tanks. Please confirm.	Stipulation of technical specification is clear. Bidder to comply with technical specification requirements.
686.	SECTION – VI, PART-A	SUB-SECTION-III-A6 ZLD	1.02.00	1 of 3	Contractor shall provide one independent train (1x100%) or two independent trains (2x50%) of Evaporative concentration system.	We propose 1x100% Evaporative Concentration System.	Stipulation of technical specification is clear. Contractor shall provide one independent train (1x100%) or two independent trains (2x50%) of Evaporative concentration system.
687.	SECTION – VI, PART-A	SUB-SECTION-IV Terminal Points & Exclusions	1.08.00	2 of 3	FGD waste water pipes shall terminate along with isolation valve at 5 meters near HCSD mixing tank	Please confirm the terminal points along for outlet of the ZLD system- Water and Solids respectively	Stipulation of technical specification is clear. Bidder to comply with technical specification requirements.
688.	SECTION – VI, PART-A	SUB-SECTION-IV Functional Guarantees & LD	4.02.00	18 of 24	Waste Water: The contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be 10 m3/h averaged over a 24 hour period for each unit.	Please clarify the exact flow rate to be considered for designing the ZLD considering 3x660 MW Barh plant and 4x250 MW BRBCL Nabinagar plant.	Bidder to refer necessary amendment in this regard.
689.	SECTION – VI, PART-B	SUB-SECTION-I-M7 ZLD	2.00.00	3 of 32	Conditions of Service - 'All Design Pressure of all device, piping, and auxiliary facilities...Device and tank maximum allowance: operating pressure x 1.5' and also ' piping	This may not apply for larger "fit for service" equipment like Evaporators and Crystallizers. We will provide our recommendations on design pressures for piping and	Technical specification requirement is clear. However, for evaporator & Crystallizer, proven design and experience meeting provenness criteria specified in tender is acceptable .

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860.	Section VI / Part A / Subsection III A5	3.01 .00	6 of 6	Gypsum shall be conveyed from the vacuum belt filter to the storage shed through a series of double stream conveyors and transfer points/junction towers.		
861.	Section VI / Part A / Sub Section III A1	3.00.00	2 of 9	The contractors scope shall include a common limestone grinding system for all the units and shall comprise of.....	Bidder understands that limestone handling system is in Bidder's scope. Kindly confirm.	Bidder's understanding is correct. Bidder to refer necessary amendment in this regard.
862.	Section VI / Part A / Subsection III A5	2.01.00	2 of 6	Limestone Handling Plant (LHP)		
863.	Section VI / Part A / Sub Section III D CIVIL WORKS	1.06.00	2 of 4	Uniform Finished Ground Level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing.	Bidder understands that filling / cutting of earth is in his scope in areas other than the main absorber. Kindly confirm.	Refer amendment issued separately.
864.	Section VI / Part A / Sub Section IV Terminal points and Exclusions	1.10.00	2 of 3	Outlet of gypsum storage silo/ shed	As per section VI, Part-A, Sub Section III - A5, Page 2 of 6, "Gypsum to be conveyed to gypsum storage Shed". Bidder shall consider only a storage shed for gypsum. Kindly confirm.	Confirmed.

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Sr. No	Section / Part / Chapter / Volume	Clause No.	Page No.	Bid specification	Bidder's Query	NTPC's Clarification
865.	Section VI / Part B / Sub Section IV-D Civil Works	3.07.00	8 of 69	Gypsum storage shed The gypsum storage shed shall be RCC framed structure with structural steel work shed with permanent colour coated profile steel sheet roof and side cladding...	Bidder requests for an option for the gypsum storage shed to be made of structural steel superstructure with Structural columns and sheeting. Kindly confirm.	Bidder shall follow technical specifications in this regard. Bidder shall also refer s.no.1 of amendment no 1 in this regard.
866.	Project information			Wind and seismic codes	Kindly confirm the following: 1) Bidder would like to consider IS 875 (Part-3):2015 for wind loading 2) Bidder would like to consider IS 1893 (Part 2):2016, "General provisions and buildings" for buildings and IS 1893 (Part-4) : 2015 "Industrial structures including stack - like structures" for stacks along with site specific spectra provided.	Bidder shall comply to site specific "criteria for wind and earthquake resistant design of structures" specified in "Project information" section of technical specification.
867.	Section VI / Part A / Sub Section II-A6 Project information, Solapur (2X660MW)	7.08.00	19 of 31	Employer has carried out geotechnical investigation in vicinity to the proposed area. Logs of representative boreholes for bidder's information in the vicinity of proposed area are enclosed with	Kindly furnish the annexure mentioned in the clause referred in the specification.	Bidder to refer amendment

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				this annexure.		
868.	Section VI / Part A / Sub Section II-A10 Project information, BARH STPP STAGE-1 (3X660MW)	2.00.00	30 of 30	List of drawings placed below in this subsection...	The topographical survey drawing no: 9562-999-POC-F-002 is unavailable. Kindly provide the same.	Refer amendment issued Separately.
869.	Section VI / Part A / Sub Section II-A4 Project information, Darlipalli (2X660MW)	7.00.00	10 of 30	Geotechnical data and foundation system for the respective project are enclosed at annexure III. The corresponding borelogs are enclosed at annexure IV.	Kindly furnish the annexure IV mentioned in the clause referred in the specification.	Bidder to refer amendment

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870.	TANDA-II-A7-2 Annexure-IV tanda-II			Bore log data	The co-ordinates of Bore-log provided in the bore logs do not go in conjunction with coordinates in the provided plot plan. Kindly furnish the revised bore-log coordinates in-line with provided plot plan and topo survey.	Bidder may refer Clause No.7.00.02, as mentioned in Clause No. 7.00.02, the available borelog data is of vicinity to proposed structure and the same has already been furnished in the tender document. Detailed Geotechnical Investigation shall be carried out by contractor.
871.	Section VI / Part A / Sub Section II A2	5.00.00	4 of 48	Damping in Structures (c) Reinforced Concrete Stacks : 3%	Bidder requests for horizontal seismic acceleration spectral coefficients for damping factor equals to 3% (as a percentage of critical damping).	The same is provided at "criteria for earthquake resistant design of structures" specified in "Project information" section of technical specification except for Lara Project. It will be furnished in the amendment to technical specification for Lara Project.

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872.	Section VI, Part B, Subsection IV-D - Civil works	39.03.00	66 of 69	Fly ash based Portland poz-zolona cement conforming to IS:1489, Part I shall preferably be used.	a) OPC cement mixed with fly ash can also be used for FGD structures except for Chimney. Owner to please confirm. b) Clause 39.03.00 is not applicable for Chimney shell. For Chimney shell, bidder have to use OPC cement only. Please confirm bidder's understanding.	a. Bidder shall comply with Technical specification requirement. b. For chimney shell, only OPC cement shall be used.
873.	General				Only two borelogs are furnished in the tender document for Barh project. Bidder request Owner to furnish additional bore holes as the FGD structures are located in a scattered manner within the existing units.	Bidder may refer Clause No.7.00.02, as mentioned in Clause No. 7.00.02, the available borelog data is of vicinity to proposed structure and the same has already been furnished in the tender document. Detailed Geotechnical Investigation shall be carried out by contractor.

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874.	Section VI, Part A, Subsection IIID, Page 1 of 4	1.04.00	1 of 4	If at any stage of work, any dismantling or modification or relocation of any existing facility is required to be done to complete the work in bidder's scope.....the same shall be done by bidder with no extra cost or time implication to the Employer	Dismantling, rerouting & restoration of existing structures which may foul with proposed FGD facilities need to be identified by Owner before hand. Hence Owner is requested to furnish the below mentioned details which are of utmost importance:a)Project wise list of existing structures/ facilities which can be rerouted to accommodate proposed FGD facilities.b) Facility wise schedule of shutdown window which will be available to FGD EPC contractor for interface activities as well as dismantling and rerouting.c)Owner shall be responsible for taking timely Shutdown of existing operational facilities, if required, in order to facilitate FGD construction work. Please confirm.	Relocation of existing facilities will however depend on the bidder's proposal. Any hindrance and evident underground facilities shall be suitably relocated by the bidder. If during the execution of the works it is found that the facilities in the Contractor's scope are fouling with any existing abandoned foundations and underground trenches including pipe and cable trenches for which the contractor is not provided any drawings by NTPC neither the Contractor was appraised beforehand, the

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						same shall be dismantled & relocated by station. However, Bidder shall note that any re-routing and modification work that will be suggested by the Bidder in such an eventuality shall be subject to the Employer's approval and, if required, Bidder shall modify his design to suite the actual site conditions.

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875.	Section VI, Part A, Subsection IIID, Page 1 of 4 Section VI, Part B, SubSection IV-D	2.00.00 12.00.00	2 of 4 30 of 69	Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be in concrete (M 35) as per IRC....Width of all such roads shall be 7.5 M concrete pavement. The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standard.	Bidder requests NTPC to provide width requirement for shoulders? Also whether shoulders are required on both sides of road?	Refer amendment issued separately.
876.	Section VI, Part A, IIA-10	7.03.00, d)	12 of 30	Pile diameter - 600 mm	NTPC Barh - Being an EPC bid, Owner to allow bidder to select pile diameter, length and capacities as per detailed soil investigation and test pile result.	Bidder shall comply the provisions of technical specification.

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Sr. No	Section / Part / Chapter / Volume	Clause No.	Page No.	Bid specification	Bidder's Query	NTPC's Clarification
877.	Section VI, Part A, IIA-10	7.03.00, b)	10 of 30	The maximum allowable bearing pressure shall be as per the approved geotechnical report and shall be limited to values as furnished in Table-2	NTPC- Barh Bearing pressure values furnished in table-2 are limited to a depth upto 2.5 m below NGL. Bidder understands that for a greater depth greater than 2.5 m, higher bearing pressure, if applicable as per approved soil investigation report shall be permitted. Please confirm bidder's understanding.	Bidder may refer amendment.
878.	General				Owner to furnish AutoCAD Copy of contour survey drawings for all projects.	Owner provides only PDF files

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Sr. No	Section / Part / Chapter / Volume	Clause No.	Page No.	Bid specification	Bidder's Query	NTPC's Clarification
879.	Section VI, Part B, Subsection IV-D - Civil worksSection VI, Part A, Subsection II - A11Section VI, Part A, Subsection II - 8A	39.03.003 9.04.007.0 8.00 g)Annexure-III (New Nabina-gar-I)	66 of 6966 of 6922 of 2921 of 31	Fly ash based Portland poz-zolona cement conforming to IS:1489, Part I shall preferably be used....or Fe500D, and conforming to other requirements of IS:1786Chemicals in ground water as observed during investigation are:.....Cement type - As specified elsewhere in the specification.g)Special requirements:Chemicals in ground water as observed during investigation are:.....In view of the above, the following shall be adopted for all foundations and substructures,	BRBCL and Nabinagar - No separate specification for cement type and reinforcement steel are mentioned in the relevant subsection. Hence bidder shall follow clause no. 39.03.00 for Cement and clause no.39.04.00 (Subsection IV-D, Section VI, Part B) for Reinforcement steel for projects, wherever special requirements are not mentioned. Please confirm bidder's understanding.	Bidders's understanding is correct.
BIDDING DOCUMENT NO.: CS-0011-109			(1A)-2	Doc No: CS-0011-109(1A)-2	CLRF-TECH-01	Page 397 of 736

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880.	Section VI, Part B, Sub Section - I-M1 Section VI, Part B, Subsection-IV-D - Civil works	3.00.00 3.14.04	5 of 51 13 of 69	The entire flue gas system, flue gas ducts, absorber etc. shall be designed to meet the following conditions: Criteria of flue gas exit velocity for sizing the flue liner material shall be specified elsewhere in the specification.	Owner to specify the below mentioned details for design of 150 m high Chimney: a) Maximum Flue gas exit velocity b) Pressure at Chimney Inlet to be considered by bidder for design. The above mentioned details have not been furnished in tender specification.	a) Specification requirement is clear under the referred cl.no. . Bidder shall comply with the specification requirements. b) To be optimized by the bidder based on its system design and selection.
881.	Errata 1 to Section VI, Part A, Subsection II - A8	Annexure B	9 of 31	a) The basic wind speed "Vb" at ten	NTPC 3x660MWNabinagar - The basic wind speed Vb at ten meters above the mean ground level may please be specified.	The basic wind speed "Vb" at 10m height above the mean ground level for "NABINAGAR-I 3X660 MW" project shall be 47 metres/second. Also refer Amendment issued separately in this regard.

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882.	Section VI, Part A, Subsection IIA6-4		Equipment layout plan at El 0.00 m	NTPC Solapur - All elevations indicated in the drawing are wrt TG building ground floor elevation as (+/-)0.00 which corresponds to RL(+) 416.5	NTPC Solapur - Bidder understands that FGL for the plant is RL 461 m whereas TG ground floor level i.e. FFL is RL 461.50. Please confirm.	Bidder's understanding is correct.
883.	Section VI, Part A, Subsection IIA6-4	7.00.01	9 of 31	The corresponding bore logs are enclosed at annexure-IV.	NTPC Solapur - Owner to furnish soil investigation report for the vicinity area as the same are not available with tender document.	Bidder to refer amendment.
884.	Section VI, Part B, Sub Section - IV-D	12.00.00	31 of 69	Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction technique.	As quantum of road work is very less and considering lack of space within the existing units, bidder understands that deployment of mechanical pavers are not mandatory. Owner to kindly confirm bidder's understanding.	Method(s) as per IRC may be followed.
885.	Section VI, Part B, Sub Section IV D, Civil works	10.00.00	26 of 69	Site LevellingSite levelling of gypsum area, lime storage area, gypsum dewatering area, truck hopper and associated areas to be levelled in one block.	Bidder is free to decide FGL based on existing NGL in order to optimize cutting and filling quantities. Owner to please confirm.	Site levelling shall be done by Owner as per the levels specified in GLP in tender document. Only site clearance and minor grading is in bidder's

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Sr. No	Section / Part / Chapter / Volume	Clause No.	Page No.	Bid specification	Bidder's Query	NTPC's Clarification
						scope.
886.	Section VI, Part A, Subsection II-A4	Annexure III	19 of 30	Employer has carried out geotechnical investigation in vicinity to the proposed area. Logs of representative boreholes for bidder's information in the vicinity of proposed area are enclosed with this Annexure	Geotechnical investigation for Dalipalli Stage-I, 2x800 MW project is not attached along with the tender document. Owner is requested to furnish the same.	Refer amendment issued separately
887.	Section VI, Part B, Sub Section - IV-D	19.00.00	39 of 69	All steel structures shall be fabricated in factory, transported and erected at site.	Bidder understands that fabrication of silo/hoppers /tanks /absorber shell,etc. can either be fabricated at factory or fabricated at site. In case of site or shop fabrication, field connection will be welded. Please confirm bidder's understanding.	Considering the large dimensions of the said equipment, Bidder's understanding is correct.

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888.	Section VI, Sub-section - IIA-3	Lara topographic survey		Topographical survey, Drg No. 9548-999-POC-F-002, Rev 0	NTPC Lara Super Thermal Power Project - Finished ground level for the plant are @ RL 203 M and RL 202 M whereas the natural ground levels (reduced levels) as per the topographical survey drawing are in the range of 224-230 M. Owner to please verify whether bidder have received the correct topographical survey drawing for the referred project.	Refer amendment issued separately.

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1161.	Part-A-Sub Section-II-A6	Clause no.7.08- Page no.19	Foundation System and Geotechnical Data- Type of Foundation system to be adopted- Open Foundation system.	The foundation design shall be based on final recommendations of geotechnical investigation report approved by Client during execution. Provision shall be made for appropriate compensation If any major variation in the soil data/ sub-soil conditions if identified.	Bidder may refer Cl. No. 7.00.03. If bidder feels, data provided is not adequate, he may carry out geotechnical investigation for bidding purpose. Further, Bidder shall comply the provisions of Technical Specification.
1162.	Sub-Section-IVD -CIVIL WORKS	Clause no.12.00	RCC Roads & RCC Drains	Bidder understands that only approach roads along with drains on both sides shall be provided from the new structures of the proposed FGD. The main plant roads and drains shall be in the scope of the client. Please confirm.	Refer Scope of work. Refer clause 2.00.00 Section-VI, Part-A of technical specification.
1163.	Sub-Section-IVD -CIVIL WORKS	Clause no.13.00	Gate Along Boundary Wall	Bidder understands that any works for construction of gate along boundary wall is excluded from the bidders scope of work.	Refer Scope of work. Refer clause 2.00.00 Section-VI, Part-A of technical specification.

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1164.	Sub-Section-IVD -CIVIL WORKS	Clause no.4.01	Contractors scope shall include construction of necessary culverts below railway lines/ roads as per the railway/IRC standards and shall take approvals of railway culverts from the concerned railway authorities.	Bidder has considered RCC hume pipe culverts only below the approach roads in the scope of works for this package. Bidder has excluded the construction of culverts below railway lines and taking their approvals from necessary railway authorities. Bidder request client to kindly confirm.	Bidder shall comply with technical specification requirement.
1165.	Sub-Section-IVD -CIVIL WORKS	Clause no.14.00	The Storm Water drainage for any area under consideration shall be taken in to account the finished grade levels of the area.	Bidder has considered only the drains along the approach roads and garland drains around the proposed structures. These drains shall be connected to the nearest main plant drains with proper slopes. Please confirm.	Bidder's understanding is correct.
1166.	Sub-Section-IVD -CIVIL WORKS	Clause no.25.02	Excavations in hard rock shall be carried by Blasting if required. The contractor shall obtain license from the competent authorities for undertaking blasting works.	Bidder request client to take necessary statutory permissions required for Blasting from the concern authorities. Bidder has excluded these from their scope of work.	Bidder shall comply with technical specification requirement.
1167.	Sub Section I-M1	Clause 5.06.06	Mist eliminator	Whether bidder can propose roof type ME with PP material	Bidder can propose roof type Mist Eliminators with the material specified in the Technical Specification.

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913.	Section VI, Part B, Sub Section IV D, Civil works	17.21.00 b)	37 of 69	Waterproofing treatment shall be provided for liquid retaining/carrying structures and basement type structures (requiring dry working condition).	Bidder understands that clause no. 17.21.00 of subsection IV-D Civil works, is not applicable for truck hopper and limestone hopper. Please confirm.	Bidder's understanding is correct.
914.	Section VI, Part B, Sub Section IV D, Civil works	3.01.00	3 of 69	Truck hopper - Chemical injection grouting for inner faces. Polymer modified cementitious coating on earth side face as per the following:		
915.	SECTION- VI, PART- ASUB SECTION-III- A1FGD	1.03.00	1 of 9	The FGD system shall have an independent absorber for each unit, common limestone milling systems and common gypsum dewatering system for each Lot 1 A Project.	The space available for installation of FGDs at most sites is very limited. In such cases, it shall be beneficial to optimise the available space when offered technology is capable to do so with equal effectiveness. Bidder offers Jet Bubbling Technology, which has excellent flexible operability even at turndown ratios of 15%. We request NTPC to accept option of offering combined absorber for multiple units. Our collaborator has proven references of such common absorbers installed for multiple units operating successfully globally.	Specification requirement is clear. Bidder shall comply with the specification requirements.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	NTPC Clarifications
1170.	Sub-Section-IVD -CIVIL WORKS	Clause no.12.00	RCC Roads & RCC Drains	Bidder understands that only approach roads along with drains on both sides shall be provided from the new structures of the proposed FGD. The main plant roads and drains shall be in the scope of the client. Please confirm.	Refer Scope of work. Refer clause 2.00.00 Section-VI, Part-A of technical specification
1171.	Sub-Section-IVD -CIVIL WORKS	Clause no.13.00	Gate Along Boundary Wall	Bidder understands that any works for construction of gate along boundary wall is excluded from the bidders scope of work.	Refer Scope of work. Refer clause 2.00.00 Section-VI, Part-A of technical specification.
1172.	Sub-Section-IVD -CIVIL WORKS	Clause no.4.01	Contractors scope shall include construction of necessary culverts below railway lines/ roads as per the railway/IRC standards and shall take approvals of railway culverts from the concerned railway authorities.	Bidder has considered RCC hume pipe culverts only below the approach roads in the scope of works for this package. Bidder has excluded the construction of culverts below railway lines and taking their approvals from necessary railway authorities. Bidder request client to kindly confirm.	Bidder shall comply with technical specification requirement.
1173.	Sub-Section-IVD -CIVIL WORKS	Clause no.14.00	The Storm Water drainage for any area under consideration shall be taken in to account the finished grade levels of the area.	Bidder has considered only the drains along the approach roads and garland drains around the proposed structures. These drains shall be connected to the nearest main plant drains with proper slopes. Please confirm.	Bidder's understanding is correct.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	NTPC Clarifications
1174.	Sub-Section-IVD -CIVIL WORKS	Clause no.25.02	Excavations in hard rock shall be carried by Blasting if required. The contractor shall obtain license from the competent authorities for undertaking blasting works.	Bidder request client to take necessary statutory permissions required for Blasting from the concern authorities. Bidder has excluded these from their scope of work.	Bidder shall comply the provisions of Technical Specification.
~~1175.~~	~~Sub Section I-M1~~	~~Clause 5.06.06~~	~~Mist eliminator~~	~~Whether bidder can propose roof type ME with PP material~~	~~Bidder shall comply with the requirements of Technical Specifications.~~
1176.	Sub Section I-M1	Clause 5.03.02	Oxidation Blower	The stoichiometric ratio of 2.5 was mostly used in the past for grid type of oxidation, now a day with new spargers, lower SR typically below 2 are in use, can we consider lower SR. Also whether we can offer 3 blowers (2W+1S) common for two units	Bidder shall comply with the requirements of Technical Specifications.
1177.	Extension			As explained during pre-bid meeting, requirement of site visits and overall complex nature of project, we request the bid submission date extension up to 17.10.2017	Not a technical query.

S. No.	Section	Clause No	Page No.	Statement of Deviation/Part/Chapter	Variations / Exceptions	NTPC Clarifications
B.	TECHNICAL DEVIATION					

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Sl. No.	Specification Reference				Employer (NTPC) Specification	Bidder Requested Clarification	NTPC Clarifications
	Part	Sub-section	Clause no.	Page			
1252.	SECTION – VI, PART-A	SUB-SECTION-II-A1 (Project Information-Kudgi Super Thermal Power Project-3x800 MW)	GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0)		Storage/Laydown area/Area for dumping of excavated material	During site visit, it has been observed that no area has been earmarked for laydown/storage/ excavated material dumping other than the areas identified for FGD. Bidder request Owner to please earmark areas at site for laydown/storage/ excavated material dumping.	Bidder to refer the revised GLP in issued amendments.
1253.	SECTION – VI, PART-A	SUB-SECTION-II-A1 (Project Information-Kudgi Super Thermal Power Project-3x800 MW)	GLP (Drawing No. 9571-999-POC-F-001, Rev-5D0)		Underground substructures, sewer pipes, water pipes, cables etc around the FGD	Bidder request Owner to please provide the drawings for underground pipes, cables, amenities, utilities etc around the FGD area.	Same will be discussed with the successful bidder during the detail engg. stage.
1254.	SECTION – VI, PART-A	Subsection-III-D Civil	1.06.00	2 of 4	Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in tender drawing	Bidder understand that Uniformed Finished ground level will be arranged by Employer (at NTP) for the area's allocated for FGD (Space for FGD mentioned in the layout drawing) Employer is requested to	Site levelling shall be done by Owner as per the levels specified in GLP in tender document. Only site clearance and minor grading is in bidder's scope.

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Sl. No.	Specification Reference				Employer (NTPC) Specification	Bidder Requested Clarification	NTPC Clarifications
	Part	Sub-section	Clause no.	Page			
						confirm on Bidders understanding.	
1255.	GENERAL POINT				Employers Hostels/guest house	Employer is requested to allow their existing hostels/gust house on chargeable basis.	This may not be possible , however during the execution stage the same canbe discussed with our site.
1256.	SECTION – VI, PART-B	Subsection-IV-D Civil Works	39.00.00	65 of 69	Sand aggregate for Construction		Query is not clear.
1257.	GENERAL POINT				Topographical Survey drawing	Bidder request topographical survey drawing in Autocad format of all proposed FGD site..	Bidder to refer necessary amendment in this regard.
1258.	GENERAL POINT				Area Drainage Study report	Bidder request Owner to furnish Area Drainage Study report for planning the drainage in the area earmarked for FGD facilities of all proposed site.	Bidder to refer the revised GLP in issued amendments.



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S.No	Clause No	Page No.	Description of Bid Document	Bidders Queries/Suggestions	NTPC Clarifications
1548.	Part- B-II Elect 2 clause no 2.01.05 & 3.02.05 Technical requirement	2 & 5	The Cable vault / Cable spreader room space below the HT/LT switchgear room, control room, Unit control equipment----- Cable Trenches shall be provided only in Swicthgear/MCC rooms	It is proposed to provide cable trenches as per cl no 3.02.05 in Switchgear room. No Cable vault / Cable spreader is considered for Switchgear room.M/s NTPC to confirm acceptance.	Bidder to provide the same as per their standard pratice complying with technical specification
1549.	Part- B-II Elect 1 clause no 7.00.09 Technical requirement	4	SIC termination kit shall be suitable for fault level of 25KA for 0.17 sec	It is requested to reconfirm the fault level for Termination Kit.	Confirmed.
1550.	Part- A Elect 1 Subsection-IIIB Electrical System/Equipment clause no 1.08.00 Technical requirement	2 of 6	Contractor scope shall include laying of cable from employer board ---- on the employers nearest trestle in the FGD Area subject to availability of space & suitability. In case of non availability of space in employer trestle , contractor shall make necessary arrangement for cable tray erection & cable laying	Due to space constraint ,It is not feasible to construct a new trestle from Main Plant Area for FGD System cabling. Hence existing Trestle shall have to be utilized for cabling to FGD Switchgear from Main plant. M/s NTPC is requested to undertake the exercise to create the space in existing trestle for FGD cabling .	Bidder shall comply with technical specification CL no:- 1.08.00.2. In case of non availability of space in employers trestle, bidder shall make necessary arrangements for cable tray erection and laying. However bidder may visit the project in order o get itself acquainted with existing electrical of plant.
CIVIL					
1551.	SUB SECTION-II-A10-PROJECT INFORMATION-BARH-I 3X660 MW	30	List of Drawings, SI No-2(Topographical Survey Drawing) & SI. No-3(Equipment Layout Plan) are missing.	NTPC to submit the soft copies(Autocad drawing) of missing drawings.	Owner provide's PDF file only.

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S.No	Clause No	Page No.	Description of Bid Document	Bidders Queries/Suggestions	NTPC Clarifications
1552.	SUB-SECTION-II-A8 PROJECT INFORMATION- NABINAGAR-I 3X660 MW	-	Topographical survey drawing is missing	NTPC to submit the soft copies(Autocad drawing) of topographical survey drawings.	Owner provide's PDF file only.
1553.	SUB-SECTION-II-A8PROJECT INFORMATION- NABINAGAR-I 3X660 MW_Clause No:6.00.00	9	SITE SPECIFIC DESIGN PARAMETERS: The various design parameters, as defined in IS: 875 (Part-3), to be adopted forthe project site shall be as follows: a) The basic wind speed "Vb" at ten	NTPC to furnish basic wind speed "Vb" at 10m height above the mean ground level.	The basic wind speed "Vb" at 10m height above the mean ground level for "NABINAGAR-I 3X660 MW" project shall be 47 metres/second. Also refer Amendment issued separately in this regard.
1554.	SUB-SECTION-II-A8 PROJECT INFORMATION- NABINAGAR-I 3X660 MW_Clause No:7.08.00_SR- g_Item No-2	21	2) In view of the above, the following shall be adopted for all foundations and sub-structures,	Item description is incomplete.	Query is not clear.

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S.No	Clause No	Page No.	Description of Bid Document	Bidders Queries/Suggestions	NTPC Clarifications
1555.	SUB-SECTION-II-A3,A4,A6,A7 & A11 PROJECT INFORMATION-	-	Bore log details for following projects are missing, 1. Solapur STPP, Stage-II (2x660MW), 2. Gadawara STPP, Stage-I (2x800MW), 3.Nabinagar TPP (4X250 MW), 4. DARLIPALLI STPP, Stage-I (2X800 MW), 5. Tanda STPP, Stage-II (2x660MW)	NTPC to furnish the borelog details of missing project.	For Borelog details, bidder may refer Project information chapter furnished in Technical Specification for Gadawara STPP, Nabinagar TPP and Tanda STPP. Further, Bidder may also refer amendment no.1 for Darlipalli STPP, Meja and Soalpur STPP.
1556.	SECTION -VI TECHNICAL SPECIFICATION, Clause: 4.02.00	18	The scope for foul water from toilets shall include layout and laying of sewers up to the Employer's main sewer line for sewerage system together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers within the building and from the building to the Employer's sewer line.	NTPC to furnish the existng Sewer layout drawing.	Drawing shall be provided after award of work.

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S.No	Clause No	Page No.	Description of Bid Document	Bidders Queries/Suggestions	NTPC Clarifications
1557.	SECTION -VI TECHNICAL SPECIFICATION, Clause: 4.02.00, Clause: 21.00.00, Clause: 15.00.00	29,41,32	Clause: 4.02.00-For sewerage below ground stoneware pipes conforming to 18: 651 with concrete bedding and haunch. Clause: 21.00.00-Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD area to the nearest available manhole of the owner. Clause: 15.00.00-Cement concrete pipes of class NP-3 as per 18:458 shall be used below ground level for sewage disposal in all areas.	NTPC to confirm the type of pipe to be used for sewage disposal.	Refer amendment issued separately.
1558.	SECTION -V TECHNICAL SPECIFICATION, Clause: 12.00.00	30	Specification pertaining to road shoulder(shoulder width, subgrade materials used and their thickness) is missing.	NTPC to furnish the shoulder specification.	Refer amendment issued separately.
1559.	SECTION -VI TECHNICAL SPECIFICATION, Clause: 15.00.00	32	Sewage pump house shall be provided as per IS:4111.	NTPC to furnish the sewage pump house specification.	Refer amendment issued separately.

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S.No	Section/Part/Chapter	Clause No.	Page No.	Statement of subject	Clarification	NTPC Clarifications
						of Sub Section-III-C of Part A of specification.
1572.						
1573.	CIVIL					
1574.	PART B				Please clarify the tender GLP drawings cover all exiting buildings and structures in the planning space.	Bidder to refer the amended GLP.
1575.	PART B				Are there some exiting buildings and structures in the planning space for FGD needed to be removed? If there were, was the removal work under the Contractor's scope, or under the Owner's scope?	
1576.	PART B				When the planning space for FGD is not enough, if the contractor could chose another fit and spare space for FGD.	Bidder to refer the revised GLP in issued amendments.
1577.	PART B				Please provide groundwater annual water level elevation and quality of groundwater, and its corrosion possibility to concrete and steel underground.	Bidder to refer the revised GLP in issued amendments.
1578.	MEJA-II-A9-2 Meja GLP				Please provide the planning space for FGD.	Query is not clear.
1579.	DARLIPAL-LI-II-A4-1 PROJECT INFOR-				Please provide BORE LOG in or adjacent to the planning space for FGD.	Bidder to refer necessary amendment.

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S.No	Sec- tion/Part/ Chapter	Clause No.	Page No.	Statement of subject	Clarification	NTPC Clarifications
	MATION					
1580.	SOLAPUR- II-A6-1 PROJECT INFOR- MATION				Please provide BORE LOG in or adjacent to the planning space for FGD.	Bidder to refer necessary amendment.
1581.	PART B				Please clarify the structures types of all kinds of sturcture for FGD	Type of Building structure (RCC/ Steel), if not specified in the technical Specification shall be decided by the bidder considering the functional requirement, schedule of construction and site constraints (if any).

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Sl.No	Section /Part / Chapter	Clause No.	Page No.	As per RFQ	Pre Bid Queries	NTPC Clarifications
	FGD SYSTEMS					
1625.	Section-VI Part-B SUB-SECTION-IV-D CIVIL WORKS	6.08.00	24 of 69	Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through RCC staircase, and roof access to all other buildings all shall be through cage ladder as per requirement.	Bidder understands that Gypsum Dewatering Building,FGD Control room,MCC building,Ball mill building ,Slurry Recirculation pump house,Oxidation blower are RCC framed building with Brick walls. In addition No wall / Cladding shall be provided for areas where Blower,Slurry Recirculation Pumps,Dewatering equipment, Limestone Ball mill were located since these areas need maintenance access for the above equipments. However Electrical Control room,MCC room will be enclosed type with Brick walls. NTPC to confirm.	Bidder shall comply with technical specification requirement.
1626.	Section-VI Part-B Sub Sec-I-M1 (FGD)	7.07.07	28 of 51	All piping, valves & instrumentation upto the employer's terminal point shall be in the contractor's scope. Contractor shall provide the complete lime dosing system (in projects where	NTPC to furnish the size of Lime powder and inform whether the lime will be supplied in the form of bags or transported through truck.	Specification requirement is clear. Bidder shall comply with the specification requirements.



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SUB-SECTION – D1

EARTHWORK IN EXCAVATION AND BACKFILLING

SPECIFICATION NO. PE-TS-463-600-C001



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



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**STANDARD TECHNICAL SPECIFICATION FOR EARTHWORK IN
EXCAVATION AND BACKFILLING**

1.0.0 SCOPE

This specification covers earth work excavation in all types of soil, soft rock and hard rock including setting out, clearing and grubbing, shoring, dewatering, back filling around foundations/pipelines to grade, watering, compaction of fills, testing, approaches, disposal of surplus earth, protective fencing, lighting etc relevant to the structures and locations covered under this contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision services, earth moving machineries, surveying instruments including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work.

b) Preparation and submission of working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering including drainage, space for temporary stacking of soils, disposal area, fencing etc and all other details as may be required by the engineer.

c) To carry tests and submit to the Engineer, test results of fill materials and degree of soil compaction of fill whenever required by the Engineer to assess the quality of fill.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc. including procurement of necessary licenses from proper authorities.

2.2.0 Work to be provided by others

No work under this specification will be provided by any agency other than the contractor unless specifically mentioned elsewhere in the contract.



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2.3.0 Codes and Standards

All works shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes unless specified otherwise.

IS-1200	Method of measurement of building and civil engineering works, Part-I: Earthwork
IS-2720	Method of test for soils (Relevant parts)
IS-3764	Excavation work - Code of safety
IS-4081	Safety code for blasting and related drilling operations
IS-4701	Indian Standard Code of Practice for earthwork on Canals
IS:6922	Criteria for safety and design of structures subject to underground blasts
IS: 3764	Excavation work – code of safety

In case of conflict between this specification and those (IS Codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by this specification/IS Codes, any other standard practice as may be specified by the engineer shall be followed.

2.4.0 Conformity with Designs

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

2.5.0 Materials

2.5.1 General

All materials required for the work shall be of the best commercial variety and approved by the engineer.

2.5.2 Material for Excavation

For the purpose of identifying the various strata encountered during the course of excavation, refer clause no. 3.4.0 for the classification of earth strata.

2.5.3 Material for Filling

Material to be used for back filling shall be free from vegetations, roots, salts, rubbish, lumps, organic matter and any other harmful chemicals etc and shall be got approved by the engineer. Normally excavated earth shall be used for back filling. In case such earth contains deleterious salts, the same shall not be used. All clods of earth shall be broken or removed. Where the excavated material is mostly rock and if filling with the same is permitted by the engineer in writing, then the filling with rock shall be done in the following



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manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as far as possible and the mixture shall then be used for filling.

In case the earth required for backfilling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. The selected earth from the borrow areas shall be got approved by the engineer. The borrowed material shall be free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods etc. The contractor shall obtain and submit necessary clearances/permissions from the concerned authorities for the borrow areas/materials acquired to the engineer.

If specified, the back filling shall be done with clean well graded sand from approved quarries free from harmful and deleterious materials.

2.6.0 Quality Control

All works shall conform to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Back filling	(a) On quality of fill material (b) On moisture content of back fill (c) On degree of compaction achieved

2.7.0 Information regarding site conditions

Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the Contractor shall be taken as a guidance only and variation therefrom shall not affect the terms of the contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and / or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction



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likely to come up during the execution of the contract so that he may evolve a realistic programme of execution.

3.0.0 EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and back filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of slopes, shoring, approaches, dewatering, drainage, berms etc. for the approval of engineer.

3.1.0 Setting out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the same shall be rectified by the contractor at his own risk and cost.

3.2.0 Initial Levels

Initial levels of the ground either in a definite grid pattern or as directed by the Engineer will be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements. All records of levels, measurements etc. and also any drawing, cross-section etc. made therefrom, shall be jointly signed by the authorised representative of the contractor and the Engineer before the commencement of work and they shall form the basis of all payments in future.

3.3.0 Clearing and Grubbing

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Trees upto 300mm girth shall be uprooted. Trees above 300mm girth to be cut shall be approved by the engineer and marked. Cutting of trees shall include removing roots as well. After the tree is cut and roots taken out, the pot holes formed shall be filled with good earth in 250mm layers and compacted unless directed otherwise by the engineer. The trees shall be cut in to suitable pieces as instructed by the



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engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timber, fire woods etc shall be the property of the owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

3.4.0

Classification

All earthwork shall be classified under the following categories:

No distinction will be made whether the material is dry or wet.

a) Ordinary Soil

This shall comprise vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category.

b) Hard Soil

This shall include :

- i) stiff heavy clay, hard shale, or compact moorum requiring grafting tool or pick or both and shovel, closely applied ;
- ii) gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm ;
- iii) soling of roads, paths, etc., and hard core ;
- iv) macadam surfaces such as water bound, and bitumen/tar bound;
- v) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar, below ground level ;
- vi) soft conglomerate, where the stones may be detached from the matrix with picks ; and
- vii) generally any material which requires the close application of picks, or scarifiers to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) and (vi) above.

c) Soft and Decomposed Rock

This shall include :

- i) limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars ;
- ii) unreinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level ;
- iii) boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded



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in river bed, soil, talus, slope wash and terrace material of dissimilar origin ; and

iv) any rock which in dry state may be hard, requiring blasting, but which when wet becomes soft and manageable by means other than blasting.

d) Hard Rock (requiring blasting)

This shall include :

- i) any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required ;
- ii) reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and
- iii) boulders requiring blasting.

e) Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging or any other agreed method.

In case of any dispute regarding classification, the decision of the Engineer shall be final.

3.5.0 Excavation for Foundations and Trenches

3.5.1 General

All excavation shall be done to the minimum dimensions as required for the safety and working facility. In each individual case, the contractor shall obtain prior approval of the engineer for the method he proposes to adopt for the excavation including dimensions, side slopes, shoring, dewatering, drainage and disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. All excavation in open cuts shall be made true to the line, slopes and grades as shown on the drawings and/or as directed by the engineer. No material shall project within the dimension of minimum excavation lines marked. Boulders (if any) projecting out of the excavated surfaces shall be removed if they are likely to be a hindrance to the work/workers in the opinion of the engineer.

Method of excavation shall in every case be subject to the approval of the engineer. The contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works etc including the safety of the workmen. If any slip occurs, the contractor shall remove all the slipped materials from the excavated pit without any extra cost to the engineer/owner. All loose boulders and semi detached rocks which are not inside but so close to the area to be excavated and may liable to fall or otherwise endanger the



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workmen, equipment of the work etc during excavation in the opinion of the engineer shall be stripped off and removed away from the area of excavation. The method to be used for removal shall be such that it should not shatter or render unstable or unsafe the portion which was originally sound and safe. In case any material not required to be removed initially but later to become loose or unstable in the opinion of the engineer shall also be promptly and satisfactorily removed.

The rough excavation may be carried out upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the engineer. If the excavation (in all types of soil and rock) is done to a depth greater than that shown on the drawing or as directed by the engineer, the excess depth up to the required level shall be filled with cement concrete not leaner than 1:4:8 or richer as directed by the engineer at the own risk and cost of the contractor. In case where excavation in soil, soft rock (including weathered rock) and hard rock are involved, the excavation in each stratum shall be carried out separately with the approved methodology and as per the instructions of the engineer.

All excavated materials such as rock, boulders, bricks, dismantled concrete blocks etc shall be the property of the owner and shall be stacked separately as directed by the engineer. All gold, silver, oil, minerals, archeological and other findings of importance, trees cut or other materials of any description and all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of the owner and the contractor shall duly preserve the same to the satisfaction of the engineer/owner. The contractor shall deliver the same to such person or persons as may be authorized or appointed from time to time by the owner to receive the same.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.

3.5.2

Excavation in All Type of Soil and in Soft Rock

The excavation in all type of soil, soft rock including decomposed rock etc shall be carried out as per the approved proposal and as directed by the engineer. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. Foundation pits shall not be excavated to the full depth unless construction is imminent. The last 150mm depth shall be excavated once concreting work is imminent. At the discretion of the engineer, the full depth may be excavated and the bed be covered with lean concrete as specified after watering and compacting the bed. As the excavation reaches the required dimensions, lines, levels and grades



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etc, the work shall be got checked and approved by the engineer. In cases where deterioration of the ground, upheaval, slips etc are expected, the engineer may order to suspend the work at any stage and instruct the contractor to carry out the protection works before the excavation will be restarted.

3.5.3 Excavation in Hard Rock

Hard rocks shall normally be excavated by means of blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is not stable against sliding, necessary supports such as props, bracings or bulkheads shall be provided and maintained during the period of construction. Where the danger of falling loose rock/boulder from the excavated surfaces deeper than 2m exist, steel mesh anchored to the lower edge of the excavation and extending over and above the rock face adequate to retain the dislodged material shall be provided and maintained.

3.5.4 Blasting

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to transport the explosives as and when required for the work in a safe manner to the work spot.

Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.



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3.5.4.1 Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

3.5.4.2 Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine. Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine.

Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be



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provided at the magazine for this purpose and should be careful

- * not to put their feet on the clean floor unless the magazine shoes on.
- * not to touch the magazine shoes on ground outside the clean floor.
- * not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

3.5.4.3 Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

3.5.4.4 Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his



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responsibilities.

Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.



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Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.

3.5.4.5 Restrictions in Blasting

- a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
- b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
- c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
- d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
- e) The last blast shall not be more than 0.50 m in depth.
- f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

3.5.5 Disposal

The excavated spoils shall be disposed of in any (or all) of the following manner as directed by the engineer.

- a) By using it straightway for backfilling.
- b) By stacking it temporarily to use for backfilling at a later date during execution of the contract.
- c)
 - i) By either spreading
 - or
 - ii) By spreading and compacting at designated disposal areas.
- a) By selecting the useful material and stacking it neatly in designated areas as indicated by the engineer for use in backfilling by some other agency.

3.5.6 Disposal of Surplus Materials

All surplus material from excavation shall be removed and disposed of from the excavation site to the designated disposal area indicated by the engineer.



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All good and sound rocks obtained from excavations and all assorted materials of dismantled structures are the property of the owner and if the contractor wants to use it, he shall have to obtain it from the engineer at a mutually agreed rate. All sound rocks and other assorted materials like excavated bricks etc shall be stacked separately.

3.5.7 Protection

The contractor shall notify the engineer as soon as the excavation is expected to be completed within a day so that he shall inspect it at the earliest. Immediately after approval of the engineer, the excavation must be covered up in a shortest possible time. But in no case the excavation shall be covered up or worked on before approval by the engineer. Excavated material shall be placed 1.5m or half the depth (of excavation) whichever is more from the edge of the excavation or further away if directed by the engineer. Excavation shall not be carried out below the foundation level of the structure close by until the required precautions are taken. Adequate fencing is to be made enclosing the excavation. The contractor shall protect all the underground services exposed during excavation. All existing surface drains in the work area shall be suitably diverted by the contractor before taking up excavation to maintain the working area neat and clean.

3.5.8 Dealing with Surface Water

All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.

No works shall commence until surface water streams have been properly intercepted , redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the Contractor may need to construct temporary drainage systems to drain surface water from working areas.

3.5.9 Dewatering

All excavation shall be kept free of water and slush. Grading in the vicinity shall be controlled to prevent the surface water running into the excavations. The contractor shall remove any water inclusive of rain water and subsoil water etc accumulated in the excavation by pumping or other means as approved by the engineer and keep the excavations dewatered and/or lower the subsoil water level to 300mm below the founding level until the construction of foundation and backfilling are completed in all respects.

Sumps made for dewatering must be kept clear of the foundations. The engineer's prior approval on the method of pumping to be adopted shall be



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taken; but in any case, the pumping arrangement shall be such that there shall be no movement or blowing in of subsoil due to the differential head of water during pumping.

3.5.10 Timber Shoring

Close or open type timber shoring as approved by the engineer depending on the nature of sub-soil, depth of pit or trench and the type of timbering shall be adopted. Timbers made out of approved quality shall only be used. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches and pits from collapsing.

3.5.10.1 Close Timbering

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called "polling boards". These shall be of 250mm wide(min.) and 40mm thick(min.) sections as directed by the engineer. The boards shall generally be placed vertically in pairs, one on each side of the cut and shall be kept apart (maximum spacing is limited to 1.20m) by horizontal walers of strong wood cross strutted with wooden struts or as directed by the engineer. The length of wooden struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of excavation and supported by vertical walers which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed to avoid any slipping out of earth.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started from one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

3.5.10.2 Open Timbering

In case of open timbering, vertical board of 250mm wide(min.) and 40mm thick(min.) shall be spaced sufficiently apart to leave unsupported strips of maximum 500mm average width. The detailed arrangement, size of timber and the spacing etc shall be subjected to the approval of the engineer. In all other respects, the specification for close timbering shall apply to open timbering as well.



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3.6.0 Treatment of Slips

The contractor shall take all precautions to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides of the excavations. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If however slips still occur, the same shall be removed by the contractor with his own risk and cost.

3.7.0 Backfilling

3.7.1 General

The material to be used for backfilling shall be approved by the engineer which shall be obtained directly from the excavation, from the nearby areas where excavation work by the same agency is in progress, from the temporary stacks of excavated spoils or from the borrow pits as directed by the engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials etc.

In locations where sand filling is required, the sand used should be clean, well graded and be of the quality normally acceptable for use in concrete.

3.7.2 Filling and Compaction in Pits and Trenches all Around the Structures

As soon as the work in foundation has been accepted, the spaces around the foundation in pits and trenches shall be cleared of all debris, brick bats, mortar droppings etc and filled with approved earth in layers not exceeding 250mm (in loose thickness). Each layer(loose) shall be watered, rammed and properly compacted to the required degree to the satisfaction of the engineer. Earth shall be compacted with approved mechanized compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the engineer. The moisture content of the fill material during compaction shall be controlled near to its optimum moisture content so as to obtain the required degree of compaction. The final surface shall be trimmed and levelled to proper profile as desired by the engineer.

3.7.3 Plinth Filling

The plinth shall be filled with earth in layers not exceeding 250mm (in loose thickness) and each layer shall be watered and compacted to the required degree with approved compaction machine or manually if specifically permitted by the engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted in order to avoid any settlement at a later stage. The finished surface of fill shall be trimmed to the slope intended to be provided for the floor.



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3.7.4 Filling in Trenches for Water Pipes and Drains

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150mm, watered, rammed and compacted taking care that no damage is caused to the pipe below.

In case of trenches excavated in rock, the filling upto a height of 300mm or the diameter of the pipe whichever is more above the crown of the pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash as per the availability at site and shall be filled in compacted layers not exceeding 150mm. The remaining filling shall be done in layers with the mixture of boulders (of size not exceeding 150mm) and fine material as specified elsewhere in the specification. Each layer shall be watered, rammed and compacted to the required degree and to the satisfaction of the engineer.

3.7.5 Filling in Disposal Area

Surplus materials from excavation which are not required for backfilling shall be disposed of in the designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250mm thick when loose, watered and compacted with the help of a compacting equipment as per the directions of the engineer. In wide areas, rollers shall be employed and compaction shall be done to the satisfaction of the engineer at the optimum moisture content which shall be checked and controlled by the contractor. In certain cases the engineer may direct the contractor to dispose the surplus materials without compaction which can be done by tipping the spoils from a high bench neatly maintaining a proper level and grade of the bench.

3.8.0 Approaches and Fencing

The contractor should provide and maintain proper approaches for the workmen and inspection. The roads and approaches around the excavation should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as around the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

3.9.0 Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.



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4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 Excavation

On completion of excavation, the dimension of the pits will be checked as per the drawings after the pits are completely dewatered. The work will be accepted after all undercuts have been set right and all over excavations are filled back to the required lines, levels and grades by placing ordinary cement concrete of 1:4:8 proportion and/or richer and/or by compacted earth as directed by the engineer. The choice of the grade of concrete will be a matter of unfettered discretion of the engineer. Over excavation of the sides shall be made good by the contractor while carrying out the backfilling. The excavation work will be accepted after the above requirements are fulfilled and all the temporary approaches encroaching inside the excavation have been removed.

4.2.0 Backfilling

The degree of compaction required will be as per the stipulation laid down in IS: 4701 and the actual method of measuring the degree of compaction will be as decided by the engineer. The work of back filling will be accepted after the engineer is satisfied with the degree of compaction achieved.

5.0.0 RATES AND MEASUREMENTS

5.1.0 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding section in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.



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e) In case blasting in hard rock is envisaged, the unit rate quoted for earth work shall include the cost of storage and safety arrangements for the materials required for blasting. No separate payment will be made on this account.

5.2.0 Measurements

Method of measurements are specified as below:

a) The length, breadth and depth shall be measured correct to the nearest centimeter if measurements are taken by tape. Rounding of numerical shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter respectively correct to the nearest of two decimal places.

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in excavation shall be computed from these levels in cubic meter.

c) In case of open footings (rafts/ pilecaps/ drains/ cable trench/ pipe trench/ sub soil beams etc.) up to the depth of 2.0 metres from ground level, around excavation of 30 cm beyond the outer dimension of footing (not the PCC dimension below footing) shall be measured for payment to make allowances for centering and shuttering. Any additional/excess excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for item of work on excavation, backfilling, carriage, dewatering etc. Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in the quoted rates in the schedule of quantities.

d) In case of open footings (Rafts/ pilecaps / drains/ cable trench/ pipe trench/ sub soil beams etc.) at a depth of more than 2.0 metre from ground level, around excavation of 75 cm beyond the outer dimension of footing (not the PCC dimension below footing) shall be measured for payment to make allowances for centering and shuttering. Any additional/excess excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for item of work on excavation, backfilling, carriage, dewatering etc. Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in the quoted rates in the schedule of quantities.

e) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a



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deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation, then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

f) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rock so arrived shall be taken as soil.

g) The authorized quantity (calculated on the basis of authorized width/working space under clause no. 5.2.0 c & 5.2.0 d) or those actually excavated, whichever, are less, shall be measured for payment.

h) Tree cutting having girth more than 300mm shall be measured in number and are separately payable as deemed not covered in excavation items of work in the schedule of quantities.

6.0.0 INFORMATION TO BE SUBMITTED BY THE BIDDER

6.1.0 With Tender

Detail of equipments and machineries proposed to be used for excavation, backfilling and compaction shall be submitted along with the tender.

6.2.0 After Award

After award of the contract the successful bidder shall submit the following for approval.

a) Within 30 days of the award of contract, the contractor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation for the various foundations and the time required for backfilling and compaction after completion of foundation for the structures. The earthwork programme shall be planned in accordance with the foundation programme. The programme should also show how the excavation and backfilling quantities will be balanced minimizing the temporary stacking of



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spoils. It is to be noted that the engineer even after initial approval of the programme may instruct the contractor to enhance or to retard the progress of work during the actual execution in order to match with the progress of foundations. The initial programme being submitted by the contractor should have sufficient flexibility to take care of such reasonable variations.

b) Within 15 days of the award of contract, the contractor shall submit the drawings for earth work in excavation and backfilling showing detail of slopes, shoring, approaches, sump pits, dewatering lines, fencing etc for the approval of the engineer.



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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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SUB-SECTION – D2

CEMENT CONCRETE (PLAIN & REINFORCED)

1.00.00 SCOPE

1.01.00 General

This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. Special requirements for structures such as reinforced concrete chimney, cooling towers, etc. have been covered under the respective specifications. Those specifications shall be used in conjunction with this specification.

1.02.00 IS: 456 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate Code, specifications and/or replacement by any International code of practice as may be specified by the Engineer shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference. However, should the list be not exhaustive and does not cover any aspect of the work, then relevant Indian and, in its absence, relevant International code shall apply.

2.00.00 General

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified shall include but not be limited to the following

- a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.
- b) Prepare Bar bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.
- c) Prepare working drawings of formworks, scaffolds, supports, etc.
- d) Prepare shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.
- e) Prepare detailed drawings of supports, templates, hangers, etc. required for



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installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

As decided by the Engineer some or all of the drawings & schedules prepared under item (b) to (e) above will have to be submitted for approval.

- f) Submit for approval detailed schemes of all operations required for executing the work, e.g. material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.
- g) Design and submit for approval concrete mix designs required to be adopted on the job.

Furnish samples and submit for approval results of tests of various properties of the following:

- i) The various ingredients of concrete
- ii) Concrete
- iii) Embedments
- iv) Joint seals
- i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.
- j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved Performa for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

2.02.00 Work by others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Information to be submitted by the Tenderer

2.03.01 With Tender

The following technical information's are required with the tender:

- a) Source and arrangement of processing of aggregates proposed to be adopted.



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- b) Type of plant and equipment proposed to be used.
- c) Names of firms with which association is sought for to execute the special items of work in the contract.
- d) Types of formwork proposed to be used.

2.03.02 After Award

The Contractor shall submit the following information and data including samples where necessary, progressively during the execution of the contract.

a) Programme of Execution

Within 30 days of the award of contract, the Contractor will submit a Master Programme for completion of the work.

This Master Programme may have to be reviewed and updated by the Contractor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day-to-day Programme of every month is to be submitted by the Contractor before the end of the previous month.

b) Samples

Samples of the following materials and any other materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities free of cost, for approval. The Engineer for future reference will preserve approved samples. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities:

- i) Coarse and fine aggregates.
- ii) Admixtures.
- iii) Plywood for Formwork.
- iv) Embedded and anchorage materials as may be desired by the Engineer.
- v) Joint sealing strips and other*waterproofing materials.
- vi) Joint filling compounds.
- vii) Foundation quality Rubber Pads.



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c) Design Mix

Design mix as per specification giving proportions of the ingredients, sources of aggregates and cement, along with test results of trial mixes as per relevant I.S., is to be submitted to the Engineer for his approval before it can be used on the works.

d) Bar Bending Schedules

Bar Bending Schedules in accordance with Clause 2.01.00 (b) and 3.16.01 of this specification.

e) Detailed Drawings and Designs of Formworks to be used

Detailed design data and drawings of standard formworks to be used as per clause 2.01.00 (c).

f) Detailed Drawings for Templates & Temporary Supports for embedment As per Clause 2.01.00 (e).

g) Mill Test Reports for Cement & Reinforcing Steel.

h) Inspection Reports

The Engineer in accordance with Clause 2.04.00 of this specification may desire inspection Reports in respect of Formwork and Reinforcement and any other item of work as.

i) Test Reports

Reports of tests of various materials and concrete as required under Clause 4.0: SAMPLING & TESTING of this specification or as directed by the Engineer.

j) Any other data, which may be required as per this specification or as directed by the Engineer.

2.04.00

Conformity with Design

The Contractor will prepare checklists in approved Form, which will be called "Pour Cards". These Pour Cards will list out all items of work involved. The Contractor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all necessary help and assistance to the Engineer for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings and specifications, the engineer will give written permission on the same Pour



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Cards allowing the contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the Contractor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the Contractor as per the I.S. Specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete will be as approved or directed by the Engineer.

2.05.00 Materials to be used

2.05.01 General Requirement

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless-stated otherwise and be of best approved quality.

2.05.02 Cement

Ordinary Portland cement of grade-43 as per IS:8112/fly ash based Portland puzzolona cement conforming to IS:1489 (Part-1) shall preferably be used in reinforced/plain cement concrete works for all areas other than for the critical structures identified below. However, other types of cement such as ordinary Portland cement conforming to IS:269, Portland slag cement conforming to IS:455 respectively can be used under special circumstances. Cement used in all concrete mixes shall be in general of grade 33/43 unless design requires a higher grade. Ordinary Portland cement shall be used for following structure.

- a) TG foundation top deck and sub structures including raft.
- b) Spring Supporting decks of all machine foundations.
- c) Structures requiring grade of concrete of M30 and above.

In special cases, Rapid Hardening Portland Cement, Low Heat Cement, Sulphate resistant cement, high strength Ordinary Portland Cement etc. may be permitted or directed to be used by the Engineer.

For Brickwork, plaster, flooring and other finishing works, ordinary Portland cement of 33/43 grade shall be used.

2.05.03 Coarse Aggregate

Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as



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Coarse Aggregate. Coarse aggregate for concrete shall be chemically inert, hard, strong durable against weathering, of limited porosity, and free from deleterious materials. It shall be properly graded. Coarse aggregates shall be either crushed gravel or stone. All aggregates shall meet the requirement of IS:383:1970. Only Coarse Aggregate from, approved quarries and conforming to IS-383 will be allowed to be used on the works. Petrographic test shall be carried out by the contractor free of cost for checking the quality of rock from quarry. This test shall be repeated by the Contractor free of cost for change in quarry or as directed by the Engineer. The results shall be checked for reactivity of silica in aggregate with alkalis of cement.

2.05.04 Fine Aggregate

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS: 383 are termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification will be allowed to be used in works. Sand shall be hard, durable, clean and free from adherent coatings or organic matter and clay balls or pellets. Sand when used as fine aggregate in concrete shall conform to IS:383. For plaster, it shall conform to IS:1542 and for masonry work to IS:2116.

2.05.05 Water

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts, or other impurities. Generally, IS: 3550 will be followed for routine tests. Acceptance of water shall be as per IS: 456.

2.05.06 Admixture

Only admixtures of approved quality will be used when directed or permitted by the Engineer. The different types of admixtures, which may be necessary to satisfy the concrete mix and the design requirement, shall be as per IS-9103 and may be one of the followings:

- a) Accelerating admixture
- b) Retarding admixture
- c) Water reducing admixture
- d) Air entraining admixture
- e) Water proofing admixture

The contractor shall inform the Engineer about the type of admixture which he is planning to use in different areas within the scope of work for the approval



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of the Engineer. The admixture shall be of proven make and from a reputed manufacturer. It should not have any adverse effect on strength, durability of concrete and reinforcement. Super plasticizers conforming to IS: 9103 or ASTM C-494 shall only be used as admixture having the above properties either individually or in a combination as per the direction of the Engineer.

2.05.07 Reinforcement

Reinforcement shall be as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars shall be of tested quality.

2.06.00 Storage of Materials

2.06.01 General

All materials shall be stored so as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and the cost incurred thereof shall be realised from the Contractor's dues. The Contractor shall maintain upto-date accounts of receipt, issue and balance (stack wise) of all materials. Storage of materials shall conform to IS: 4082.

2.06.02 Cement

Sufficient space for storage, with open passages between stacks, shall be arranged by the Contractor to the satisfaction of the Engineer.

Cement shall be stored off the ground in dry, leak proof, well-ventilated warehouses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.

Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Engineer, as soon as it is detected.

2.06.03 Aggregates

Aggregates shall be stored on raised surface constructed by providing planks or steel plates or on concrete or brick masonry pavement. Each size shall be kept separated with wooden or steel or concrete or masonry bulkheads or in separate stacks and sufficient care shall be taken to prevent the material at the



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edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer.

2.06.04 Reinforcement

Reinforcing steel shall be stored consignment-wise and size-wise off the ground and under cover, if desired by the Engineer. It shall be protected from rusting, oil, grease, and distortions.

If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust at no extra cost to the Owner. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

2.07.00 Quality Control

Contractor shall establish and maintain quality control for different items of work and materials as may be directed by the Engineer to assure compliance with contract requirements and maintain and submit to the Engineer records of the same. The quality control operation shall include but not be limited to the following items of work:

a) Admixture:	Type, quantity, physical, and chemical properties that affects strength, workability, and durability of concrete. For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits.
b) Aggregate:	Physical, chemical and mineralogical qualities. Grading, moisture content and impurities.
c) Water:	Impurities tests.
d) Cement:	Tests to satisfy relevant IS Specifications.
e) Formwork:	Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating.
f) Reinforcement:	Shapes, dimensions, length of splices, clearances, ties and supports. Quality and requirement of welded splices.



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Material tests or Certificates to satisfy relevant IS Specification.

- g) Grades of Concrete: Usage and mix design, testing of all properties.
- h) Batching & Mixing: Types and capacity of plant, concrete mixers and transportation equipment.
- i) Joints: Locations of joints, water stops and filler materials. Dimension of joints, quality, and shape of joint material and splices.
- j) Embedded and Anchorage Items: Material, shape, location, setting.
- k) Placing: Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors.
- l) Compaction: Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, rodding and tamping.
- m) Setting of base & Bearing plates: Lines, elevations, and bedding mortar.
- n) Concrete Finishes: Repairs of surface defects, screening, floating, steel trowelling and brooming, special finishes.
- o) Curing: Methods and length of time.

Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Engineer for approval as may be desired.

3.00.00

INSTALLATION

All installation requirements shall be in accordance with IS: 456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not



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cover all the aspects to the full satisfaction of the Engineer.

3.01.00 Washing and Screening of Aggregates

Washing and screening of coarse and fine aggregates to remove fines, dirt, or other deleterious materials shall be carried out by approved means as desired by the Engineer.

3.02.00 Admixture

All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete. Admixtures including plasticisers of approved make may be used with the Engineer's approval in accordance with IS-456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or owner satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as directed by the Engineer.

3.03.00 Grades of Concrete

Concrete shall be in one of the grades designated in IS: 456. Grade of concrete to be used in different parts of work shall be as shown on the drawing. In case of liquid retaining structures, IS: 3370 will be followed. Minimum cement content shall be as per IS: 456.

3.04.00 Proportioning and Works Control

3.04.01 General

"Design Mix Concrete" and "Nominal Mix Design" is defined as follows for use in this specification:

- a) Proportioning of ingredients of concrete made with preliminary tests by designing the concrete mix. Such concrete shall be called "Design Mix Concrete".
- b) Proportioning of ingredients of concrete made without preliminary tests adopting nominal concrete mix. Such concrete shall be called "Nominal Mix Concrete".

As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades M-15 or lower only may be used if shown on drawings or approved by the Engineer. In all cases the Proportioning of ingredients and works control shall be in accordance with IS: 456 and shall be



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adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

3.04.02 Mix Design Criteria

Concrete mixes will be designed by the Contractor to achieve the strength, durability, and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations

- a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.
- b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.
- c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.
- d) The finished concrete should have adequate durability in all condition, to withstand satisfactorily the weather and other destruction agencies, which it is expected to be subjected to in actual service.
- e) The mix design shall have required workability and characteristic strength as per IS: 456. The quantity of cement, aggregates, and admixtures shall be determined by mass.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete in structural design. The Contractor will strictly abide by the same in his design of concrete mix installation. Various trials shall be given by the contractor with specific cement content on each trial. In some cases, plasticizers and other admixtures may be necessary to achieve the desired results.

3.05.00 Strength Requirements

The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland Blast furnace slag cement is used, shall be as per IS:456. All other relevant clauses of IS:456 shall also apply.

3.06.00 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as per IS: 456. Contractor has to consider actual environmental exposure condition at



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site. Based on various tests results and as per Engineer, the environment condition shall be adopted for which minimum cement content shall be considered. No extra payment shall be made on account of any variation in environment condition.

- a) Sufficient number of trial mixes (to be decided by the Engineer) will be taken at the laboratory for the various designs and graphs of w/c ratio Vs crushing strengths at various ages will be plotted.
- b) All tests will be done in presence of the Engineer who shall be the final authority to decide upon the adoption of any revised minimum cement content. The Contractor will always be responsible to produce quality concrete of the required grade as per the acceptance criteria of IS: 456.
- c) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

3.07.00 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on:-

- a) The requirement of strength.
- b) The requirement of durability.

3.07.01 Strength Requirement

In case of "Design Mix Concrete" the water-cement ratio of such value as to give acceptable test results as per IS: 456, will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete, the maximum water-cement ratio for different grades of concrete is specified in Table-5 of IS: 456 and no tests are necessary. The acceptance test criterion for nominal mix concrete shall be as per IS: 456.



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3.07.02

Durability Requirement

Tables 4 & 5 of IS: 456 give the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful chemicals. Impermeability may also be an important consideration.

Whenever the water-cement ratio dictated by Durability consideration is lower than that required from strength criteria, the former should be adopted.

In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer/super-plasticizer. Trial mix shall be carried out accordingly. However, the contractor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer.

3.08.00

Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of 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-V

LIMITS OF CONSISTENCY

Degree of workability	Slump in mm with Standard Cone as per IS: 1199		Use for which concrete is suitable
	Min.	Max.	
Very low	0	25	Large Mass concrete structure with heavy compaction equipments, roads
Low	25	50	Uncongested wide and shallow R.C.C. structures
Medium	50	100	Deep but wide R.C.C. structures with congestion of reinforcement and inserts
High	100	150	Very narrow and deep R.C.C. structures with congestion due to reinforcement and inserts.

Note: Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment will be made for this additional cement.

The workability of concrete shall be checked at frequent intervals by slump tests.

3.09.00 Size of coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Engineer

Very narrow space	- 12 mm
Reinforced concrete Except foundation	- 20 mm



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Ordinary Plain concrete and Reinforced
concrete foundations - 40 mm

Mass concrete - 80 mm

Lean concrete - 40 mm

Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stockpiles

80 mm to 40 mm, 40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.

3.09.01 Temperature control of concrete in top decks of machine foundations (i.e. of TGs, BFPs, Fans and Mills) as extra payable over RCC item of BOQ:

The temperature of fresh concrete shall not exceed 23°C when placed. A suitable measuring device for measuring the temperature of concrete as approved by the Engineer shall be used. For maintaining the limiting temperature of the 23°C, crushed ice shall be used as mixing water. The ice shall be formed of water conforming IS: 456. The Contractor shall establish the quantity of crushed ice to be mixed in order to achieve the limiting temperature of 23°C.

3.09.02 Base raft of Turbo Generator foundations and top decks of all machine foundations shall be cast in a continuous operation without any construction joint.

3.10.00 Mixing of Concrete

Ingredients of the concrete mix shall be measured by weight. Concrete shall always be mixed in mechanical mixer. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case



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shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent Aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS: 4634 on all mixers employed at site only those mixers whose efficiencies are within the tolerances specified in IS: 1791 will be allowed to be employed.

Batching Plant shall conform to IS: 4925. The measuring gauges of batching plant shall be periodically calibrated for which the contractor shall provide standard weights. The accuracy of all gauges shall be within limits prescribed by the Engineer.

When hand mixing is permitted by the Engineer, for unimportant out of the way locations in small quantities, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch at no extra cost to the owner.

3.11.00 Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If, in spite of all precautions, segregations does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers, which will reduce the rate of loss of water, by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before, commencement of concrete mixing. Such equipments shall be kept free from set concrete.



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3.12.00

Placing and Compacting Concrete

Where specifically covered, the relevant I.S. Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in relevant I.S. code for any particular aspect of work, any other standard code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces:

- a) Earth foundation
- b) Rock foundation
- c) Formwork
- d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. Earth foundation on which direct placement of concrete is allowed, will be consolidated as directed by the Engineer such that it does not crumble and get mixed up with the concrete during or after placement, before it has sufficiently set and hardened.

Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer.

Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed or cement slurry will be spread thoroughly on the rock Foundation or construction joint just prior to



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placement of concrete.

After concrete has been placed, it shall be spread, if necessary & thoroughly compacted by approved mechanical vibration to maximum, subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of Practice: In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to IS: 4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS: 2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement, and formwork are not displaced or distorted during placing & consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green Concrete, which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.

Slabs, beams, and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Mouldings, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings, or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation there from shall be set right by the Contractor at his own expense as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same -at the Contractor's expense.

The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.



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Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

3.13.00 Construction Joints and Cold Joints

3.13.01 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction.

Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12.

Where the location of the joints are not specified, it will be in accordance with the following:

- a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.
- b) Concrete in a beam shall preferably be placed without a joint, but if Provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.
- c) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.
- d) Feather-edges in concrete shall be avoided while forming a joint.
- e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.
- f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.02 Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of



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placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:

- a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.
- b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.
- c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not raise inspite of extensive vibration, the joint, will be left to harden for at least 12 - 24 hrs. It Will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

3.14.00 Repairs, Finishes, and Treatment of Concrete surfaces

3.14.01 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing, and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete at the Contractor's cost. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods at no extra cost to the Owner, All concrete work shall be inspected by the Contractor immediately after the forms are removed & he will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations:

- a) Sack rubbing with mortar and stoning with carborundum stone.



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- b) Cutting away the defective concrete to the required depth shape.
- c) Cleaning of reinforcement & embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.
- d) Roughening by sand blasting or chipping.
- e) Installing additional reinforcement/welded mesh fabric.
- f) Dry packing with stiff mortar.
- g) Plastering, guniting, shotcreting etc.
- h) Placing and compacting concrete in the void left by cutting out defective concrete.
- i) Grouting with cement sand slurry of 1:1 mix.
- j) Repairing with a suitable mortar either cement or resin modified mortars.
- k) Polymer modified patching and adhesive repair & mortar for beams & columns.

3.14.02 Finishing unformed Surface

The contractor shall provide normal finishes in unformed surfaces which can be achieved by screeding, floating, trowelling etc. A few typical and common cases of treatment of concrete surface are cited below

a) Floor

Whenever a non-integral floor finish is indicated, the surface of reinforced concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done, as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes,



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ripples, and trowel marks.

A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beans, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy, and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.

3.15.00 Protection and Curing of concrete

Newly placed concrete shall be protected by approved means from rain, sun, and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days, or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive 'Loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, hessian, canvas, or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the Contractor. Quality of water for curing shall be as per IS: 456.

If permitted by the Engineer, liquid curing compound may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form a thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall be emulsified paraffin based and shall comply with ASTM requirements for



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acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water from concrete surface. It is important not to apply the curing compound when standing water is still present on concrete.

The contractor shall arrange for the manufacturer's supervision at no extra cost.

The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case the Engineer notices any lapse on the part of the Contractor, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost thereof from the Contractor, or deduct certain amount from contractor's payment for the part where inadequate curing was noticed entirely at the discretion of the Engineer.

3.16.00 Reinforcement

Mild steel round bars, TMT bars, Hot rolled deformed bars or cold twisted deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc, will be used as reinforcement as per drawings and directions. In an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per IS: 9077, as shown on the drawing or as directed by the Engineer.

3.16.01 Bar Bending Schedules

The Contractor shall prepare Bar Bending Schedules showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, progressively, starting within one week of receipt of approval on corresponding design of RCC structure. As decided by the Engineer, some or all the detailed drawings and schedules will have to be submitted for approval. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the contract. The contractor for record and distribution shall submit six prints of the final drawings & schedules with one reproducible print.

3.16.02 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or



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other harmful matters immediately before placing the concrete.

3.16.03 Bending

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS: 2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding with the final Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any cutting, bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Rebending can be done only if approved by the Engineer. Reinforcing bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.

3.16.04 Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire or by tack welding in case of Bar larger than 25 mm dia., as may be directed by the Engineer. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the Contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases he should not start placing any bar before obtaining clearance from the Engineer.

3.16.05 Welding / Coupler for Splicing

Lapping shall normally do splicing of reinforcement. For M.S. reinforcement bars, butt-welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS: 2751 and IS: 456. For High yield strength deformed bars, lap welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards as per IS: 9417.



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Welding of High yield strength deformed bar shall not be allowed.

Splicing of reinforcement using mechanical coupler may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian standards for "Reinforcement couplers for mechanical splices of bars in concrete" as per IS: 16172. Corrosion test in the coupler-bar connections exposed to marine or severe environmental conditions to rule out any risk of galvanic corrosion will be done by the contractor at no extra cost. Proper fitting & fixing of mechanical coupler to rebar shall be ensured at site for each coupled joint as per inspection testing plan developed at site in consultation with manufacturer of coupler. If so required at site, coupler/ threading on rebar shall be such that two bars can be coupled by moving couplers not rebar (as being heavy reinforcement weight and L shaped, it is not feasible to rotate the rebar for fixing up the coupler) at no extra cost.

3.16.06 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS: 456, unless otherwise specified. The laps shall be staggered as far as practicable and as directed by the Engineer. Arrangements for placing concrete shall be such that reinforcement in position does not have to bear extra load and get disturbed. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by –volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by the Engineer.

3.17.00 Cold Weather Concreting

When conditions are such that the ambient temperature may be expected to be 5°C or below during the placing and curing period, the work shall conform to the requirement of IS: 456 and IS: 7861.

3.18.00 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS: 7861 and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 38°C while placing. Positive temperature control by precooling, post cooling or any other method, if required, will have to be done by the



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contractor at no extra cost.

3.19.00 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of IS: 456.

3.20.00 Form Work

3.20.01 General

If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for formwork and centring and get them approved by the Engineer. The formwork shall conform to the shape, grade, lines, levels and dimensions as shown on the drawings.

Materials used for the formwork inclusive of the supports and centring shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centring shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rakers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight and horizontal pressure of the concrete as a liquid as well as the working load. In case the contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel and concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.



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For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are in true plumb and thoroughly cross-braced to keep them so. All floor and beam centring shall be crowned not less than 8 mm in all directions for every 5 metres span. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

3.20.02 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, sawdust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.03 Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns, and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork.

Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.



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3.20.04

Inspection of Forms

Casting of Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.05

Removal of Forms

Formwork shall be kept in position after casting of concrete for a minimum period as mentioned in IS: 456, however the period of retaining form in position can be extended as per drawing, instruction of Engineer or as required for satisfactory completion of work without any extra cost. Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if the Engineer so desires.

The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly. The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost to the Owner, The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

If any other type of cement other than ordinary Portland cement and Rapid hardening cement is used, the time of removal of forms shall be revised such that the strength of this cement at the time of removal of forms match with strength of Portland cement at the time of removal of form.

3.20.06

Tolerance

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this specification or drawings or directed by the Engineer:-

- For -
- a) Sectional dimension - ± 5 mm
 - b) Plumb - 1 in 1000 of height
 - c) Levels - ± 3 mm before any deflection has taken place

The tolerance given above are specified for local aberrations in the finished concrete surface & should not be taken as tolerances for the entire structure



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taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.07 Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.08 Classification

Generally, the "ordinary" class formwork shall be used unless otherwise specified.

- a) **Ordinary:** These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.
- b) **Plywood:** These shall be used in exposed surfaces, where specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class, if it is still in good condition.
- c) **Ornamental:** These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned timbers or of plywood, which can be shaped correctly.

3.21.00 Opening, Chases, Grooves, Rebates, Blockouts etc.

The Contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer.

3.22.00 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and other misc. Embedded Fixtures

The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as shown on drawings and secure the same as may be required. The materials shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and



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to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to paint with one coat of approved anti- corrosive paint and/or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material, the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer.

Items to be embedded

- a) Inserts, hangers, anchors, frame around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.
- b) Anchor bolts and plates for machinery, equipment and for structural steel work.
- c) Steel structurals to be left embedded for future extension, special connection etc.
- d) Dowel bars, etc. for concrete work falling under the scope of other contractors.
- e) Lugs or plugs for door and window frames occurring in concrete work.
- f) Flashing and jointing in concrete work.
- g) Any misc. embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor.

3.23.00 Expansion and Isolation Joints

3.23.01 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved



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laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension, and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

3.23.02 Bitumen Board/ Expanded Polystyrene Board

a) Bitumen Board

Bitumen impregnated fibreboard of approved manufacturer as per IS: 1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

b) Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.03 Joint sealing strips

Joint sealing strips may be provided at the construction, expansion, and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I., Aluminums, or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation -including the material and tools required for jointing, testing, protection, etc. If desired by



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the Engineer, joints in rubber seals may have to be vulcanized.

a) Metal Sealing Strips

Metal sealing strips shall be either G.I., Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing. The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak proof. If required, longer lap lengths and different method of brazing which will render it leak proof, will be adopted by the Contractor. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

i) G.I. Strips

G.I. strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The standard of Galvanizing shall be as per relevant Indian Standards for heavy-duty work. At the joints, the overlapping should be for a minimum length of 50 mm.

ii) Aluminium Strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS: 737 of 19000 grades or 31000 grade (Designation as per IS: 6051). A minimum lap of 50 mm length is required at the joints.

iii) Copper Strips

The Copper strips shall be minimum 18 SWC in thickness and 300 mm width unless specified otherwise and shall conform to the relevant Indian Standards. It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

b) Non-metallic Sealing Strips

These will be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features:

i) Plain

ii) Central bulb

iii) Dumb-bell or flattened ends

iv) Ribbed and Corrugated Wings



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v) V shaped

As these types of seals can be easily handled in very large lengths unlike metal strips, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs & the edges accurately.

c) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion, and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25 - 30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75°C
Ultimate Elongation	:	Not less than 350%

b) P.V.C., Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion, and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly

Specific Gravity	:	1.3 to 1.35
Shore Hardness	:	60A to SOA
Tensile Strength	:	10 - 15 N/Sq.mm



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Maximum Safe Continuous
Temperature : 70 Deg.C

Ultimate Elongation : Not less than 275%

3.23.04 Bitumen Compound

When shown in drawing or directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834.

3.23.05 Isolation Joints

Strong and tough alkathene sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.06 Pad

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24.00 Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If specified on drawings, admixtures like Aluminium powder, "Ironite" etc. may have to be added with the grout in required proportions. Premixed non-shrink grout of approved manufacture having proper strength shall be used with Engineer's approval for important machineries.



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3.25.00

Precast Concrete

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose. This yard shall be dry, properly levelled and having a hard and even surface. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven) days of curing and can be removed for erection after 28 (twenty-eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling, and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials, and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as per drawings. If centrings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

3.26.00

Waterproofing of Concrete Structure

3.26.01

General

Where required, waterproofing of concrete structures shall be ensured internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the joints. In addition to the above measures, the structures shall be made watertight by adopting "structural waterproofing" as per specification. The design, material, and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the



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Engineer, test certificates for the materials and samples shall be submitted by the Contractor free of charge. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.02

Water Bar/Seal/Special Treatment of Construction Joint

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be metallic, rubber, or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint shall be provided as per clause 3.13.1 with or without water bar/seal as shown on the drawing. In case of water bars being used at the construction joint, fixing of the same has to be done carefully, so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods.

Method 1: A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting. In case of walls, the above bonding agent will be mixed with water, which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two-component epoxy resin-bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days

Compressive strength	-	55 to 60 N/Sq.mm
Flexural strength	-	5 to 30 N/sq.mm
Tensile strength	-	15 N/Sq.mm (approx.)
Bonding strength to concrete	-	3 N/Sq.mm (approx.)
Bonding strength to steel	-	20 N/Sq.m (approx.)

The whole operation shall be done as per manufacturers specification. The contractor shall provide manufacturer's supervision at no extra cost to the owner.



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Method 2: One row of threaded nozzles at regular intervals not exceeding 1.5 m centre to centre shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the concrete has set to seal the voids in concrete near the construction joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 kg/sq.cm. The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision. The cost of such manufacturer's supervision shall be borne by the contractor.

3.26.03

Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar/plaster shall conform to IS: 2645. The admixture shall not cause decrease of strength of concrete/plaster at any stage and it shall be free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5%. The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement, but a lower dosage will always be preferred. The product shall be stored in strong moisture proof packings. However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water reducing concrete admixture shall be used to provide a waterproof concrete, For achieving high strength concrete having cement content around 400 kg/cu.m. a melamine based super plasticizer will be preferable.

- a) In concrete: The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor at no extra cost to supervise the work, if desired by the Engineer.
- b) In Plaster: The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor at no extra cost. On completion, the Plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.04

Structural waterproofing

- a) Nozzles spaced as required after the concrete is completed shall be drilled



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into surfaces to be rendered watertight. Non-shrink cement grout with waterproofing compound as per manufacturers specifications shall be injected under pressure to seal all voids. Special care shall be taken at joints by providing additional nozzles. The pressure grouting shall be done on the internal surface.

b) External Treatment

Two layers of (1:4) plaster of 12 mm thick each with waterproofing compound as per manufacturer's specification shall be provided on outer surface of concrete underground structures.

3.26.05 Protective coating on Inside Surface.

Two coats of cement based two components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be applied on the walls/floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

3.26.06 Bitumen Felt: Application for Tanking

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials shall conform to IS: 1322, and the workmanship to IS: 1609. The bitumen felt should be hessian base and/or fibre base as specified in Drawing. If required by the Engineer, tests as specified in relevant IS Codes shall be arranged by the Contractor without charging any extra to the Owner.

The Contractor shall execute this work in direct collaboration with one of the well-known specialized firm approved by the Engineer.

Cleaning the surface, keeping it dry, providing, necessary corner fillets and cement rendering and cutting chases, etc. shall be done as per drawings and/or instructions. If any protective brickwork on/against concrete sub-bases or walls are required, the same shall be provided. A twenty (20) years guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the Contractor even if it is beyond the specified maintenance period of the contract as a whole.

3.26.07 Polyethylene Films: Application in Walls or base of structures

Waterproof treatment shall be applied as outlined and as per sequence given hereunder



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- i) the concrete surface shall be made smooth with 12 mm cement plaster 1:6.
- ii) apply hot bitumen 80/100 grade (IS: 73-1961) at the rate of 1.0 Kg/Sq.m minimum
- iii) lay black polyethylene film 250-micron (IS: 2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.

Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethylene film to be heat-sealed. On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a cellophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another cellophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat-sealing, the cellophane tape is to be removed and the joints are to be tested for leaks.

- iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen,
- v) Lay hot bitumen 80/100 grade (IS: 73-1961) at 1.0 Kg/Sq.m minimum.
- vi) Lay 250-micron polyethylene film as second layer similar to (iii) above.
- viii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.
- ix) Apply hot bitumen (straight run grade) to IS: 73-1961 at 1.0 Kg/Sq.m dusted with fine sand.
- x) Protecting with a layer of 75 mm plain cement concrete M-10, or a layer of brick laid in cement mortar 1:6 in case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

3.27.00 Protective Coating on Concrete Surface

3.27.01 On Foundation

The outside faces of foundation of important structures will be protected from adverse effect of soil/underground water, if shown on drawing by using rubber/bitumen emulsion protective coating of approved manufacturer.



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4.00.00 SAMPLING AND TESTING

4.01.00 General

The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

4.02.00 Cement

Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths as per guidelines of IS: 269. Soundness Tests may also be required to be carried out if required by the Engineer. The Contractor shall carry out the tests without any expense to BHEL. No cement from a particular consignment/batch will be used on the works unless satisfactory 3 (three) days and 7 (seven) days test results for compressive strength are known. The Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the BHEL or the Contractor. These tests are of great importance, as their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.

4.03.00 Aggregates

The contractor shall carry out any or all the tests on aggregates as may be required by the Engineer in accordance with IS: 2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.04.00 Water

Sampling and Testing of water being used for concrete works as per IS: 3550 will be carried out by the Contractor at regular intervals and whenever directed by the Engineer. The acceptance criteria will be as per IS: 456.

4.05.00 Admixture

4.05.01 Air Entraining Agents

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the Contractor by carrying out sufficiently large number of tests. After that, at regular intervals



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and whenever directed by the Engineer, the Contractor will check up the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results.

4.05.02 Other Admixtures

Tests for establishing the various properties of any other admixtures, which may be required to be added, shall be carried out by the Contractor.

4.06.00 Concrete

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS: 516 and IS: 1199, the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS: 516. Sampling procedure, frequency of sampling and test specimen shall conform to IS: 456. To control the consistency of concrete from every mixing plant, slump tests shall be carried out by the Contractor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference. The acceptance criteria of concrete shall be in accordance with IS: 456. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor at his own cost. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

5.00.00 ACCEPTANCE CRITERIA

5.01.00 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to IS: 456.

5.02.00 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to IS: 456.

5.03.00 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to IS: 456.

5.04.00 Load Test

Load tests of structural members as per IS:456 may be required by the Engineer, when the strength of test specimen results falls below the required



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strength.

If the member shows evident failure, the Contractor shall make the structure adequately strong free of cost to BHEL.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good, free of charge by the Contractor to the satisfaction of the Engineer.

6.00.00 RATES AND MEASUREMENTS

6.01.00 Cast-in-situ Concrete

6.01.01 Rates

- a) The unit rates shall include the cost of labour, materials, equipment, handling, transporting, botching, mixing, placing in position, vibrating, compacting, finishing, curing, testing, etc. at all elevations. This shall include the cost of curing by regular wetting or by using curing compound.
- b) The unit rates shall include for all working conditions including at locations under water, liquid, mud, in or under foul positions and extreme weather conditions.
- c) The unit rates for exposed concrete works (including machine foundations) shall include all incidentals, rendering, smoothening with carborandum stone, finishing with a paste of cement sand mortar, curing, etc.
- d) The unit rates shall include all arrangement for maintaining stability of structure during execution.
- e) Nothing extra shall be payable for the handling/mixing of extra cement on account of any reason or pouring of second stage concrete.
- f) Nothing shall be payable to the Contractor on account of facilities and arrangement provided by him for conducting ultrasonic pulse velocity (UPV) tests or other relevant tests to ascertain grade and quality, etc. of the concrete in case the concrete quality is in doubt and contractor has to establish the quality by further tests. In case of any defects, the Contractor shall rectify the same by cement/epoxy grout at his own cost.

However, mandatory UPV test as specified in the drawings shall be carried out including arrangement of all its facilities, staging, etc. and shall be



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payable to the contractor as per BOQ item.

- g) The unit rates for controlling of the temperature of concrete shall include storing and mixing of ice, water, cooling of aggregate etc.
- h) The quoted rate shall include the cost of MIX design, making of all trial mixes using admixtures and mixing in concrete etc. complete.

6.01.02 Measurements

- a) Actual volume of concrete work as executed or as per drawings issued, whichever is less shall be measured in cubic metres to the nearest two decimals.
- b) No deductions shall be made for the following:
 - i) Ends of dissimilar materials embedded inside for example, beams, posts, girders, rafters, purlins, trusses, corbels and steps upto 500 sqcm in cross section;
 - ii) Opening upto 0.1 sq.m.
 - iii) Volume occupied by reinforcement, sleeves, anchor bolts, and similar items.
 - iv) Volume occupied by pipes, conduits, sheathing, etc. not exceeding 100 sq.cm. each in cross sectional area.
- c) The concrete works of different grades; below and above ground floor finished level shall be measured separately, unless otherwise specified in the schedule of items. Accordingly rates shall be applied for concrete in foundation for concrete below ground floor finished level and concrete in superstructure for concrete above ground floor finished level.
- d) For temperature control measures, measurement shall be done in terms of quantity of concrete in cum. in concreting of which the ice have been used or cooling of aggregates has been done to keep the temperature of freshly laid concrete to less than 23°C.

6.02.00 Reinforcement

6.02.01 Rates

- a) The unit rates shall include for cover block, providing binding wire, welding, separator pieces between two or more layers of reinforcement required for keeping the steel in position, etc. at all elevations.



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- b) No extra will be paid for transportation from stores, cleaning, straightening of steel, cutting, bending, binding with annealed wire, welding, tack welding, placing the reinforcement modification of already embedded reinforcement, if required, due to faulty fabrication or placement and other cost of tools and plants, materials, labours, return of unused steel to the store, etc.
- c) However, lap welding of reinforcement steel if permitted shall be paid under separate item as provided in the BOQ and no deduction for labour and binding wire saved for not providing lap length shall be made. Similarly, splicing of reinforcement bars using mechanical couplers if permitted shall be paid under separate item as provided in the BOQ and no deduction for labour and binding wire saved for not providing lap length shall be made.
- d) No extra shall be paid for preparing and getting approved bar bending schedules (including all revisions).
- e) Generally members are straight and have straight edges. However, for bending, binding, placing of reinforcement in any curved member in length or cross section or both, no extra payment shall be made.

6.02.02 Measurements

- a) Bar or any other type of reinforcement used like hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in tonnes. The weight shall be arrived at by multiplying the actual or theoretical length measured alongwith standard hooks, cranks, bends, authorized laps, etc. whichever is less by the sectional weights. Claims for payment for this item shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS Section weight. Nothing extra will be payable to the Contractor on account of, difference in weight, if any, due to different methods adopted for issue and measurement.
- b) Standard hooks, cranks, bends, authorised laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tonnes.

6.03.00 Formwork and Staging

6.03.01 Rates

- a) The unit rates shall be inclusive of all staging, scaffolding, making the formwork watertight, etc. for all elevations and in all types of works.



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- b) No separate payment shall be made for providing fillets, for rounding or chamfering at junctions, comers, etc.
- c) The unit rates shall include the cost of labour, materials etc. and the extra time, which shall be required for the removal of shuttering/ support for satisfactory completion of work.
- d) No extra payment shall be made on account of difficulty, wastage etc. for placement/removal of formwork between the network of closely placed steel beams or for the lacing/bracing portions and ribbed slab constructions.
- e) Payment for curved shuttering shall be made for curved members/wall whose centerline radius in plan is less than 6m.
- f) If the contact surface area in pockets is less than or equal to 0.1 sq.m. in each case, payment shall be done under item for providing formwork in pockets.

6.03.02 Measurements

- a) Formwork for different classes (types) shall be measured separately as the actual surface in contact with the concrete and paid on area basis unless included in the rate for concrete. The unit of measurement shall be in sq.m.
- b) Openings upto 0.1 sq.m or boxing left for inserts etc. for facility of Contractor's work, shall be neglected as if nonexistent for the purpose of formwork measurement of surface in which the openings occur.

For suspended floor, no deduction shall be made for flange area of secondary steel beams.

- d) No measurement shall be taken for the formwork in pockets, openings, chases, blockouts, etc. in concrete, the contact surface area is less than or equal to 0.1 sq.m. in each case.
- e) For pockets, if the contact surface area is less than or equal to 0.1 sq.m. in each case, measurement shall be done under item for providing formwork in pockets.
- e) Formwork, if required, for joints shown on drawing or instructed by the Engineer, shall be paid for the 'leading side' only.

6.04.00 Embedded Parts

6.04.01 Rates

- a) The unit rate for erection of embedded steel parts, supplied by Engineer



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shall include transportation from Owner's store to the place of work, erection & installation including setting material in concrete, etc. complete.

- b) The unit rate for MS pipe embedments and PVC pipe embedments shall include cutting, welding, fabrication, erection, embedding, and transportation to site. Unit rate shall also include the cost of the pipes.
- c) Rate for expansion fasteners shall include cost of fasteners, installation, and fixing including cost of washers and nuts and site testing if required.

6.04.02 Measurements

- a) The measurement of the embedded steel parts fabricated and installed by the Contractor shall be based on the calculated weight of steel sections in tonne corrected to second place of decimal.
- b) Embedded steel parts supplied by Owner and installed by Contractor Measurement shall be done for the net weight of the embedments installed in tonnes correct to second place of decimal.
- c) For PVC pipes/conduits, measurements shall be in quintals correct to second place of decimal for the net weight.
- d) For mild steel pipes, measurement shall be in quintals, correct to second place of decimal, for the net weight of the steel pipe supplied, fabricated, and installed.
- e) The lugs shall be measured in Kg. correct to second place decimal for the net weight.
- f) The expansion fasteners shall be measured in number according to tension capacity.
- g) The rails shall not be treated as embedded steel part and the track shall be measured in running metres along the centre line and paid for under separate item of work as specified in schedule of items. Other related civil items associated with the laying of track shall be measured separately and paid under respective items of works.

6.05.00 Groutings

6.05.01 Rates

Rate shall include the cost of surface preparation, admixtures, and curing.

6.05.02 Measurements:



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- a) Measurement shall be in cubic decimeters.
- b) Measurement for grouting shall be by volume of the block out, pockets or bolt hole upto the top surface of foundation concrete and shall be calculated from the dimensions shown on the drawings.
- c) Measurement for underpinning shall be by volume between the top surface of the foundation concrete and the underside of the base plate, the plan dimensions being as indicated on the drawings.
- d) No deduction shall be made for shims, bolts, shear keys and such other embedments.
- f) Pressure injection grouting with cement based grout if required as per drawing shall be applied at appropriate spacing to cover the desired surface area and measurement shall be made for the surface area grouted in sqm as per BOQ item. However in water retaining structures, the structural grouting if required to ensure water tightness shall not be payable separately as deemed to be covered in water retaining concrete item of BOQ.

6.06.00 Joints

6.06.01 Rates

The unit rate shall include all the activities described in the schedule of items.

6.06.02 Measurements

- a) Bitumen Board/Expanded polystyrene.

The measurement for bitumen board shall be based on actual finished surface area in square meters nearest to second decimal, for the specified thickness.

- b) Water Stops

The measurement for water stops shall be in running metres of actual length of the joint covered, for specified thickness, width, and shapes. No separate measurement shall be made for laps/splices for cross-joints and mitered joints.

- c) Metal Cover Strips

The measurement for Metal Cover Strips shall be based on actual finished surface area in square metres for the specified thickness.



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d) Vibration Damping Resilient Pads

The measurement for this item shall be in square metres for the specified thickness, measured correct to the second place of decimal, of the actual finished surface area.

6.07.00 Dismantling/Demolishing Work – RCC and PCC and Chipping of Concrete

6.07.01 Rates

The unit rates shall include the cost of all necessary propping, shoring, underpinning scaffolding, safety measures, temporary enclosures, disposal/stacking of serviceable/unserviceable materials, etc. for all types of work and for all grades of concrete.

In the case of dismantling/demolishing work, the cutting of reinforcement shall also be included in the rate.

In the case of chipping work, the cutting of reinforcement shall be paid separately.

If the serviceable material including reinforcement steel from dismantled structure is allowed to be used/taken out by bidder, suitable rebate shall be given by bidder.

6.07.02 Measurements

a) Dismantling of PCC and RCC work shall be measured in cu.m separately. Measurement of all work, except hidden work shall be taken before execution of work and no allowance for increase in bulk shall be allowed. Specifications for deductions of voids, openings etc, shall be done on the same basis as that applied for construction work.

b) Chipping of concrete, making holes/pockets etc. shall be measured in cubic decimeters (i.e. 0.001 cu.m.).

c) Cutting of reinforcement in chipping work for making of pockets and openings shall be measured in sq. cm. of cross-sectional area.

6.08.00 Precast Concrete

This clause shall be read in conjunction with relevant provisions specified elsewhere for cast in-situ Concrete.

6.08.01 Rates



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- a) The unit rate shall include cost of preparation of casting yard, formwork, concrete and its casting, finishing as specified, setting filling of gaps between adjacent pre-cast concrete units with concrete, or cement mortar, curing, handling, erection, grouting, welding, preparation of supporting surface, etc.

6.08.02 Measurements

The measurement of pre-cast concrete members shall be on the basis of volume of concrete in cubic metres nearest to second place of decimal. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings up to 0.1 sq.m. The setting of element with cement mortar shall not be measured separately The filling of concrete cement mortar between the gaps of adjacent precast units shall be considered while computing the volume of pre-cast concrete work and shall be paid for under this item itself.

7.00.00 LIST OF IS CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed:-

- IS: 73 - Indian Standard Specification for Paving Bitumen
- IS: 216 - Indian Standard Specification for Coal Tar Pitch
- IS: 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
- IS: 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement
- IS: 455 - Indian Standard Specification for Slag Cement
- IS: 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete
- IS: 457 - Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive



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Structures

- IS: 516 - Indian Standard Specification for Methods of Test for Strength of Concrete
- IS: 702 - Indian Standard specification for industrial bitumen.
- IS: 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete
- IS: 1322 - Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing
- IS: 1489 - Indian Standard Specification for Portland Pozzolona Cement
- IS: 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.
- IS: 1609 - Code of Practice for Laying Damp-proof Treatment using Bitumen Felts
- IS: 1786 - Indian Standard Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement.
- IS: 1791 - Indian Standard Specification for Batch Type Concrete Mixers.
- IS: 1838 - Indian Standard Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
- IS: 2185 - Indian Standard Specification for Hollow Cement Concrete Blocks
- IS: 2210 - Indian Standard Specification for Design of Reinforced Concrete shell Structures and Folded Plates
- IS: 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII
- IS: 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
- IS: 2505 - Indian Standard Specification for Concrete Vibrators, Immersion Type
- IS: 2506 - Indian Standard Specification for Screed Board Concrete Vibrators



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IS: 2514 -	Indian Standard Specification for Concrete Vibrating Tables
IS: 2571 -	Code of practice for laying in-situ cement concrete floors.
IS: 2645 -	Integral cement water proofing compound
IS: 2722 -	Indian Standard Specification for Portable Swing Weigh Batches for Concrete (Single and Double Bucket type)
IS: 2750 -	Indian Standard Specification for steel scaffoldings.
IS: 2751 -	Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction
IS: 2770 -	Indian Standard Specification for Method of Testing Bond in Reinforced Concrete
IS: 3025 -	Indian Standard specification for Methods of Sampling and Test (Physical and Chemical) for Water used in Industry
IS: 3067 -	Code of practice for general design details and preparatory work for damp proofing and water proofing of building.
IS: 3201 -	Indian Standard Specification for Design and Construction of Precast Concrete Trusses
IS: 3370 -	Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids
IS: 3414 -	Code of practice for design and installation of joints in buildings.
IS: 3550 -	Indian Standard Specification for Method of Test for Routine Control for Water used in Industry
IS: 3558 -	Code of Practice for use of Immersion vibrators for Consolidating Concrete
IS: 3696 -	Safety Code for Scaffolding and Ladders
IS: 3812 -	Indian Standard Specification for Fly Ash for Use as Admixture for Concrete
IS: 4014 -	Code of practice for steel tubular scaffolding.
IS: 4031 -	Indian Standard Specification for Method of Tests for



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Hydraulic Cement

- IS: 4082 - Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site
- IS: 4090 - Indian Standard Specification for Design of Reinforced Concrete Arches
- IS: 4634 - Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixes
- IS: 4656 - Indian Standard Specification for Form Vibrators for Concrete
- IS: 4925 - Indian Standard Specification for Concrete Batching and Mixing Plant
- IS: 4926 - Indian Standard Specification for Ready Mixed Concrete
- IS: 4990 - Indian Standard Specification for Plywood for Concrete Shuttering work
- IS: 4991 - Indian Standard Specification for Blast Resistant Design of structure for Explosion above ground
- IS: 4995 - Indian Standard Specification for Design of Reinforced Part-I & II Reinforced Concrete Bins for the Storage of Granular and Powdery Materials
- IS: 4998 - Indian Standard Specification for Design of Reinforced Concrete Chimneys.
- IS: 5256 - Code of practice for sealing joints in concrete lining on canals.
- IS: 5512 - Indian Standard Specification for Flow Table for use in Tests of Cement and Pozzolanic materials
- IS: 5513 - Indian Standard Specification for vacate Apparatus.
- IS: 5515 - Indian Standard Specification for Compaction Factor Apparatus.
- IS: 5525 - Recommendation for detailing of reinforcement in reinforced concrete works.
- IS: 5624 - Indian Standard Specification for foundation bolts.
- IS: 5751 - Indian Standard Specification for Precast Concrete Coping



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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: 5892 - Indian Standard Specification for transit mixer and agitators.
- IS: 6452 - Indian Standard Specification for High Alumina Cement for Structural Use
- IS: 6909 - Indian Standard Specification for Super sulphated Cement
- IS: 6923 - Indian Standard Specification for Method of Test for Performance of Screed Board Concrete Vibrators.
- IS: 6925 - Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures.
- IS: 7242 - Indian Standard Specification for Concrete Spreaders.
- IS: 7246 - Indian Standard Specification for Table Vibrators for Consolidating Concrete.
- IS: 7251 - Indian Standard Specification for Concrete Finishers.
- IS: 7293 - Safety code for working with construction machinery.
- IS: 7320 - Indian Standard Specification for Concrete Slump Test Apparatus.
- IS: 7861 - Indian Standard Specification for Recommended Practice Part-I&II for Extreme Weather Concreting.
- IS: 7969 - Safety Code for Storage and Handling of Building Materials.
- IS: 8041 - Indian Standard Specification for Rapid Hardening Portland cement.
- IS: 8112 - Indian Standard Specification for high strength Ordinary Portland Cement.
- IS: 8142 - Indian Standard Specification for Determining Setting time of concrete by Penetration Resistance.



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- IS: 8989 - Safety Code for Erection of Concrete Framed Structures.
- IS: 9012 - Recommended method for shotcreting.
- IS: 9013 - Indian Standard Specification for Method of Making, Curing, and determining compressive Strength of Accelerated-cured Concrete Test Specimens.
- IS: 9077 - Code of Practice for Corrosion Protection of Steel Reinforcement in RB and RCC Construction.
- IS: 9103 - Indian Standard Specification for Admixtures for Concrete.
- IS: 10262 - Recommended Guidelines for Concrete Mix Design.
- IS: 13311 - Non-destructive testing of concrete.
- SP: 34 - Handbook of concrete, reinforcement and detailing.



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CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-463-600-C003



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



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CARPENTRY AND JOINERY

1.00.00 SCOPE

This section covers supply, fitting and fixing of timber frames to doors and windows with M S holdfasts, flush doors, windows, shutters, partitions, wall panelling, pelmets, shelves, furniture, etc. as shown in drawings, including a prime coat of approved paint, varnish, or fixing of decorative plastic laminate where called for. This shall also include the supply and fixing of all hardware and fixtures shown in drawing or specified.

2.00.00 INSTALLATION

2.00.01 Materials

a) Timber

Unless otherwise specified, all timber shall be best quality well seasoned CP teakwood free from large or loose knots, cracks or any other defects. All timber shall be treated with approved wood preservative before use, unless specified otherwise. The rough timber shall be approved by the Engineer before incorporating in the works and starting the carpenter's work.

b) Plywood

Plywood shall be of commercial quality or with decorative surface veneer. Unless specifically permitted otherwise, the adhesive used in plywood shall be phenol formaldehyde synthetic resin of BWP grade conforming to IS: 848.

c) Decorative Laminated Plastic Sheets

The colour, pattern, finish and texture shall be approved by the Engineer. The bulk supply shall be procured in full sheet sizes which will ensure the least number of joints in one surface.

d) Flush Doors

Flush doors shall be solid core doors with commercial or decorative faces and hardwood edges conforming to IS: 2202 (Part-1). The core for solid core doors shall be of block board or wood particle board. Manufacturer's literature and test certificates shall be submitted for the approval of the Engineer. The Contractor shall give a guarantee that the adhesive used is BWP grade phenol formaldehyde synthetic resin conforming to IS: 848. The thickness shall be as specified.



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e) Panel Doors

Panel door shall be of teakwood shutter frame, unless otherwise noted and panels with teakwood/commercial ply/teakwood particle board. Other considerations shall be as mentioned in item (d) above.

f) Windows, Ventilators

Windows and ventilators shall made of teakwood shutter frame, unless specified otherwise and glazing of specified thickness shall be fixed with wooden beadings.

g) Fixtures

Fixtures for doors, windows, furniture etc. shall be as shown on drawing or specified.

2.02.00 Workmanship

2.02.01 General

The work shall be done by skilled carpenters as per details shown on drawing or instructed by the Engineer.

Framing timber and other work shall be close - fitting with proper wood joinery, accurately set to required lines or levels and rigidly secured in place. The surface of frames etc., which will come in contact with masonry after fixing, shall be given two coats of approved paint before fixing. Mastic caulking shall be done after fixing external door and window frames. Special care shall be taken to match the grain of timber or plywood, which will be subsequently polished. Screwing or nailing will not be permitted to the edge of plywood and particle board. The edge of all plywood, blackboard and particle board shall be finished with teakwood lipping unless otherwise shown on drawings.

Fixing to frames and partitions shall generally be with 40 mm x 6 mm x 300 mm long M S holdfasts bifurcated at end and grouted with 1:2:4 cement concrete. The gap between masonry and external door and window frame shall be caulked with polysulphide mastic. M.S. grills or guard bars shall be provided to windows where called for in the drawings.



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2.02.02 Finish

All carpentry work after finishing shall be sand papered smooth. A prime coat paint shall be given after inspection of the Engineer to all surfaces other than those, which shall be subsequently polished or covered with laminated plastic sheet.

2.02.03 Surface Treatment

When shown on drawings or called for, decorative ply or laminated plastic sheets shall be bonded under pressure to the surface to be finished. The adhesive used shall be of brand and brought to site in sealed containers. The rate of application and the length of time for which the pressure is to be applied shall be as per the manufacturer's instructions. The edge of sheets shall be protected by teak lipping or bevelled as shown on drawings.

3.00.00 ACCEPTANCE CRITERIA

3.00.01 Door and Window Frames

All frames shall be square and flat at the time of delivery and shall be checked for dimensions and corner angles. After fixing they shall be on a fine vertical plane. All external door and window frames shall be caulked with mastic.

3.02.00 Door and Window Shutters

All doors and window shutters shall be of proper size, shape, and design and free of warp. When fixed to frames, these shall operate smoothly without jamming and all latching or locking devices shall engage properly without undue pressure.

3.03.00 Partitions, Paneling, Pelmet, Furniture, etc.

3.03.01 General

These shall conform to drawings in all details. No unsightly nail marks etc. shall be permitted. Plywood grains shall be matched to give a uniform and pleasing appearance.

3.03.02 Partition

Shall be checked for rigidity of fixing, plumb and horizontal as well as vertical alignment.



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3.03.03 Pelmets

Shall be checked for rigidity of fixing and adequate clearance of fixture.

3.03.04 Cupboard Shutters

Shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used.

3.03.05 Drawers

Shall operate smoothly and have backstops to prevent them from being pushed too far. Locks shall engage securely.

3.03.06 Loose Furniture

When placed on a level surface, tables tops etc. shall be horizontal and the pieces stand stably on legs or supports.

4.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 848 - Synthetic resin adhesives for plywood (Phenolic and Aminoplastic)

IS: 1003 - Timber panelled and glazed shutters.

IS: 2191 - Wooden flush door shutter (Cellular and hollow core type).

IS: 2202 - Wooden flush door shutters (solid core type).

IS: 4021 - Timber door, window, and ventilator frames.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall include of all activities mentioned in "Schedule of Item" for completion of the work. No separate payment shall be made for fixing, caulking, application of primer coat, polishing, providing of butt hinges,



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holdfasts, sliding/tower bolts, door stoppers, door closers and other fittings and fixtures.

5.02.00 Measurement

Measurement shall be done in Sqm for doors, windows, ventilators, shutters, partitions etc.

Measurement for wooden frame shall be in CuM.

Pelmets shall be measured in RM.



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**ROOF AND UNDERGROUND STRUCTURES WATER
PROOFING, INSULATION AND ALLIED WORKS**

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



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**ROOF AND UNDERGROUND WATER PROOFING,
INSULATION AND ALLIED WORKS**

1.00.00 SCOPE

This section covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of roof and underground water-proofing, insulation and allied works for buildings and at locations covered under the scope of this package.

2.00.00 INSTALLATION

2.01.00 GRADING UNDERBED

The surface to receive the underbed shall be roughened and thoroughly cleaned with wire brush and water. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed.

The underbed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The underbed shall be cured under water for at least 7 days.

The underbed shall be laid to provide an ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Upto an average thickness of 25mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete. The underbed shall be finished to receive the waterproofing treatment direct or insulation as the case may be.

2.01.01 Cement Mortar Underbed

The underbed grading plaster shall be average 25 mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The sand and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts.

The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

2.01.02 Cement Concrete Underbed

The underbed cement concrete shall be used where the subgrade is more than average 25 mm thick. It shall consist of cement concrete 1:2:4 nominal mix



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by volume with 12 mm down stone chips and coarse sand. The aggregate shall be mixed dry and minimum quantity of water shall be added to make the mix workable.

The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

2.02.00 INSULATION

The Tenderer shall, along with the tender, send specifications of insulating materials he proposes to use and the proposed method of laying. Before bulk supply, the contractor shall send samples of insulating material to the Engineer, and after approval of the samples, the Contractor shall procure and transport the bulk material to the site. Whenever asked by the Engineer, the Contractor shall furnish test certificates from testing laboratory on the insulating and other properties of the materials.

After laying the insulation, the surface shall be made ready as required to receive the waterproofing treatment. If any plastering is used it shall be not leaner than 1:4 cement sand by volume and not thinner than 12 mm and it shall be cured for seven days.

2.02.01 Foam Concrete

This shall be of lightweight foam concrete of average 50 mm thickness or as specified or as shown on drawings. This may be laid in situ in suitable panels or precast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed 0.125 Kcl/sq.m. hr degree C. Before starting the laying of foam concrete samples shall be prepared at site and got tested for approval of the Engineer.

The foam concrete laid shall be sufficiently strong to withstand the usual workload and standard loads expected on the roof. Any damaged portion shall be removed and replaced forthwith. Approval of the Engineer shall be taken before laying the waterproofing over the insulation.

While laying the foam concrete, samples from each batch of the mix shall be kept for test if so desired by the Engineer.

2.02.02 Expanded Polystyrene Blocks

The expanded polystyrene block Insulation shall be fire retardant quality and shall have a maximum thermal conductivity of 0.026 Kcl m/sq.m h °C. It must be strong enough to withstand without any deformation under the workload and standard loads expected on the roof.



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The Contractor shall lay the expanded polystyrene block as per manufacturer's approved specification. Only specifically experienced workers shall be used for this work. If the Engineer is not satisfied about the efficiency of the workers the Contractor shall secure manufacturers supervision at no extra cost to the Owner.

2.03.00 Fillets

Fillets at Junction of roofs and vertical walls shall be provided with the same insulating material as provided for the main roof insulation. The fillets shall be 150 mm x 150 mm in size unless otherwise shown on drawings or instructed by the Engineer.

Where there is no insulation over roof slab, fillets shall be cast-in-situ cement concrete (1:2:4) nominal mix volume.

2.04.00 Waterproofing Treatment

2.04.01 Bitumen Felt Treatment

Waterproofing treatment shall be laid by a specialist firm with long experience in the particular trade.

The waterproofing treatment for roofs with bitumen felts shall be done following relevant IS: 1346. Bitumen felt shall conform to IS: 1322 and Bitumen primer to IS: 3384.

The bonding materials shall consist of blown type conforming to IS: 702 or residual bitumen conforming to IS: 73 or a mixture of the two to withstand local conditions of prevailing temperature or gradient of roof surface. The Contractor shall convince the Engineer that the bonding material proposed to be used is suitable for the particular job.

The Contractor shall state the source from where he proposed to procure the materials. Samples of the self-finished felt shall be submitted in advance to the Engineer along with test certificates for his review. Test certificates for the bonding materials shall also be submitted and samples, if desired by the Engineer, shall be provided for confirmatory tests. Samples shall be submitted if instructed by the Engineer.

Minimum overlaps of 100 and 75 mm shall be given at the end and sides of strips of felt and properly bonded with bitumen. Joints in successive layers of felt shall be staggered.

Normal treatment with one layer of felt, heavy treatment with two layers of felt or Extra Heavy treatment with three layers of felt shall be indicated. Brief details of the various treatments shall be as follows:



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a) Normal Treatment - Five courses

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)
- 3) Hessian base self finished felt, type 3, grade 1.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)
- 5) 20 mm thick pressed precast concrete tiles with 15 mm, thick 1:4 cement-sand mortar underbed.

b) Heavy Treatment - Seven Courses

With Hessian base felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 3) Hessian base self-finished felt, type 3, grade 1.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 5) Hessian base self-finished felt, type 3, grade I.
- 6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With fiber base felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Not applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 3) Fiber base self-finished felt, type 2, grade 2.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 5) Fiber base self-finished felt, type 2, grade 2.



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6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

c) Extra Heavy Treatment – Nine courses

With fiber based felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

3) Fiber-base self-finished felt type 2, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (min.)

5) Fibre base self-finished felt type 2, grade 1.

6) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

7) Fibre base self-finished felt type 2, grade 1.

8) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

9) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With Hessian base felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

3) Hessian base self-finished felt, type 3, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

5) Hessian base self-finished felt, type 3, grade 1.

6) Hot applied bitumen at the rate of 1.2 kg/sqm. min.

7) Hessian base self-finished felt, type 3, grade 1.



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8) Hot applied bitumen at the rate of 1.2 kg/sqm. min.

9) 20 mm thick pressed precast concrete tiles with 15 thick 1:4 cement: sand mortar underbed.

However, in special cases, more courses, or a combination of fibre base and hessian base felts may be asked for.

The surface to receive the waterproofing treatment must be cleaned and dried satisfactorily and the Engineer's approval taken before starting the work. If any existing waterproofing treatment is being augmented the existing top course shall be completely removed and all damaged felts or other defects repaired.

The Engineer may instruct the Contractor to lay part of the stipulated courses at the first instant to be followed later on with the balance courses. This interim finish shall be done with a course of hot applied bitumen. While doing the balance again hot bitumen shall be applied to start with after repair of all damages to the already laid course.

After completion the surface shall be cleaned taking care that felt cuttings etc. do not find their way into rainwater down comers.

2.04.02

Elastomeric Membrane

a) Material

The material shall consist of high solid content Polyurethane based cold liquid applied coatings as per ASTM C836-89a comprising of urethane pre-polymers extended with flexible material, which cure by reaction with atmospheric moisture to give a continuous film which is rubbery and elastic or any other equivalent material permitted as per ASTM and approved by the Engineer. The material shall consist of high solid coating designed to give a high-build film. The material shall not be diluted. The coating shall have physical feature like high viscosity, 90% solids, high resistance to impact, abrasion and cracking, superior tensile strength, application limit of 70°C minimum, 300% elongation and forming a perfectly smooth permanently flexible seamless membrane which should have good adhesion to roof substrates (RCC, tiles, brick, and metals), having a minimum life of 10 years. It should also be resistant to acid (mild concentrated), alkalies and have a very low water absorption rate (0.5%) max. at ambient temp. after 7 days.

The pack shall not be older than 9 months after the date of manufacture and packing.

b) Primer coat

It shall consists of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush over the prepared bed as an adhesion coat of an application rate of minimum 6 sq.m per litre.

The primer shall be allowed to dry for minimum of 2hrs. time before the successive finishing coats of P.U. liquid membrane are applied.

c) Finishing coats :

The finishing coats shall consist of two successive liquid coatings of high solids content urethane pre-polymers or equivalent material to form an elastomeric membrane. The overall dry film thickness shall be 1.5mm subject to minimum 500 gm per sq.m per coat application rate.

Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface should be dry and smooth before application.

The coating shall be continued up the parapets/walls for a minimum of 150mm over the finished roof surface. It shall be continued into rain water pipes by atleast 100mm.

The final coat of P.U. liquid when tacky shall be sprinkled with the sand.

For edges, expansion joints and any vulnerable points a later of polyscrim cloth /fabric to be embedded between 2 finishing coats.

d) Surface Finish :

Areas of roof treatment which are vulnerable to accidental damage shall be provided with wearing course consist of minimum 20 mm thick PCC of Grade M15 (using 12.5mm size aggregate) cast in panel of maximum size of 1.20m x 1.20m and reinforced with 0.56mm diameter galvanised chicken wire mesh and sealing of joints using sealant or elastomeric compound.

When the roof surface is subjected to foot traffic or used as a working area, a cement mortar (1:4) shall be applied over the top most layer of roofing treatment. Over this, a layer of chequered cement concrete flooring tiles conforming to IS:13801 shall be provided in place of stone grit and cement painted. The tiles shall be laid as per IS:1443.



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2.04.03

Waterproofing By Epoxy Resin Based Application

Exposed surfaces of cement concrete, lime concrete or brickwork to be treated for waterproofing by the resin-based application shall be thoroughly cleaned and the epoxy resin based material to be applied as directed by the manufacturer. The material shall not have any adverse effect on the surface on which it is applied and must stick to it uniformly to make a strong durable bond. It shall not be affected by short duration fire, sun exposure, and light duty traffic. The application shall be resistant to growth of fungus and proof against saltpetre action. If desired by the Engineer, a sample shall be prepared in advance and tested for waterproofness for 48 hours under 300 mm depth of standing water. The Contractor shall arrange the demonstration by providing free the materials and labour for the application as free of cost to Owner. This item shall carry a guarantee as specified.

2.04.02

Flashing

Unless otherwise stated flashing shall be done in the same way as the waterproofing except that the last layer shall be finished with two coats of bituminous primer. The flashing shall be extended up the vertical surfaces as shown on drawing. The flashing shall end in grooves in vertical walls. The grooves shall be at least 65 mm deep and caulked with waterproof mastic cement. The minimum overlap with horizontal roofing felt shall be 100 mm.

Where specified or directed by the Engineer, metal flashing shall be provided. The materials shall be 18 Gage or 22 G G.I. sheets, as specified or as directed by the Engineer.

2.05.00

WATER-PROOFING OF UNDERGROUND STRUCTURES

Basements, ducts, pits, tunnels (excluding tanks) etc below the ground water table and in contact with soil are covered under this. Bonding material shall be blown bitumen of 65/25 grade conforming to IS: 702.

Waterproofing shall be provided on the outside of walls and top of RCC slab and shall be carried out upto 150mm above ground level. The number of layers of bitumen felt to be used for walls and floor unless otherwise shown in the drawing shall be:

- a) 2 layers - for depths up to 5m below ground level
- b) 3 layers - for depths beyond 5m below ground level

2.05.01

Method of laying the bitumen felts and workmanship shall be as per IS: 1609 and IS: 3067. Water proofing work shall be taken in hand only when the sub-soil water level is at its lowest; the site shall be kept dry by adequate arrangements for pumping out water till the work has been completed.

For this purpose drains shall be formed along the edges of the excavation but beyond the building line, with suitable collecting sumps.

In case of large excavation areas where it is necessary to dewater under the floor, additional land drains shall be formed across the excavation, to adequately drain the area.

Adequate arrangement shall be made to protect the sides of excavation from slipping while the work is in progress.

The base concrete or mud-mat shall be rendered smooth by a 20mm thick sand-cement plaster (6:1). Any sharp edges/corners, over which the waterproofing course is to be laid, shall be eased out by means of cement.

The surface must be dry before the next operation is carried out.

Water proofing/damp proofing treatment:

A) Heavy Treatment (Two layers of felt)

- i) Primer (For vertical faces only), as per I.S. 3384.
- ii) Hot applied blown bitumen at the rate of 1.2 Kg/m²
- iii) Hessian base, bitumen felt type 3 grades 2
- iv) Hot applied blown bitumen @ 1.2 Kg/m²
- v) Hessian base, bitumen felt type 3 grade 2
- vi) Hot applied blown bitumen @ 1.2 Kg/m²

B) Extra Heavy treatment (Three layers of felt)

- i) Primer (for vertical faces only) as per I.S. 3384
- ii) Hot applied bitumen at the rate of 1.2 Kg/m²
- iii) Hessian base bitumen felt type 3 grades 2
- iv) Hot applied bitumen at the rate 1.2 Kg/m²
- v) Hessian base bitumen felt type 3 grades 2
- vi) Hot applied bitumen at the rate of 1.2 Kg/m²



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vii) Hessian base bitumen felt type 3 grades 2

viii) Hot applied bitumen at the rate of 1.2 Kg/m²

The surface must be dry before the next operation is carried out at each stage said above.

The laying of felt over the bitumen so applied that it shall always commence on the floor, and shall be carried over to the walls only after treatment of the floor is complete. The minimum over lapping at sides and ends of strips shall be 10cm. Joint for subsequent layers completely sealed by blow lamp.

A protective flooring of either brick flat in cement mortar (1:3) or 6cm thick cement concrete (M 15) or a coat of cement plaster (1:3) 4 cm thick shall be constructed over the bitumen layers to prevent damage to the latter during subsequent construction of the structural floor.

The walls shall be treated in a similar way; the bitumen felts joining at the base with the projecting felt laid over the mud-mat. The wall surface shall be made smooth where necessary with a coat of cement plaster (1:3), the felts laid as for the floor, ensuring that the surface to be treated is dry and then a protective brick wall, 12.5 cm nominal thickness shall be built in cement mortar (1:3) over the projecting mud-mat, the space between the wall and felt being grouted with cement.

3.00.00

ACCEPTANCE CRITERIA AND GUARANTEE

The surface level shall be such as to allow quick draining of rains without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation or underbed.

The contractor shall give a guarantee in writing for all works executed under this specification supplemented by a separate and unilateral guarantee from the specified agency for the roof waterproofing treatment work. The guarantee shall be for materials and workmanship as under:

For Bitumen Felt Treatment under clause no. 2.04.01: 5 years in case of normal treatment, 10 years for heavy treatment and 20 years for extra heavy treatment.

For Elastomeric Membrane under clause no. 2.04.02: 10 (ten) years

In case guarantee is more stringent in owner specification, more stringent guarantee shall be applicable. The mode of execution of the guarantee shall be such, which shall be acceptable to the Owner.



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4.00.00

I.S. CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

- a) IS: 73 - Paving Bitumen
- b) IS: 702 - Industrial Bitumen
- c) IS: 1203 - Methods of testing tar and bitumen
- d) IS: 1322 - Bitumen felts for waterproofing and damp proofing.
- e) IS: 1346 - Code of practice for waterproofing of roofs with bitumen felts.
- f) IS: 1609 - Damp-proofing Treatment using Bitumen Felts – Code of Practice
- g) IS: 3067 - Code of practice for General design details and preparatory work for Damp-proofing and waterproofing of buildings
- h) IS: 3384 - Bitumen primer for use in waterproofing and damp proofing.

5.00.00

RATES AND MEASUREMENT

5.01.00

Rates

Rates shall be for complete work, including the cost of all materials and labour, as detailed in the specification unless any portion is specifically excluded in the “Schedule of Items”.

No extra shall be paid for finishing around opening, sleeves, pipes, ducts, inserts, etc.

No separate payments shall be made for cleaning of surface, treating of cracks and surface preparation.

5.02.00

Measurement

The finished work shall be measured in Sqm of actual surface area for the purpose of payment.



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No deduction shall be made and no extra shall be paid for openings upto 0.4 sqm.



TITLE:
**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

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METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

SPECIFICATION NO. PE-TS-463-600-C005



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



TITLE:
**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-463-600-C005
VOLUME - II B
SECTION - D | SUB-SECTION – D5
REV.NO. 00 DATE 23/12/2019
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METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

1.00.00 SCOPE

This section covers supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions, etc. The scope of work shall also include the assembly and erection of all doors, windows, louvers, glazed partitions, etc. Supplying and/or fixing of all door and window accessories and hardware are also included in the scope.

2.00.00 INSTALLATION

2.01.00 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified.

Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS:733 or IS:1285 or as manufactured by Indian Aluminium Company Limited or approved equivalent. Aluminium door, windows and ventilator shall be fabricated as per IS:1948 and IS:1949. The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

Hardware and fixtures shall be as specified and the best quality from approved manufacturers shall only be used. The tenderer shall specifically state the particular manufacturer's materials he proposes to use. Improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Contractor's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closures shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or shall be replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance Requirements and endurance test stated in IS: 3564 - Appendix-A. The Contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards end for incorporation in the job. The mastic for caulking shall be of best quality from a manufacturer approved by, the Engineer. In general, mastic for fixing of metals frames shall be as per IS: 1081 or as approved by the Engineer.



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2.02.00 Fabrication**2.02.01 Steel Doors, Windows, Ventilators, louvers etc.****a) Door Frames**

Frames shall be fabricated from 16 gage(G) sheets. They shall, be mortised, reinforced, drilled, and tapped for hinge lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitered Corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose “T” masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be installed. Frames shall be brought to site with floor ties/weather bars installed in, place.

b) Double Plate Flush Door Shutters

Door shutters shall be 45 mm thick, completely flush design and shall comprise of the outer sheets or 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centres.

Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting-stile edges bevelled or rebated. Where shown on drawing, or called for in the schedule of items, the doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled, and tapped in shop for hinges, locks, and bolts. They shall also be reinforced for closers, push-plates, and other surface hardware where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown drawing, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections and suitable for fixing 6 mm. glass. Louvers blades shall be V or Z shaped and made out of 16 G sheets.



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c) Single Sheet Door Shutters

Single sheet doors shall be made from best quality 18 G mild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall convey the lock and other fixture. The frames shall be made from best quality, 16 G mild steel sheets.

Wherever required, provisions for fixing glass panes, louvers etc. shall be made.

The manufacturing shall be done as specified in 2.02.01 (b) “Double Plate Flush Door Shutters.”

d) Sliding Door

Sliding doors shall be either double plate or single plate Construction made out of 18 gauge steel sheets with adequate stiffeners. The contractor shall specify the weight of the door in his shop and submit the manufacturer's catalogue of the sliding gear he proposes to use. Where called for the Contractor shall make provision for openings to the door for monorail beams. Doors shall close positively to exclude rainwater from seeping in. When called for, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e) Door Threshold

Door threshold shall be provided. Doors without threshold shall have bottom tie of approved type.

f) Steel Windows, Sashes, and Ventilators etc.

These shall conform in all respects to IS: 1038 and IS: 1361 latest editions. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, and pivot arrangements for ventilators, etc. or as called for. All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are required the individual window units shall be joined together with requisite transoms and mullions. All windows shall be outside glazed, fixed with putty or metal glazing beads as specified. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Indal Section No. 2209) unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.



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2.02.02 Aluminium Door, Windows, and Frames

Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 15 micron thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent Coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce an uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.03.00 Shop Coat or Paint

The shop Paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from, approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Where called for, all steel doors, windows, etc. shall be hot dip galvanized to give a coating weight of 1½ - 2 oz. per sqft. One coat zinc chromate primer coat shall then be applied as shop paint.

Portions of aluminium frame, which come in contact with masonry construction shall be (before shipment from workshop) protected with a heavy coat of alkali resistant paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.04.00 Handling & Storage of Fabricated Material

All metal doors, windows, etc. shall be packed and crated properly before dispatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

When taking delivery of items supplied by Owner, the Contractor shall satisfy



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himself that the items supplied are up to the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

2.05.00 Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and mullions for composite units in respective places, keening proper “Lines and levels”, and in approved workmanlike manner, to give trouble free and leak-proof installations. Installation shall be done according to instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take all precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good the same quality of paint used in shop coat.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the cement in original sealed containers of manufacturer and shall apply it as per the instruction. For all frames supplied by either the owner or the Contractor, mastic shall be supplied by the Contractor and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one metres from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

2.06.0 Fire proof Door

Fire proof doors shall be provided at all fire exit points as specified and also to restrict the spread of fire within buildings whether from internal fire or from external fire. The construction details of door shall conform to the



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requirements stipulated in IS:3614(Part-1). Doors shall comply with the testing requirement mentioned in IS:3614 (Part-2). The doors shall be approved by Tariff Advisory Committee and shall have minimum 2 hrs. fire rating.

Metal covered (on both sides) Doors having insulating core filled up with mineral wool shall be used at all fire exit points and shall open out side.

All necessary accessories and hardware shall also be supplied along with doors. Fire proof door shall be provided with zinc silicate primer (minimum DFT 75 micron) after blast cleaning the surface to near white metal surface and shall be finished painted with epoxy based painting.

3.00.00 ACCEPTANCE CRITERIA

3.01.00 For fabricated Items

- a) Overall dimensions shall be within ± 1.5 mm of the size shown on drawings.
- b) Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.
- c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm for double leaf doors; the gap at the meeting stiles shall not be more than 1.5 mm.
- d) Door leaves shall be undercut where shown on drawings.
- e) Doors, windows, frames, etc. shall be on a true planes, free from warp or buckle.
- f) All welds shall be dressed flush on exposed and contact surfaces.
- g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures
- h) Provision for hardware and fixtures to be installed at site.
- i) Glazing beads shall be cut with mitered corners.
- j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.
- k) Shop coats shall be properly applied.
- l) Exposed aluminum surfaces shall be free from scratches, stains, and discoloration. Anodized surfaces shall present a uniform and pleasing look.



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3.02.00 For installed Items

- a) Installations shall be at correct location, elevation and in general, on a true vertical plane.
- b) Fixing details shall be strictly as shown on drawings.
- c) Assembly of composite units shall be strictly, as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete.
- d) All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.
- e) All openable section shall operate smoothly without jamming.
- f) Locks, fasteners etc. shall be engage positively. Key shall, be non-interchangeable.
- g) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.
- h) Aluminium doors, windows, etc. shall be free from scratches stain or discoloration.

4.00.00 INFORMATION TO BE SUBMITTED

4.01.00 With Tender

- a) Names of manufacturers for Doors, windows etc.
- b) Manufacturer's catalogue for all hardware and fixtures proposed to be used.

4.02.00 After Award

- a) Before starting fabrication of all metal doors, windows, etc. the Contractor shall submit detailed fabrication drawings to the Engineer for approval. The fabrication shall be started only after approval of drawings.
- b) He shall submit a programme of work to be done for the approval of the Engineer.
- c) Before bulk supply, he shall submit for the approval of the Engineer samples of all bought out items and samples of each type of fabricated items. The samples shall be retained by the Engineer for comparison of bulk supply and returned to the Contractor towards the end for final incorporation in the job.



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5.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

Specification for Wrought Aluminium and Aluminium Alloy bars, rods and sections (for general engineering purpose)	-	IS: 733
Specification for Wrought Aluminium and Aluminium Alloy, extruded round tube, hollow section (for general engineering purpose)	-	IS: 1285
Steel doors, windows, and ventilators	-	IS: 1038
Steel windows for industrial, building	-	IS: 1361
Aluminium doors windows, and ventilators	-	IS: 1948
Aluminium windows for industrial buildings	-	IS: 1949
Steel doorframes	-	IS: 4351
Code of practice for fixing and glazing of Metal (steel and aluminium) doors, windows and Ventilators.	-	IS: 1081
Specification for Fire-check Doors – Part 1: Plate, Metal covered and Rolling type	-	IS: 3614
Hot Rolled Steel Sections for Doors, Windows and Ventilators – Specification	-	IS: 7452

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

Rates shall be applicable of all elevation. Rates shall include preparation of working drawings (if required), supply of material, fixtures, gaskets, erection of unit, caulking and jamming of frames, including cutting/drilling/welding, grouting, grinding, making good of the structure for installing the unit etc. complete as per “Schedule of Items”.



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Rates shall also include cost of surface preparation, application of primer, enamel painting or anodizing as applicable.

Rate for fire proof door is inclusive of providing insulation core, primer, shop painting (epoxy based), all hardware as specified in Schedule of items.

6.02.00 Measurement

Supply and installation of doors, windows, and ventilators shall be measured in Sqm or Kg as per BOQ item. If measured in sqm, it shall be for net outer to outer (excluding frame) area of doors, windows, and ventilators of each type used as described in “Schedule of Items”. Frame for steel or aluminium shall be measured in Kgs. Wooden frames shall be measured in Cum. Measurement for aluminium partition frames shall be in Kg. Panelling and glazing shall be paid separately if not covered in BOQ item description.

Measurement for fire proof door shall be in SqM in net area outer to outer of the door.



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ANNEXURE-A

SCHEDULE OF FIXTURES

A. TIMBER DOORS

1. For single leaf panel/flush doors

i) 100 mm brass butt hinges with screws	-	3 Nos.
ii) 150 mm brass tower bolts with screws	-	1 No.
iii) 100 mm x 225 mm clear plastic push Plate with counter sunk brass screws	-	1 No.
iv) 30 mm brass ring pull handle with Plates and screws	-	1 No.
v) 150 mm brass coat hook with screws	-	1 No.

vi) Heavy duty, cylinder looks on active leaf - for flush door. For door-closure, see "Door Schedule".

B. ALUMINIUM DOORS

1. For double leaf door

- | |
|--|
| i) Concealed hanging arrangement for door leaves. |
| ii) Concealed two points bolt encasing simultaneously at head and threshold
on inactive leaf, operable from inside. |
| iii) Heavy duty, cylinder look on active leaf. |
| iv) Pull handle of approved design on both leaves. |
| v) Doors stops for both leaves. |
| vi) Overhead door closure for both leaves. |



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ANNEXURE-A

C. STEEL DOORS AND WINDOWS

1. Doors

a) Double leaf doors

- i) 100 mm butt hinges - 3 Nos. on each leaf.
- ii) 300 mm aluminum tower bolt - 2 Nos. (top and bottom)
On inside of inactive
Leaf. 1. No. (Top only)
On inside active leaf.
- iii) 200 mm anodized aluminum
pull handle - 1 No. of each leaf.
- iv) Door stop of approved design - 1 No. of each leaf.

NOTE: For locks, door closure and threshold, see "Door Schedule".

b) Single leaf doors

- i) 100 mm butt hinges - 3 Nos.
- ii) 300 mm aluminum tower bolt - 2 Nos. top & bottom of Inside
face
- iii) 200mm anodised aluminum
Pull handle - 1 No.
- iv) Door stop of approved design - 1 No.

NOTE: For locks, door closures and threshold, see "Door Schedule".

2. Windows, Ventilators, etc.

a) Side Hung Windows

- i) Hinges - As per standard Practice of the
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hinges Per leaf.
- ii) 12" peg stays - 1 No. per leaf



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- iii) 2 point handles - 1 No. per leaf
- b) Top Hung Ventilators (Projecting Out)
 - i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
 - ii) Adjustable sliding fabrication assemblies - 2 Nos. per leaf.
 - iii) 2 point handles - 1 No. per leaf.
- c) Bottom Hung Ventilators (Projecting in)
 - i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
 - ii) Concealed side arms for opening adjustment. - 2 Nos. per leaf.
 - iii) Spring Catch - 1 No. per leaf.



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ANNEXURE-A

D. ALUMINIUM WINDOW, VENTILATORS, ETC.
(As per IS-1948 latest editions)

a) Side Hung Windows

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) 300 mm peg stays - 1 No per leaf
- iii) 2 point handles - 1 No per leaf

b) Top Hung Ventilators (Projecting out)

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) Adjustable sliding fabrication assemblies - 2 Nos. per leaf
- iii) 2 Point handles - 1 No. per leaf

c) Bottom Hung Ventilation & (Projecting In)

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) Concealed side arms for opening adjustment - 2 Nos. per leaf
- iii) Spring Catch - 1 No. per leaf



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-463-600-C006

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GLASS AND GLAZING

SPECIFICATION NO. PE-TS-463-600-C006



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



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GLASS AND GLAZING

1.00.00 SCOPE

This section covers supplying and fixing of all glass and glazing including all clips, putty, mastic cement etc. wherever required as per specifications.

2.00.00 INSTALLATION

2.01.00 General

The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions, from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractive index and free from flaws, specks, and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site.

Materials

- a) Glare reducing or heat absorbing glass shall be "Calorex" of Hindustan Pilkinton or approved equivalent and special care shall be taken to grind smooth and round off the edges before fixing.
- b) Clear glass shall be flat draw sheet glass and shall be at least 4 mm thick. Sheet glass for doors shall be minimum 5.5 mm thick.
- c) Wired glass shall be thick- rolled glass with centrally embedded 42g wire mesh of Georgian type. This may be of clear or coloured glass, as required.
- d) Obscure glasses shall have a cast surface in one side.
- e) Coloured and figured glass shall be as per approved sample.
- f) In general, the putty shall conform to IS: 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing.
- g) Neoprene gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation.

2.03.00 Glazing, Setting, and Finish

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor.



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FOR GLASS AND GLAZING**

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All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing chips shall be provided per glass pane, except for large panes where six or more clips shall be used as per engineer's instructions. All holes that may be necessary for holding the clips glazing heads and all other attachments shall be drilled by, the Contractor.

Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where mouldings or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Where owner will supply glass, the Contractor shall cut it to size and fix them in the same as specified above.

The Contractor shall supply necessary glazing clips, putty, mastic cement etc.

After completion of glazing, the Contractor shall remove all dirt stains, excess putty etc. clean glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the contractor's own cost.

3.00.00

ACCEPTANCE CRITERIA

- a) All installation shall be free from cracked, broken, or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked, or underground edges.
- b) Glazing shall be carefully done to avoid direct contact with metal frames.
- c) All glass shall be embedded in mastic or fixed by neoprene gaskets to give a leak proof installation.
- d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.

4.00.00

I.S. CODES

Following are some of the important I.S.Codes relevant to this Section:

IS: 3548 - Code of practice for glazing in building.

IS: 1081 - Code of practice' for fixing and glazing metal doors, windows ventilators.



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-463-600-C006

VOLUME - II B

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RATES

Rates of glass and glazing if not included in respective items for supply and installation of window, ventilator, and partitions shall be paid separately as per BOQ items provided. No separate payment shall be made for glazing clips, mastic cement, putty, screws; rails, etc. nor for drilling holes in frames for inserting glazing clips.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROLLING STEEL SHUTTERS AND
GRILLS**

SPECIFICATION NO. PE-TS-463-600-C007

VOLUME - II B

SECTION - D SUB-SECTION - D7

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ROLLING STEEL SHUTTERS AND GRILLS

SPECIFICATION NO. PE-TS-463-600-C007



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



TITLE:
**TECHNICAL SPECIFICATION FOR
ROLLING STEEL SHUTTERS AND
GRILLS**

SPECIFICATION NO. PE-TS-463-600-C007
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ROLLING STEEL SHUTTERS AND GRILLS

1.00.00 SCOPE

This Section covers the design and supply of materials, fabrication, delivery and erection of Rolling Shutters/Grills with motor drive and/or manual operation including all accessories as hereinafter specified.

2.00.00 INSTALLATION

2.01.00 Components

- a) Slats for rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick for shutters upto 4.5 M wide and not less than 1.25 mm thick for shutters having width more than 4.5 M, wide and above, machine rolled at 75 mm rolling centers, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.
- b) Rolling grills shall be constructed out of 6mm rods at 35 mm on centers running horizontally flexible connected with vertical links spaced not more than 200 centers. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6mm dia rods.
- c) End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats unless specified otherwise.
- d) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor.
- e) Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.m.
- f) Shafts shall be of steel pipe of sufficient size to carry the tensional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.
- g) Hoods shall be formed of not less than 20 gauge steel, suitable reinforced to prevent sag.
- h) Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as prescribed by the Engineer.



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- i) Power unit shall be suitable for 3 phase, 50 cycles, 400-volt A.C. power supply and be either floor or wall mounted unit. The motor shall be of sufficient capacity, to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building unless otherwise stated in drawing.

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

- j) Operating chains shall be of tested quality, heavily galvanized and with all ends rounded to assure smooth operation and hand protection.
- k) Reduction gears shall be high strength grey cast iron, machine moulded from machine out patterns.

2.02.00 Manually Operated Shutters/Grills

Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 1.3 metres per second. In general, manually operated shutters shall be push pull type for opening up to 9 Sq. metre in area. Larger shutters shall, be either chain and gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both sides as desired by the Engineer.

2.03.00 Power operated Shutters/Grills

These shall be operable from a push button station conveniently located beside the door. One emergency hand chain/crank operation shall also be provided for use in case of failure of the electric system. Where called for, externally mounted shutters shall be operated by control mechanism located inside the building.

2.04.00 Shop Coat

Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, doors shall be galvanized and subsequently painted one coat of zinc chromate for adhesion of field coat.

2.05.00 Erection

Door shall be installed by the manufacturer or his authorized representative and all work shall be as per manufacturer's instructions. Any drilling or cutting to concrete, masonry etc. shall be made good after erection of shutters and all abrasion to shop coat shall be touched up. All electrical work shall be

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	in strict accordance with the latest Indian Electricity Rules. 3.00.00 ACCEPTANCE CRITERIA AND GUARANTEE 3.01.00 Shop Inspection After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings. 3.02.00 Field Inspection After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance. 3.03.00 Guarantee The Contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters. 4.00.00 I.S. CODE IS: 6248 - Metal rolling shutters and rolling grills. 5.00.00 RATES AND MEASUREMENT 5.01.00 Rates Rates for rolling shutters and grill shall include the cost of the locks, guide channels, cost of drive as specified. In case of electrically operated rolling shutters, the rate shall also include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections and cost of electric motor. 5.02.00 Measurement Supply and installation of rolling shutter and grill shall be measured in Sqm in net outer to outer (including frame) area of each type used as described in “Schedule of Items”.	



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MASONRY AND ALLIED WORKS**

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MASONRY AND ALLIED WORKS

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Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
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MASONRY AND ALLIED WORKS

1.00.00 SCOPE

This section covers furnishing, installation including handling, transporting, batching, mixing, laying scaffolding, centering, shuttering, finishing, curing, protection, maintenance and repair of common building materials till handing over of masonry and allied works for use in structures and locations covered under the scope of this package.

2.00.00 MATERIALS

a) Brick

Bricks for general masonry work shall be of class designation 7.5 of nominal dimensions as per standard specification under IS: 1077, well burnt, of uniform size, shape and colour, free from cracks, flaws or modules of free lime and emit clear ringing sound when struck. Fractured surface shall show uniform texture free from grits, lumps holes etc. Water absorption after 24 hours immersion shall not exceed 20% by weight for bricks. Dimensional tolerance shall not exceed 8% of the size shown in drawings for bricks. All bricks shall have rectangular faces and sharp straight edges. The bricks shall show no efflorescence after soaking in water and drying in shade.

Each brick shall have the manufacturer's identification marks clearly marked on the frog. Representative samples shall be submitted and approved samples shall be retained by the Engineer for further comparisons and reference. Any brick not found up to the specification shall be removed immediately from site at the Contractor's own cost.

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

b) Stone

All stones shall be obtained from approved quarries, hard, tough, durable compact grained, uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. The surface of a freshly broken stone shall be bright, clean, and sharp and shall show uniformity of texture, without



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loose grains and free from any dull, chalky, or earthy appearance. Stone showing mottled colours shall not be used for face work. A stone shall not absorb more than 5 per cent of its weight of water after 24 hours immersion. The type of stone shall be as specified on drawings and/or instructed by the Engineer. Samples shall be submitted by the Contractor and approved samples shall be retained by the Engineer for comparison of bulk supply.

c) Cement

Cement used shall be Ordinarily Portland Cement or Portland Slag Cement or Portland Pozzolana Cement conforming to IS Codes and shall be fresh when delivered. In special cases, Rapid Hardening Portland Cement, Low Heat Cement etc. may be permitted or directed to be used by the Engineer. The Contractor shall submit the manufacturer's certificate for each consignment of cement procured to the Engineer. If at any time, the Engineer feels that the cement being used by the Contractor is not up to specification, he may stop the work and send the samples of the cement to a testing laboratory for standard tests and all expenses incurred thus shall be borne by the Contractor. The Contractor shall also have no claim for this type of suspension of work.

The cement shall be stored above the ground level in perfectly dry and watertight sheds. The bags shall be stacked in a manner so as to facilitate removal or first in first out basis. Any material considered defective by the Engineer shall not be used by the Contractor and shall be removed from the site immediately.

d) Coarse Aggregate

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

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

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

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



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segregation.

Aggregates shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass, or any other injurious substances at any stage.

Aggregate of different size shall be kept in separate stacks. If so desired by the Engineer aggregate from different sources shall be stacked separately with proper care to prevent intermixing.

e) Sand

Sand shall be hard, durable, clean, and free from adherent coatings or organic matter and shall not contain clay balls or pellets. The sand shall be free from impurities such as iron pyrites, alkalis, salts, coal, mica, shale or other laminated materials in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of mortar, plaster or concrete or to cause corrosion to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded and shall be as per relevant IS Code. Sand for concrete shall conform to IS: 383.

f) Water

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

g) Reinforcement

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings, which may impair proper bond. Structural steel shall conform to IS: 2062. Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement shall conform to IS: 432. Cold twisted steel bars shall conform to IS: 1786. Hand drawn steel wire fabric shall conform to IS: 1566. Hexagonal wire netting shall conform to IS: 3150. All steel bars including and above 10 mm diameter shall be of tested quality. All wire netting shall be galvanized.

Reinforcement bars shall be stored off the ground and under cover if so desired by the Engineer. If necessary, a coat of cement wash shall be given to the bars to guard against rusting.

3.00.00 INSTALLATION

3:01.00 Soling

3.01.01 Brick Soling



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The ground shall be dressed, consolidated by ramming, or by light rolling and a 12 mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine joints and placed firmly in position by hammering with wooden mallet. The surface shall be free from undulations. The 'frog' side shall be on the underside. The joints shall be broken the in all direction and bricks cut as required. The pattern of laying and number of layers shall be as per Schedule of item. Orientation shall be as desired by the Engineer. After laying of each layer of bricks sand shall be spread over and worked into the joints to pack the bricks tight.

3.01.02 Stone Soling

The stones for soling shall be selected on the basis of thickness of soling specified in the Schedule of Items. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water.

3.02.00 Brick-on-Edge

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.

3.03.00 Masonry

3.03.01 General

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

3.03.02 Cement Mortar

Cement mortar shall be prepared with materials specified in clause 2.00.00. Sand for masonry mortar shall conform to IS: 2116. Cement and sand in the specified proportion shall be mixed dry thoroughly and minimum water added to attain required workability.

Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar, which has stood for more than half an hour, shall be used.



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3.03.03 Brick Masonry

Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing.

Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

3.03.04 Exposed Brickwork

Brickwork in superstructures, which is not covered by plaster, shall be as shown on drawing and executed by specially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule, and string. All brickwork shall be cleaned at the end of days work. If face bricks are specified, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean, and pointed as specified. Where face bricks are used carborandum stone shall be used for rubbing down.

3.03.05 Reinforced Brickworks

Reinforcements shall be as specified. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. columns or welded to steel stanchions.

3.03.06 Stone Masonry



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Stones shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall be not less than 8 mm and not greater than 25 mm. At least two stones shall run the full width of the wall for every square meter of surface area.

3.03.07 Exposed Stone work

Stonework, which is to be kept exposed, shall be as shown on approved drawing. It shall be executed by specially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or instructions. A sample wall, 10 Sq.M. area shall be built and approved by the Engineer and all works shall match with this sample.

3.03.08 Composite Masonry

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.

3.03.09 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings and specified. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

3.03.10 Mouldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with Carborundum stone.



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3.03.11 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days work top surface of masonry shall be kept wet by ponding.

3.03.12 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

3.03.13 Encasing of Structural Steel

This shall be done by building masonry work round flanges, webs etc., and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm.

3.04.00 Damp Proof Course (DPC)

Unless otherwise specified Damp-proof course shall be 40 mm thick 'artificial stone' in proportion 1:1½:3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double chequered and cured by ponding for seven days.

3.05.00 Damp Proof Membrane

Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in IS: 1609. The number of courses shall be as shown as drawings or as specified. Sequence of work shall be as directed by the Engineer. Extreme care shall be taken to prevent damage to felt during and after laying. The Contractor shall be obliged, at his own expense, to rectify any leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.

Where shown on drawing, damp proof membrane with one layer bitumen paper or one layer alkathene sheet shall be laid with minimum 150 mm lap under slabs on grade.

3.05.00 Plinth Protection

Plinth of buildings shall be protected with brick-on-edge paving of minimum 750mm width unless otherwise shown on the drawings. The treatment shall



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consist of laying bricks in cement mortar 1:6 (1 cement: 6 sand) over a 75mm thick bed of dry graded brick aggregate, 40mm nominal size, grouted with sand. The top shall be finished with 1:2 cement mortar pointing (1 cement: 2 sand). Plinth protection shall be laid with a minimum outward slope of 1 in 50. The brick aggregate shall be well graded, broken from well burnt or slightly overburnt and dense brickbats. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt or any other foreign matter.

The ground shall first be prepared to the required slope around the building. The high portions of the ground should be cut down; hollows and depressions filled up to the required level from the excavated earth and rammed so as to give uniform outward slope. The bed shall be watered and rammed with heavy iron square rammers. Surplus earth, if any, shall be disposed off beyond a lead of 50m or as directed by the Engineer.

Over this, 75mm thick bed of aggregate of 40mm nominal size, shall be laid with a minimum outward slope of 1 in 50. Aggregates shall be carefully laid and packed, bigger sized being placed at the bottom. The brick aggregates shall be consolidated dry with heavy iron rammers.

The aggregates shall then be grouted evenly with sand at the rate of 0.6 cubic metre per square metre area, adequately watered to ensure filling of voids by sand and again rammed with heavy iron rammers. The finished surface shall give uniform appearance. After the subgrade has been compacted thoroughly, brick flooring with bricks of specified strength in cement mortar 1:6 (1 cement: 6 sand) shall be laid.

The bricks shall be laid on edge in Diagonal/Herring Bone Bond or other pattern as specified or as directed by the Engineer. Bricks shall be laid on 12mm thick mortar bed and each brick shall be properly bedded and set home by gentle tapping with handle of trowel or wooden mallet. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. On completion of the portion of flooring, the vertical joints shall be fully filled from the top with mortar. The surface shall present a true plain surface with the required slope.

The pointing shall be done in cement mortar 1:2 (1 cement: 2 sand). The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks so as give a smooth appearance. The edges shall be neatly trimmed with a trowel and a straight edge. The mortar shall not spread over surface of the masonry.

Brick flooring & pointing shall be kept wet for a minimum period of seven days. These shall be protected from rain by suitable covering when the mortar is green.



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I.S. CODES

Some of the important relevant codes for this section are:

- IS: 1127: Recommendations for dimensions and workmanship of natural building stones for masonry work.
- IS: 1597: Code of Practice for Construction of stone Masonry.
- IS: 1609: Code of Practice for laying Damp proof treatment using bitumen felts.
- IS: 2212: Code of Practice for Brickwork.
- IS: 2250: Code of Practice for preparation and use of masonry Mortar.
- IS: 5134: Bitumen Impregnated Paper & Board.

5.00.00

RATES AND MEASUREMENTS

5.01.00

Rates

Unit rate for masonry work shall include the following:

- Raking out joints for plastering or pointing or finishing the joint flush as the work proceeds.
- Preparing top sand sides of existing wall for joining old with new work.
- Providing, dismantling and removing the scaffolding.

Unit rate for DPC shall be inclusive of formwork and bitumen painting.

5.02.00

Measurement

Brickwork in wall of half brick thickness shall be measured separately in Sqm stating the wall thickness and more than half brick thickness shall be measured by volume. Plaster thickness shall not be considered for computation of volume.

Masonry work in sub structure and super structure shall be measured separately, unless otherwise specified in the Schedule of items.

No deductions shall be made and no extra payment shall be made for following:

- Opening upto 0.1 Sqm each in area. In calculating the area of the opening lintels or sills shall be included along with the size of the opening.



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- b) Drainage holes and recesses for cement blocks to embed holdfasts for doors, windows etc.
- c) Pipe and fixtures upto 300mm dia. and nothing extra shall be paid for the mortar used for fixing.
- d) Ends of dissimilar materials (i.e. joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc); up to 0.1 sqm in section;
- e) Chases of section not exceeding 50 cm in girth;
- f) Iron fixtures, such as wall ties and hold fasts for doors and windows;
- g) Cement concrete blocks as for hold fasts and holding down bolts;
- h) Wall plates, bed plaros, and bearing of slabs, CHAJJAS and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;

Reinforcement in masonry work shall be paid separately under respective items.

Damp proof course shall be measured in Sqm. No deduction shall be made and no extra shall be paid for opening upto 0.1 Sqm in area.

Plinth protection shall be measured under respective item of works executed required for completion of the work as specified.



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-463-600-C008

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MISCELLANEOUS METAL

SPECIFICATION NO. PE-TS-463-600-C008



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



TITLE:
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MISCELLANEOUS METAL

1.00.00 SCOPE

This section covers supply, fabrication and erection of miscellaneous metal items of light nature in gates, balcony and stair hand rails, structural works, ladders, hangers, masonry anchors, anchor bolts, fasteners, chain link fencing, barbed wire fencing etc. as specified or shown on drawing or as instructed by the Engineer. The above items shall be of fabricated or cast of mild steel, aluminium, brass, cast iron, M.S.& galvanized M.S. sheets, aluminium sheets, expanded metal, wire mesh as shown on drawings or specified.

2.00.00 INSTALLATION

2.01.00 Fabrication/casting

2.01.01 General

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural or foundry shop.

2.01.02 Shop Connections

- a) All shop connections shall be riveted or welded except when noted otherwise on drawings.
- b) Welding of steel shall be done in accordance with IS: 816.
- c) Welding of aluminium shall be done accordance with IS: 2812, “Arc welding of Aluminium and Alloys.” Special care shall be taken to grind smooth all welded surface that shall remain exposed to view. Welds shall be electrically continuous if so required by the Engineer.

2.01.03 Shop Coat

Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill seals, rust and foreign matter. Except where encased in concrete, all steelwork shall be given one coat of approved metal protective paint, applied by brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. When specified steel work shall be galvanised or painted with a coat of zinc chromate primer. Aluminium surfaces, which shall come in contact with masonry, shall be given one coat of bituminous paint.



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2.02.00 Erection

2.02.01 Bracing

The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected, including erection of equipment and operation of the same.

2.02.02 Temporary Bolting-Up

As erection proceeds the Contractor shall plum up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever erection equipment or other loads are carried by members during erection, proper provision shall be made to take care of the stresses resulting from the same.

2.02.03 Turned Bolt

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

2.02.04 Welding

Where specified on drawings, welding shall be done in accordance with IS: 816 for steel and IS: 2812 for Aluminium & Alloys.

2.02.05 Cutting and Fitting

No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings holes, cuttings, etc. shall be provided as required for installation, to the work by the other Contractors. No additional holes or cuttings, than those shown on drawings, shall be made without the approval of the Engineer.

2.02.06 Drifting

Correction minor misfits and a reasonable amount of reading and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections, reaming that weakness the members or make it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins or a moderate amount or reaming and slight



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chipping and cutting shall immediately be called to the attention of the Engineer-and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.02.07 Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials and used for the shop paint or equivalent.

2.02.08 Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

2.02.09 Grouting

All bearing plates, loose, lintels and beams, etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done in 1:1½:3 concrete with 6 mm down stone chips or as specified in schedule of items.

2.02.10 Anchor Fasteners

The anchor fasteners shall be of two type viz. light duty for carrying tensile load upto 0.5MT per fasteners and heavy duty for carrying tensile load of 0.5MT to 5.0MT per fasteners. These anchor fasteners shall be fixed into concrete. The Contractor shall submit the Manufacture's literature showing the average pull out and average shear value for anchor of various sizes. Anchors shall be fixed in position strictly as per the manufacturers instructions and as approved by the Engineer.

Heavy Duty Anchor Fasteners

The safe tensile load carrying capacity of the anchors shall be arrived by providing the minimum factor of capacity of 2.5 for the characteristic load of the anchor. Minimum size of anchor shall be M8 (8mm). All anchors shall be from the approved manufacturers like HILTI or equivalent.

- a) Anchor fasteners shall be supplied and fixed in position by the contractor. Anchor fasteners can be of mechanical bonding or chemical bonding.
- b) Capacity of the anchor shall be established after considering the effect of concrete grade, embedment depth, concrete thickness, anchor spacing and edge distance from the concrete edge.
- c) The selection for the particular type of bonding for the anchors shall be made after considering the concrete grade, available embedment depth, load to be transferred, space available for installing anchors.
- d) The mechanical bonding anchor are torque controlled anchors made from carbon steel of grade 8.8 as per IS:1367 part 3. Anchors in bolt as well as



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nut version are acceptable. The bolt version anchors consists of bolt washer, sleeves, plastic section, expansion sleeves and a cone. Nuts version anchor consists of nuts, threaded rod, washer, sleeves, plastic section, expansion sleeves and a cone. All steel component of anchor shall be electro galvanised to minimum 5 micron coating thickness. The plastic section shall be of polyacetal Derlin 100 or equivalent.

- e) Chemical bonding anchor shall consist of foil capsule and threaded rod. The foil capsule shall contain the resin and hardener. The threaded rod shall have chiselled tip. The behaviour of anchors under fire shall conform the heating curves as per ISO:834. Anchors of size M8 to M24 shall conform to grade 5.8 and anchors of size M27 to M39 shall conform to grade 8.8 as per IS:1367 part 3. All steel components of the anchors shall be electro-galvanised to minimum 5 micron thickness.

Light Duty Anchors

This anchor shall comprise of stud, nut, washers, expansion sleeve. The one end of the stud shall have thread and the other end shall have cold formed conical head. All steel components of the anchors shall be electro-galvanised to minimum 5 micron thickness. The expansion sleeve shall preferably be of stainless steel of SS316. The anchors shall conform to minimum grade 5.8 as per IS:1367 part 3.

2.02.11 Pipe Joints

MS pipes or GI pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot joined and caulked with hemp and molten head.

2.03.0 FENCING

2.03.01 Chain Link Fencing

The material requirement shall conform to IS: 2721 latest edition. The chain link fencing shall be woven from 3.15mm dia. wire with mesh size of 50mm. The mesh wire shall not vary from specified dia. by more then ± 0.05 mm. all steel wire shall be hot dipped galvanised wire. The dia shall be measured over the galvanised coating. The line wire shall be 4.0mm dia. mild steel. The stirrup wire for securing the line wire to the intermediate post (RCC/structural steel) shall be 2.5 mm diameter mild steel. The tying wire for securing the chain link fencing to the line wire shall be 1.6mm diameter mild steel. Hair pin chain staples for fastening down the bottom of galvanised chain line fencing to the concrete sill shall be 3.15mm wire. The ends shall be bent outwards for securing anchorage.

Cleat for eye bolts shall be of uniform size and shall consist of mild steel angle of 75 x 50 x 8 mm. The eye bolts strainer shall consist of bolt with welded eye



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sufficiently threaded and fitted with a nut and washer. Two-way eye bolt strainer shall have suitable ring nuts fitted after the wires have been strained on one side. Stretcher bar shall consist of mild steel flats 25 x 4.75 mm. They shall be secured to the cleats by steel bolts.

The chain link fencing shall be strained between each pair of straining posts and secured to each straining posts by means of a stretcher bar. One of top line wire shall be threaded through appropriate adjacent row of mesh, care being taken that no meshes in the row are bypassed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall be strained in front of the fencing. The fencing shall be attached to the top and bottom line wire by wire ties spaced at 150mm apart and to the other middle line wire by wire ties spaced at 450mm apart.

The bottom of fencing shall be treated as follows:

Continuous concrete sill 125mm wide x 225mm high for full length between posts shall be cast with the top 25mm above GL and 25mm below the chain link fencing. Hair pin staples shall be threaded through the bottom row of mesh at 750mm c/c and set in the sill to a depth of 150mm.

2.03.02

Barbed Wire Fencing

The barbed wire shall be conform to IS:278 latest edition. The barbed wire shall be galvanised and galvanising shall conform to the requirement laid down for 'light-coated wire' of IS:4826 and it shall be smooth and relatively free of lumps etc. Wire with excessive roughness blisters, salammoniac spots shall be rejected. The barbed wire shall be made from two line wire and two point wire of 2.5 mm thickness each. The barbs shall have four point and shall be formed by twisting two point wires, each two turns, tightly around both or one line wire (Type A - around both line wire, Type B - around one line wire) making altogether four complete turns. The barbs shall be so finished that four points are set and located or locked as far as possible at right angle to each other. The barbs shall have a length of not less than 13mm and not more than 18mm. The distance between two barbs shall be 75 ± 12 mm.

Straining posts shall be provided at all ends and corners of fences or at changes in direction or acute variation in level and at intervals not exceeding 66 M on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3.0m. Struts shall be fitted to all straining posts behind the chain link fabric in the direction of line of fence. There shall be four evenly spaced row of line wire in all. The top line wire shall be doubled, making five line wire in all. The bottom wire shall be closed to the ground. Each line wire shall be strained tightly by means of eyebolts strainers or winders at each straining points. Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hold in the post and secured to the line wire by three complete turns on each sides of the post. The barbed wire shall be fitted with one dropper at the centre of each bay, secured



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to the wire so that they could not be bunched together. Droppers for barbed wire shall be of mild steel of not less than 25 x 4.75 mm thick with 38 x 4.85 mm half round staples for fastening the barbed wire to them. Bracing for the rows of barbed wire shall be approved by the Engineer.

3.00.00 ACCEPTANCE CRITERIA

- a) All items shall be correct shape, size, weight etc. shown on drawings and schedule of items.
- b) For installed items, the tolerances shall be as follows
 - i) Permissible deviation from, straightness – 1 in 1000.
 - ii) Seats, stiffener connections etc. shall be as per approved drawings and shall not interfere with architectural clearances.
- c) All castings shall be free from blowholes, cracks, and other blemishes.
- d) All MS wire fencing shall be in true vertical plain, and shall not bulge.

4.00.00 IS CODES

IS:278	Specification for Galvanised Steel Barbed wire for fencing.
IS:816	Code of practice for use of Metal Arc welding for general construction in mild steel.
IS:1367	Industrial Fasteners – Threaded steel fasteners - Technical supply condition.
IS:2721	Specification for Galvanised Steel Chain Link fence fabric.
IS:2812	Arc welding of Aluminum and Alloy

5.00.00 RATES AND MEASUREMENTS

5.01.0 Rates

Rates shall include supply, fabrication and installation for misc. metals works as required for completion of works like gates, fencing, handrails, ladders, hangers, anchors etc., unless otherwise specified in Schedule of Items. Rate for fencing shall also include excavation, concreting and supply, erection & fabrication of post (post made of either structural steel or reinforced cement concrete), unless any specific item is excluded.



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5.02.0

Measurements

Measurement for MS gates shall be in MT.

Measurement for galvanised MS wire fencing shall be in Sqm.

Measurement for Anchors shall be in nos. for the type as specified in schedule of items.

Measurement of other misc. metals shall be done in MT unless otherwise specified in schedule of items.



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



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FINISH TO MASONRY AND CONCRETE

1.00.00 SCOPE

This Section covers finishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment.

Before commencing finishing items the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimize damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.00.01 INSTALLATION

2.01.00 Preparation of Surface

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be rushed down with stiff wire brush to remove all loose dust from joints and thoroughly, washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.

2.02.00 PLASTERING

2.02.01 Mortar

Mortar for plastering shall be as specified.

For sand cement plaster, sand and cement in the specified proportion shall be mixed dry, on a watertight platform and minimum water added to achieve



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working consistency. The sand for plaster shall conform to IS: 1542.

No plaster, which has stood for more than half an hour, shall be used; plaster that shows tendency to become dry before this time shall have water added to it.

2.02.02 Application of Plaster

Plaster, when more than 12 mm thick, shall be applied in two coats a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat; the overall thickness of the coats shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, doorjambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

2.02.03 Finish

Generally, the standard finish shall be used unless otherwise Shown on drawing or directed by the engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the engineer regarding the texture, color and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough; otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.



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b) Neat Cement Finish

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. per Sq.M. and rubbed smooth with a trowel.

c) Coloured Plaster Finish

This shall be done in the same way as specified in Clause 2.02.02 but using Coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the topcoat only shall be made with coloured cement.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to Appendix-A of IS: 2114 latest editions.

Samples of colouring material shall be submitted to the engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All coloured cement and/or pigments shall be stored in an approved manner in order to prevent deteriorations.

d) Pebble-dash Finish

Mortar of required thickness consisting of 1 part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.02.02. While the mortar is still plastic small pebbles or crushed stone of size generally from 10mm to 20mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of oil a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) Rough-cast Finish

A wet plastic mix of 3 parts coloured cement 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition.

f) Scraped Finish

Ordinary plaster as described under Clause 2.02.02 after being leveled and allowed to stiffen for a few hours, shall be scraped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the



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g) Textured Finish

Mortar consisting of 1 part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause 2.2.2 Ornamental treatments in the form of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

h) Sand Faced Plaster

The plaster shall be applied in 2 coats. The first coat or the scratch coat should be approximately 14mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows, etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The mortar proportion for this scratch coat shall be as specified in the respective item or work. The scratch coat shall be cured for at least 7 days & then allowed to dry. The second coat shall be 6mm thick and it shall not be applied until at least 10 days have elapsed after the application of scratch coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation & without joints; finish shall be straight, true, & even. The mortar of this coat shall be as specified under the respective item of work. White sand for finish shall be used for the second coat & for finishing work. Sand for finish shall be of even coarse size & shall be dashed on the surface & sponged.

2.02.04 Curing

All plastered surfaces after laying shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

2.03.00 Pointing to masonry

All Joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finishes with suitably tools to shape as shown on



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the drawings. Any surplus mortar shall be scalped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.04.00 Plaster with Metal Lath

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two-layers. The mortar for plastering shall consist of 1 part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.02.01. The application, finish etc. shall be as specified under relevant clause above. Where called for a 2 mm Plaster of Paris punting shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

2.05.00 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The punning shall be applied by skilled workman and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.06.00 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. areas and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.07.00 Stone Facing

Stone facing where specified shall be done as shown on design drawings and



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approved shop drawings. The stone shall be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawings for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodible anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanized (weight of zinc coating shall not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer.

The completed surface shall be neat, or uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings.

3.00.00 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

4.00.00 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 1661: Code practice for cement and cement-lime plaster finish on wall & ceilings.

IS: 4101: code of practice for external facings and veneers.



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5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall also include providing, dismantling and removing of scaffolding, surface preparation, curing and all type of surface, shapes/ profiles and at all elevations.

5.02.00 Measurement

All plastering shall be measured net (on surface area on which it is applied) in Sqm. Plaster work shall be classified according to the type used and shall be measured separately. Plaster on ceiling and walls shall be measured separately. Soffits of stairs shall measured as plastering on ceiling.

No deduction shall be made for opening not exceeding 0.5 Sqm and for ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sills of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.



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Project Engineering Management
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PAINTING, WHITE WASHING, POLISHING, ETC.

1.00.00 SCOPE

This section covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster of paris, false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items.

Copper, bronze, chromium plate, Nickel, stainless steel and aluminium shall generally not be painted or finished except if otherwise specified.

Before commencing painting, the Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage; disfiguration or staining to work of other trades or other installations.

2.00.00 INSTALLATION

2.00.01 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade is obtained from the same manufacturing batch. Each and every supply of primer, finish paint etc. shall be accompanied by manufacturer's test certificate. All paint shall be subject to analysis from random samples taken at site from painters bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finished coats to be applied.

All unspecified materials such as snellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.



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a) White Wash/Colour Wash

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the engineer, and shall conform to IS: 712 latest editions. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 liters of white wash water and a little of indigo or synthetic ultramarine blue shall be added to the lime. Mineral colour not affected by lime shall be added to white wash to get the required tint/shade approved by the Engineer.

b) Dry distemper

Shall be made from suitable pigments, extenders, lime proof tinters, water-soluble binders etc. and shall conform to IS: 427. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

c) Oil Bound Washable Distemper

Shall be of oil emulsion type containing suitable preservatives and shall conform to IS: 428. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

d) Waterproof Cement Paint

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS: 5410.

e) Acrylic Emulsion Paint

Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide conforming to IS: 5411 (Part-1). It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild soap and water without any deterioration in colour, or without showing flaking, blistering, or peeling.

f) Synthetic Enamel Paint



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Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and resist interior surfaces. White and pastel shades shall not yellowing and darkening with aging. The paint shall conform to IS: 2932 and IS: 2933.

g) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

h) Varnishing

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

i) French Polish

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well known approved manufacturer. The material shall conform to IS: 348.

French polish shall not be used on bare wood it shall only be used as finishing coat on wood after the woods pretreated with a liquid wood filler conforming to IS: 345 is applied and rubbed out.

j) Bitumen paint (black bituminous anti-corrosive paint)

Bitumen based anti-corrosive paint conforming to IS: 158 shall be used.

2.00.02 Storage

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement, & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

2.01.00 Preparation of surface

Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.



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2.01.02 Wood

All surfaces shall be free from, dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellace coating applied thinly & extended 25 mm beyond the area. All large, loose, or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS: 2338.

2.01.02 Masonry, Concrete, and Plastered Surface

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint, or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from, the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with **Mildew or Efflorescence** shall be treated as below:

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80ml liquor ammonia and diluted to water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.01.03 Metal

The surface preparation shall be done in accordance with IS:1477(Part-1) 'Code of practice for painting of ferrous metals in building' and as directed by Engineer. All metal surfaces shall be absolutely clean, dry, and free from rust, scales, weld slag, flux deposit, wax, grease, dried soap films, foreign matters like cement mortar etc and free from existing loose red oxide zinc chromate primer and should be removed by means of wire brushes, hand scrappers, sand paper, emery cloth, emery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanized iron surfaces shall be pretreated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. The actual painting work should be commenced only after obtaining clearance from the Engineer regarding proper cleaning of the surface.



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2.02.00 Application

2.02.01 General

The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints.

Proper tools and implements shall be used. Scaffoldings used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor notes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to free of sags, runs, crawls, or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoat for painting shall be applied by brush only, and rollers spray equipments etc. shall not be used.

No work shall be done under conditions that are unsuitable production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint, which seals the surfaces to moisture shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered property by applying the specified number of coats, further coats shall be applied by the Contractor when so desired by the Engineer.

All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

Painting on ferrous metal surface shall, be done as per IS: 1477 (Part I & 2). The total dry thickness of film should not be less than 120 Micron.

2.02.02 White Washing

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before white washing.



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One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required the Contractor shall do so without any extra cost to the Owner. No brush marks shall show on the finished surface.

2.02.03 Dry Distemper

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1 part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement-plastered surface, the surface shall be washed with solution of 100 gms. of zinc sulphate to 1 litre of water and allowed to dry.

Dry distempering shall be done as per manufacturers instruction. In applying the distempers the brush, should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long, otherwise brush marks may result.

2.02.04 Oil bound washable distemper

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.

2.02.05 Waterproof Cement Paint

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

2.02.06 Acrylic Emulsion Paint

Paint shall be applied after providing one coat of cement primer solvent of approved quality and primer shall be conform to IS: 109. Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be done strictly as per manufacturer's specification.



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2.02.07 Synthetic Enamel Paint

Shall be applied on properly primed surface. Subsequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.02.08 Aluminium Paint

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.02.09 Clear Synthetic Varnish

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on white the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has begun to set shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flatting varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

2.02.10 French polish

All unevenness of the surface shall be rubbed down to smoothness with sand paper and the surface shall well dusted. The pores in the shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt siemme or umber.



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After application of the filler paste, the French polish shall be applied with a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for 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.

2.02.11 Chemical Resistant Paint

For chemical resistant paints, epoxy, chlorinated rubber, or vinyl butryl paint system shall be used. Manufacturer's recommendation shall be followed regarding the paint system, exposed to moderately to severe corrosive condition and subject to acid/alkali spillage & fumes, shall be followed.

2.03.00 Protection

Furniture and other movable objects, equipment, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipment shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.04.00 Cleaning up

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

3.00.00 ACCEPTANCE CRITERIA AND TESTING

- 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.



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Testing

- a) As, each part of the work is under progress, i.e. preparation of surface, providing primer, providing different coats of finishing paints, it shall be passed by the Engineer. Variation from the drawings or specification or standard etc. shall not be accepted. The Contractor shall ascertain from the Engineer as to which parts will be inspected and passed from time to time. The Contractor shall provide all necessary arrangement for inspection of the painting work during its different working phase. The Contractor shall provide necessary scaffolding, approach for inspection of the above as per direction and satisfaction of the Engineer. All the necessary cost for scaffolding, approach, platform, lighting arrangement testing and inspection shall be borne by the Contractor. Such inspection and testing will not, however, exonerate the Contractor from his responsibilities for proper workmanship, material etc.
- b) The Contractor shall carry out all sampling and necessary testing in accordance with the relevant Indian Standards and shall conduct such tests as called for by the Engineer. Where no specific testing procedure is mentioned in the relevant codes, the tests shall be carried out as per the prevalent accepted Engineering practice as per the direction of the Engineer. Tests shall be done in a laboratory, approved by the Engineer, and cost of testing shall be borne by the contractor.
- c) Material/workmanship unsuitable for acceptance shall be removed and replaced by the Contractor. The work shall be redone as per Specification of the contract and direction of the Engineer without extra cost to owner.

4.00.00

I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 348	Specification for French polish
IS: 427	Specification for Distemper, dry colour as required.
IS: 428	Specification for Distemper oil emulsion, colour as required.
IS: 1477 (I & II)	Code of Practice for painting of ferrous metal in buildings.



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- IS: 2338 Code of Practice for finishing of wood and wood based materials.
 (I & II)
- IS: 2339 Specification for Aluminium, Paints for general purposes in dual containers.
- IS: 2395 Code of Practice for painting concrete, masonry, and Plaster surface.
- IS: 2932 Specification for enamel, exterior type-1.
- IS: 5410 Specification for cement paint, colour as required.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rates for complete items described in the “Schedule of Items”.

Rate shall include cleaning, preparation of surface, supply and application of primer, painting and providing all protection and scaffolding required at site.

5.02.00 Measurements

Painting over the concrete/masonry/wooden surface shall be measured net (on the surface area on which it is applied) in Sqm.

No deduction shall be made for opening not exceeding 0.5 Sqm and ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sill of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.

Corrugated surfaces shall be measured flat and measured area shall be increased by 15%.

Painting of structural steel works shall be measured in M.T. of fabricated steel (as per section D-17 clause 6.02.00 i.e Mode of measurement of technical specification for fabrication of structural steel works) unless specified otherwise.



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Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
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FLOOR FINISH AND ALLIED WORKS

1.00.0 SCOPE

This section covers furnishing, installation, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes, and allied items of work as listed below

a) In Situ Finishes

- i) Integral finish to concrete base
- ii) Terrazzo finish
- iii) Granolithic finishes
- iv) Patent Stone
- v) Metallic Hardener like “Ironte”/Hardonate Finish
- vi) Mastic Asphalt finishes
- vii) Chemical Resistant finish

b) Tiled Finishes

- i) Terrazzo tile
- ii) Chequered tile
- iii) Glazed tile
- iv) Tesse rae (Mosaic etc.)
- v) Chemical Resistant
- vi) Rubber, Vinyl etc.
- vii) Stone Slab including Kota Stone.

1.01.00 Base

The base to receive the finish is covered under other relevant specifications.



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1.01.01 Sequence

Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer in view the activities of other agencies working in that area. However, the Contractor for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damages whatsoever till handing over.

2.00.00 INSTALLATION

2.00.01 Special Materials

Basic materials are covered elsewhere under the Specification. In general, all such materials shall be as per relevant Codes where available. In all cases these materials shall be of the best quality available indigenously unless specified otherwise.

The materials for finishing items must be procured from well-reputed specialized manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use substandard items to maintain in the construction schedule.

2.00.02 Workmanship

Only workers specially experienced in particular items of finishing work shall be engaged, where such workers are not readily available, with the Engineer's permission, experienced supervisors recommended by the manufacturer shall be engaged. In particular cases where the Engineer so desires the Contractor shall get the finishing items installed by the manufacturer.

2.00.03 Preparation of the Base Surface

The surface to be treated shall be thoroughly examined by the Contractor. Any rectification necessary shall be brought to the notice of the Engineer and his approval shall be taken regarding method and extent of such rectification work.

For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all 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.

To prevent of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up.

The surface shall be bone dry where adhesives are used for fixing the finishes.



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Prior to commencement of actual finishing work the approval of the Engineer shall be taken as per the acceptability of the surface.

2.01.00 In Situ Finishes

2.01.01 Integral Finish To Concrete Base

While the surface of the concrete laid as per specification for 'Cement Concrete' has been fully compacted and levelled but the concrete is still 'green' thick slurry, made with neat cement shall be applied evenly and worked in with iron floats. When the slurry starts to set it shall be pressed with iron floats to have a firm compact smooth surface without trowel mark or undulations. This finish shall be as thin as possible by using 2.2 kg. of cement per Sq.M. of area.

The surface shall be kept in shade for 24 hours and then cured for at least 7 days continuously by flooding with water. The surface shall not be subjected to any load or abrasion till 21 days after lying.

As desired by the Engineer the surface, while still 'green' shall be indented by pressing strings, the marking shall be of even depth, in straight lines and the panels shall be of uniform and symmetrical patterns.

2.01.02 Terrazzo Finish in Situ

It shall consist of an underbed and a topping laid over an already laid and matured concrete base.

a) Thickness

Unless otherwise specified the total thickness of the 'finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall be not less than 10 mm. While the topping shall be of uniform thickness the underbed may vary in thickness to provide necessary slopes. The vertical surface shall project out 6 mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to acc ate the specified thickness. All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

b) Mix

i) Underbed

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 parts cement, 1½ parts sand and 3 parts stone chips by volume. For vertical surfaces the mix shall consist of 1 part cement to



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3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only sufficient water to be added to give a workable consistency.

ii) Topping

The mix for the topping shall be composed of cement, colour Pigment, marble dust and marble chips. Proportions of the ingredients shall be such as to produce the terrazzo of colour texture and pattern approved by the Engineer. The cement shall be white or gray or a mixture of the two to which pigment shall be added to achieve the desired colour. To 3 parts of this mixture 1 part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1½ parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and nonfading. It must be very finely ground. The marble powder shall be from White marble and shall be finer than IS Sieve No.: 30. The size of marble chips shall be between 1 mm to 20 mm. Sufficient quantity to cover each visible area shall be prepared in one lot to ensure uniform colour. Water to make it just workable shall be added to a quantity that can be used up immediately before it starts to set.

c) Laying

The underbed shall be laid in panels. The panels shall not be more than 5 Sq.M. in area of which no side shall be more than 2.5 M. long. For exposed locations the maximum area of a panel shall be 2.0 Sq.M. The panel shall be laid in alternate bays or chequered board pattern. No panel shall be cast in contact with another already laid until the latter has contracted to the full extent.

Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbeds plus topping.

After laying, the underbed shall be levelled compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat "green" but firm enough to receive the topping. A slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled 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.



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d) Curing

The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days.

e) Grinding and Polish

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no.80) grit blocks, till the marble chips are exposed and the surface is smooth. Then the surface shall be thoroughly washed and cleaned. A grout with already prepared mixture of cement and pigment shall be applied to fill up all pinholes. The surface shall be cured for 7 days by keeping it moist and then ground with fine grit blocks (no.: 120). It shall again be cleaned with water, the slurry applied again to fill up any pinholes that might have appeared and allowed to be cured again for 5 days. Finally, the surface is ground a third time with very fine grit blocks (no.: 320) to get smooth surface without any pinhole. A suitable machine shall do the grinding. Where grinding machine can not be used hand grinding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.:60), second rubbing with medium grade (no.: 80) and final rubbing and polishing with fine grade (no.: 120). The surface shall be cleaned with water, dried, and covered with soil free, clean sawdust if directed by the Engineer. The final polishing shall be postponed till before handing over if desired by the Engineer. Just before handing over the surface shall be dusted with oxalic acid at the rate of 0.33 gm. per. Sq.M., water sprinkled on to it and finished by buffing with felt or hessian bobs. The floor shall be cleaned with soft moist rag and dried. However, all excess wax polish to be wiped off and the surface to be left glossy, but not slippery.

2.01.03

Granolithic Finish

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.

a) Thickness

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

b) Mix

The mix shall consist of 1 part cement: 1 part coarse sand 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 12 mm. Minimum quantity of water to get workability shall be added.



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c) Laying of Monolithic Topping

The concrete base shall be laid as per specification “Cement Concrete” and levelled upto the required grade. The form shall remain sufficiently protruding to take the finish.

Within about 3 hours of laying the base while it is still fully -green- the topping shall be laid evenly to proper thickness and grade. If considered necessary the surface ‘ of the base shall roughened by wire brushing. Unless manual operation is permitted by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly secure full bond with concrete base.

The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then the lightly trowelled to remove all, marks. When sufficiently set, hand trowelling shall be done to secure a smooth surface without disturbing the stone chips.

For large areas the laying shall be in panels of maximum 25 Sq.M. area. The panels shall be laid in chequered board pattern.

d) Laying of Topping Separately on Hardened Base

The base concrete shall be prepared as stated in clause 2.00.03 and a slurry of neat cement applied just prior to laying the granolithic concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping.

Curing

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or 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 2.01.02 (e) shall be followed. However, the Engineer shall decide upon the ultimate polish required.

g) Finishing

Where specified, sodium, silicate or magnesium or zinc silico fluoride treatment shall be done. The number of coats to be applied shall be as per



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approved drawings or as instructed. The concentration and method of application of the solutions shall be as specified in IS: 5491.

2.01.04 Patent Stone

It shall consist of an underbed and a topping laid on an already laid and matured concrete base.

a) Thickness

The patent stone finish shall have thickness as stipulated under clause 2.01.02 (a) except that the topping shall be 12 mm thick.

b) Mix

i) Underbed

The mix shall be as stipulated under clause 2.01.02 (b).

ii) Topping

The mix for the topping shall consist of 1 part cement and 2 part stone aggregate 6mm nominal size by volume.

c) Laying

The Patent Stone finish including the underbed shall be laid in alternate bays or in Chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of the latter has already taken place.

The maximum area of each panel shall be 3 Sq.M. of which no side shall be more than 2 M. long.

A cement grout shall be applied and worked into the surface to receive the finish; the underbed then laid, compacted, and leveled to proper grade with a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond. The topping shall be trowelled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a soft cloth to give a clean smooth surface.

After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing. If desired the finish shall be polished as directed by the Engineer.



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2.01.05

Metallic Hardener Like 'Ironite'/'Hardonate' Finish

This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is 'green'.

a) Thickness

Unless otherwise specified the metallic hardener finish shall be of 12 mm depth.

b) Material

The hardening compound shall be uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials when desired by the engineer, actual samples shall be tested.

c) Mix

Proportion of the metallic hardener shall be as specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry, with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1 part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable.

d) Laying

The concrete floor shall be laid as per specification 'Cement Concrete' and levelled upto required grade. The forms, if any, shall remain sufficiently projecting to make the finish. The surface shall be roughened by wire brush as soon as possible.

The finish shall be laid while the concrete underbed is still very 'green' within about 3 hours of laying of the latter. The finish shall be of uniform thickness and even dense surface without trowel marks, pin holes etc. This topping layer shall be pressed firmly and worked vigoursly and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished smoothened with steel trowel.

The finished floor shall be cured for 7 days by keeping it wet.



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2.01.06

Mastic Asphalt Finish

This is a one-layer treatment on concrete or brick base.

a) Thickness

The thickness shall be as specified in the drawing.

b) Materials

Bitumen shall be industrial Bitumen of the grade 90/15 and 75/15 conforming to IS: 702.

Mineral filler shall be dry stone dust passing through 75 micron IS Sieve.

Fine aggregate shall be crushed and graded natural limestone or other hard work.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate 6 mm stone chips shall be used for finish upto 20 mm thick & 10 mm chips for thicker finish.

c) Composition

Bitumen mastic shall conform IS: 1195 and shall be either brought to site in blocks weighing about 25 Kg or prepared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, preferably preheated fed in successive portions until the complete change is thoroughly, incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205°C.

d) Laying

The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be leveled and when cooled to some extent shall be finished with a wooden float with addition of small quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature.

The mastic shall be laid in suitable panels of about 1.5 Sq.M. in area each formed by formers. Succeeding panels shall be laid overlapping the finish panel so as to melt its edges and form a continuous finish without joint.



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2.01.07 Chemical Resistant in Situ Finish

Chemical resistant in situ finish shall be as epoxy resin with suitable filler material over a primer. The minimum thickness shall be 6 mm. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence. The contractor shall get it done by a specialized Manufacturer and get guarantee of performance from the organization and pass it on to the Owner in addition to his own guarantee.

2.02.00 Tiled Finish

These shall include finish tiles, stone slabs, and similar manufactured or natural items over already laid and matured base of concrete or masonry by means of an underbed or an adhesive layer.

2.02.01 Terrazzo Tile Finish

The finish will consist of manufacture terrazzo and an underbed.

a) Thickness

The total thickness including the underbed shall be minimum 40 mm for floors 30 mm for walls unless otherwise specified.

The skirting, dado and similar vertical surfaces shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the tiled finish, to accommodate the specified thickness shall be done.

b) Tiles: Terrazzo

The tiles shall, unless specifically permitted in special cases be machine made under quality control in a shop. The tile shall be pressed hydraulically to a minimum of 140 Kg. per Sq.cm.

Each tile shall bear on its back permanent and legible trademark of the manufacturer. All angles of the tiles shall be right angles all arises sharp and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowance length and breadth shall be ± 1 mm and the thickness ± 3 mm. Face of the tile shall be plane, free from pinholes and other blemishes.

The tiles shall be composed of a backing and topping. The topping shall be of uniform thickness not less than 10 mm.



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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 gray cement and 3 parts of stone chips by weight mixed with water.

The topping shall be as specified under clause 2.01.02 (b).

The tile shall be cured at the shop for at least 14 days before delivery to the site. First grinding shall be given to the tiles at the shop before delivery. Tiles shall be packed properly to prevent damage during transit and storage. The tiles must be carefully stored to prevent staining by damp, rust, oil, and grease or other chemicals.

Tiles made in each batch shall be kept and used separately so that colour of each area of the floor may remain uniform.

The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles. The containers for the grout mix shall be suitably marked to relate it to the particular type and batch of tiles.

c) Mix: Underbed

The underbed for floor and similar horizontal surfaces shall be 1 part lime putty: 1 part surkhi: 2 parts coarse sand by weight mixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 12 mm thick and composed of 1 part cement and 3 parts coarse sand by weight.

d) Laying

The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The surface shall be roughened for better bond. Before the underbed had time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or a cement slurry applied and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The 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



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in advance and approval of the Engineer taken.

At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be kept moist and allowed to mature undisturbed for 7 days. Heavy traffic shall not be allowed.

If desired dividing strips as specified under Clause 2.01.02(c) may be used for dividing the work into suitable panels.

e) Grinding and Polishing

Procedure shall be same as Clause 2.01.02(e). Grinding shall not commence earlier than 14 days after laying of tiles.

2.02.02 Chequered Tile Finish

The finish shall consist of manufactured gray or coloured cement tiles or terrazzo tiles with chequered face and an underbed laid over concrete or brick surface.

a) Thickness

Thickness shall be same as in clause 2.02.01 (a).

b) Tiles: Chequered

The tiles shall have chequers not less than 2.5 cm. c/c and not more than 5 cm. c/c. Depth of grooves shall be not less than 5 mm. The grooves shall be uniform and straight.

The tiles shall conform to clause 2.02.01 (b) except that these may have the topping in terrazzo or plain gray cement or colour pigment added to cement.

c) Under-bed

As per clause 2.02.01 (c).

d) Laying

As per clause 2.02.01 (d).

e) Grinding and Polishing

As per clause 2.02.01 (e) except that the tiles shall be ground and polished by hand and after laying taking special care in polishing the grooves properly and uniformly.



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2.02.03

Glazed Tiles Finish

This finish shall be composed of glazed earthenware tiles with an underbed laid over a concrete or masonry base.

a) Thickness

The total thickness shall be between 20mm and 25mm including the underbed.

The tile finish on vertical surface shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.

b) Tiles: Glazed

The tiles shall be of earthenware, covered with glaze white or coloured, plain or with designs, of 150 mm x 150 mm nominal sizes and 5.5 mm to 6 mm on thick unless otherwise specified. The tolerance shall be ± 1.5 mm for length and breadth and ± 0.5 mm for thickness specials like internal and external angles; beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt, unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and homogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawlings, etc. and other imperfections. The edge and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar.

The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.

c) Mix: Underbed

The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

c) Laying

Same as clause 2.02.01 (d).

e) Finishing

The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be cleaned with soap or



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suitable detergent, washed fully, and wiped with soft cloth to prevent scratching before handing over.

2.02.04

Tesserae Finish (Mosaic etc.)

This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an underbed over a concrete or masonry surface, already laid.

a) Thickness

The total thickness including the underbed shall be between 16 mm & 25 mm.

b) Tesserae Finish

These shall usually be 6 mm thick small piece of ceramic vitreous china, tinted glass, or similar hard wearing, strong, and durable material in desired shapes and sizes and patterns.

The supply shall come in the desired pattern in full or sections conveniently for handling, stuck to pieces of strong thick paper on the surface to be exposed. The gum used for this purpose must be water soluble and non-staining. The sections shall be properly marked to avoid mistakes and master drawing shall be available at the site for guidance.

c) Mix: Underbed

Same as clause 2.02.03 (c)

d) Laying

The specification for laying if given by the manufacturer of the item shall be followed provided it is approved by the Engineer. Otherwise clause 2.02.03 (d) shall generally be followed. However, instead of gray cement the slurry shall be made with white cement to fix the panels. The paper-mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.



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2.02.05

Chemical Resistant Tiled Finish

This shall include all varieties of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry.

a) Tiles

The chemical resistant tiles shall be of the best indigenous Manufacture unless otherwise specified and shall be resistant to the chemical (both acid and alkali). The tiles shall have straight edges, uniform thickness, plain surface, uniform nonfading colour, and textures.

Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 Kg/cm². The surface shall be abrasion resistant and durable.

b) Laying

The mortar used for setting or for underbed these tiles shall be durable, strong and chemical resistant epoxy mortar. The grout, which shall be to the full depth of tile, shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

2.02.06

Rubber, Vinyl, or Vinyl Asbestos Tiles Finish

This shall include various types of tiles manufactured from rubber, vinyl etc. set with an adhesive on concrete or masonry base. An underbed may be required to secure desirable surface and grade.

a) Thickness

The thickness of the tiles shall be as incorporated in drawing.

b) Tiles

Unless otherwise desired the tiles shall be squares of approved dimensions. The tolerance in dimensions shall be ± 1.5 mm.

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 alkalis, cleaning agents and usual floor polishes.

Each tile shall be marked on the back legibly and indelibly with manufacturer's trademark, the thickness, sizes, batch number, and date of



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manufacturer.

Tiles shall be delivered securely packed and stored in clean, dry well ventilated place at a temperature near about to that the tiles shall be called upon to stand ultimately.

Adhesive to be used for sticking the tiles shall be approved by the tile manufacturer. The adhesive shall have a short drying time and long life in addition to toughness.

c) Mix: Underbed

The underbed where required to make up the specified thickness or to give the required grade or to get the right type of surface shall be composed of 1 part like putty:1 part cement: 3 parts coarse sand mixed with just sufficient water to make it workable.

d) Laying

The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air-conditioned space, the air-conditioning shall be completed before tiling is taken up.

The surface to receive this finish shall be firm even textured but not too smooth, without undulations and other deficiencies. If an underbed is laid the same shall be cured for at least 7 days by keeping it moist and then fully dried.

The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleaned by use of detergent.

The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool. If the edges tend to curl, weights are to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the tiles. The joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

e) Finishing

If any adhesive mark is there on the surface a soft cloth soaked in solvent shall be used to wipe it off. The surface shall be cleaned with soft soap, dried, and polished with an approved type of polish just before handing over.



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2.02.07

Stone Slab Finish: Marble, Stone, and Similar Fine Grained Stone including Kota stone

a) Thickness

The underbed shall be minimum 12 mm and average 20 mm thick. The slabs will be 20 mm thick.

b) Stone Slab

The stone slabs shall be made from selected stock, which is hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, and free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions. Tolerance of ± 5 mm in dimensions and ± 2 mm in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm.

The stone slabs shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints.

The slabs shall be delivered to the site well protected against damages and stored in dry place under cover.

c) Mix: Underbed

Same as clause 2.02.01 (c).

d) Laying

The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed before laying.

The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed, and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to stiffen a little. Next, thick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, gray / white / mixed with pigment matching the colour of the stone slabs. The slab shall be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet.



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e) Polishing, Finishing

Fine chiselling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be done as specified under clause 2.02.01 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

2.02.08

Stone Slab Finish: Sand Stone and Similar Coarse Grained Stone Finish

Generally clause 2.02.07 shall be followed except that the workmanship and finish shall not be fine as which are explained hereunder.

The slabs shall be rough chiselled or fine chiselled as specified. Tolerance may be allowed upto ± 6 mm for rough finish, but no sharp unevenness and shall be allowed. For fine chiselling the unevenness shall be limited to ± 2 mm. The sides shall be chisel dressed at least to half slab depth so that the maximum deviation from straight line shall be within 25 mm. Beyond this depth the edge may be slightly splayed.

The joint thickness shall be kept limited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider joints are specified. The joints shall be grouted with white or coloured cement. If fine joints in the flooring are specified, the edges of slabs shall be cut in such a way that it shall form a inverted 'Y'.

3.00.00

ACCEPTANCE CRITERIA

The finish shall be checked specially for:

- a) Level, Slope, Plumb as the case may be
- b) Pattern and Symmetry
- c) Alignment of joints, dividing strip etc.
- d) Colour, texture
- e) Surface finish
- f) Thickness of joints
- g) Details at edges, junctions etc.
- h) Performance
- i) Precautions specified for durability



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4.00.00

I.S. CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

- IS: 777 : Glazed earthenware tiles
- IS: 1196 : Code of practice for laying bitumen mastic flooring.
- IS: 1197 : Code of practice for laying of rubber floors
- IS: 1237 : Cement concrete flooring tiles
- IS: 1443 : Code of practice for laying and finishing of cement concrete flooring tiles.
- IS: 2114 : Code of practice for laying in situ terrazzo floor.
- IS: 3461 : PVC asbestos floor tiles
- IS: 4860 : Specification for acid resistant bricks
- IS: 5518 : Code of practice for laying of flexible PVC Sheet and tile flooring.
- IS: 5491 : Code of practice for laying in situ granolithic floor topping.

5.00.00

RATES AND MEASUREMENT

5.01.00

Rates

Rates shall be for the complete work (including dividing strips, ironite, metals, tiles etc. if any) as per the schedule of items. Rates shall be applicable for application on horizontal and vertical surfaces at all elevations and for all types of work including stairs tread and riser, laying in desired pattern and panels, cost of specials (if any) rounding of corners, mouldings etc.

Rates shall be including provision of side shuttering (if required) for casting of floor in alternate panels and or without dividing strips.



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5.02.00

Measurement

The finished surface shall be measured in Sqm for area unless otherwise specified. Deduction shall not be made for opening or embedded articles having area not exceeding 0.1 Sqm.



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SHEET WORK IN ROOF AND
SIDING**

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SHEET WORK IN ROOF AND SIDING

SPECIFICATION NO. PE-TS-463-600-C013



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



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SHEET WORK IN ROOF AND
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SHEET WORK IN ROOF AND SIDING

1.00.00 SCOPE

This section covers supply, cutting & fabrication and erection of corrugated/plain asbestos, corrugated galvanized iron, aluminum, permanently colour coated troughed zinc-aluminium alloy coated M.S. sheet or other sheet for covering to roof and sides at various elevations as specified.

2.00.00 INSTALLATION

2.01.00 Storage of Materials

All materials shall be stored by the Contractor in proper way to prevent all damage.

2.02.00 Workmanship

The workmanship shall be according to best construction practice to give a watertight finish to the satisfaction of the Engineer. Fixing of gutters and down pipes shall be according to IS: 2527.

2.02.01 Asbestos Sheeting

Asbestos sheets of profiles as specified shall be fixed with minimum 150 mm end lap and side laps as per manufacturer's specification. Hook bolts or J-bolts shall be 8 mm dia. at 305 mm centres. Six (6) mm dia. galvanized iron seam bolt and nut with G.I. flat washers and bitumen washers shall be used for stitching ridge cappings, corner pieces, ventilators, north light curves etc.

2.02.02 C.G.I. Sheeting and Aluminium Sheeting

Side laps shall be 2 corrugations for roof and one corrugation for side sheeting. End laps shall be minimum 150 mm for roof and 100 mm for side sheeting. In ridges and hips where plain sheets are used, the end laps shall be minimum 100 mm. Holes in C.G.I. sheets shall preferably be made on the ground. The sheets should be placed on purlins/trestles and holes punched in the ridge of the corrugation from the outside inward for obtaining proper seating of limpet washers. Sheets shall be secured to sheet framing by 8 mm dia. galvanised iron hooks or J-bolts and maximum spacing of the bolts shall be 305 mm. The length of the hook or J-bolts shall be to suit the sections of the bearers. Sheets shall also be bolted at the ends at every third corrugation with 6 mm dia. galvanized iron seam bolts and G.I. flat washers and bituminous washers.

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2.02.03	Fibre Glass Reinforced Plastic Sheeting This shall be of thickness and profile as specified. Colour and light transmittance shall be as mentioned. Where used in conjunction with C.G.I. or asbestos sheeting, the end and side laps and fixing device shall be same as used for general sheeting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads. In all cases, the installation shall be completely watertight and able to withstand the designed wind-pressure.	
2.02.04	PERMANENT COLOUR COATED (SANDWICHED INSULATED) METAL CLADDING SYSTEM i. Troughed zinc-aluminium alloy coated (both sides) M.S. sheet having 0.6mm minimum thickness (or high tensile steel sheet having minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 150 gm/sq.m. The outer side (exposed face) shall be permanently colour coated with Polyfluro Vinyl Coating (PVF₂) of Dry Film Thickness (DFT) 20 microns (minimum) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns. ii. Galvanised M.S. sheets of minimum 0.6mm thickness shall be used as inner liner (internal face) of cladding system. The exposed face shall be permanently colour coated with silicon modified polyester paint of DFT 20 microns (minimum) over primer. Inner face of external sheet shall be provided with suitable pre-coating of minimum 7 microns. The rate of galvanization shall not be less than 275 gm/sqm. iii. The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability. iv. Inner sheet shall be fixed directly to side runners and Z spacers made out of at least 2 mm thick galvanized steel sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50M centre to centre to hold the insulation and external sheeting. The fasteners shall be of high quality corrosion resistant grade of self tapping / self drilling type provided with suitable cap. v. The insulation shall be of bonded mineral wool of minimum thickness 50mm conforming to IS:8183, having a density of 32 Kg/cu.m. for glass wool & 48 Kg/cu.m. for rock wool.	
2.02.05	PERMANENT COLOUR COATED (NON-INSULATED) METAL CLADDING SYSTEM i. Troughed zinc-aluminium alloy coated not less than 150 gm/sq.m M.S. sheets having 0.6 mm minimum thickness (or High tensile steel sheet having	

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	minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used for the cladding system. The outer side (exposed face) shall be permanently colour coated with PVF₂ paint of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 12 microns over primer. These shall be fixed directly to runners. The sheets shall meet the general requirement of IS:14246 and shall conform to class 3 for the durability. ii. FLASHING, CAPS, TRIM CLOSURES ETC. All flashings, trim closures caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding. 3.00.00 ACCEPTANCE CRITERIA The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked: a) Side and end laps b) Absence of cracks, holes or damages in sheet c) Spacing of bolts d) Provision of double washers (G.I. and asbestos or bituminous washers) e) Proper installation of flashing. 4.00.00 I.S. CODE All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. - IS: 3007 : Code of practice for laying of asbestos cement sheets. - IS: 2527 : Code of practice for fixing rainwater gutters and down pipes for roof drainage. - IS: 1626 : Specification for asbestos cement building pipes, gutters and fittings. - IS: 277 : Specification for galvanized steel sheets (plain and corrugated).	



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5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rate for complete item described in “Schedule of Items” and shall include all wastage.

5.02.00 Measurement

Sheeting work in roof & sides shall be measured in Sq.M. for net area of the work done. Profiled sheeting shall be measured flat and not girthed. Opening less than 0.40 Sqm shall not be deducted. No extra shall be paid for extra labour in cutting and for wastage etc. No payment shall be made for laps, flashings, sealing, fasteners etc. in sheeting works.



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**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

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SUSPENDED CEILING

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



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SUSPENDED CEILING

1.00.00 SCOPE

This section covers supply and installation of suspended ceiling together with the suspension system as shown on drawing or specified in schedule of item with all materials, labour and equipments. The work shall also include providing of openings in the ceiling for lighting, air-conditioning diffusers etc. as shown on drawings or as instructed by the Engineer.

2.00.00 INSTALLATION

2.01.00 Suspension System

2.01.01 General

Suspension system shall consist of the grid supporting the ceiling panels, intermediate runner supports for the grid if any and hangers, wall angles etc. required to suspend the grid or the runners from structural works, slabs and beams.

All members of the suspension system shall be of sufficient strength and rigidity to carry, the ceiling boards or sheets in a true and level plane without exceeding a deflection of 1/360th of their span. All joints in ceiling panels shall run straight and cross joint shall be at perfect right angles. Angle moulds where shown on drawings shall be securely fixed to walls. All drillings of structural concrete and installation of suitable anchoring device for installation including welding of the suspension system shall be included in the rate. All M.S. sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer.

2.01.02 Metal Grid Suspension System

Aluminium grid ceiling system shall be "Bead lock" as manufactured by W A Beard shell and Co. Pvt. Ltd. or Ajit India Limited or approved equal. Steel grid ceiling system shall be 'Jolly Snap Grid' as manufactured by Jolly Board Limited or approved equal.

Steel tees as intermediate members and steel channels, as end pieces will be assembled in the form of grid. Size of tees and channels shall be as required.

The cross-tees shall intersect main tee runners in pattern shown on drawing and positively locked together with intersection members. All perimeter areas shall have tee runners fixed to vertical wall surfaces and end channels shall be fixed to runners leaving return air space between vertical wall and channels,



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unless otherwise shown on drawings. Angle cleats or other suitable fixing device shall be fixed to the structural beams above for fixing of hangers. Main runners shall be hung by M.S. flats, angles, rods or 12G or heavier galvanized tie wire hangers at maximum 1.2 metre centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings. Turnbuckles shall be provided in M.S. rods for adjustment in levels.

2.02.00 Ceiling Panels

2.02.01 Material

Ceiling panels shall be best quality material in thickness and properties called for in the “Schedule of items”. The Contractor shall submit test certificates to the Engineer for approval before bulk supply. The ceiling panels may be of following type:

- a) Plaster of Paris board (decorative)
- b) Expanded polystyrene insulation board with plastic fascia.
- c) Fibre Insulation board.
- d) Bonded wooden particle board (Plain and decorative)
- e) Glass fibre reinforced polystyrene sheets.
- f) Flat asbestos sheets (with plastic fascia).

2.02.02 Installation of Ceiling Panels

Installation of Ceiling panels shall be strictly as per manufacturer’s instruction.

For concealed grid system, tiles shall be fixed to the supporting grid in manner shown on drawing or as specified by the manufacturer. Where V joints in tiles are called for in drawings, these shall be in true lines. Where flush surface is required, the joints shall be filled with approved filler material and finished to give a neat uniform surface. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures, diffusers etc.

2.02.03 Aluminium Lineal Ceiling System

Aluminium lineal ceiling system shall be “Luxalon 84C ” or approved equal and the installation shall be strictly as per manufacturer’s instruction/ specification subject to approval of the Engineer.



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Aluminium lineal ceiling shall comprise of plain panels, 84 mm wide and 12.5 mm deep with a 23.9 mm recessed flange, roll formed out of 0.5 mm thick aluminium alloy panels stove enamelled on both sides, fixed on roll-formed carriers made of enamelled 0.95 mm thick aluminium, 32 mm wide and 39 mm deep with prongs to hold panels in the module of 100mm, at maximum spacing 1.2 M centre to centre. The carriers shall be suspended from roof by 4 mm dia galvanised steel wire hangers with special height adjustment clips made out of spring steel at maximum spacing of 1.2 M c/c. Hangers shall be fixed to roof by 'J' hooks and nylon inserts. 25 mm thick resin bonded mineral wool (spintex 300 or equivalent) insulation bound in polythene shall be laid on top of panels. Lineal ceiling shall be fixed in pattern as per detailed drawings.

3.00.00 SAMPLES

Samples of Ceiling panels and metal suspension system components as noted below shall be submitted for Engineer's approval:

Panels : 3 samples approximately 300 mm square/long each

Suspension System : 3 samples of short length : each of main and secondary system

4.00.00 SHOP DRAWINGS

Shop drawings shall be submitted for approval as required and approval shall be obtained prior to delivery of suspended ceiling components. Shop drawings shall be co-coordinated with all related work and shall show the following information:

- a) A reflected ceiling plan of areas indicated to receive the ceiling showing electrical and mechanical features.
- b) Typical Intermediate framing for support where required.
- c) Hanger fastening details.
- d) Panels - unit support at ceiling penetrations.
- e) Details of splicing method for main and cross runners.
- f) A table indicating load bearing capacity of main and cross runner
- g) A note stating that the suspension system member furnished will not deflect more than 1/360 of the span under the indicated loading.

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5.00.00	ACCEPTANCE CRITERIA Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from, sags, warps, disfigured, or damaged board. Cutouts for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations.				
6.00.00	RATES AND MEASUREMENT				
6.01.00	Rates Rates shall be for the complete item called for in the “Schedule of Items”. No extra payment will be made for alignment and adjustment of lighting fixtures, air-conditioning diffusers, access panels etc. The rate shall include all cutting and wastage from standard size sheets, runners/carries etc.				
6.02.00	Measurement Actual area of work shall be measured in Sqm correct to second place of decimal. However, no deduction will be made for opening upto 0.25 Sqm. each in area.				



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**WATER SUPPLY, DRAINAGE
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Project Engineering Management
PPEI Building, Power Sector,
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WATER SUPPLY, DRAINAGE AND SANITATION

1.00.00 SCOPE

This section covers supply of all materials labour and incidentals required for supply, laying and installation of under/over ground pipes for water supply, drainage and sanitation with all fittings, fixtures and jointing, construction of ancillary works like manholes, drop connections, gully chambers, septic tank, soak pits, surface drain etc.

The supply and installation of water supply/sanitation fixtures and accessories like water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap container etc. with all fittings, fixtures, water supply/sanitation pipes and water storage tanks etc.

2.00.00 MATERIAL

All materials, fittings, fixtures, and appliances shall be of the best quality conforming to relevant Indian Standard and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the Contractor shall submit samples of fittings and fixtures, which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model, and manufacturer lies completely with the Engineer.

It shall be the responsibility of the Contractor to procure the materials selected by the Engineer. Hence orders are to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement.

The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threads, sockets, and similar items shall be specially protected till final installation. Brass and other expansive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site.

2.01.01 Pipes and Pipe Fittings

For water supply, galvanised mild steel pipe of medium grade conforming to IS: 1239 shall be used. The galvanising shall not be less than 400gm/sqm of pipe surface area. Galvanising shall be smooth and shall be subjected to testing as per IS: 2633 for uniformity of coating. The zinc coating shall be free from defects.

For Roof drainage and building sanitation works following type of pipe are coved in this Section:



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- a) Cast Iron pipe
- b) Steel pipe (lined, coated with bituminous composition, out coated with cement concrete or mortar or galvanized)
- c) Concrete pipe
- d) Asbestos cement pipe
- e) PVC pipe
- f) Stoneware pipe
- g) Vitrified pipe
- h) Lead pipe (not to be used for portable water)

2.02.01

Fixtures

All material, fittings, fixtures, appliances, accessories shall be of approved quality and shall be procured from reputed brands like Hindustan/Pasriware/Cera or equivalent or as approved by Engineer. The bidder shall procure the fixtures from the above named reputed manufacturers and shall mention in his bid the type & make of the fixtures he intends to use.

All items brought to the site must bear the manufacturer's identification mark. Procurements shall be made well in advance and should get inspected & approved immediately by the Engineer. All fixtures shall be adequately protected, covered, and plugged till handing over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The chromium plating shall be of grade-2 (10micron thickness) confirming to IS: 4827. Powder coating shall be of approved colour and shall have minimum thickness (DFT) of 20micron. Stainless steel accessories shall be of grade SS-304 and from reputed manufacturer (like Salem Steel) and shall be polished bright finish.

Unless specified in the contract the fixtures shall be as specified hereinafter.

Water closet

a) European type

It shall consist of European type glazed vitreous china basin (confirming to IS: 2556, part-II), with siphon open front solid plastic seat and plastic cover, low level glazed stoneware flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium



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plated. Colour of basin, cistern, seat and cover shall be as approved by the Engineer.

b) Squatting type

It shall consist of Orissa pattern glazed vitreous china squatting pan with integral foot rests (confirming to IS:2556, part-III) and high level cast iron flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The flushing cistern shall be painted as specified by the Engineer.

Urinals

It shall consist of wall type glazed vitreous china urinals (conforming to IS:2556), cast iron automatic flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. Frequency of automatic flushing shall be approximately once every five minutes. For every four urinals (maximum) located together may be served by one cistern of adequately capacity. All fittings shall be chromium plated.

Wash Basin

It shall be made of glazed vitreous china conforming to IS:2556, part-IV. The basin shall be flat back, wall hung by painted cast-iron brackets and complete with hot and cold CP brass faucets with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 32mm dia. Chromium plated brass waste of standard pattern, 32mm dia. CP brass trap union complete with necessary fittings.

Sink

It shall be made of glazed vitreous china conforming to IS:2556, part-V. It shall be wall hung by painted cast iron brackets and complete with one CP brass faucet with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 40mm dia. chromium plated brass waste of standard pattern, 40mm dia. CP brass trap union complete with necessary fittings.

Bathroom mirror

It shall be made of the best quality 6 mm thick glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws, and other fittings shall be chromium plated.



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Glass shelves

Class shelves shall consist of 6 mm thick clear glass with guardrails and shall be wall mounted with brackets. All brackets, guardrails, and screws shall be chromium plated.

Towel rail

Towel rails shall be 20 mm dia chromium plated MS pipes wall mounted with steel brackets. The brackets, screws etc. shall also be chromium plated.

Soap holder

It shall be made of chromium plated strong members. The holders shall be wall mounted with chromium-plated screws.

Liquid Soap Dispenser

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

Toilet roll holder

It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screw shall be chromium plated.

Valve, cocks, Taps

All valves, stop cocks, taps etc. shall conform to relevant Indian standard specification and shall be of best quality from approved manufacturers. These shall be suitable for normal working pressures. Nominal size and material shall be as required / specified.

2.03.00 Water Storage Tank

Water storage tank shall be PVC of approved brand and make (Syntex or equivalent). Reservoirs made of concrete masonry or fabricated steel shall be covered by respective work specifications.

3.00.00 INSTALLATION

3.01.00 General

Basic layouts may be available in the drawings provided, the details might have to be supplemented by the Contractor and get the approval of the Engineer before installation. Special attention shall be given to economise the layout. Symmetry of layout is very important. Fittings meant for operation



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shall be located and oriented to allow easy reach and operation. Maintenance, repairs, and replacements of pipes, fittings, and fixtures must be conveniently possible. All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry, and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance.

All pipelines, fittings, and fixtures shall be installed leak proof. When the works under scope of this specification linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases.

3.02.00 Portable water supply Pipe Lines

3.02.01 Laying

In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level and shall run on the surface of the walls, ceiling or in chases. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. All pipes used for water supply should be thoroughly and efficiently disinfected before taken in to use.

3.02.02 Back Flow

The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely watertight, thereby avoiding waste of water, damage of property and the risk of contamination of the water conveyed.

3.02.03 Contamination

There shall be no cross connection whatsoever between a pipe/fitting for conveying or containing wholesome water and a pipe/fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any other purpose. No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith.



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3.02.04 Underground Piping

Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable. The size and depth of the trench shall be as approved by the Engineer. Back filling shall be done with selected fine earth, unless otherwise permitted, in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling, the laid pipe shall be fully tested and approved.

Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support. The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.

3.02.05 Concealed Piping

Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The Contractor may co-ordinate with the building Contractor for leaving the chases, openings, and conduits as necessary. However, the Contractor will rectify if required the chases, openings, and conduits, supplement and make good after laying and testing of the concealed pipelines.

3.02.06 Jointing of Pipes

All G.I. pipes shall be properly thread/weld jointed and made completely water tight and durable. Burr from the joints shall be removed after screwing. Union joints shall be provided for all required location to facilitate maintenance.

3.02.07 Painting

Where required, underground G.I. pipes shall be given 2 coats of bituminous paint on the outside after laying. When painting is to be done above ground G.I. pipes shall be given one coat of red lead or zinc chromate primer and top coats shall be minimum 2 coats of best quality paint as specified.

3.03.00 RAINWATER DOWN COMERS

3.03.01 Pipes

Rainwater down comers shall be standard Cast Iron or Asbestos Cement Pipes. In case where specifically desired, M.S. pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paints under a coat of primer.

Rainwater down comers shall run along and be secured to walls, columns etc.

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	Where desired by the Engineer these may have to be installed in chases cut in the structure. All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type, or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed. All bends and junctions shall be supplied with watertight cleanouts. Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings. All horizontal pipes shall have a minimum fall of 1 in 100. 3.03.02 Khurras The khurras shall be constructed before the work in parapet wall is taken up and it shall be 45x45 cm in size, unless otherwise specified and shall be formed of cement concrete of M-20 grade. 3.03.03 Gutters The gutters shall be made of G.I. or A.C and procured from reputed specialised manufacturers. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means. Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no sagging even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by riveting, bolting or soldering. All joints between successive lengths of gutters shall have on overlap of at least 5 cm. The drop in the overlap shall always be in the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured. 3.04.00 SOIL AND DRAINAGE PIPES 3.04.01 Gradients If not specified the minimum gradients of soil and drainage pipeline shall be as follows:	

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	100 mm nominal dia : 1 in 35 150 mm nominal dia : 1 in 65 230 mm nominal dia : 1 in 120 300 mm nominal dia : 1 in 200	
3.04.02	Relation with water supply pipelines Unless specifically cleared by the Engineer, under no circumstances shall drainage and sewer pipes be allowed to come close to water supply pipelines.	
3.04.03	Laying Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.	
3.04.04	Support and Protection of Pipelines All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing. To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone over laid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil. The minimum support and protection for glazed stoneware pipes shall be as follows: a) When cover is less than 2 metre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete.	



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- b) Where pipes are laid on soft soil with the maximum water table laying at the invert of the pipe, the sewer shall be bedded on concrete.
- c) Where the pipes have to be laid on soft soil with the maximum water table rising above the invert of the pipe, but below the top of the barrel, the pipe sewer shall be haunched.
- d) Where maximum water table is likely to rise above the top of the barrel or wherever the pipe is laid on soft soil the pipe sewers shall be completely encased or surrounded with concrete.

Vitrified clay pipes shall be laid on a bed of 150 mm thick cement concrete (1:3:6) nominal mix by volume.

Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust.

3.04.05 Entry into structures

For entry of the pipe lines into any building of structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipelines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended.

3.04.06 Ducts

Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin, or backflow.

3.04.07 Traps and Ventilating Pipes

Pipes are carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap. Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-



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syphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C. I. unless desired otherwise by the Engineer.

3.04.08 Manhole & Inspection Chambers

At every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. However, for truck route (for pipes above 900 mm dia.) this distance can be increased to 45 M. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise provision of IS: 4111 (Part-1) shall be followed for construction of a manhole. Manhole shall be constructed so as to be watertight under test. The change in alignment shall be carried out in such a manner as to provide no lodgement for any splashings in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement, sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connecting to existing sewer lines shall be through a manhole.

Unless otherwise specified, 560 mm dia. circular cast iron manhole cover with frame, heavy-duty, conforming to IS: 1726 shall be provided. The covers shall be close fittings so as to prevent gases from coming out.

3.04.09 Cutting of Pipes

Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe.

3.04.10 Jointing

Jointing of pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and watertight when underground. Method of jointing shall be as per instructions of the pipe and fittings manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed hereunder shall be used.

a) Cast Iron Pipes

Socket and spigot pipes shall be jointed by the cast lead joints. The spigot shall be centred in the socket of the pipe by tightly caulking in sufficient



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turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yarn has been caulked tightly a jointing shall be placed round the barrel and tightened against the face of the socket to prevent airlock. Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face.

Joints in cast iron pipes with special jointing arrangements like 'Tyton' Joints etc. shall follow the instructions of the manufactures.

In special cases if flanged joints are accepted by the Engineer the joints shall be made leak proof by inserting approved type of rubber gaskets. The bolts shall be secured in stages to avoid uneven strain.

b) Concrete Pipes

Jointing of concrete pipes shall be generally of rigid type. Unless otherwise stated collar type joint shall be provided. IS: 783 shall be followed for general guidance.

The two adjoining pipes shall be butted against each other and adjoined in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The angular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement : 2 sand) which shall be rammed with caulking tool. After a day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured for 7 days.

c) Glazed Stoneware Pipes

Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to fill more than 1/4 of the total depth of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar 1:1 (1 cement : 1 sand). A fillet shall be formed round the joint with a trowel, forming an angle of 45 deg. with the barrel of the pipe. The newly made joints shall be protected, until set and shall be cured by covering with damp cloth or other suitable materials.

d) Vitrified clay pipes

The vitrified clay pipe shall be made from refractory clay mixed with crushed pottery and stone and burnt at a high temperature. These shall be hard, compact, and glazed to make them acid resistant and impervious, and



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shall be obtained from approved manufacturer.

Special care shall be taken in handling these pipes. The pipes shall not be jointed until the earth has been partly refilled over the portion of the pipe between the joint holes. Before laying the second pipe, the socket of the first pipe laid shall be thinly painted all round on the inside with cement slurry (1 part of cement and 2 parts of clean, sharp sand). A ring of rope yarn (closely twisted hemp or jute) dipped in neat cement paste or tar or bitumen, shall be inserted in the socket of pipe and driven home with caulking tools. The rope shall fully encircle the spigot with a slight overlap and shall not occupy more than one-fourth of the total depth of the socket. Where the spigot end of the pipe is made for receiving the gasket, it shall be wrapped with two or three turns of tarred spun, as close to the end as possible, before inserting into the socket. The joint shall then be completely filled with cement mortar (1:1), which shall have very little water. A fillet shall be formed round the joint with trowel, forming an angle of 45 degrees with the outside pipe. Special care shall be taken so that any excess mortar etc. left inside the pipe joints is neatly cleaned off immediately after each joint is made. A semi-circular wooden scrapper or a rubber disc to which a long handle is fixed could be used for this purpose.

e) Lead Pipes

The joints in lead pipes shall be made as wiped solder joint. The minimum and the maximum length of the wiped solder joints shall be 8 cm. and 9 cm. respectively. The solders shall generally consist of two parts of lead and one part of tin.

f) Polyethylene Pipes

The joints shall be thermo welded or bolted as per manufacturer's instructions.

g) Jointing Cast Iron Pipes with Stoneware Pipes

Where any cast iron drain pipe, ventilating pipe or trap is connected with a stoneware or semi-vitrified waste pipe, the beaded spigot end of such cast iron drain pipe, waste or ventilating pipe or trap shall be inserted into a socket of such stoneware pipe and the joint made with mortar consisting of one part of cement and one part of clean sand after placing a ratted gasket or hemp yarn soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool.

h) Jointing Stoneware with Cast Iron Pipes

Where any water closet pan or earthenware trap connected to such a pan is to



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be jointed with a cast iron soil pipe, the joint between the stoneware spigot and the cast iron socket shall always be of a flexible nature. Such joint shall be made with a mixture of bitumen and chopped asbestos fibre.

3.04.11 Trenches and other excavations

Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.

Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavation shall be properly timbered, where necessary.

Efficient arrangements for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the Contractors from the appropriate authorities.

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.

The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during hand packing with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimize inconvenience of traffic where applicable.

3.04.12 Protection

Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, sockets, or spigot are not damaged and no foreign material can find its way into the pipeline. Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over.



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3.05.00

WATER STORAGE TANKS

Overhead/loft type water storage tank shall be made of PVC. These tanks shall be provided for each toilet block and placed on the roof/loft of the building. Tank shall be installed with proper supports and anchorage for applicable wind and seismic condition. Installation of tank shall be carried out according to the recommendation of IS: 12701. These tanks shall rest preferable on flat surface so as to distribute the load evenly. The tank shall be leakproof and water tight.

The outlet pipe shall be 50 mm above the bottom of the tank and provided preferably with strainers. The wash out or draining pipe shall be connected at the lowest point and flush with bottom of tank.

Tank shall be provided with all fittings for inlet, outlet, overflow pipes and ball valves.

3.06.00

SEPTIC TANK AND EFFLUENT DISPOSAL

3.06.01

Septic tank

Septic tank shall consist of the tank itself with inlet and outlets there from complete with all necessary earthwork and backfilling. The details of septic tank shall be as shown on drawings. This item shall also include ventilating pipe of at least 100 mm dia whose top shall be provided with a suitable mosquito proof wiremesh and cowl. Ventilating pipe shall extend to a height of about 2 meter when the septic tank is at least 15 meter away from the nearest building and to a height of 2 meter above the top of building when it is located closer than 15 meter. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

3.06.02

Effluent Disposal

The effluent from the septic tank shall be disposed by allowing it into an open channel or a body of water if the concerned authority approves or into a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed SW pipes laid in a trench filled with broken bricks.

3.06.03

Soak pit

The soak pit shall be complete. It shall consist of a 900 mm dia pit 1000 mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone; brick or concrete blocks set in cement mortar (1:6) and filled with brickbats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure.

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3.06.04	Open joined SW Pipe/dispersion trenches Minimum dia of the SW pipes shall be 150 mm nominal. The trench for laying the pipes shall be a minimum 600 x 600 mm. The joints of the pipes shall be left unsealed. The entire length of the pipe within the trench shall be buried in a 250 mm layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 mm bed of well-graded coarse aggregate. Ordinary soil is used for filling the top of trench.	
3.06.05	Commissioning septic tank After the septic tank has been proved watertight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge a small quantity of decaying organic matter such as digested cow-dung may be introduced.	
3.07.00	Related Works All works, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated directly with installation of water supply and sanitation systems shall come under scope of the Contractor unless specifically excluded. These works are not detailed out in this Section.	
3.08.00	Regulation The work which is required to be carried out under this section, shall be executed by a licensed Plumber only (engaged by the Contractor) and he shall obtain all necessary sanctions, permissions, certificates etc., from Municipal and/or other Local Authorities and shall abide by all the rules of such Authorities.	
4.00.00	TESTING AND ACCEPTANCE CRITERIA	
4.01.00	Inspection Before installation All pipes, fittings, and appliance shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.	
4.02.00	Testing of Water Supply pipe line	
4.02.01	Testing of Mains After Laying	



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After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop-cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/sq.cm or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a watertight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

4.02.02 Testing of Service Pipes and Fittings

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely watertight. All piping, fittings, and appliances shall be checked for satisfactory support and protection from damage, corrosion, and frost.

4.03.00 Testing of Drain and Sewerage Pipelines

All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground, shall be gas tight. All sewers and drainpipes laid below ground shall be tested water tight. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below:



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a) Smoke test

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tarpaper or similar material in the combustion chamber of a smoke machine. Chemical smokes shall not be used.

b) Water test

The pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimetre of diameter per kilometre may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system, with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of test water may be due to one or more of the following cases:

- a) Absorption by pipes and joints
- b) Sweating of pipes or joints
- c) Leakage at joints or from defective pipes
- d) Trapped air.

Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good.

c) For straightness

- i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball will roll down the invert of the pipe and emerge at the lower end; and
- ii) By means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipeline is not straight.

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4.04.00	Fittings and Fixtures etc. All fittings and fixtures shall be connected by water tight joints. No dripping of water shall be acceptable.	
4.05.00	Testing Septic Tank The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to soak for 24 hours. Then, it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15 mm in 24 hrs.	
5.00.00	I.S. CODES Important relevant IS Codes for this specification are listed below: Latest editions shall always be consulted.	
	IS: 404 : Lead pipes.	
	IS: 407 : Brass tubes for general purposes.	
	IS: 458 : Concrete pipes (with or without reinforcement)	
	IS: 783 : Code of Practice for laying of concrete pipes.	
	IS: 1172 : Code of basic requirements for water supply, drainage and sanitation.	
	IS: 1200 (Pt.XVI) : Laying of water and sewer lines, including appurtenant items.	
	IS: 1230 : Cast iron rain water pipes and fittings.	
	IS: 1239 (Pt.I & III) : Specification for Mild Steel Tubes and Mild Steel Tubulars and other wrought steel pipe fittings (10 mm to 15 mm nominal diameter).	
	IS: 1536 : Specification for centrifugally cast (Spun) iron pressure pipes for water gas and sewage.	
	IS: 1537 : Specification for vertically cast iron pressure pipes for water, gas and sewage.	
	IS: 1592 : Asbestos cement pressure pipes,	

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	IS: 1626 : Asbestos cement pressure pipes, gutters and fittings (Spigot and Socket types). IS: 2065 : Code of Practice for Water Supply in buildings. IS: 2501 : Copper tubes for general engineering purposes. IS: 2556 : Specification for vitreous sanitary appliances (vitreous china) Part – I - General requirement IS: 2633 : Method of testing, uniformity of coating on zinc coated articles. IS: 3076 : Low density polyethylene pipes for portable water supplies. IS: 3486 : Specification for Cast iron spigot and socket drain pipes (80 mm to 250 mm nominal diameter). IS: 3589 : Specification for Electrically welded steel pipe for water, gas and sewage (200 mm to 2000 mm nominal diameter). IS: 4827 : Specification for electro plated coatings of nickel and chromium on copper and copper alloy. IS: 4964 : High-density polyethylene pipes for portable water supplies. IS: 12701 : Rotational moulded polyethylene water storage tanks	
6.00.00	RATE AND MEASUREMENT	
6.01.00	RATE	
6.01.01	G.I. Pipes For Water Supply	
	Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. with cutting, making chases and jointing of pipes, making good the walls.	
6.01.02	Rainwater Down-comers	
	Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. The rate also include cost of jointing and making good the opening in structure.	



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6.01.03

Sanitary Fixtures

Rate shall include providing and fixing of sanitary appliances & fixtures and at all elevation, including all accessories and fittings, connections pipes, waste trap and pipes all complete as per description of “Schedule of Items”. Rate shall also include the jointing of waste & traps to drain pipes.

6.01.04

Drainage and Sewer Pipes

Rate shall be inclusive of providing, laying and jointing of pipes as specified. Rate also include cost of lead joints or other joint as specified, cost for painting and cutting and making good walls, floors etc.

6.01.05

Floor and Gully Traps

Rate of traps is inclusive of all excavation, filling, repair, making good of opening in floor and walls, grating, painting etc. complete as described in “Schedule of Items”.

6.01.06

Manholes, Septic Tank, Soak Pit and Cover

Rate of manholes, septic tank, soak pit shall be paid under respective items of work executed like brick work, plastering, concrete, reinforcement steel etc. provided for completion of the structure as per drawing and specifications. Manhole cover shall be paid separately as per description of item.

6.01.07

Water Storage Tank

The rate for water storage tank is inclusive of supply and installation of tank with all fittings, inlets, outlets, valves etc. complete.

6.02.00

MEASUREMENTS

6.02.01

Pipe for Water Supply and Drainage

For G.I.Pipe of water supply line, rainwater down comers, drainage and sewer pipe, the measurements shall be in running metres and shall be taken along centre line of pipe or specials.

The pipe shall be measured separately according to dia. and class of pipe.

Fixtures like bibcock, stopcocks, valves etc. shall be measured in numbers.



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6.02.02

Sanitary Appliances & Fixtures and Allied Works

All sanitary appliances & fixtures like sink, washbasin, WC, shall be measured in numbers for the complete work as described in schedule of items.

Floor and gully traps shall be measured in numbers unless otherwise specified.

Water storage tank shall be measured in numbers for the capacity as specified in “Schedule of Items”.

The item of work executed for completion of manholes, septic tank & soak pit shall be measured in respective items of work like brick work, RCC, plastering etc. CI cover shall be measured in numbers as specified in “Schedule of Items”.



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ROAD AND DRAINAGE



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



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**Standard Technical Specification
For Road and Drainage**

1.00.00 Scope

The scope include all works required for the construction of road including construction of embankment, sub-base course, base course, tack coat, bituminous macadam, wearing course, liquid seal coat, shoulder and all incidental items of work specified or not shown but reasonably implied or necessary for the completion of the work etc.

The scope also include all works required for the construction of drainage including construction of road side drains, RCC culverts, pipe culverts, drainage pipes, manholes and all other incidental items necessary for the completion of the work etc.

1.01.00 Works To Be Provided By The Contractor

The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following.

- a) Construction of roads including providing all materials, labour, supervision, services, equipments, tools and plants, transportation etc all required for the completion of the work.
- b) Submission of detailed scheme of all operations required for executing the work (e.g. material handling, placement, services, approaches etc) to the engineer for approval.
- c) Carrying out tests whenever required by the engineer to assess the quality of work and submission of the test results to the engineer after completion of the same etc.

1.02.00 Work To Be Provided By Others

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

1.03.00 Conformity With Designs

The contractor shall carryout the work as per the construction drawings, specification and as directed by the engineer.



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1.04.00 Materials To Be Used

All materials required for the work shall be the best commercial variety and as approved by the engineer.

2.00.00 Codes and Standards

All works under this specification shall conform to the latest revision and/or replacement of the following or any other IRC/IS Codes and Standard Practices unless specified otherwise.

- a) Specification for road and bridge works of Ministry of Shipping & Transport (Road Wing) Published by the IRC
- b) IRC: 19 - Standard specification and code of practice for Water bound Macadam
- c) IRC :SP 11 - Hand Book of Quality Control for Construction of Roads and Runways
- d) IS:456 - Indian Standard Code of Practice for Plain and Reinforced Concrete.
- e) IS:2212 - Code of Practice for Brick work
- f) IS: 783 - Code of Practice for Laying of Concrete Pipes
- g) IS: 1201 - Methods of testing tar and bituminous materials to 1220
- h) IS: 73 - Specification for paving bitumen
- i) IS: 215 - Specification for Road tar
- j) IS: 216 - Coal tar pitch
- k) IS: 217 - Specification for cut-back bitumen
- l) IS: 454 - Specification for cut-back bitumen from waxy crude
- m) IS: 1834 - Specification for hot applied sealing compound for joint in concrete
- n) IS: 1838 - Specification for performed fillers for expansion joints in concrete, non extruding and resilient type
Part I Bitumen impregnated fibre



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Part II CNSL Aldehyde resin and coconut pith

- o) IS : 334 - Glossary of terms relating to bitumen and tar
- p) IS: 1077 - Common burnt clay building bricks
- q) IS : 3117 - Specification for bitumen emulsion roads (anionic type)
- r) IS : 1200 - Method of measurement of building and civil engineering work (Part-17)- Road work including airfield pavements
- s) Other specifications mentioned elsewhere in this specification.

In case any particular aspect of work is not covered specifically by the specification/Indian Standard Code of practices, any other standard practice as may be specified by the engineer shall be followed.

2.01.00 Quality Control

The Contractor shall establish and maintain quality control for all materials, procedures, workmanship and equipments used. All works shall conform to the lines, grades, cross sections and dimensions shown on the drawings, specification and as directed by the engineer. Permitted tolerances for road works are described hereinafter.

a) Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of $\pm 25\text{mm}$ therefrom. The corresponding tolerance for edges of the roadway and lower layers of the pavement shall be $\pm 40\text{mm}$.

b) Longitudinal Profile

The finished levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the engineer and shall not exceed the tolerances as mentioned below.

Sub-grade $\pm 25\text{ mm}$
Sub-base $\pm 20\text{ mm}$
Base course $\pm 15\text{ mm}$
Wearing course $\pm 10\text{ mm}$

Tolerance in wearing course shall not be permitted in conjunction with the



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positive tolerance on base course if the thickness of the wearing course is thereby reduced by more than 6 mm.

c) Surface Regularity of Sub-grade and Pavement Courses

The surface regularity of the completed sub-base, base course and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table - I. The longitudinal profile shall be checked with a 3m long straight edge at the middle of each traffic lane along a line parallel to the centre of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10m.

TABLE -I

PERMITTED TOLERANCE OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sl. No.	Type of Construction	Longitudinal profile with 3m straight edge				Cross Profile	
		Maximum permissible Undulation (mm)	Maximum number of undulations permitted in any 300m length with undulation exceeding (mm)				Maximum permissible variation from specified profile under camber template (mm)
			18	12	10	6	
1	2	3	4	5	6	7	8
1.	Earthen sub-grade	25	30	-	-	-	15
2.	Granular sub-base	15	-	30	-	-	12
3.	Water Bound Macadam with oversize metal (40-90 mm size)	15	-	30	-	-	12
4.	Water Bound Macadam with normal size metal (20-50 mm and 40-63 mm size), Bituminous Penetration Macadam	12	-	-	30	-	8
5.	Surface dressing** (two coat) over WBM (20-50 mm or 40-63 mm size metal), Bituminous penetration macadam	12	-	-	20	-	8
6.	Open graded premix carpet, mix seal Surfacing	10	-	-	-	30	6
7.	Bituminous macadam	10	-	-	-	20***	6



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8.	Semi-dense carpet	10	-	-	-	20***	6
9.	Asphaltic Concrete	8	-	-	-	10***	4

Notes:

1. ** For surface dressing in all other cases, the standards of surface evenness will be the same as those for the surface receiving the surface dressing.

2. *** These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance upto 50 percent above these values in this column may be permitted at the discretion of the Engineer. However this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 on the table.

3. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

3.00.00 Execution

3.01.00 Setting Out

Within 15 days of the award of contract, the contractor shall prepare and submit to the Engineer detailed drawings/schemes of embankment filling and excavation works as proposed to be executed by him showing the dimensions as per construction drawings and specification adding his proposals of drainage and dewatering of pits, watering and compacting the embankment fill etc. On receiving the approval from the Engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking. These permanent points and markers will be checked by the Engineer and certified by him after which the contractor shall proceed with the work. It should be noted that this checking by the Engineer prior to the start of the work will in no way absolve the contractor of his responsibility of carrying out the work to true lines and levels as per the approved drawings. If any errors are noticed in the Contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. Profiles of the embankment made with Bamboo, earth or other convenient materials and strings shall be set up at suitable intervals for the guidance of the workmen.

3.02.00 Clearing and Grubbing

Before commencement of earthwork, the surface area of ground to be occupied shall be cleared of all fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below ground level or 300mm below formation level whichever is deeper. After the removal of roots of



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trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the Engineer. The trees shall be cut into suitable pieces as instructed by the Engineer. Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to the approved disposal areas as may be specified. Useful materials, saleable timbers, firewood etc shall be the property of the Owner and shall be stacked properly at the work site in a manner as directed by the Engineer.

3.03.00 Filling in Embankment

3.03.01 General

The material used for constructing the embankment shall be earth, moorum, gravel or a mixture of the above or any other material approved by the Engineer. The material shall be free from lumps and clods, boulders and rock pieces, roots and vegetation, harmful salts and chemicals, organic materials, loose silts, fine sands and expansive clays in order to provide a stable embankment. The filling and compaction operation should be such that the best available materials are saved for the top portion and will result in an acceptable and uniform gradation of material and provide impermeability and stability to the embankment when compacted. The size of the coarse material in the mixture of earth shall ordinarily not exceed 75mm. However the Engineer may at his discretion permit the use of material coarser than the specified if he is satisfied that the same will not present any difficulty as regard to the placement and compaction of the fill material are concerned. Ordinarily, only the materials satisfying the density requirements as given below in Table-II shall be employed for embankment construction.



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Table - II

Density Requirements of Embankment Materials

Sl. No.	Type of Work	Maximum laboratory dry density when tested as per IS: 2720 (Part - VII)
1.	Embankment upto 3m height	Not less than 1.44 gm/cc
2.	Embankment exceeding 3m height and embankment of any height subject to long period of inundation	Not less than 1.52 gm/cc
3.	Top 0.5m of the embankment below sub-base and shoulders (where earth shoulders are specified)	Not less than 1.65 gm/cc

Expansive clays exhibiting marked swell and shrinkage properties shall not be used for embankment construction.

The material for embankment construction shall be obtained from approved sources with preference given to the materials available from nearby road excavation or any other excavation under the same contract.

3.03.02 Setting Out

After the site clearance, the work shall be set out true to lines, curves, slopes, grades and sections as shown on the approved drawings or as directed by the Engineer. The contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboo, stones, lime, mortar, concrete etc required in connection with the setting out of the works and establishment of the bench marks. The limits of the embankment shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. To ensure the safety, the pegs should normally be fixed about 500mm away from the actual limits of the fill and to be painted in a distinct colour. The centreline of the embankment shall be pegged at regular intervals of 25/30m and at all skews/curves. The actual profile of the embankment shall be made at every third centre line peg with bamboo posts and strings. Preferably prototype profiles developed with wooden planks need to be fixed at every 200m and at the intersection points at curves. The profile shall be about 3m long.



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3.03.03 Stripping and Storing top soil

The construction of the earthen embankment by filling shall conform to the dimensions, slopes and other details shown in the approved drawings. Before commencement of the embankment construction, the surface area of ground to be occupied after clearing and grubbing shall be stripped off to a minimum depth of 150mm or more as directed by the Engineer in order to remove all perishable materials and any soil which may become unstable on saturation or may interfere with the development or proper bonding between the foundation and embankment. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. In localities where most of the available embankment fill materials are not conducive to plant growth or when so directed by the Engineer, the top soil suitable for plant growth existing over the embankment foundation areas shall be stripped to specified depths not exceeding 150mm and stored for covering the embankment slopes where revegetation is desired.

3.03.04 Compacting Original Ground

In all cases, the original ground after stripping shall be compacted by rolling with a minimum six passes of 8-10 tonne roller and as directed by the Engineer.

Where the height of the proposed embankment is less than 0.5m and the original ground does not already have a relative compaction of atleast 95 percent of Standard Proctor density (maximum dry density), the same shall be loosened upto a depth of 0.5m and filled in layers not exceeding 250mm in loose thickness and each layer shall be watered and compacted to 100% maximum dry density of the fill material determined in accordance with IS:2720, Part-VII. However before relaying and compacting the loosened material, the surface below this level shall be suitably compacted as directed by the Engineer with a minimum six passes of 8 - 10 tonne roller.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced with approved materials suitably compacted. Embankment work shall not proceed until the foundation soil of the embankment is inspected by the Engineer and approved.

3.03.05 Filling

The embankment material shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder. Moisture content of the fill material shall be checked at the source of supply and if found less than that specified for compaction, the same shall



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be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case water shall be sprinkled directly from a hose line or from a truck mounted water tank and flooding shall not be permitted under any circumstances. After adding required amount of water, the soil shall be processed by means of harrows, rotary mixers or by any other approved method until the layer is uniformly wet.

If the material delivered to the road bed is too wet, it shall be dried by aeration and exposure to the sun till the moisture content is acceptable for compaction. Should circumstances arise where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended.

Moisture content of each layer shall be checked in accordance with IS:2720, Part-II and unless otherwise specified shall be so maintained making due allowance for evaporation losses that during compaction, the moisture content shall be in the range of 1 percent above to 2 percent below the optimum moisture content as determined in accordance with IS:2720, Part-VII.

Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5m portion of the embankment below sub-base.

Hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer to minimise rutting or uneven compaction.

Where the embankment is to be constructed across a low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed layer to a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

3.03.06

Compaction

Compaction equipment approved by the Engineer shall only be employed for construction. If directed by the Engineer, the Contractor shall demonstrate the efficiency of the plant he intends to use by carrying out compaction trials. Each layer shall be thoroughly compacted to the density as specified in Table-III. Subsequent layers shall be placed only after the finished layer has been tested and accepted by the Engineer.



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Table - III

Compaction Requirements For Embankment

Sl. No.	Type of work/material	Field dry density as a percentage of maximum laboratory dry density as per IS : 2720, Part-VII
1.	Top 0.5m portion of embankment below sub-base and shoulders	Not less than 100
2.	Other portions of embankment	Not less than 95

When density measurements reveal any soft area in the embankment, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft area shall be removed and replaced with approved material and compacted to the density requirements and satisfaction of the Engineer.

3.03.07 Drainage

The surface of the embankment at all times during construction shall be maintained at such a cross fall as will shed water and prevent ponding.

3.03.08 Finishing Operations

Finishing operations shall include the work of shaping and dressing the shoulders, road bed and side slopes to conform the alignment, levels, cross sections and dimensions as shown on the drawings or as directed by the Engineer. Both the upper and lower ends of the side slopes shall be rounded off to improve the appearance and merge the embankment with the adjacent terrain.

3.04.00 Turfing With Sods

3.04.01 General

This work shall consist of furnishing and laying live sod of perennial turf forming grass on embankment slopes, shoulders or other locations as shown on the drawings or as directed by the Engineer. Unless otherwise specified the work shall be taken up following the construction of embankment provided the season is favourable for establishment of the sod.

3.04.02 Materials

The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically



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free from weeds and other undesirable matters. At the time the sod is cut, the grass shall have a length of approximately 50mm and the sod shall be free from any debris.

Thickness of the sod shall be as uniform as possible with about 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that practically all the dense root system of the grass are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than 250mm x 300mm in size but not so large so that it is convenient to handle and transport without damage. During wet weather the sod shall be allowed to dry sufficiently to prevent rearing during handling and during dry weather it shall be watered before lifting to ensure its vitality and to prevent dropping of soil during handling.

3.04.03

Placing The Sods

The area to be sodded shall be previously constructed to the required slope and cross section. Soil in the area shall be loosened, freed from all stones larger than 50mm size, sticks, stumps and any other undesirable foreign matters etc and brought to a reasonably granular texture to a depth not less than 25mm for receiving the sod.

Where required, top soil shall be spread over the slopes. Prior to placing the top soil, the slopes shall be roughened and wetted in order to have a satisfactory bond. The depth of top soil (to be spread) shall be 75mm.

Following soil preparation and top soiling (if required), fertilizer and ground limestone when specified shall be spread uniformly. After spreading, the materials shall be incorporated in the soil by discing or other means. The prepared sod bed shall be moistened if not already sufficiently moist and the sod shall be placed thereon within 24 hours after the same has been cut. Each sod strip shall be laid in close contact with each other and shall be lightly tamped with suitable wooden or metal tampers so as to eliminate air pockets and to press it into the underlying soil. At points where water may flow over the sod, the upper edges of the sod strips shall be turned into the soil below the adjacent area and a layer of earth shall be placed over it followed by thorough compaction.

3.04.04

Staking the Sods

Where the side slope is 2 to 1 or steeper and the distance along the slope is more than 2m, the sods shall be staked with pegs or nails spaced approximately 500 to 1000mm along the longitudinal axis of the sod strips. Stakes shall be driven approximately plumb through the sods and to be almost flushed with them.



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3.04.05 Top Dressing

After the sods have been laid in position, the surface shall be cleaned of any loose sod, excess soil and other foreign materials. Thereafter a thin layer of top soil shall be scattered over the top dressed surface and the area shall be thoroughly moistened by sprinkling water.

3.04.06 Watering and Maintenance

The turfing so laid shall be well watered and protected until final acceptance. Watering shall be done in such a way that no erosion or damage to the sodded areas/embankment occur. The Contractor shall erect necessary warning signs and barriers, repair or replace the sods which are failing to show uniform growth of grass or damaged by his operation and shall maintain the sod at his own cost until final acceptance.

3.05.00 Shoulder Construction

3.05.01 Description

This work shall consist of constructing shoulder on either side of the pavement in accordance with the requirements of this specification and in conformity with the lines, grades and cross sections shown on the approved drawings and as directed by the Engineer.

3.05.02 Materials

Shoulder shall be made of selected earth or granular material as specified conforming to relevant IRC standards.

3.05.03 Construction Operations

Except in the case of bituminous pavements, the shoulders shall be constructed in advance to the laying of pavement courses. The compacted thickness of each layer of shoulder shall correspond to the compacted layer of pavement course to be laid adjacent to it. After compaction, the inside edges of shoulders shall be trimmed vertical and the area enclosed between the shoulders shall be cleaned of all spilled materials before proceeding with the construction of the pavement layer.

In the case of bituminous pavements, shoulder shall be constructed only after the pavement courses have been laid and compacted.

Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed without any damage to the



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pavement and the area so affected shall be thoroughly cleaned. During all stages of shoulder construction, the required crossfall shall be maintained to drain off surface water.

3.06.00 Kerb

3.06.01 Material

Kerb if required for the construction of footpath shall consist of precast concrete blocks with concrete grade of M-20. The blocks shall be of 100mm thick and of suitable length. The depth of blocks unless otherwise mentioned elsewhere shall be 375mm considering 225mm height of footpath above the road level.

3.06.02 Laying

The kerb shall be laid by cutting trenches of 150mm deep. The width of the trench shall be minimum and just sufficient to insert the kerbs. The inside faces of the kerbs shall be in plumb and the gap between the block shall not be more than 10mm. The gap shall be filled with cement mortar as specified.

The kerbs shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workmanlike manner acceptable to the Engineer.

3.07.00 Sub-base (Granular Sub-base)

3.07.01 Description

This work shall consist of laying and compacting well graded material on the prepared sub-grade in accordance with the specification. The material shall be laid in one or more layers as shown on the drawings and shall conform to the lines, grades and cross sections shown on the drawings and as directed by the Engineer.

3.07.02 Materials

The materials to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, kankar etc or combinations thereof depending upon the grading required. The mixed materials shall be free from organic and other deleterious constituents and conform to one of the three grading given in Table - IV below.



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**Table - IV
Grading for Granular Sub-base Material**

Sieve designation	Percent by weight passing the sieve		
	Grading 1	G r a d i n g 2	G r a d i n g 3
80 mm	100	100	100
63 mm	90 - 100	90 - 100	90 - 100
4.75 mm	35 - 70	40 - 90	50 - 100
75 micron	0 - 20	0 - 25	0 - 30
Minimum CBR value for the fraction of material passing 20 mm sieve.	30 %	25%	20%

Note : The materials passing 425micron sieve for all the three gradings when tested according to IS : 2720, Part V shall have liquid limit and plasticity index not more than 25 percent and 6 percent respectively.

3.07.03 Physical Requirements

The fraction of materials passing 20mm sieve shall give a CBR value as specified in Table – IV when tested in accordance with IS : 2720, Part XVI after preparing the samples at maximum dry density and optimum moisture content corresponding to IS : 2720, Part VII and soaking the same in water for 4 days.

3.07.04 Spreading and Compacting

Immediately prior to laying of sub-base, the sub-grade already finished shall be prepared by removing all vegetations and other extraneous matters, lightly sprinkled with water if necessary and rolled with one pass of 8 - 10 tonne smooth wheeled roller.

The sub-base material shall be spread on the sub-grade with the help of a drag spreader, motor grader or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of each layer after compaction shall not exceed 150mm.



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Moisture content of the loose material shall be checked in accordance with IS : 2720, Part II and shall be suitably adjusted by sprinkling additional water from a hose line, truck mounted water tank or other approved means so that at the time of compaction it shall be from 1 percent above to 2 percent below the optimum moisture content. While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer until the layer is uniformly wet.

Immediately thereafter, rolling shall be done with 8 to 10 tonne smooth wheeled rollers or with any other approved plant. Rolling shall commence from the edges and progress towards the centre longitudinally except on super elevated portions where it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and camber shall be checked and any high spots or depressions which become apparent shall be corrected by removing or adding fresh material.

Rolling shall be continued till the density achieved is at least 100% of the maximum dry density of the material determined as per IS : 2720, Part VII. The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose materials. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and recompact.

3.08.00 Water Bound Macadam Sub-base/Base Course

3.08.01 Description

Water bound macadam shall consist of clean crushed aggregates mechanically interlocked by rolling and bonded together with screenings, binding material wherever necessary and water, laid on the prepared sub-grade or sub-base as the case may be and finished in accordance with the specification and in conformity with the lines, grades and cross-sections shown on the approved drawings.

3.08.02 Materials

a) Coarse Aggregates - General Requirements

Coarse aggregates shall be either crushed or broken stone. The aggregates shall conform to the physical requirements set forth in Table - V.



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Table – V

Physical Requirements of Coarse Aggregates for Water Bound Macadam

Sl.No.	Type of Construction	Test	Test method	Requirements
1.	Sub-base	Los Angeles Abrasion Value * or Aggregate Impact Value	IS : 2386 (Part IV) IS : 2386 (Part IV) or IS : 5640**	50 percent maximum 40 percent maximum
2.	Base	a) Loss Angeles Abrasion value* or Aggregate Impact Value b) Flakiness Index ***	IS : 2386 (Part IV) IS : 2386 (Part IV) or IS : 5640 ** IS : 2386 (Part I)	50 percent maximum 40 percent maximum 15 percent maximum

* Aggregates shall satisfy requirements of either of the two tests.

** Aggregates like brick metal, kankar and laterite which get softened in presence of water shall be tested for impact value under conditions in accordance with IS : 5640.

*** The requirements of Flakiness Index shall be enforced only in case of crushed or broken stone and crushed slag.

b) Crushed or Broken Stone

Crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other objectionable matters.

c) Grading Requirements of Coarse Aggregates

The coarse aggregates shall conform to one of the gradings given in Table – VI. However the use of Grading-1 shall be restricted to sub-base courses only.



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**Table - VI
Grading Requirements of Coarse Aggregates**

Grading	Size range	Sieve designation	Percent by weight passing the sieve
1.	90mm to 40 mm	100 mm 80 mm 63 mm 40 mm 20 mm	100 65 - 85 25 - 60 0 - 15 0 - 5
2.	63 mm to 40 mm	80 mm 63 mm 50 mm 40 mm 20 mm	100 90 - 100 35 - 70 0 - 15 0 - 5
3.	50 mm to 20 mm	63 mm 50 mm 40 mm 20 mm 10 mm	100 95 - 100 35 - 70 0 - 10 0 - 5

d) Screenings

Screenings to fill the voids in the coarse aggregate shall generally consist of the same material as the coarse aggregates. However where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material is below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 percent.

As far as possible, screenings shall conform to the grading set forth in Table-VII. Screenings of Type-A in Table-VII shall be used with coarse aggregates of Grading-1 in Table-VI. Screenings of Type-A or B shall be used with coarse aggregates of Grading-2. Screenings of Type-B shall be used with coarse aggregates of Grading-3.



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**Table - VII
Grading For Screenings**

Grading classification	Size of screenings	Sieve designation	Percent by weight passing the sieve
A	12.5 mm	12.5 mm	100
		10.0 mm	90 - 100
		4.75 mm	10 - 30
		150 micron	0 - 8
B	10 mm	10 mm	100
		4.75 mm	85 - 100
		150 micron	10 - 30

e) Binding Material

Binding material to be used for water bound macadam construction shall comprise of a suitable material approved by the Engineer having plasticity index value less than 6 as determined in accordance with IS : 2720, Part V. Application of binding material may not be necessary when the screenings used are of crushable type such as moorum or gravel.

3.08.03

Construction Operations

a) The sub-grade/sub-base to receive the water bound macadam coarse shall be prepared to the specified grade and camber and made free of any dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm. Where water bound macadam is to be laid over an existing black topped surface, 50mm x 50mm furrows shall be cut at an angle of 45 degrees to the centre line of the road at 1m intervals in the latter before laying the coarse aggregates.

b) Inverted Choke

If water bound macadam is to be laid directly over the sub-grade without any other intervening pavement course, a 25mm course of screenings (Grading-B) shall be spread on the prepared sub-grade before application of coarse aggregates is taken up.

c) Spreading Coarse Aggregates

The coarse aggregates shall be spread uniformly over the prepared surface in such quantities that the thickness of each compacted layer is limited to 100mm for Grading-1 and 75 - 100mm for Grading-2 and 3. The spreading shall be



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done from stockpiles along the side of the roadway or directly from the vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregates nor shall hauling over permitted. The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregates as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operation.

d) Rolling

Immediately following the spreading of the coarse aggregates, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity or with tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and be indicated by the Engineer.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road. Each pass of the roller shall uniformly overlap not less than one half the width of the track made in the preceding pass.

Rolling shall continue until the aggregates are thoroughly keyed and the creeping of aggregates ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wavelike motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities found shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and rerolled until the entire surface conform to the desired camber and grade. In no case shall the use of screenings be permitted to make up the depressions.

e) Application of Screenings

After the coarse aggregate has been rolled, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreader or directly from trucks. Trucks operating for spreading the screenings shall be so driven as not to disturb the coarse aggregates.



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The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms or hand brooms or with both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregates.

The spreading, rolling and brooming of screenings shall be carried out in only such lengths of road which could be completed within one day's operation.

f) Sprinkling and Grouting

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to seep the wet screenings into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional screenings applied as necessary until the coarse aggregates are thoroughly keyed, well bonded and firmly set to its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or sub-grade does not get damaged due to the addition of excess quantity of water during construction.

g) Application of Binding Material

After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water and the resulting slurry shall be swept in with hand brooms or mechanical brooms to fill the voids properly and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling the voids form a wave ahead of the wheels of the moving roller.

h) Setting and Drying

After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam is set. The Engineer shall have the discretion to stop hauling traffic from using the complete water bound macadam course if in his opinion it would cause excessive damage to the surface.

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3.09.00 Tack Coat									
3.09.01 Description									
The work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction.									
3.09.02 Materials									
The binder used for tack coat shall be bitumen of a suitable grade as approved by the Engineer and conforming to IS-73, IS-217 or IS-454 as applicable or any other approved cutback.									
3.09.03 Construction Operations									
a) Preparation of Base									
The surface on which the tack coat is to be applied shall be thoroughly swept and scraped clean of dust and any other extraneous materials before the application of the binder.									
b) Application of Binder									
Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer and sprayed on the base at the rate specified below. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be supplied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.									
3.10.00 Bituminous Macadam Binder Course									
3.10.01 Description									
This work shall consist of construction in a single course of 50mm/75mm thickness of compacted crushed aggregates premixed with a bituminous binder laid immediately after mixing on a base prepared previously in accordance with the specification and in conformity with the lines, grades and cross sections shown on the approved drawings.									
3.10.02 Materials									
a) Binder									
The Binder shall be straight run bitumen of a suitable grade as directed by the									



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Engineer complying with IS : 73.

b) Aggregates

The aggregates shall consist of crushed stone, crushed gravel (shingle) or other stones. They shall be clean, strong, durable, fairly cubical in shape and free from any disintegrated pieces, organic and other deleterious matter and adherent coats. The aggregates shall preferably be hydrophobic and of low porosity.

The aggregates shall satisfy the physical requirements set forth in Table - VIII.

Table – VIII

Physical Requirements of Aggregates For Bituminous Macadam

Sl. No.	Test	Test method	Requirements
1.	Los Angeles Abrasion Value *	IS : 2386 (Part IV)	35 percent maximum
2.	Aggregate Impact Value *	IS : 2386 (Part IV)	30 percent maximum
3.	Flakiness Index	IS : 2386 (Part I)	35 percent maximum
4.	Stripping Value	IS : 6241 (Part IV)	25 percent maximum
5.	Water Absorption	IS : 2386 (Part III)	2 percent maximum

*Aggregates may satisfy requirements of either of the two tests.

The aggregates for bituminous macadam for different thickness shall conform to Grading- A or B as given in Table-IX or X as the case may be.

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Table-IX**Aggregates Grading For 75mm Compacted Thickness of Bituminous Macadam**

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
63 mm	100	
50 mm	90 - 100	
40 mm	35 - 65	100
25 mm	20 - 40	70 - 100
20 mm	-	50 - 80
12.5 mm	5 - 20	-
4.75 mm	-	10 - 30
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

Table-X**Aggregates Grading For 50mm Compacted Thickness of Bituminous Macadam**

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
50 mm	100	
40 mm	90 - 100	
25 mm	50 - 80	100
20 mm	-	70 - 100
12.5 mm	10 - 30	-
10 mm	-	35 - 60
4.75 mm	-	15 - 35
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

c) Proportioning of Materials

The binder content for premixing shall be 3.5 and 4.0 percent by weight of the total mix for aggregate Grading-A and B respectively unless directed otherwise by the Engineer. The quantity of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

d) Variation in Proportioning of Materials

The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content



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upto ± 0.3 percent by weight of total mix shall however be permissible for individual specimens taken for quality control tests.

3.10.03

Construction Operations

a) Weather and Seasonal Limitations

Bituminous macadam shall not be laid during rainy weather or when the base course is damp or wet.

b) Preparation of Base

The base on which the bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross sections as shown on the drawings and as directed by the Engineer. The surface shall be thoroughly swept and scraped clean and free of any dust and foreign matter.

c) Tack Coat

A tack coat shall be applied over the base.

d) Preparation and Transport of Mix

Hot mix plant of adequate capacity shall be used for preparing the mix. The temperature of binder at the time of mixing shall be in the range 150 Deg. - 165 Deg. C and to that of aggregates shall be in the range 125 Deg. - 150 Deg. C provided the temperature difference between the binder and the aggregate at no time exceeds 25 Deg. C. Mixing shall be thorough to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly. The mixture shall be transported from the mixing plant to the point of use in a suitable vehicle. The vehicle employed for transport shall be clean and be covered over in transit if so directed by the Engineer.

e) Spreading

After mixing, the mix shall be spread immediately by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix to the specified lines, grade and cross sections. However in restricted locations and in narrow widths where the available plants cannot operate in the opinion of the Engineer may permit manual laying of the mix. The temperature of mix at the time of laying shall be in the range 110 Deg. - 135 Deg. C.

In multilayer construction, the longitudinal joint in one layer shall offset into the layer below by about 150mm. However, the joint in the topmost layer shall be at the centre line of the pavement.



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Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

f) Rolling

After spreading of mix, the rolling shall be done with 8 to 10 tonne power roller or with any other approved plant. Rolling should start as soon as the materials are spread. Rolling shall be done with care to avoid any undulation in the pavement surface.

Rolling on the longitudinal joint shall be done immediately after the paving operation. After this, the rolling shall commence at the edges and progress towards the centre longitudinally except on superelevated portions where it shall progress from the lower to the upper edge parallel to the centre line of the pavement.

The initial or breakdown rolling shall be done as soon as it is possible to roll the mixture without cracking the surface and no mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling as early as possible and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while the material is still workable enough for removal of roller marks.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding fresh materials. The rolling shall then be continued till the entire surface has been rolled to compaction and there is no crushing of aggregates and till all the roller marks are eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheels shall be kept damp if necessary to avoid the bituminous material from sticking on the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose.

Rolling operation shall be completed in every respect before the temperature of the mix fall below 80 Deg. C.

Rollers shall not stand on the newly laid material as it may lead to undue deformation. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

The bituminous macadam shall be provided with a final surfacing without any delay. If there is to be any delay the course shall be covered by seal coat before allowing any traffic over it.



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3.11.00 Open Graded Premix Carpet

3.11.01 Description

This work shall consist of laying and compacting open graded carpet of specified thickness in a single course of suitable small sized aggregates premixed with bituminous binder on a previously prepared base to form wearing course in accordance with the specification.

3.11.02 Materials

a) Binder

The binder shall be bitumen of suitable grade as approved by the Engineer and satisfying the requirements of IS: 73, 217, 454 or any other approved cutback as applicable.

b) Aggregates

The aggregates shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, gravel or river shingle and be free of elongated and flaky pieces, soft and disintegrated materials, vegetable and any other deleterious matter etc. They shall preferably be hydrophobic type. The aggregates shall satisfy the quality requirements set forth in Table-VIII except that the flakiness Index shall be limited to a maximum of 30.

c) Proportioning of Materials

The materials shall be proportioned as per the quantities given in Table-XI for 20mm thick open graded premix carpet.



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Table - XI

Quantity of Materials Required For 10 Sq. M of Road Surface For 20mm Thick Open Graded Premix Carpet

Aggregates for Carpet

i)	Stone Chippings - 12mm size ; passing 20 mm sieve and retained on 10 mm sieve	0.18 Cu.m
ii)	Stone Chippings - 10 mm size; passing 12.5 mm sieve and retained on 6.3 mm sieve	0.09 Cu.m
Total		0.27 Cu.m

Binder for premixing (quantities in terms of straight run bitumen)

i)	For 0.18 Cu.m of 12 mm size stone Chippings at 52 Kg per Cu.m	9.5 Kg
ii)	For 0.09 Cu. M of 10mm size stone Chippings at 56 Kg per Cu.m	5.1 Kg
Total		14.6 Kg

3.11.03 Construction Operation

a) Weather and Seasonal Limitations

Open graded premix carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 Deg. C or below.

b) Preparation of Base

The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with the drawing, specification and as directed by the Engineer. The surface shall be well cleaned by removing caked earth and other foreign matters with wire brushes, sweeping with brooms and finally dusting with sacks as necessary.



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c) Tack Coat

A tack coat complying with clause 3.09.00 shall be applied over the base preparatory to laying of the carpet. However application of tack coat shall not be necessary when the laying of carpet follows soon after laying the bituminous course.

d) Preparation of Premix

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer in boilers of suitable design avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. The mixing of binder with chipping shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit if so directed.

e) Spreading and Rolling

The premixed material shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material are laid, rolling shall be commenced with 6 to 8 tonne power rollers preferably with smooth wheel tandem type or with any other approved plant. Rolling shall begin at the edges and progress toward the centre longitudinally except on the superelevated portions where it shall progress from the lower to upper edge parallel to the centre line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to compaction and all the roller marks have been eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose. Rollers shall not stand on newly laid material as it may lead to undue deformations.

The edges along and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted



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with a thin surface coat of approved binder before the new mix is placed against it.

f) Seal Coat

A seal coat conforming to clause 3.12.00 shall be applied to the surface immediately after laying the carpet. No traffic shall be allowed on the road till the seal coat has been placed.

3.12.00 Seal Coat

3.12.01 Description

This work shall consist of application of a seal coat as specified for sealing the voids in the bituminous surface laid to the specified levels, grade and camber.

Type-A : Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chippings.

Type-B : Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

3.12.02 Materials

a) Binder

The binder shall be bitumen of suitable grade as directed by the Engineer and conforming to the requirements of IS : 73, 217 or 454 as applicable or any other approved cutback.

The quantity of binder to be adopted in terms of straight run bitumen shall be 9.8 Kg and 6.8 Kg per 10 square metre area for Type-A and Type-B seal coat respectively.

b) Stone Chippings for Type A Seal Coat

The stone chippings shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matters etc. Stone chippings shall be of 6mm size defined as 100 percent passing through 10mm sieve and retained on 2.36mm sieve. The quantity used for spreading shall be 0.09 cu.m per 10 sq.m area. The chippings shall satisfy the quality requirements spelled out in Table- VIII except that the upper limit for flakiness Index shall be 30.



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c) Fine Aggregate for Type B Seal Coat

The fine aggregate shall be sand or fine grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky material, organic matter or other deleterious substances. The aggregate shall pass 1.7 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cubic metre per 10 square metre area.

3.12.03

Construction Operations

a) Preparation of Base

The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat, the surface shall be cleaned free of any dust or other extraneous matters.

b) Construction of Type-A Seal Coat

The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer and sprayed on the dry surface in a uniform manner preferably with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the sprayer or through leakage or due to any other reason shall be suitably corrected before the stone chippings are spread.

Immediately after the application of binder, stone chippings in a dry and clean state shall be spread uniformly on the surface preferably by means of a mechanical grittier or otherwise manually so as to cover the surface completely. If necessary the surface shall be broomed to ensure uniform spread of chippings. Immediately after the application of the cover material, the entire surface shall be rolled with a 8 - 10 tonne smooth wheeled roller. Rolling shall commence from the edges and progress towards the centre except in superelevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up the irregularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present an uniform closed surface.

c) Construction of Type-B Seal Coat

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer. Also the aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before the same are placed in the mixer. Mixing of



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binder with aggregates to the specified proportions shall be continued till the latter is thoroughly coated with the former. The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed. As soon as sufficient length has been covered with the premixed material, the surface shall be rolled with 6 - 8 tonne smooth wheeled power rollers. Rolling shall be continued till the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

3.12.04 Opening to Traffic

In case of Type-B Seal coat, traffic may be allowed soon after the final rolling when the premixed materials are cooled down to the surrounding temperature. However in case of Type- A seal coat, the traffic shall not be permitted until the following day.

3.13.00 Repair of Existing Water Bound Macadam Surfaces

Pot holes or patches and ruts in the water bound macadam base or surface course which is to be surface treated shall be repaired by removing all loose materials by cutting in rectangular patches and replacing with suitable materials. The repair shall be done as under.

Pot holes, patches and ruts shall be drained of any water and cut to regular shape with vertical sides and then be filled either with i) coarse aggregates and screenings conforming to the specification for water bound macadam and compacted with rollers or other approved rammer etc or with ii) premixed material conforming to the specification for open graded premix carpet and compacted with rollers or other approved means after painting the sides and bottom of the holes with a thin application of bitumen or a combination of both as directed by the Engineer.

3.14.00 Road Side Drains

3.14.01 Drains

The road side drains shall be made in sizes and slopes as shown on the approved drawings. The sides and bottom shall be neatly dressed after excavation. Proper connections shall be made to the culverts outside the plant area as per the drawings and instructions of the Engineer.

The excavated spoils other than that required for backfilling shall be transported and filled in low areas within the plant area or in embankments as instructed by the Engineer. The lining for drains shall be as per the drawings. Lining of drains may be of bricks or cement concrete blocks of specified grade as shown on the approved drawing or as directed by the Engineer. If shown



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on approved drawing, drains shall be of R.C.C. construction with necessary slopes.

3.15.00 Culverts

Excavation in trenches for foundation of culverts and wing walls shall be done with side slopes as per the drawings and instructions of the Engineer after clearing the site etc. As described in the “Specification for Earthwork in Excavation and Backfilling”, backfilling in layers with watering and compaction shall be done after the construction of foundations. The construction of culverts shall be done true to the lines and levels as shown on the drawings. The specification for Masonry and/or Plain and Reinforced Cement concrete shall be followed as applicable.

3.16.00 Pipe Culverts and Drainage Pipes

3.16.01 Materials

The drainage pipes shall be made of R.C.C and shall be either class NP-2 or NP-3 as shown on the approved drawings. Pipe culverts shall be made of reinforced concrete pipe and shall be of class NP4 or RDSO class for railways as shown in the drawing. All pipes shall meet the requirements of IS : 458 and shall be procured from approved manufacturers with collars as per manufacturer’s specification. The tenderer shall specifically mention the particular manufacturer’s product he proposes to use.

Cement shall be ordinary Portland Cement as per IS:269. Coarse Aggregates shall be as per IS:383. Maximum size shall not exceed one third the thickness of the pipe or 20 mm whichever is smaller. Fine aggregates for concrete shall be as per IS:383.

3.16.02 Laying of Pipes

Laying of concrete pipes shall correspond to IS:783 and as per the specification given below.

a) The foundation bed for pipe shall be excavated true to lines and grades shown on the drawings and as directed by the Engineer. When trenching is involved, its width on either side of the pipe shall not be less than 150mm and not more than one third the diameter of pipe unless otherwise instructed/permitted by the Engineer. The sides of the trench shall be as nearly vertical as possible. Side slope, shoring, bailing out water etc as required shall be done by the Contractor.

Side slips if there be any shall be removed by the Contractor. After laying of the pipes are completed, backfilling of the trenches shall be done as per “Specification for Earthwork in Excavation and Backfilling” to the



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satisfaction of the Engineer. The surplus spoils shall be transported and filled in low areas within the plant area as instructed by the Engineer.

When bedrock or boulder stratum is encountered during excavation, the excavation shall be taken down to at least 200mm below the bottom of the pipe with prior permission of the Engineer and all rock/boulders in the area shall be removed and space filled with approved earth free from stone or fragmented materials, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe.

Filling of trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur and shall be done as per the "Specification for Earthwork in Excavation and Backfilling". When two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to a minimum of 450 mm. Laying of pipes shall start from the outlet and proceed towards inlet. All pipes and fittings shall be gradually lowered into the trench or placed on the supports by approved means taking due care to avoid any damage. Under no circumstances the pipes shall be dropped into the trench or on supports from heights.

b) Pipe bedding shall be first class projection bedding for positive projecting pipes as per IS : 783 having a projection ratio not greater than 0.70. The pipe shall be carefully laid on bedding made up of fine granular materials in an earth foundation; the bedding shall be carefully shaped to fit the lower part of the pipe exterior for at least ten percent of its overall height and in which the fill material is thoroughly compacted in layers not exceeding 150mm in depth around the pipe for the remainder of the pipe laid in trench.

When indicated on the drawings or directed by the Engineer, the pipe shall be bedded on a cradle constructed of concrete having a mix not leaner than M-15. The shape and dimension of the cradle shall be as indicated on the drawing or as directed by the Engineer. The pipe shall be laid on the concrete bedding before the concrete is set.

c) The drop walls shall be made with first class brickwork in 1:4 cement mortar.

d) The pipe culverts shall be made with proper care with respect to the invert of the pipe, gradient if any etc as specified on the drawings and as instructed by the Engineer.

e) Where R.C.C pipes are encased in concrete at road crossings or at other places the pipes need be suitably supported avoiding reinforcements of concrete blocks, joints properly done before concreting is taken up. Concreting of total height of block may be done in a single operation or may be done upto some height for pipes to be properly laid in position and the balance height of the block shall be concreted subsequently.



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f) The R.C.C. pipes shall be joined with cement mortar. Cement mortar shall consist of 1 part of cement and 2 part of clean sand with only enough water for workability. Procedure of jointing shall be as per IS : 783.

3.16.03 Relation With Water Supply Pipeline

Unless specifically cleared by the Engineer, under no circumstances shall the drainage pipes be allowed to come close to water supply pipelines.

3.17.00 Manholes and Inspection Chambers

The maximum distance between the manholes shall be 30m unless specifically permitted otherwise. In addition, at every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The distance between the manhole or inspection chamber and gully chamber shall not exceed 6 meters unless permitted otherwise. Manhole shall be constructed so as to be water tight under test. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide a smooth flow. Connection to the existing pipelines shall be through a manhole. Manholes shall be provided with standard covers usually of C.I. or as directed by the Engineer. The cover shall be closely fitted so as to prevent gases from coming out.

4.00.00 Testing and Acceptance Criteria

All testing as mentioned in the specification and as mentioned in Clause No. 900 of the “Specification for Roads and Bridge Works, 1983” published by IRC on behalf of Ministry of Shipping and Transport (Roads Wing) shall be carried out by the Contractor as per the direction of the Engineer.

5.00.00 MEASUREMENT

Method of measurement shall be as per the latest version of IS:1200, Part-17 and as directed by the Engineer.



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FABRICATION OF STRUCTURAL STEEL WORK



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



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SUB-SECTION – D XVII

FABRICATION OF STRUCTURAL STEEL WORK

1.00.00 SCOPE

This specification covers supply, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and rivets, bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following

- a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on the approved design drawings. As decided by the Engineer, some or all of these detailed drawings will have to be submitted for approval.
- b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made.
- c) To submit design calculations for joints and. connections developed by the contractor along with detailed fabrication drawings.
- d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary rivets, bolts, nuts, washers, tie rods and welding electrodes for field connections,
- e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.
- f) Suitably mark, bundle, and pack for transport all fabricated materials.
- g) Prepare and furnish detailed Bill of Materials, Drawing Office Dispatch lists, Rivet and Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork.
- h) Insure, load and transport all fabricated steelwork field connection materials to site.
- i) Maintain a fully equipped workshop at site for fabrication, modification

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and repairs of steelwork at site as may be required to complete the works in accordance with the Contract.									
2.02.00		Work by others							
No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract.									
2.03.00		Codes and standards							
All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard specification, any other standard practice, as may be specified by the Engineer shall be followed:									
IS : 226 - Structural steel (Standard Quality)									
IS : 800 - Code of Practice for general construction in steel.									
IS : 806 - Code of practice for use of steel tubes in general building construction.									
IS : 808 - Rolled steel beams, channels, and angle sections									
IS : 813 - Scheme of symbols for welding									
IS : 814 - Covered electrodes for metal arc welding of structural steel									
IS : 815 - Classification and coding of covered electrodes for metal arc welding of structural steels.									
IS : 816 - Code of practice for use of metal arc welding for general construction in mild steel									
IS : 817 - Code of practice for training and testing metal arc welders									
IS : 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations									
IS : 822 - Code of practice for inspection of welds									
IS : 919 - Recommendations for limits and fits for Engineering									
IS : 961 - Structural Steel (High Tensile)									

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	IS : 1148 - Rivet bars for structural purposes IS : 1149 - High tensile rivet bars for structural purposes IS : 1161 - Steel Tubes for structural purposes IS : 1200 - Method of measurement of steelwork and ironwork (Part 8) IS : 1239 - Mild Steel Tubes IS : 1363 - Black hexagon bolts, nuts and lock nuts (dia. 6 to 30 mm) and black hexagon screws (dia 6 to 24 mm) IS : 1364 - Precision and semi-precision hexagon bolts, screws, nuts and 1 locknuts (dia, range 6 to 39 mm) IS : 1367 - Technical supply conditions for threaded fasteners IS : 1442 - Covered electrodes for the metal are welding of high tensile structural steel IS : 1608 - Method for tensile testing of steel products other than sheet strip, wire and tube IS : 1730 - Dimensions for steel plate, sheet, and strip for structural and general engineering purposes. IS : 1731 - Dimensions for steel flats for structural and general engineering purposes IS : 1852 - Rolling and cutting tolerances for hot-rolled steel products IS : 1977 - Structural steel (ordinary quality) St-42-0 IS : 2062 - Steel for General Structural Purposes IS : 2074 - Ready mixed paint, red oxide Zinc chromate priming IS : 2595 - Code of Practice for Radiographic Testing IS : 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and Steel IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles IS : 3757 - High strength structural bolts	

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	IS : 4759 - Specifications for Hot-Dip Zinc Coatings on Structural Steel and other allied products IS : 7205 - Safety Code for Erection of Structural Steelwork IS : 7215 - Tolerances for fabrication of steel structures IS : 7280 - Bare wire electrodes for submerged arc welding of structural steels. IS : 9595 - Recommendations for metal arc welding of carbon and carbon manganese steels.	
2.04.00	Conformity with Designs The contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum Utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.	
2.05.00	Materials to be used	
2.05.01	General All steel materials required for the work will be supplied by the contractor unless otherwise specified elsewhere in the contract. The materials shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tones or less of any particular section. The arc welding electrodes shall be of approved reputed manufacture and conforming to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and amperage (Polarity in case of D.C. supply) for which the electrodes are suitable.	



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2.05.02 Steel

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

- a) IS : 2062 - Steel for general structural purposes
- b) IS : 961 - Structural steel High Tensile
- c) IS : 1977 - Structural steel (Ordinary quality) St-42-0

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

2.05.03 Rivet Steel

All rivet steel used in construction within the purview of this Specification shall comply with one of the following Indian Standard Specifications as may be applicable:

- a) IS : 1148 - Rivet Bars for structural purpose
- b) IS : 1149 - High tensile rivet bars for structural purposes. Where high tensile steel is specified for rivets, steps shall be taken to ensure that the rivets are so manufactured that they can be driven and heads formed satisfactorily without the physical properties of steel being impaired.

2.05.04 Electrodes

All electrodes to be used under the Contract shall be of approved reputed manufacture, low hydrogen electrode and shall comply with any of the following Indian Standard Specifications as may be applicable

- a) IS : 814 - Covered electrodes for metal arc welding of structural steel
- b) IS : 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel
- c) IS : 1442 - Covered electrodes for the metal arc welding of high tensile structural steel
- d) IS : 7280 - Bare wire electrodes for submerged arc welding of

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2.05.05 Bolts and Nuts

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

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

a) Mild Steel

All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 $\frac{1}{A}$, where "A" is the cross sectional area of the test specimen

i) IS: 1367: Technical supply conditions for threaded fasteners

ii) IS: 1608: Method for tensile testing of steel products other than sheet, strip, wire and tube

b) High Tensile Steel

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

2.05.06 Washers

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

a) IS : 2062 - Steel for general structural purposes

b) IS : 961 - Structural Steel (High Tensile Quality)

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

d) IS : 6649 - Hardened washers

2.05.07 Paints

Paints to be used for shop coat of fabricated steel under the purview of this

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	contract shall conform to the Indian Standard Specification IS: 2074 - Ready mixed Paint, Red oxide Zinc Chromate Priming. 2.06.00 Coal Bin 2.06.01 Shape of bins shall be circular, polygonal, square, or rectangular in plan. Bottom hopper portion may have be conical-cum-hyperbolic or any other profile shape as shown in the drawing. Bin shall be termed as bunkers or silos according to their shape and plane of rupture of coal. 2.06.02 For general requirements, fabrication and construction details IS: 9178 (Pt.1 & 11) shall be followed as general guidance. The bins shall be fabricated and erected in segments. 2.06.03 The Coal bins shall be made of mild steel plates joined together with full strength butt weld and provided with stiffeners at regular interval. Stiffeners shall be provided on the external face and it may be welded with external face. 2.06.04 Bending of plates and rolled sections to the required shape for fabrication shall be done by plate bending machine or cold bending process Without resorting to heating, hammering, angle smithy and black smithy process. 2.06.05 Poking hole (manual or pneumatic) and striking plate shall be provided to facilitate coal flow. Poking holes shall have circular MS pipe and cover cap as detailed in the drawing. 2.07.00 New Erection Marks 2.07.01 Additional structures involving new erection marks may be required to be added at any stage of work. 2.07.02 All such new erection marks shall be detailed and included in marking schemes and fabrication carded out thereafter. 2.07.03 All such new erection marks shall be considered under item of original fabrication work. As a result of additional structures becoming necessary if the work is delayed beyond the time schedule stipulated, the Engineer shall give suitable extension of time provided he is satisfied about the reasonableness of the delay involved. However, no claim for extra payments or revision of rates due to delay shall be entertained.	

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2.08.00	ELECTRO FORGED STEEL GRATINGS	
2.08.01	Factory made fabricated electro forged gratings unit with steel conforming to IS: 2062 shall be supplied, fabricated, transported, erected and aligned in floorings, platforms, drain and trench covers, walkways, passages, staircases with edge binding strips and anti skid nosing in treads etc.	
2.08.02	All grating units shall be rectangular in pattern and electro forged. The size and the spacing of the bearing bars and cross bars shall be as detailed in fabrication drawings. The contractor shall submit the grating design for different spans and load intensities along with fabrication drawings. The depth of the grating unit shall be 40 mm, unless specified otherwise.	
2.08.03	The gratings shall be made up in panel units designed to coincide with the span of the structural steel framing or openings as indicated in the design/scope drawings. Maximum possible standardization of the grating panel sizes shall be tried and designed.	
2.08.04	The grating unit shall be accurately fabricated and finished, free from wraps, twists, or any defects that would impair their strength, serviceability, and appearance.	
2.08.05	Grating work shall include cut outs and clearance opening for all columns, pipes, ducts, conduits or any other installation penetrating through the grating work. Such cut outs and clearances shall be treated as specified in subsequent clauses.	
2.08.06	The gratings shall be notched, trimmed and neatly finished around flanges and webs of the columns, moment connections, cap plates, and such other components of the steel structures encountered during the placement of the gratings. In all such cases, the trimming shall be done to follow the profile of the components encountered. After trimming, the binding strip shall be provided on the grating to suit the profile so obtained.	
2.08.07	Opening in gratings for pipes or ducts that are 150mm in size or diameter or larger shall be provided with steel bar toe plates of not less than 5mm thickness and appropriate width, set flush with the bottom of the bearing bars.	
2.08.08	Penetrations in gratings that are more than 50mm but less than 150mm in size or diameter shall be welded with plates of size shown in the detailed drawings set flush with the bottom of the grating panel.	
2.08.09	Unless otherwise indicated on the drawings, grating units at all penetrations shall be made up in split section, accurately fitted and neatly finished to provide for proper assembly and erection at the job site.	

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	these defects noticed on visual or microscopic inspection shall render the material liable to rejection. 2.09.05 There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per IS: 2633. 2.09.06 When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose. 2.09.07 Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications or lack of quality control in any manner in the galvanizing plant, shall render the entire, production in the relevant shift liable to rejection. 2.09.08 All structural steel shall be treated with sodium dichromate or an approved equivalent solution after galvanizing; so as to prevent white storage stains. 2.09.09 If the galvanizing of any member is damaged, the Engineer shall be shown of the extent of damage, if so directed the galvanizing may have to be redone in the similar manner as stated above at no extra cost to the Owner. 2.10.00 STAINLESS STEEL HOPPERS (As per BOQ item) 2.10.01 Material In case SS Hopper is to be fabricated & erected as per BOQ item with SS415M, following specification shall be followed. Stainless steel hopper of grade SS 415M as manufactured by SAIL or equivalent shall be provided in the lower portion of bunker hopper. SS 4 15M having the following chemical composition shall be used. <table> <tr> <th>Material</th><th>%</th><th>Remarks</th></tr> <tr> <td>Carbon</td><td>10.03%</td><td>Max.</td></tr> <tr> <td>Silicon</td><td>1.60%</td><td>Max.</td></tr> <tr> <td>Manganese</td><td>0.80% to 1.50%</td><td></td></tr> <tr> <td>Phosphorous</td><td>0.03%</td><td>Max.</td></tr> <tr> <td>Sulpher</td><td>0.03%</td><td>Max.</td></tr> <tr> <td>Chromium</td><td>10.80% to 12.50%</td><td></td></tr> </table>	Material	%	Remarks	Carbon	10.03%	Max.	Silicon	1.60%	Max.	Manganese	0.80% to 1.50%		Phosphorous	0.03%	Max.	Sulpher	0.03%	Max.	Chromium	10.80% to 12.50%		
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Nickel1.50%Max. Titanium0.75%Max. Nitrogen0.03%Max. The mechanical properties shall be as follows: <table><tr><th>Description</th><th>Value</th><th>Remarks</th></tr><tr><td>Hardness Rock Well B Scale</td><td>90</td><td>Max.</td></tr><tr><td>Tensile Strength</td><td>450 MPa</td><td>Min.</td></tr><tr><td>Yield Strength</td><td>300 MPa</td><td>Min.</td></tr><tr><td>Elongation</td><td>25%</td><td>Min.</td></tr></table>							Description	Value	Remarks	Hardness Rock Well B Scale	90	Max.	Tensile Strength	450 MPa	Min.	Yield Strength	300 MPa	Min.	Elongation	25%	Min.
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2.10.02		Fabrication The fabrication, erection, alignment and welding shall be carried out as per the accepted practice and in accordance with relevant I.S. and international specification as well as stipulations contained herein. Fabrication drawings shall be prepared by the contractor on the basis of the design / scope drawings furnished by Engineer. The fabrication and erection works shall be done as per the approved fabrication drawings.																			
2.10.03		Fabrication Drawings a) Fabrication drawing shall give the cutting plan for each hopper plate. Such, cutting plan shall be based on the size of the Stainless Steel plate available at store. In order to reduce the wastage and ensure the maximum utilization of stainless steel plate, the cutting plan shall take in the consideration of the reverse curvature and place the various elements of hopper plate in opposite fashion to reduce the end wastage. Similarly the hopper plate element having different radii shall be placed one inside the other, to optimize the stainless steel plate use. Such optimization may also required adjustment in the size of the each element of hopper plate and also additional weld joints. b) The bill of material of hopper plate shall indicate the inner surface area of the hopper, weight of the hopper based on the inner surface area, weight of each of the cut plate of hopper fabrication, weight of cut and scrap pieces generated. Contractor shall return to the Owner’s store all unutilized (surplus) stainless steel plates and all waste and cut pieces generated. Non return of any part of the surplus/waste steel pieces to the Owner’s store will call for the penal recovery at three (03) times the maximum																			

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	procurement rate for the weight of stainless steel pieces not returned to the store. c) In case the contractor does the cutting of the stainless steel without approved cutting plan then all the wastage (i.e. the difference between the weight of stainless steel plate cuts and the actual finished weight considered for the measurement for payment) shall be subjected to the penal recovery at the rate mentioned above. 2.10.04 Cuffing Cutting may be affected by shearing, or by using plasma. The cut edges of all plates shall be perfectly straight and uniform through out. Cutting shall be done as per the cutting plan shown in the fabrication drawing. Should the Engineer find it necessary, the edges shall be ground smooth afterwards by contractor within the unit rates quoted by him. All the edge s shall be ground smooth before they are welded. 2.10.05 Jointing Welding shall join stainless steel. All weld joints (along the inclined plane) shall be staggered. Any common welding process can weld stainless steel viz. MIG, metal arc or plasma using the covered compatible electrodes as per IS: 5206 or by inert gas arc welding as per IS: 2811. Shielding gas shall be Argon + Hydrogen mixture or Argon + Oxygen mixture. However, Argon + Oxygen mixture shall be preferred. Carbon-di-oxide mixture shall be avoided. 308L and 315L electrodes/fillers shall be used for the welding of Stainless Steel to Stainless Steel and Stainless Steel to Mild Steel respectively. However, the welding process and the type of the electrodes to be used for welding shall be as per welding procedure, as approved by the Engineer. On the basis of the welding procedure, the Contractor shall conduct qualification test. 2.10.06 Bending The stainless steel plates shall be subjected to cold forming and bending in order to get the desired shape and profile. 2.10.07 Welding sequence The type of electrodes, welding sequence, preheat and interpass temperature and post weld heat treatment shall be as approved by the Engineer. 2.10.08 Acceptance Criteria of Fabricated Structures The acceptance of the fabricated structure work shall depend upon correct dimensions and alignment, absence of distortion in the structure, satisfactory results from the inspection and testing of the welded structure joints and the	

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	with the mortar and some is squeezed out. The surplus shall be troweled off and after the mortar is fully set the temporary supports removed. 2.12.00 Storage of material 2.12.01 General All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged, shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain upto date accounts in respect of receipt, use, and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks. 2.12.02 Steel The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section wise and lengthwise so that they can be easily inspected, measured, and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather. 2.12.03 Electrodes The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating. 2.12.04 Bolts, Nuts and Washers Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length, and quality. 2.12.05 Paints Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.	

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2.13.00	Quality Control The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor. Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work. The quality control procedure shall cover but not be limited to the following items of work a) Steel: Quality manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used. b) Rivets, Bolts, : Manufacturer's certificate, dimension checks, Nuts & Washers material testing. c) Electrodes : Manufacturer's certificate, thickness and quality of flux coating. d) Welders : Qualifying Tests e) Welding sets : Performance Tests f) Welds : Inspection, X-ray, Ultrasonic tests g) Paints : Manufacturer's certificate, physical inspection reports h) Galvanizing : Tests in accordance with IS 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.	

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2.14.00

Standard dimensions, forms and weights

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

2.15.00

Fabrication Drawings

The contractor shall within thirty (30) days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural Steelworks, for approval. Within one week after receipt of approval on design of any steel structure (part or full) based on the approved design. As decided by the Engineer, six (6) copies each of some or all of the detailed fabrication drawings will have to be submitted for approval.

The sequence of preparation of fabrication drawings shall match with the approved fabrication and erection schedule. The above-mentioned approval for fabrication drawings will be accorded only towards the general conformity with the design requirements as well as specifications. The approval of drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The fabrication drawings shall include but not limited to the following:

a)

Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.

b)

Dimensional drawings of base plates, foundation bolts location etc.

c)

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

d)

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

e)

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

These drawings shall give all the necessary information for the fabrication, erection, and painting of the steelwork in accordance with the provisions of this Specification. Fabrication drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Fabrication drawings shall give complete information necessary for fabrication of the various components of the steelwork,

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	including the location, type, size, and extent of welds. These shall also clearly distinguish between shop and field rivets, bolts, and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the fabrication drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification. IS: 813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length. The Contractor shall be responsible for and shall carry out at his cost any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract. 3.00.00 WORKMANSHIP 3.01.00 Fabrication 3.01.01 General All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS: 800 - Code of Practice for general construction in steel and other relevant Indian Standards or equivalent. 3.01.02 Straightening Material Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification on IS: 1552 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600°C. 3.01.03 Cutting Shearing, cropping, or sawing shall affect cutting. Use of a mechanically controlled gas-cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.	



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To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges, occasional notches or gouges not more than 4 mm deep will be permitted. Gouges greater than 4 mm that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion.

3.01.04 Planning of edges

Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

3.01.05 Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams web shall be not more than 3 mm at each end, but where for practical reasons greater clearance is necessary, suitably designed cheatings shall be provided.

3.02.00 Riveted and bolted construction

3.02.01 Holes

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of rivet or bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the rivet or black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of BS as specified in IS: 919. Parts to be connected shall be firmly held together by



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tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

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

3.02.02

Assembly

All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be reamed. Poor matching of holes shall be cause for rejection .The component parts shall be so assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Rivets shall ordinarily be hot driven, in which case their finished heads shall be approximately hemispherical in shape and shall be of uniform size throughout the work for rivets of the same size full, neatly finished and concentric with he holes. Rivets shall be heated uniformly to a temperature not exceeding 1 125°C they shall not be driven after their temperature has fallen below 540°C.

Rivets shall be driven by power riveters, of either compression or manually operated type, employing pneumatic, hydraulic or electric power. Hand driven rivets shall not be allowed unless in exceptional cases specifically approved by the Engineer. After driving, rivets shall be tight, shall completely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking shall be fully filled by the rivet, any proudness of the countersunk head being dressed off flush, if required.

Riveted members shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

All loose, burnt, or otherwise defective rivets shall be cut out and replaced and special care shall be taken to inspect all single riveted connections. Special care shall also be taken in heating and driving long rivets. The Contractor shall prove the quality of riveting by cutting some rivets chosen at random by the Engineer. No extra payment will be made to the Contractor for such cutting and replacing. Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets is found to be sound. If the ratio is below 75%, all the rivets in the particular section or group shall be cut, removed and replaced and tested again at the

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	Contractor's expense. For cases between 75% and 90% the engineer shall have the option to instruct cutting and replacing any number of further rivets at the Contractor's cost as he deems necessary. Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if shown on drawing or directed by the Engineer. Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project 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. 3.03.00 Welded Construction 3.03.01 General Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS: 817. 3.03.02 Preparation of material Surface to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch. 3.03.03 Assembling Parts to be fillet welded shall be brought in, as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2°). The work shall be positioned for flat welding whenever practicable.	



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3.03.04

Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shop splicing not more than three sub-sections, each made in accordance with this paragraph.

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

3.03.05

Welding technique

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

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

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

3.03.12

Temperature

No welding shall normally be done on parent material at a temperature below (-) 5°C. However, if welding is to undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When

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	the parent material is less than 40 mm thick and the temperature is between (-) 5°C and 0°C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is hand warm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20°C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard. 3.03. 13 Peening Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool, peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening. 3.03. 14 Equipment These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer. 3.04.00 Finish Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butt over the whole section with a clearance not exceeding 0.1 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc; after welding/riveting together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles of channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 1.0 mm. 3.05.00 Slab bases and caps Bases and caps fabricated out of steel slabs, except when cut material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face, which is to be grouted direct to a foundation, need not be machined if such face is true and parallel to the upper face. To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.	

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3.12.00	Lacing bars The ends of lacing bars shall be neat and free from burns. 3.13.00 Separators Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used. 3.14.00 Bearing Plates Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings. 3.15.00 Floor Grating All grating units shall be rectangular in pattern and of pressure locked assembly. The size and spacing of bearing bars and cross bars shall be as approved in detailed drawings. Alternatively diamond pattern grating if approved may be used. The grating shall be made in panel units designed to span as indicated in structural steel framing drawing or as directed by the Engineer. The grating units shall be finished free from warps, twists, or any other defects. Grating work shall include cutouts and clearance openings for all columns, pipes, ducts, conduits etc. The gratings shall be notched, trimmed, and neatly finished around components of the steel structures encountered. Binding strip shall be provided on the grating to suit the profile. Openings in gratings shall be provided with steel bar toe plates of not less than 5 mm thickness and 100 mm width. Unless otherwise indicated on drawings, all penetrations of grating units shall be made up in split section, accurately fitted, and neatly finished. Grating units shall be provided with all necessary clips, bolts, lock washers etc. for proper assembly and installation on supporting steel members. Maximum deviation in linear dimension shall not exceed 12 mm. 3.10.00 Chequered Plates Minimum thickness of chequered plate floorings, covers etc. shall be 6 mm O/P. Chequered plate shall be accurately cut to the required sizes and shapes and the cut edges properly ground. Stiffeners shall be provided wherever required from design consideration.	

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3.11.00

Architectural Clearances

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

3.11.00

Shop connections

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

b) Heads of rivets on surfaces carrying brick walls shall be flattened to 10 mm thick projection.

c) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the contractor will have to make the desired changes at no extra cost to the exchequer.

3.13.00

Castings

Steel castings shall be annealed.

3.14.00

Shop erection

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchange ability.

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3.15.00	Shop painting																
3.15.01	General Unless otherwise specified, steelwork, which will be concealed by interior building finish, need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer. After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other methods of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by the solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by trough sweeping with a fibre brush.																
3.15.02	Inaccessible parts Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, Positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.																
3.15.03	Contact surfaces Contact surface shall be cleaned in accordance with sub-clause 3.13.1 before assembly.																
3.15.04	Finished surfaces Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.																
3.15.05	Surfaces adjacent to field welds Unless otherwise provided for, surfaces within 50 of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.																

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3.16.00	Galvanizing	
3.16.01	General	
	Structural steelwork for switchyard or other structures as may be specified in the contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS: 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.	
3.16.02	Surface Preparation	
	All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly. The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.	
3.16.03	Procedure	
	Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS: 4759 - Specification for Hot-dip zinc coatings on Structural Steel & other allied products. After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection. The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping. Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after leaving been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport, handling, and	

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	erection. Damages, if occur, shall be made good in accordance or as directed by the Engineer. 4.00.00 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY 4.01.00 Inspection Unless specified otherwise, inspection to all, work shall be made by the or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification. The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract. The Contractor shall guarantee compliance with the provisions of this Specification. 4.02.00 Testing and Acceptance Criteria 4.02.01 General The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own Cost. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test. 4.02.02 Steel All steel supplied by, the Contractor shall conform, to the relevant Indian Standards. Except otherwise mentioned in the contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be born by the contractor. All material shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance.	

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4.02.02	Welding a) The weld surface shall be cleaned with steel wire brush to remove spatter metal, slag etc. and 100% of welds shall be inspected visually for size, length of weldment and external defects. Weld gauges shall be used for checking weld sizes. The surface shall be clean with regular beads and free from slags, cracks, blow-holes etc. b) Non-destructive examination shall be carried out to determine soundness of weldments as follows: i) 10% at random on fillet-joints. ii) 100% on all butt-joints. c) Should the ND tests indicate defects like improper root penetration, extensive blowholes, slag intrusion etc., such welds shall be back gauged, joints prepared again and rewelded. All defects shall be rectified by the Contractor at no extra costs. d) All electrodes shall be procured from approved reputed manufacturers with test certificates. The correct grade and size of electrode, which has not deteriorated in storage, shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tones of welded fabrication, the Engineer may ask for 1(one) test-destructive or non-destructive including X -ray, ultrasonic test or similar, the cost of which shall be borne by the Contractor. 4.02.04 Rivets, bolts, nuts and washers All rivets, bolts, nuts, and washers shall be procured from M/s. Guest Keen William Ltd. or equivalent and shall confirm to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor. In addition to testing the rivets by hammer, 2% (two per cent) of the rivets done shall have to be cut off by chisels to ascertain the fit, quality of material and workmanship. The removal of the cut rivets and re-installing new rivets shall be done by the Contractor at his own cost. 4.02.05 Shop painting All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.	

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4.02. 12	Galvanizing All galvanizing shall be uniform and of standard quality when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and 15: 4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.																
4.03.00	Tolerance The tolerances on the dimensions of individual rolled steel components shall be as specified in IS: 1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures shall be as specified in IS: 721 - Tolerances for Fabrication of Steel Structures.																
4.04.00	Acceptance Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable to rejection. No Structure or part of the structure once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check some of the tests at an appropriate laboratory at the contractors cost. When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue acceptance certificate, upon receipt of which, the items will be shop painted, packed and dispatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.																
4.05.00	Delivery of materials																
4.05.01	General The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own discretion.																

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4.05.02	Marking Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection. 4.05.03 Shipping Shipping shall be strictly in accordance with the sequence stipulated in the agreed Programme. Contractor shall dispatch the materials to the e worksite securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All parts shall be adequately braced to prevent damage in transit. Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following: a) Name and address of the consignee b) Name and address of the consignor c) Gross weight of the package in tonnes and its dimensions d) Identification marks and/or number of the package e) Custom registration number, if required All markings shall be carried out with such materials as would ensure quick drying and indelibility. Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers. Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially - a) Name of the Contractor b) Number and date of the Contract c) Name of the office placing the contract d) Nomenclature of stores	

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5.00.00 5.01.00	e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each. The shipping dimensions of each packing shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads. After delivery of the materials at site, all packing materials shall automatically become the property of the Owner. Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor at no additional cost to the Owner. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor. The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges. If, however, the Owner has to make payment of any of the above-mentioned charges, the amount paid will be deducted from the bills of the Contractor. Necessary advise regarding the shipment with relevant details shall reach the Engineer at least a week in advance. INFORMATION TO BE SUBMITTED With Tender The following information is required to be submitted with the Tender: a) Progress Schedule The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work. i) Preparation and approval of fabrication drawing ii) Procurement of Materials iii) Fabrication and shipping of all anchor bolts iv) Fabrication and shipping of main steelwork. v) Fabrication and shipping of steelwork for bunkers, tanks and/or silos	

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	as applicable. vi) Fabrication and shipping of all other remaining steelwork including miscellaneous steelwork. vii) Final date of completion of all shipments. b) Shop Location of the Tenderer's fabrication workshop giving details of equipment, manpower, the total capacity, and the capacity that will be available exclusively for this contract shall be submitted. 5.02.00 After Award After award of the Contract the successful Tenderer is to submit the following: a) Complete fabrication drawings, material lists, cutting lists, rive and bolt lists, field welding schedules based on the approved design drawings prepared by him in accordance with the approved schedule. b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day o. each month, giving the up-to-date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information. c) Detailed monthly material reconciliation statements relevant to the Work done and reported in the Progress Report, giving the stock at hand of raw steel, work in progress, finished materials. d) Results of any test as and when conducted and as require by the engineer. e) Manufacturer's mill test report in respect of steel materials, rivets, bolts, nuts, and electrodes as may be applicable. 6.00.00 RATES AND MEASUREMENT 6.01.00 Rates 6.01.01 The items of work in the Schedule of items describe the work in brief. The various items of the Schedule of items shall be read in conjunction with these specifications including amendments and additions, general conditions of contract, special conditions of contracts, and other tender documents, if any. For each item of Schedule of Items, the bidder's rates shall include the activities covered in the description of the item as well as all necessary	

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	operations described in the Specifications. 6.01.02 The bidder's rates shall include cost of all minor details which are obviously and fairly intended and which may not have been included in the description in these documents but are essential for the satisfactory completion of the work. Rates shall also include for taking all safety measures. 6.01.03 The bidder's -rates for all items of schedule of items shall include complete cost towards plant, equipment, erection and dismantling of scaffolding, men, materials and consumables, skilled and unskilled labour, levies, taxes, royalties, duties, transport, storage, repair/rectification/maintenance until handing over, contingencies, overhead and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work. 6.01.04 No claims shall be entertained, if the details shown on the 'Released for Construction' drawings differ from those shown on the bid/tender drawings. 6.01.05 Rates shall be inclusive of all leads and lifts/elevation. 6.01.06 The bidder's rates for Structural Steel shall include for fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, erection scheme, alignment, welding, including preheating and post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus/waste steel materials including cut pieces/waste steel, provision of additional butt/weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work. The rates for fabrication are inclusive of all tests on welds and material and no extra shall be payable for quality tests specified for fabrication of structure in shop or at site. Separate BOQ items for test on welds like radiography or Ultrasonic, DPT, magnetic particle tests are kept for tests on material/fabrication not covered under regular fabrication item of BOQ. 6.01.07 The bidder's rates for foundation bolts assembly shall include fabrication, threading, heat treatment, erection, installation, and alignment of complete bolt assembly with nuts, locknuts, anchor plates, stiffener plates, protective tape, etc. This shall also include the cost of all materials not issued by the Owner. Material issued by Owner will be specified in GCC.	

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6.01.08	The bidders rates for application of inorganic primer shall include surface preparation to near white metal surface by blast cleaning, abrasives, touch up painting, suitable enclosure to avoid contamination and the necessary statutory approval from the factory inspector/pollution control board etc. regarding the method of blast cleaning and abrasives used, and getting approval of the specialized agency supplying the primer specified.	
6.01.09	The bidder's rates for application of finish painting system shall include surface preparation, application of intermediate (under) coat, finish coat and final finish coat, and getting approval of the specialized agency supplying the finish paint.	
6.01.10	The bidder's rates for electro-forged gratings (if specified) shall include supply, fabrication, transportation to the site, erection and alignment of factory made electro-forged gratings, all taxes, duties thereon etc. The rates shall also include preparation of grating design for different spans and load intensifies, preparation of design and fabrication drawings, edge preparation, blast cleaning followed by finish paint.	
6.01.11	The bidder's rates for galvanization of factory made electro-forged gratings (if specified) shall include the application of hot dipped galvanization as finish over the fabricated gratings and the treatment to be given for prevention of white storage stains, as per the technical Aspiration.	
6.01.12	The bidder's rates for permanent mild steel bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types of Structural Steel works, as per the technical specification.	
6.01.13	The bidder's rates for high strength structural bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types, of Structural Steel works, as per the technical specification.	
6.01.14	The bidder's rates for dismantling, additions to, alterations in and/or modifications shall be inclusive of all operations such as lowering of material, carriage etc., as mentioned in the technical specification. Unutilised steel pieces cut/removed shall be returned to the project stores free of charge. Non-return of unutilized steel pieces to the Owner's store would be considered as wastage and recovery would be affected as per the provision of contract for structural steel consumption. This shall not include the weight of temporarily dismantled/supported members, connected member.	
	The bidder should prepare an optimised cutting plan as per fabrication drawing to utilise the steel material upto maximum extent and minimise the wastage/scrap. Quantity of wastage/scrap of material should be limited to the percentage mentioned elsewhere in the conditions of tender/contract specifications.	

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6.01.15	The bidder's rates for re-erection of erection marks after additions to, alterations in and/or modifications shall be inclusive of all operations mentioned in technical specification for the calculated weight of the rectified/modified erection mark rejected at site. This shall not include the weight of temporarily dismantled/supported members, connected member. All the operations mentioned above for restoring such members shall be carried out at no extra cost. The work of erection of any erection mark which has not been dismantled but have been modified/rectified before erection shall not be paid under this item but shall be paid under relevant item of fabrication and erection of steel work of Schedule of items for the modified weight.	
6.01.16	The bidder's rates for PTFE shall include design, supply, transportation of the complete assembly with guides and dust protection cover and installation of bearings in position drilling, bolting, erecting aligning etc. along with any taxes, duties thereon etc.	
6.01.17	The bidder's rates for Stainless Steel hopper (if specified) shall include fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, all other operations mentioned in the technical specification. The rates shall also include for erection scheme, alignment, making cutting plan, cutting, jointing, bending, rolling, grinding, drilling, bolting, assembly, edge preparation, welding including pre-heating, post-heating, testing of welders, inspection of welds, inspection and testing, protection against damage in transit, stability of structures, installation of temporary structures etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus / waste steel materials including cut pieces/waste steel, provision of additional butt / weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.	
6.01.18	The bidders rates for preformed flexible open ended bellow strap of neoprene (if specified) shall include supply and transportation, installation in position, drilling, bolting, aligning etc. complete along with any taxes, duties thereon etc.	
6.01.19	The bidder's rates for Stainless Steel Hand Rail (if specified) shall include complete Hand Rail including, materials, fabrication, grinding & finishing, stainless steel beading, stainless steel cleats, stainless steel fasteners, neoprene gaskets, preparation of shop drawing but excluding the cost of glazing. The Owner shall supply no material for this item of work.	
6.02.00	MODE OF MEASUREMENT	
6.02.01	The measurement for the item of foundation bolts assembly including that of nuts; locknuts shall be based on the calculated weight of steel installed in Metric Tonne, corrected to second place of decimal. The weight of the	

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	foundation bolt shall be calculated in the same way as that done for the item of fabrication, erection, alignment of structural steel. The weight of the nut / locknut shall be taken as per actual weight supplied by the contractor and accepted by the Engineer. 6.02.02 The measurement for the item of fabrication, erection, alignment, welding, etc. of structural steel work shall be based on the approved weight of steel nearest to a Kg, by applying the unit weight as adopted at the time of issue of structural steel on the measurements worked out as given below. 6.02.03 For ISMB, ISMC, ISA, flats, round bars, square bars and pipes, length shall be taken as per distance between planes normal to the axis of the member passing through the extreme points of the section. 6.02.04 Gussets plates in trusses, and bracings, brackets plates, stiffeners, and skew cuts if any in plates for butt welds, the area shall be assumed as the minimum circumscribed rectangle. However deduction for any notch/skew cut shall be made as mentioned in clause no-6.02.06. 6.02.05 For bunker wall plates, the minimum-circumscribing rectangle of the individual plate/pieces out of which these wall plates are assembled by butt-welding, shall be measured. Care shall be taken to ensure maximum utilization of cut-pieces generated by providing extra butt joints (for which no extra payment shall be made). 6.02.06 For all other plates, where the area of any notch/skew cut in the plate is less than 0.05 sq.m. the area of the plate shall be assumed as that of the minimum circumscribing rectangle for the purpose of measurement and calculation of area for the purpose of payment. However, if the area of any notch/skew cuts in a plate is more than 0.05 sq.m, the area of notch/skew cut shall be deducted from assumed minimum circumscribing rectangular area for the purpose of payment. 6.02.07 No deduction shall be made for the hole in the members, if the area of individual hole is less than 0.05 sq.m. The weight shall be calculated by deducting the area of holes, if area of individual hole is more than 0.05 sq.m. 6.02.08 All cut-pieces and scrap generated due to cutting of holes, skew-cuts of plates, gussets, brackets, stiffeners, etc. shall be stacked separately and handed over to the project stores without being considered for material accounting as the circumscribing rectangle has been considered for payment. 6.02.09 The splice plate shown in the fabrication drawing or approved by the Engineer shall only be measured for payment. 6.02.10 The weight of permanent bolts, washers and nuts and welds shall not be included in the weights of the members. No extra payment shall be made for	

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	welding/bolting. 6.02.11 The bolts and nuts required for erection purpose shall not be paid for and may be taken away by the Contractor after final welding for members. Erection boltholes left after removal of erection bolts shall be suitably plugged with welds. 6.02.12 The measurement for the item of application of inorganic primer including blast cleaning of steel surfaces shall be based on the weight on which the zinc silicate primer is applied, after blast cleaning in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works. 6.02.13 The measurement for the item of application of finish primer system shall be based on the weight on which the epoxy based finish primer is applied in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works. 6.02.14 The measurement for the item of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor, and accepted by the Engineer. Nothing extra shall be payable for making cutouts, notches, openings of any profile, trimming profiles etc. in the grating units. 6.02.15 The measurement for the item of hot dipped galvanization of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal of gratings galvanized by the Contractor and accepted by the Engineer. 6.02.16 The measurement for the item of permanent bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules. 6.02.17 The measurement for the item of High Strength Structural bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules. 6.02.18 The measurement for the item of the work of dismantling, additions, alterations, reerection etc. shall be as given below 6.02.19 For dismantling, the unmodified weight of the actually dismantled erection marks shall only be measured. 6.02.20 For the work of addition to, alteration in and / or modification of 'erection	

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	marks' either in erected position or in the fabrication yard, measurement of weight for payment purpose shall be calculated as the arithmetic sum of weight of steel cut and removed from the erection mark, weight of steel reutilised out of such cut and removed pieces and weight of additional new steel pieces added to the erection mark. 6.02.21 For re-erection the weight of the modified erection mark shall only be measured. 6.02.22 The weight shall be measured nearest to kg. and shall be arrived in a manner similar to the measurement for the item of fabrication, erection, alignment and welding of structural steel. 6.02.23 The measurement for the item of PTFE bearings shall be based on the load carrying capacity of PTFE in MT, corrected to third place of decimal, supplied by the contractor and as accepted by the Engineer and as per the approved bearing schedule, for the total vertical load carrying capacity, for all bearings. 6.02.24 The measurement for the item of stainless steel hopper shall be based on the actual finished weight of hopper weight in Kgs, corrected to second place of decimal. The hopper weight shall be arrived by multiplying of the inner surface area of the hopper with the unit weight of the hopper plate. 6.02.25 The measurement for the item of flexible open-ended bellows straps of neoprene shall be based in running meter, corrected to second place of decimal. Bellow Straps shall be supplied as per the requirement of the approved drawings. The measurement shall be done for the inner circumference of the bunker on which neoprene has been fixed and for the length supplied by the Contractor 'and as accepted by the Engineer. 6.02.26 The measurement for the item of Stainless Steel Hand Railing shall be based on finished weight of handrail in Kgs corrected to second place of decimal. The weight shall also include the weight of Stainless Steel fasteners, Stainless Steel beading, Stainless Steel cleats etc. The weight shall be the finished weight of Hand Rail, as accepted by the Engineer.	



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**SECTION - D
(PART I)**

SUB-SECTION – D 18

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



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SUB-SECTION – D 18

ERECTION OF STRUCTURAL STEELWORK

1.00.00 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at site, installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following:

- a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour, and supervision required for erection of the structural steelwork.
- b) Receiving, unloading, checking, and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The Contractor shall pay all demurrage and/or wharfage charges etc. on account of default on his part.
- c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, riveting, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures.
- d) Checking center lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. Any defect observed in the foundation shall be rectified with Engineer's approval. The Contractor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.
- e) Aligning, plumbing, leveling, riveting, bolting, welding and securely fixing the fabricated steel structures including floor gratings, chequered plates etc. in accordance with the Drawings or as directed by the Engineer.
- f) Painting of the erected steel structures.
- g) All minor modifications of the fabricated steel structures as directed by the



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Engineer including but not limited to the following:

- i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.
- ii) Cutting, chipping, filling, grinding, etc. if required for preparation and finishing of site connections.
- iii) Reaming of holes for use of higher size rivet or bolt if required.
- iv) Refabrication of parts damaged beyond repair during transport and handling or refabrication of parts, which are incorrectly fabricated.
- v) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.
- vi) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.
- vii) Carry out tests in accordance with this specification.

2.02.00 Work by Others

No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Codes and Standards

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

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

IS: 456 - Code of practice for main or reinforced concrete.

2.04.00 Conformity with Designs

The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the sequence and the design criteria laid down by the Engineer. All work shall conform to the provisions of this specification and /or instructions of the engineer. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specifications and/or the instructions of the Engineer.

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All fabricated steel structures and connection materials shall be supplied by the Contractor to the site. The Contractor shall take delivery from railway wagons or trucks at site, and unload the materials and perform all formalities like checking of materials and attend to insurance matters in accordance with Sub-Clause 2.01.00 and as specified hereinbefore.

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

All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the engineer shall be at liberty to get the materials removed by agency and the cost incurred thereof shall be realised from the Contractor's dues.

The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other raw steel materials such as structural sections and plates as required. The yard shall have facilities like drainage, lighting, and suitable access for large cranes, trailers, and other heavy equipments. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved Programme of work.

The Tenderer must visit the site prior to submission of his tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed by the Engineer.

All field connection materials, paints, cement etc. shall be stored on well



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designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor.

2.07.00 Quality Control

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the Following items of work :

- i) Erection: Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.
- ii) Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency, and strength of grout.
- iii) Painting: Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

2.08.00 Taking Delivery

The Contractor shall take delivery of fabricated structural steel and necessary connection materials from railhead/trucks as may be necessary and as directed by the Engineer. He shall check, unload; transport the materials to his stores for proper storing at his own cost. The Contractor shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof shall be borne by him.

The Contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted. The Contractor shall salvage, collect, and deliver all the packing materials to the Owner free of charge.

3.00.00 WORKMANSHIP

3.01.00 Erection

3.01.01 Plant and Equipment

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



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3.01.02 Method and sequence of erection

The method and sequence of erection shall have the prior approval of the Engineer. The Contractor shall arrange for most economical method and sequence available to him consistent with the drawings and specifications and other relevant stipulations of the contract.

3.01.03 Temporary Bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install, free of cost to the Owner, temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made free of cost to the Owner.

The requirement of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned, and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

The temporary guys, braces, false work, and cribbing shall not be the property of the Owner and they may be removed immediately upon completion of the steel erection.

3.01.04 Temporary Floors for Buildings

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or bylaws of state, Municipal or other local authorities.

3.01.05 Setting Out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. For heavy columns, etc. the Contractor shall set proper screed bars to maintain proper level. No extra payment shall be made for this.



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Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance under this Specification.

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

3.01.06 Field Riveting

All rivets shall be heated and driven with pneumatic tools. Hand passing or "throwing" of rivets are desirable. Any other method of conveying hot rivets from the furnace to the driving point must be approved by the engineer. No-cold rivets shall be driven. All other requirements of riveting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steelwork of the Project.

3.01.07 Field Bolting

All relevant Portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following:

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other, defects that would prevent solid seating of the parts. Contact surfaces within friction type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut Method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the Joint are brought into good contact with each other. 'Snug tight' is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-I with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation



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there shall be no rotation of the part not turned by the wrench.

TABLE-I

Bolts length not exceeding 8 times dia or 200 mm	Bolt length exceeding 8 times dia or 200 mm	Remarks
1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation-30° over or under.

Bolts may be installed without hardened washers when tightening is done by the turn -of-nut -method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench Tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE-II (See Note below the Table). Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE-II

Nominal Bolt Diameter (mm) (Kg.M) of IS:1367	Torque to be applied for bolt class 8.8
20	59.94
22	81.63
24	103.73

Note: The above torque values are approximate for providing tensions of 14.



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7 T for 20 mm dia.; and 21.2 T for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular wrench.

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

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds. Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause.

3.01.08 Field Welding

All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints.

3.01.09 Holes, Cutting and Fitting

No cutting of sections, flanges, webs, cleats, rivets, bolts, welds etc. shall be done unless specifically approved and /or instructed by the Engineer.

The erector shall not cut, drill, or otherwise alter the work of other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is obtain specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. The Contractor shall not be entitled for any payment on account of any such work.

3.02.00 Drifting

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member



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or makes it impossible to fill the holes properly or to adjust accurately after reaming, shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

3.03.00 Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)

Grouting shall be carried out with Ordinary Cement grout as described below:

The mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert supervision, taking care to avoid air locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm down graded stone chips may be added to the above noted cement-sand grout mix, if required, by the Engineer or shown on the drawings.

No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, leveled, and plumbed and sufficient floor beams are tied in position.

Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.

If required by the Engineer, certain admixtures like aluminium powder, "ironite" or equivalent, may be required to be added to the grout to enhance certain desirable properties of the grout. Approved non-shrink pre-mixed grout having required flowability and compressive strength may also be used with Engineer's approval.

3.04.00 Painting after Erection

Field painting shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. Normally, final painting shall be done only after the floor slabs are concreted and masonry walls are built. However, touch up painting, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the Contractor free of cost to the Owner. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural



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steelwork applicable for the project.

Painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.

All field rivets, bolts, welds, and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces, which will be in contact after site assembling, shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet.

Surface, which will be inaccessible after field assembly shall receive the full, specified protective treatment before Bolts and fabricated steel members who are galvanized or otherwise treated and steel members to be encased shall not be painted.

The final painting shall be of tow coats of Synthetics Enamel painting or Aluminium paint of approved manufacture as per the approved "Schedule of Painting". The shades shall also be as per the approved schedule. Synthetic enamel paint shall conform to IS: 2932.

3.05.00 Final cleaning up

Upon completion of erection and before final acceptance of the work by the Engineer, the contractor shall remove free of cost all false work, rubbish and all Temporary Works resulting in connection with the performance of his work.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 General

Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member as per the Contract and no payment towards the cost of the dismantled portion and any connected work shall be made to the contractor. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good free of cost by the Contractor, to the satisfaction of the Engineer. The Cost of the tests specified hereinafter shall be borne by the Owner; but if the structure fails to pass the tests, the cost of the tests shall be recovered from the Contractor. Any extra claim due to loss of time, idle labour, etc. arising out of these testing operations shall not be entertained, however, only reasonable and appropriate time extensions will be allowed.



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The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following sub-clauses 4.01.01, 4.01.02 and 4.01.03. The method of testing and application of loading shall be as approved by the Engineer.

4.01.01 Stiffness Test

In this test, the structure or member shall be subjected, addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 per cent of the maximum increase in strain or deflection recorded during the second test.

4.01.02 Strength Test

The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on the removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load.

4.01.03 Structure of same design

Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.



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When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

4.01.04 Repair for subsequent test and use after strength tests

An actual structure which has passed the "Strength Test" as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.01.01 hereinbefore.

4.02.00 Tolerances

Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steel work applicable to this Project and as specified below: The specified tolerance is mainly for welded erection. In case of bolted erection, no tolerance is desired so that all prefabricated bolt holes are matched on erection.

I. For Buildings Containing Cranes

Component	Description	Variation Allowed
1.	2.	3.
Main columns	a) shifting of column axis at foundation level with respect to building line	
	i) In longitudinal direction	i) ± 3.0 mm
	ii) In lateral direction	ii) ± 3.0 mm
	b) Deviation of both major column axis from vertical between foundation and	



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other member connection
levels:

i) For a column upto and
including 10M height

i) ± 3.5 mm from true
vertical

ii) For a column greater
than 10M but less
than 40M height

ii) ± 3.5 mm from
true vertical for any
10 M length measured
between connection
levels, but not more
than ± 7 mm per 30m
length.

c) For adjacent pairs of columns
across the width of the building
prior to placing of truss

± 9.0 mm on true
span.

d) For any individual column
deviation of any bearing or
resting level from levels shown
on drawings.

± 3.0 mm

e) For adjacent pairs of columns
either across the width of building
or longitudinally level difference
allowed between bearing or seating

3.0 mm

Trusses

least.

a) Deviation at centre of span
of upper chord member from
vertical plane running through

centre of bottom chord.

1/1500 of the span or
greater than 10mm
whichever is the

Trusses

b) Lateral displacement of
top chord at center of
span from vertical plane
running through center of
supports.

1/250 of depth
of truss or 20 mm
which ever is the -
least.

Crane Cirders

a) Difference in levels of
crane rail measured between
adjacent columns.

2.0 mm.

b) Deviation to crane rail-
gauge

± 3.0 mm



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-463-600-C018

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c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermite welding. 1.0 mm.

d) Deviation of crane rail axis from centre line of web. ± 3.5 mm

Setting of
Expansion
gaps

At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length.

iv) For Building without Cranes

The maximum tolerances for line and level of the steel work shall be ± 3.0 mm on any part of the structure. The structure shall not be Out of Plumb more than 3.5 mm on each lox section of height and not more than 7.0 mm per 30 m section.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

4.03.00 Acceptance

Structures and members have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.01.00, 4.01.01, 4.01.02, 4.01.03 and 4.01.04 and other applicable provisions of this specification and are within the limits of tolerances specified in Sub-clause 4.02.00 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this contract.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 Before Tender

5.01.01 Tentative Programme

The Tenderer shall submit a tentative programme based on the information available in the Tender Document and visit to site indicating the structure-wise erection schedule proposed to be maintained by the Contractor to complete the job in time in accordance with the Contract.

	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-463-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 23/12/2019 SHEET 17 OF 17
5.01.02	Constructional Plant and Equipment, Tools, Temporary works & manpower A detailed list Of all constructional plant and equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.	
5.01.03	Erection Yard A site plan showing the layout and location of the erection yard proposed to be established by the tenderer shall also be attached with the tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever.	
5.02.00	After award of the Contract After award of the contract, the Contractor shall submit the following:	
5.02.01	Detailed Programme The Contractor shall submit a detailed erection programme within a month of the award of the Contract for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required, and an assessment of required strength of various categories of workers in a proforma approved by the Engineer.	
5.02.02	Fortnightly Progress Report The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.02.01 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and the strength of his workers.	



TITLE:

**TECHNICAL SPECIFICATION FOR
ROOF DECKING**

SPECIFICATION NO. PE-TS-463-600-C019

VOLUME - II B

SECTION - D | SUB-SECTION – D19

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VOLUME: II B

SECTION - D

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ROOF DECKING

SPECIFICATION NO. PE-TS-463-600-C019



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



TITLE:

**TECHNICAL SPECIFICATION FOR
ROOF DECKING**

SPECIFICATION NO. PE-TS-463-600-C019

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TITLE:

**TECHNICAL SPECIFICATION FOR
ROOF DECKING**

SPECIFICATION NO. PE-TS-463-600-C019

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ROOF DECKING

1.00.00 Scope

This section of the specification covers the supply, fabrication and erection of profiled light gauge Metal Decks (coated and painted) as roof decking to the main plant building and any other area as indicated in the drawings.

2.00.00 Material

2.01.01 Roof of main plant TG and Deareator bay and bunker building consists of permanently colour coated (on exposed face) galvanized MS trough metal sheet decking plate of approved colour over roof purlins for cast-in-situ roof slab as per IS: 14246 and conform to class 3. Thickness of deck plate shall be minimum 0.8mm and minimum trough depth of 44 mm and centre to centre of the valley shall be 130mm with minimum yield strength of 250 Mpa. Silicon modified polyester paint shall be used for permanent coating over galvanized surface with minimum rate of galvanization 150 gm/sqm. DFT of permanent colour coating shall be 20 microns. It shall serve as permanent shuttering for cast-in-situ roof slab. It should have adequate strength to support weight of green concrete and imposed load during construction. The thickness of the deck plate shall however be designed suitably according to the spacing of roof purlins.

3.00.00 INSTALLATION

The Contractor shall furnish all labour, equipment and materials as required for the design, fabrication, coating, erection and fixing of the decking over purlins, painting and for the complete performance of the work in accordance with the construction drawings and as described herein.

The description, which follows, gives a general indication of the nature and extent of the work but is not necessarily exhaustive and does not purport to cover all the details/operations which will be necessary in order to carry out the work.

3.01.00 Detailed Design of Roof Decking

The Contractor, in conjunction with the manufacturer, shall be responsible for the detailing of the profiled decking, fittings and fixtures and shall submit with his tender particulars of the proposed manufacturer and of the particular product proposed for use. The detailing is to be based on typical details furnished by the Engineer. The Contractor shall submit to the Engineer, two copies of the general arrangement and detailed working drawings for the proposed design, together with all calculations necessary to verify the adequacy and completeness of the design & detailing of decking sheets,

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	fixtures, flashings and trims. After approval he shall supply further eight copies. The Engineer will verify the correct interpretation of his requirements but may not necessarily check the design and details, and the Contractor shall be entirely responsible for the accuracy of the drawings and the correctness of the design and the suitability of the details. Manufacture of roof decking sheets shall not commence until the necessary approval of the Engineer has been obtained. 3.02.00 Erection & Fixing 3.02.01 Sequence of Manufacture/Erection Cutting Schedules, delivery to site and stacking arrangements in store shall ensure that sheets are erected in a sequence which follows that for the manufacture. The decking sheets shall be erected using an arrangement of sheets and joints to conform with the requirements of this specification. Decking erection for each elevation or feature shall commence at one end only and proceed towards the other end, in order to ensure tight fitting laps. 3.02.02 Position and Location of Laps Side and end laps of roof decking sheets shall be located and positioned in such a manner as to provide the maximum weather protection taking into account the direction of the prevailing wind. The lines formed by horizontal laps and fixing shall where possible, be continuous and coincide with the edges of large openings in the roof. 3.02.03 Alignment of Sheets and Fixings All roof decking sheets shall be fixed plumb and level with all fixings evenly spaced and accurately lined. All dirt and grease shall be removed from the surfaces of the sheets as the work proceeds. 3.02.04 Site Cutting Approval must be obtained before the roof decking sheets are cut at site. Generally cutting of sheets to length will not be permitted, only special cutting and trimming for small openings shall allowed. Where possible, site cut edges shall be concealed at laps. 3.02.05 Damaged Sheets Distorted, blemished or water stained sheets and any other fittings shall not be used.																

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-463-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 23/12/2019 SHEET 5 OF 7
3.02.06	Laps End laps and side laps to roof decking sheets shall be sufficiently large to ensure that the decking complies with the weather tightness and other requirements of this specification. The length of each decking sheet shall be adjusted so that the end laps shall bear on the purlins. In no case end laps shall not be less than 150 mm and side laps shall not be less than 53 mm.	
3.02.07	End Lap Fixings	
	End lap fixings shall be located at least 25 mm from the end of each sheet.	
3.02.08	Side Lap Fixings	
	The spacing of side lap fixings shall ensure compliance with this specification regarding tightness. The spacing of these fixing screws shall not exceed 500mm. The fixing shall be located in the bottom flat of the corrugation.	
3.02.09	Holes	
	Holes in MS decking sheets shall be punched. In case holes are drilled holes, it is to be ensured that the holes do not go oversize due to the small thickness of the sheeting. All drilling swarf shall be removed from the surfaces of decking, supporting steel work, purlins etc.	
3.02.10	Location and Spacing of Fixings	
	Fixings shall be accurately located in position in the centre of the corrugations to ensure that the heads of bolts, nuts and washers bear squarely down on the surface of the sheeting and are not located at the edge or on the joints in supporting purlins.	
3.02.11	Fixings	
	The tenderer shall submit with his tender details of the proposed method for securing the roofing sheets to the metal purlins. The roof decking sheets are to be fixed to the roof purlins with hex washer head white zinc plated heat treated carbon steel self drilling / self tapping screws of minimum thread diameter of 5.6mm. These self drilling screws shall be drilled through the roofing sheets and purlins supporting the roofing sheets. These purlins shall be suitably spaced as per the requirement of roofing sheets and the roofing sheets shall not sag more than span/250 for the loads likely to be imposed during concreting and in future. The self-drilling screws are to be spaced at a maximum distance of 390mm centre to centre along the length of the purlins and top chord of truss. The screws are to be located preferably in the valley only and shall be installed in accordance with the manufacturer's	

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	recommendations using tools approved by the manufacturer which do not damage the coating of the decking sheets. 3.03.00 Protection during Construction Precautions shall be taken during the erection of the roof decking to ensure that partially erected decking are protected during inclement weather and damage at all times. 3.04.00 Damage Any damage to coating & primer during transportation is to redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner. 4.00.00 Acceptance Criteria The installation shall present a neat appearance and shall be checked for water tightness. The following shall be checked : a) Side and end laps b) Absence of damage in the sheeting. c) Conformity of fixings with the approved design. 5.00.00 IS Codes All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. IS : 513 - Specification for cold rolled carbon steel sheets. IS : 3618 - Specification for phosphate treatment of iron and steel for protection against corrosion. IS : 4431 - Specification for carbon & carbon manganese free cutting steel. IS : 1573 - Electroplated Coatings of zinc on iron and steel.	

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6.00.0	RATES AND MEASUREMENTS 6.01.00 Rates Rates shall be unit rate for complete item described in the Schedule of Items and shall include all wastage. 6.02.00 Method of Measurement Roofing shall be measured for net area of the work done. Profiled sheeting (coated & painted) shall be measured in plan area of sheets and not girthed. No deduction shall be made for openings measuring up to 0.1 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size. No payments shall be made for laps.	



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-463-600-C020

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FALSE FLOORING

SPECIFICATION NO. PE-TS-463-600-C020



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



TITLE:

**TECHNICAL SPECIFICATION
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FALSE FLOORING

1.00.00 General

This section of the specification covers the supply, fabrication and installation of false flooring system having PVC top finish particle board, GI supporting system, painting etc. as per schedule of items in the main plant building and any other area as indicated in the drawings.

The scope of contractor covers supply of all materials, fabrication & installation works required to be carried out for completion of false flooring in the area specified in the drawings.

2.00.00 MATERIAL

2.01.00 Supporting structure

Supporting pedestals shall be made of steel and will be of height as required. Supporting pedestal shall be truly vertical and located at distances to conform with size of floor panels and shall be equipped with locking devices to prevent disturbances of finished elevation. Base of pedestal shall have integral load dispersion plate of size 100x100x8mm to transmit the load evenly to the base floor. Adjustment of pedestal shall be provided by threaded vertical rod of 25mm diameter and elevating nut. The pedestal head shall provide positive interlocking of the steel grid channels supporting system and shall prevent lateral shifting.

The grid channels shall be made of galvanised steel of 40mm x 40mm x 3.15mm thick and shall be placed at 610mm centre to centre both ways to support floor panels in uniform levelled elevations. Nominal height of the false flooring system shall be 600 mm unless otherwise indicated. Pedestal head shall be equipped with conducting grounding pad if so desired by the Engineer

2.02.00 Floor Panels

The floor panels shall be made of fire resistant particle board, phenol formaldehyde bonded. Size of each panel shall be 610mm x 610mm with all panel edges finished to a tolerance of ± 0.2 mm. Floor panel shall have 2mm thick non-static PVC on top, 2mm thick hard PVC strip lipping on four edges and 26 G aluminium sheet fixed with araldite at bottom. Minimum thickness of the panel shall be 35mm, unless otherwise noted. All panels shall be completely interchangeable and easily removable with a suction lift tool. Panels shall be square within a tolerance of ± 0.25 mm on the diagonal. The floor panels shall be cut, wherever required for providing suitable outlets for cables and edges shall be lipped with hard PVC sheets.



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2.02.01 Strength

Each 610mm x 610 mm floor panel must be capable of withstanding the designed service load. The ultimate strength shall provide a safety factor of 3. The false flooring shall be capable of carrying a axial load of 800 kg and uniform load of 2000 kg/sq.m with maximum deflection of 1/350. If required by the Engineer, the samples shall be accepted only after carrying out load tests. The Engineer may relax the test requirements with concentrated load in case cabinets are not handled with castor fitting arrangement.

One additional pedestal shall be provided under floor stringer along front panel area of each control board for taking possible additional load that may occur from time to time.

2.02.02 Surface finish

All removable panels shall have the top surface finished with 2 mm thick flexible PVC flooring conforming to IS:3462 and shall be fixed to the surface with compatible high-creep resistant adhesive. The PVC floor tile shall be in single piece for each floor panel. Under side of panels shall also be painted with suitable epoxy or oil based paint.

2.02.03 Damaged Floor Panels

Distorted, blemished or stained floor panels shall not be used.

2.03.00 Skirting

Skirting shall be 150 mm high and 2 mm thick, completely matching with false flooring surface finish materials and shall be fixed to the wall surface as per manufacturer's installation instructions.

3.00.00 INSTALLATION

3.01.00 Base

The system shall be placed over a base of RCC floor slab and beams. Any grouting etc. that is necessary to fix the supporting structure shall be done.

The concrete sub floor shall be sealed with two coats of polyurethane paint to prevent moisture from coming in contact with cables and to minimise dust problem.

The floor panels and channels shall be completely interchangeable and remain in position without screwing or bolting under working/imposed loadings.

Any damage to the sub floor during installation of the false flooring system



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shall be made good by the contractor without any extra cost to the Owner. All steel surfaces are to be protected by two coats of polyurethane paint over a compatible primer and any damage to the paint during installation shall be made good. In case the loads exerted by the weight of machines are above the stated characteristics of floor finish material, the floor shall be protected by overlaying hard board during installation of machine or equipment.

All installation work of the false flooring system shall be supervised by the manufacturer's authorised representative.

3.03.00 Painting

After fixing the false flooring supporting system the sub floor shall be given a coat of polyurethane paint.

3.04.00 Protection during Construction

All precautions shall be taken during the erection of the false flooring to ensure that partially erected flooring are protected and shall not be damaged before handing over to owner.

3.05.00 Damage

Any damage of coating to supporting system caused during transportation is to be redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner.

4.00.00 ACCEPTANCE CRITERIA

The false flooring system shall only be accepted after completion of following checks :

- a. Level
- b. Alignment of joints
- c. Thickness of joints
- d. Surface finish
- e. Colour and texture
- f. Details of edges, junctions etc.
- g. Performance
- h. Criteria specified for strength.



TITLE:

**TECHNICAL SPECIFICATION
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5.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS:5318 Laying of flexible sheet and flooring.

IS:3462 Flexible PVC flooring

IS:3087 Wood particle boards (medium density) for general purposes.

6.00.0 RATES AND MEASUREMENTS

6.01.00 Rates

Rates shall be unit rate for complete item described in the Schedule of Items and shall include, but not limited to, supply & installation of floor panels, supporting systems, paintings etc.

6.02.00 Method of Measurement

False flooring shall be measured in Sq.M for net area of the work done. No deduction shall be made for openings measuring up to 0.4 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.



TITLE:

**TECHNICAL SPECIFICATION FOR
BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-463-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION – D21

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SECTION - D

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BORED CAST-IN-SITU RCC PILES

SPECIFICATION NO. PE-TS-463-600-C021



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



TITLE:

**TECHNICAL SPECIFICATION FOR
BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-463-600-C021

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**TECHNICAL SPECIFICATION FOR INSTALLATION OF BORED
CAST-IN-SITU PILES**

1.00.00 SCOPE

This specification covers the installation of bored cast-in-situ reinforced concrete vertical piles of specified load carrying capacity and diameter for various structures. This specification also covers carrying out initial and routine load tests on piles to assess their vertical, horizontal and pull out load carrying capacities.

2.00.00 GENERAL REQUIREMENTS

2.01.00 This specification along with specific requirements under Annexure-A covers the technical requirements for piling work.

2.02.00 The work shall include supplying and providing necessary materials, mobilization of all necessary equipments (Annexure-B), providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour, etc. as required to carryout the complete piling work, and submission of records as per schedule.

2.03.00 The Contractor shall carryout all works as mentioned in Scope above. All works shall be executed to the satisfaction of the Engineer.

2.04.00 Pile capacities in vertical compression, horizontal, pullout loads for various pile diameters are given in Annexure-A.

2.05.00 The Contractor shall confirm and guarantee the "Safe Load" capacities by conducting both initial and working load test on piles as mentioned in the specific requirements.

2.06.00 The Contractor shall submit along with tender documents his tender design of piles based on soil data furnished by the Owner along with this specification. The ultimate load capacity of a pile may be estimated using suitable static formula and the minimum factor of safety shall be 2.5. However, safe load carrying capacity shall be conformed and guaranteed by conducting initial and routine load tests.

2.07.00 In case of initial or routine load test piles, if the Contractor fails to establish the safe load capacity as per his design, the Owner has the right to either derate the pile capacity on prorata basis or insist the Contractor to modify the pile design, to achieve the desired safe load capacity at no extra cost to the Owner.

2.08.00 Derating is acceptable up to 90 percent. In such case, additional piles shall be installed as per the design requirements.

**TITLE:**

TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES

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- 2.09.00 The Owner shall decide whether to derate or modify the design based on the design considerations such as providing additional piles in the designed pile cap, provision for extending the pile cap size, etc.
- 2.10.00 In case the Owner decides to modify the design instead of derating the pile, the contractor shall carry out the same and install separate test piles and test the same to guarantee the safe load at no extra cost to the Owner. However no extra shall be charged for the additional test piles as well as testing of these piles as per agreed contract conditions.
- 2.11.00 In case of working piles, if the pile does not meet the guaranteed capacity or rejected due to any other reason, the Contractor shall install extra piles at no extra cost to the Owner. Further, the extra cost, due to the increase in the pile cap size if any, on account of extra piles, shall be borne by the Contractor.
- 2.12.00 It is essential that all equipment and instruments are properly calibrated both at commencement and immediately after the completion of tests so that they represent true values. Certificates to this effect from an approved institution shall be furnished to the Engineer. If the Engineer so desires the Contractor shall arrange for having the instruments tested at an approved laboratory at no extra cost to the Owner and the test report shall be submitted to the Engineer. If the Engineer desires to witness such tests Contractor shall arrange to conduct the test in his presence.
- 2.13.00 The Contractor shall make his own arrangements for locating the coordinates and position of piles as per drawings supplied to him and for determining the Reduced Levels (RL) of these locations with respect to the benchmark indicated by the Engineer. Two established reference lines in mutually perpendicular direction shall be indicated to the Contractor. The Contractor shall provide at site all the required survey instruments to the satisfaction of the Engineer so that the work can be carried out accurately according to specifications and drawings.
- 2.14.00 The contractor shall assure the quality of piling work including cleaning of pile bore, quality of concrete, integrity of piles, etc.
- 2.15.00 **AVAILABLE SUB-SOIL DATA**
- An abstract of the sub soil data is furnished in the tender document. However, the detailed soil investigation report shall be made available for reference of the bidder, if so required, at the office of the Owner. The soil data furnished is in good faith and only for the guidance of the Bidder, to arrive at design parameters and construction methods.



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3.00.00 MATERIALS

3.01.00 General

All materials viz cement, steel, aggregates, water, etc. which are to be used for pile construction shall conform to relevant IS codes for properties, storage and handling of common building materials. However, aggregates more than 20 mm size shall not be used.

3.02.00 CONCRETE

Concrete shall be manufactured either by central batching plant or Ready Mix concrete. However, for initial test piles suitable method as approved by the Engineer may be used. Concrete shall conform to IS: 10262 & IS: 456.

3.02.01 Technical Specification for Cement Concrete (Plain and Reinforced) works along with IS: 2911 Part I/Sec 2 shall be followed for concrete works of piles. Use of plasticiser to control the water cement ratio shall be permitted on specific approval from the Engineer. Water cement ratio shall not be greater than 0.5.

3.02.02 Grade and minimum cement content
Minimum grade of concrete shall be as per Annexure-A conforming to IS: 456. Minimum cement content of 400 Kg/M³ of concrete shall be used for M-20 grade concrete.

3.02.03 Slump of concrete
The slump of concrete shall vary between 150 to 180 mm.

3.03.00 REINFORCEMENT

3.03.01 Longitudinal reinforcement in pile shall be high strength deformed steel bars conforming to IS: 1786 unless specified otherwise. Lateral reinforcement in pile shall be of mild steel conforming to IS: 432 Part-1 or HYSD bars as per IS: 1786.

3.03.02 The longitudinal reinforcement shall be provided considering the combination of vertical (compression and tension) and horizontal loads. However, the minimum longitudinal reinforcement shall be 0.4 percent of the sectional area calculated on the basis of nominal pile diameter. Minimum six numbers of bars shall be provided for longitudinal reinforcement. The diameter of longitudinal reinforcement bars shall not be less than 12mm. The stipulated minimum reinforcement shall be provided for the full length of pile.

3.03.03 The longitudinal reinforcement shall project 50 times its diameter above cut off level unless otherwise indicated.



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3.03.04	The laterals shall be tied to the longitudinal reinforcement to maintain its shape and spacing. The laterals may in the form of links or spirals. The minimum diameter of the links or spirals shall be 6 mm and the spacing of the links or spiral shall not be less than 150 mm and in no case more than 250 mm.		
3.03.05	Reinforcement cage shall be sufficiently rigid to withstand handling and installation without any deformation and damage. As far as possible number of joints (laps) in longitudinal reinforcement shall be minimum. In case the reinforcement cage is made up of more than one segment, these shall preferably be assembled before lowering into casing tube/pilebore by providing necessary laps as per IS: 456.		
3.03.06	The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100 mm for the full depth of cage.		
3.03.07	The laps in the reinforcement shall be such that the full strength of the bar is effective across the joint and the reinforcement cage is of sound construction.		
3.03.08	Laps shall be staggered as far as practicable and not more than 50% bars shall be lapped at a 'particular section. Lap joints shall be staggered by at least 1.3 times the lapped length (Centre to Centre).		
3.03.09	Proper cover and central placement of the reinforcement cage in the pile bore shall be ensured by use of suitable concrete spacers or rollers, cast specifically for the purpose.		
3.03.10	Minimum clear cover to the longitudinal reinforcement shall be 50 mm, unless otherwise mentioned.		
3.03.11	Bundling of bars is not permitted.		
4.00.00	PILE INSTALLATION		
	Installation of piles shall be carried out as per pile layout drawings, installation criteria, and the direction of the Engineer.		
4.01.00	Equipment and Accessories		
4.01.01	The equipment and accessories for installation of bored cast-in-situ piles shall be selected giving due consideration to the sub soil conditions, ground water conditions and the method of casting, etc. These shall be of standard type and shall have the approval of the Engineer.		
4.01.02	List and details of equipment and accessories proposed to be used for the job shall be submitted along with the bid.		

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4.01.03	The capacity of the rig shall be adequate so as to reach the specified founding level.	
4.01.04	Provision shall be kept for chiselling within the pilebore, as specified elsewhere in this specification. Chiselling shall be carried out only with the approval of Engineer.	
4.02.00	Installation Criteria	
4.02.01	For determining the founding level of piles in soil as specified elsewhere, the Contractor shall have to perform Standard penetration test (SPT) as per IS: 2131 in a separate bore hole. The SPT shall be conducted at 1.0 m interval between the depths covering 5 metres each above and below the specified founding level. The bore shall be 100 mm diameter and method of boring shall conform to IS: 1892.	
4.02.02	For determining founding level of piles in rock, as specified elsewhere socketing horizon shall be established by the Contractor by collecting rock cores of NX size in a separate borehole, and testing the same for uniaxial compressive strength (UCS). Cores shall be collected by double tube core barrel attached with diamond bit. Coring shall be done upto a depth as indicated in the "specific requirements." Coring in rock shall conform to IS: 6926.	
4.02.03	In case it is not possible to test the cores so obtained for uniaxial compressive strength, cores shall be tested for point load strength index and correlated to obtain uniaxial compressive strength.	
4.02.04	Number of boreholes for carrying out SPT in soil or uniaxial compressive strength in rock, shall vary from one in 100 to 150 piles or pile group of 150 Sqm depending on the site condition and as decided by the Engineer. However, at the location of initial load test piles, one such borehole shall be done.	
4.02.05	A protocol between contractor and BHEL site shall be maintained regarding the strata at founding level. SPT value and UCS from the nearest borehole shall be indicated therein.	
4.02.06	The founding level of the pile shall be decided based on the criteria elaborated in the specific requirements under Annexure-A. Concreting shall not be done until the above conditions for founding level are satisfied.	
4.02.07	Approval of founding level by the Engineer shall in no way absolve the Contractor of his responsibility to guarantee the Safe load capacity of the piles as indicated in this document.	



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4.03.00 Control of position and alignment

4.03.01 Piles shall be installed as accurately vertical as possible. The permissible limits for deviation with respect to position and (inclination) alignment shall conform to IS: 2911 Part I/Sec. 2, which is reproduced below for ready reference.

- a) The maximum deviation of vertical piles shall not exceed 1.5 per cent in alignment.
- b) Piles shall not deviate more than 75 mm or D/4 whichever is less (75mm or D/10 whichever is more in case of piles having diameter more than 750mm) from their designed position at the working level.

4.04.00 Boring

4.04.01 Boring operations shall be done by rotary or percussion type drilling rigs using reverse mud circulation (RMC) method. Rotary hydraulic pulley shall be preferred.

4.04.02 The Contractor shall satisfy himself about the suitability of the method to be adopted for site. If DMC (direct mud circulation) or RMC is used Bentonite slurry shall be pumped through drill rods by means of high-pressure pumps. The cutting tool shall have suitable ports for the bentonite slurry to flow out at high pressure. If on mobilisation, the Contractor fails to make a proper bore for any reason, the Contractor has to switchover to other boring methods as approved by the Engineer at no extra cost to the Owner.

4.04.03 Working level shall be above the cut off level. After the initial boring of about 1.0m a temporary guide casing of suitable length shall be lowered in the pile bore. The diameter of guide casing shall be of such diameter, so as to give the necessary finished diameter of the concrete pile. The centre line of guide casing shall be checked before continuing further boring. Guide casing shall be minimum of 1.0m length. Additional length of casing may be used depending on the condition of the strata, ground water level etc.

4.04.04 Use of drilling mud (bentonite slurry) for stabilizing the sides of the pile bore is necessary wherever subsoil is likely to collapse in the pile bore. Drilling mud to be used shall meet the requirement as given in Annexure-C.

4.04.05 The bentonite slurry and the cuttings, which are carried to the surface by the rising flow of the slurry, shall pass through settling tanks of adequate size to remove the sand and spoils from the slurry before the slurry is recirculated to the boring. The bentonite slurry mixing and recirculation plant shall be suitably designed and installed.

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4.04.06	The bentonite slurry shall be maintained at 1.5m above the ground water level during boring operations and till the pile is concreted. When DMC or RMC method is used the bentonite slurry shall be under constant circulation till start of concreting.	
4.04.07	The size of cutting tools shall not be less than the diameter of the pile by more than 75mm. However, the pile bore shall be of the specified size.	
4.05.00	Chiselling	
4.05.01	Chiselling may be resorted to with the permission of the Engineer below the socketing horizon. The chiselling tool or bit shall be of adequate size and weight so as to reach the desired depth.	
4.06.00	Cleaning of Pile bore	
4.06.01	On completion of the pile bore upto the required depth, the bottom of the hole shall be cleaned very carefully before concreting work is taken up. Cleaning shall ensure that the pile bore is completely free from sludge/bored materials, debris of rock/boulder etc. Necessary checks shall be made as given in clause 5.0 to confirm the thorough cleaning of the pile bore.	
4.06.02	Pile bore shall be cleaned by fresh drilling mud through tremie pipe after placing reinforcement and just before start of concreting.	
4.06.03	Pile bore spoil along with used drilling mud shall be disposed off from site as directed by the Engineer.	
4.06.04	Pile bore bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before and after placing the reinforcement cage.	
4.07.00	Adjacent Structures	
4.07.01	When working near existing structures care shall be taken to avoid any damage to such structures.	
4.08.00	Concreting	
4.08.01	The Contractor shall carry out concrete mix design in accordance with IS: 10262 and submit mix design calculations and get them approved from the Engineer well in advance for installation of piles. Adequate number of tests on cubes, etc. shall be carried out as mentioned in clause 5.0 to ensure concrete of the minimum specified strength in accordance with IS: 456 at requisite workability (slump).	

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4.08.02	Concreting shall not be done until the Engineer is satisfied that the bearing strata (soil/rock) met with at the termination level of pile.	
4.08.03	The time interval between the completion of boring and placing of concrete shall not exceed 6 hrs. In case the time interval exceeds 6 hrs the pilebore shall be abandoned. However, the Engineer may allow concreting provided the Contractor extends the pile bore by 0.5 m beyond the proposed depth, and clean the pilebore. The entire cost of all operation and materials for this extra length shall be borne by the Contractor.	
4.08.04	Proper placement of the reinforcement cage to its full length shall be ensured before concreting.	
4.08.05	Concreting shall be done by tremie method as specified by IS: 2911 (Part I /Sec.2). The level of drilling mud shall be maintained sufficiently above the ground water level.	
4.08.06	The concreting operations shall not be taken up when the specific gravity of bottom slurry is more than 1.2 and sand content more than 7%. The drilling mud sample shall be collected from the bottom of pilebore as mentioned in clause 5.	
4.08.07	Consistency of the drilling mud suspension shall be controlled throughout the concreting operations in order to keep the bore stabilized as well as to prevent concrete getting mixed up with the thicker suspension of the mud.	
4.08.08	It shall be ensured that volume of concrete poured is at least equal to the theoretically computed volume of pile shaft being cast.	
4.08.09	The temporary guide casing shall be withdrawn cautiously, after concreting is done upto the required level. While withdrawing the casing concrete shall not be disturbed.	
4.09.00	Cut off level (COL)	
4.09.01	Cut off level of piles shall be as indicated in drawings released for construction or as indicated by the Engineer.	
4.09.02	The top of concrete in pile shall be brought above the COL to remove all laitance and weak concrete and to ensure good concrete at COL for proper embedment in to pile cap.	
4.09.03	When the pile cut off level is less than 1.0 metre below the working level, concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection. In case COL of pile is more than 1.0 metre below working level then concrete shall be cast to a minimum of one metre above COL.	

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4.10.00	Sequence of Piling 4.10.01 Each pile shall be identified with a reference number. 4.10.02 The convenience of installation may be taken into account while scheduling the sequence of piling in a group. This scheduling shall avoid piles being bored close to other recently constructed piles. 4.11.00 Building up of Piles 4.11.01 If any pile, already cast as per construction drawing, requires any extra casting due to any change in cut off level or the cast pile top level is less than the specified level or for any other reason, then the pile shall be built-up by using atleast one grade higher concrete than that used for concreting of the same pile, ensuring proper continuity with the existing concrete and to the satisfaction of the Engineer. Necessary reinforcement as per design requirement and suitable shuttering shall be provided before casting the concrete. Surrounding soil shall also be built up to the required level by proper compaction to ensure lateral capacity of the pile. 4.12.00 Breaking off of Piles 4.12.01 If any pile already cast, requires breaking due to lowering in cut off level or for any other reason, then the same shall be carried out, not before seven days of casting without affecting the quality of existing pile such as loosening, cracking etc. and to the satisfaction of the Engineer. 4.13.00 Preparation of Pile head 4.13.01 The soil surrounding the piles shall be excavated upto the bottom of the lean concrete below the pile cap, with provision for working space, sufficient enough to place shuttering, reinforcement, concreting and any other related operations. 4.13.02 The exposed part of concrete above the COL shall be removed/chipped off and made to a uniform level at COL, but not before seven days of casting of pile. 4.13.03 The projected reinforcement above COL shall be properly cleaned and bent to the required shape and level to be anchored into the pile cap. 4.13.04 The pile top shall be embedded into the pile cap by 50mm or clear cover to reinforcement, whichever is higher. 4.13.05 All loose material, like debris due to chipping/breaking of pile head to the desired level, shall be removed and disposed off as directed by the Engineer.	

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4.14.00	Rejection and Replacement of Defective Piles	
4.14.01	The Engineer reserves the right to reject any pile which in his opinion is defective on account of load capacity, structural integrity, position, alignment, concrete quality etc. Piles that are defective shall be pulled out or left in place as judged convenient by the Engineer, without affecting the performance of adjacent piles. The Contractor shall install additional piles to substitute the defective piles as per the directions of the Engineer, at no extra cost to the Owner.	
4.15.00	Recording of Piling Data	
4.15.01	The Contractor shall record all the information during installation of piles. Typical data sheet for recording pile data shall be as shown in Appendix D of IS: 2911 Part I/Sec.2. The pile data shall also include all the details as in Annexure-D. On completion of each pile installation, pile record in triplicate shall be submitted to Engineer within two days of completion of concreting of the pile.	
5.00.00	SAMPLING, TESTING AND QUALITY ASSURANCE	
5.01.00	Facilities required for sampling and testing of materials, concrete, etc. in field and in laboratory should be provided by the Contractor. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and this Specification. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice and as per the directions of the Engineer. Tests shall be done in the presence of the Engineer or his authorized representative. In case the Engineer requires additional tests, the Contractor shall arrange to get these tests done and submit to the Engineer the test results in triplicate within three days after completion of any test.	
5.02.00	The Contractor shall maintain records of all inspection and testing, which shall be made available to the Engineer. The Engineer at his discretion may waive some of the stipulations for small and unimportant concreting operations and other works.	
5.03.00	Materials found unsuitable for acceptance shall be removed and replaced by the Contractor. The work done by this unsuitable material shall be redone as per specification requirements & and to the satisfaction of the Engineer at no extra cost to the Owner.	
5.04.00	Quality Assurance Programme	
	a) The Contractor shall submit and finalize a detailed Field Quality Assurance Programme within 30 days from the date of award of the contract, according to the requirements of this specification. This shall include setting up of a testing laboratory, arrangement of testing apparatus/equipment,	

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	deployment of qualified/experienced manpower, preparation of field quality plan, etc. On finalized field quality plan, the Owner shall identify, customer hold points, beyond which work shall not proceed without written approval from the Engineer. The testing apparatus/equipment installed in the field laboratory shall be calibrated/ corrected by the qualified persons as frequently as possible to give accurate testing results. b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in Table - 1. The testing shall be done at field laboratory or any other laboratory approved by the Engineer. However, the testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications. The materials shall be tested to meet all the specified requirements before acceptance at manufacturers premises or at independent government approved laboratory. Tests indicated in the table are for cross checking at site the conformity of the materials to some of the specifications. 5.05.00 Testing of Concrete 5.05.01 Concrete and other materials shall be tested for quality, strength and other properties. Details of testing shall be as specified under technical specification for Cement concrete (Plain and Reinforced). 5.05.02 One sample consisting of six test cubes shall be made from the concrete used in each test pile, three to be tested after 7 days and three after 28 days. 5.05.03 For working piles, minimum one sample consisting of six test cubes shall be made from the concrete for the first ten piles, three to be tested after 7 days and three after 28 days. Thereafter, minimum one sample consisting of three test cubes for every 10 piles shall be tested for the 7-days & 28-days cube strength. 5.05.04 In preparation of test cubes or specimens vibrators shall not be used. 5.05.05 Concrete shall be tested for slump at every 1-hour interval during concreting of piles. 5.05.06 The frequency of sampling and testing of concrete and materials shall be done as per technical specification for cement concrete (Plain & Reinforced). 5.05.07 The acceptance criteria shall be as mentioned in Table-1. 5.06.00 Testing for position and alignment 5.06.01 Each pile shall be checked for its position with respect to specified location. Each pile bore shall be checked for its alignment. 5.06.02 Permissible limits for deviation shall be as specified under clause no. 4.03.	



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5.07.00 Properties of Drilling mud

5.07.01 Properties of drilling mud shall be checked as per requirement under Annexure C. Prior to the commencement of piling work and thereafter minimum once in a week or as found necessary by the Engineer, one sample consisting of 3 specimens shall be tested. Acceptance criteria applicable are as specified else where with 5% variation. This relaxation is not applicable for properties of drilling mud before concreting.

5.07.02 Density of the drilling mud shall be checked in each pile before concreting.

5.08.00 Check for Pile bore

5.08.01 On completion of boring and cleaning the bottom of each pilebore shall be checked from the sample collected from near the bottom of pile bore or by any other methods as approved by the Engineer, to ensure that it is free from pilebore spoil/debris and any other loose material, before concreting. Concreting shall be done only after the approval of the Engineer.

5.08.02 For sampling of drilling mud from the pilebore the following method or any other suitable method shall be adopted.

- a) A solid cone shall be lowered by a string to the bottom of pilebore. A sampler tube closed at top with a central hole (hollow cylinder) is lowered over the cone, and then a top cover shall be lowered over the cylinder. Care shall be taken for proper fittings of assembly to minimize the leakage while lifting the cone assembly to the ground surface. The slurry collected in the sampler tube shall be tested for density and sand content.
- b) Use of borehole camera for checking the pile bore spoil and strata is acceptable on approval of the Engineer.

5.09.00 Pile Integrity test

5.09.01 Low strain integrity test shall be conducted on 50% of the jobs piles and on all test piles or as directed by Engineer. The system shall have the computer readout facility and report on the findings of this shall be furnished to the Owner. This test shall be used to identify the job piles for routine load test.

Piles shall be trimmed to cut off level or sound concrete level. No pile cap blindage work should be undertaken prior to this test. The cast in-situ piles should not be tested before 14 days of casting.

5.09.02 The test shall be undertaken by persons trained and experienced and capable of interpreting the results with specific regard to piling. This test is limited to



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testing the integrity of the shaft and is not intended to replace the use of static load testing.

5.09.03

Low Strain Integrity Test Methodology:

- a) In this test, a low stress wave is set up in the pile shaft and is also known as Sonic Integrity or Sonic Echo test.
- b) A small metal/hard rubber hammer is used to produce a light blow on top of the pile. The shock wave travelling down the length of the pile is reflected back from the toe of the pile and recorded through a suitable transducer/ accelerometer in a computer for subsequent analysis.
- c) The primary shockwave, which travels down the length of the shaft, is reflected from the toe by the change in density between the concrete and sub strata. However, if the pile has any imperfections or discontinuities within its length these will set up secondary reflections, which will be added to the return signal.
- d) By analysis of the captured signal and knowledge of the conditions of the ground, age of concrete, etc. a picture of the locations of pile shaft defects can be built up. The observed signals are amplified into digital display as velocity versus length records providing information on structural integrity of piles.
- e) The stress wave velocity and approximate pile lengths are provided as input for the integrity testing. The stress wave velocity is dependent on the Young's Modulus and mass density of pile concrete.
- f) More than one recording of signals shall be done until repeatability of signals is achieved on the same pile.
- g) The tests shall be conducted at 3-6 locations to cover the entire cross section of the pile.

6.00.00

PILE TESTING

Pile load test shall be carried out as per IS:2911 Part-4 (latest edition) or as directed by Engineer.

6.01.00

INITIAL LOAD TEST

Initial load test shall be carried out on separately cast piles for confirmation of estimated pile capacities and to fix a more accurate driving criteria viz. set/bow, total number of blows and approximate depth etc. of founding level. At least 2 nos. of tests shall be conducted for each mode (vertical compression, pull out and lateral). The maximum test load shall be as



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mentioned in bill of quantities.

6.02.00 ROUTINE LOAD TEST

Routine load tests shall be carried out on job (working) piles for 0.5% of total no. of piles (for each mode and type). Maximum test load shall be 1.5 times the design safe load capacity. Piles showing unsatisfactory results as per load test results shall be treated as defective piles. Defective piles shall be removed or left in place and replaced by additional piles as directed by Engineer at no extra cost to the owner. Any additional cost towards design implications, if any, due to above shall be born by the contractor.

7.00.00 CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

- IS: 432 - Specification for mild steel and medium tensile steel bars (Part 1 & 11) and hard drawn steel wire for concrete reinforcement.
- IS: 456 - Code of practice for plain and reinforced concrete.
- IS: 1200 - Measurement of Building and Civil Engineering works (Part 23) Piling.
- IS: 1786 - Code of practice for twisted steel high strength deformed bars for concrete reinforcement.
- IS: 1892 - Code of practice for Subsurface Investigation for foundation.
- IS: 2131 - Method of Standard Penetration Test for Soils
- IS: 2911 - Code of practice for design and construction of pile Part I/Sec 2 foundations - Bored cast-in-situ concrete piles.
- IS: 2911 - Code of practice for design and construction of pile Part IV foundation - Load test on piles.
- IS: 6926 - Code of practice for Diamond core Drilling for Site Investigation for River Valley Projects.
- IS: 10262 - Recommended guidelines for concrete mix design.



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8.00.00 RATES AND MEASUREMENTS

The clauses below shall apply for item rate contracts only. They shall not be applicable to turnkey/lump sum Contracts.

8.01.00 Rates

8.01.01 The items of work in the schedule of items, describe the work in brief. The various items in schedule of items shall be read in conjunction with the corresponding sections in the Technical Specifications, including amendments, and additions, if any. For each item in schedule of items, the unit rate shall include for the activities covered in the description of the item as well as for all necessary operations described in the specification and specific requirements.

8.01.02 The unit rates shall include for minor details which are obviously and fairly intended, and which may not have been included in the description in these documents, but are essential for the satisfactory completion of the work. Unit rates shall also include for all safety measures as required by codal provisions, local regulations, acts, bye-laws, etc. and for execution of work to the satisfaction of the Engineer.

8.01.03 The quoted rate for each item shall be inclusive of mobilization of all plant, equipment, scaffolding, labour, materials, skilled and unskilled labour, and demobilization after completion of work, supervision, establishing the level and coordinates at each work.

8.01.04 The quoted rate for piling for a particular diameter and capacity of pile shall remain valid for the actual lengths provided /to be provided irrespective of the minimum length specified elsewhere in this specification.

8.01.05 The quoted rate for piling as per description of item works shall be inclusive of providing all plant equipment, labour, materials, skilled and unskilled labour, making observations, establishing the ground level and coordinates at each location of pile by carrying levels from one established bench mark and distances from one set of grid lines furnished by the owner.

8.01.06 The quoted rate for piling shall be inclusive of bailing out all the pile bore spoil from the pilebore, keeping the borehole free from bored material/debris etc. and disposing the bored/chiselled material along with the drilling mud upto 2 Km. beyond plant boundary or as directed by Engineer, flushing the pile bore by fresh bentonite before concreting, collection of samples from bottom of pilebore, transporting to laboratory, testing and reporting of results.

8.01.07 The quoted rate for piling shall include shifting of plant and equipment from one pile location to another pile locations, providing temporary casing pipe and removal of the same after completing, concreting, supply of necessary materials,

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	equipment and manpower, cost of boring by approved method as specified, circulation of bentonite slurry and cleaning of borehole free from sludge, as specified, etc. 8.01.08 The quoted rate for piling shall also include chiselling, if any, required for socketing the pile in rock. 8.01.09 The quoted rate for the piling shall include concreting by termite method, length of pile above COL, withdrawal of guide casing, cost for preparation of pile head and disposal of debris etc., resulting from breaking off of pile upto COL, upto a distance of 2 Km from the plant boundary or as directed by Engineer. 8.01.10 The quoted rate for piling shall also include providing reinforcement and its cleaning, straightening, cutting, bending, binding with annealed wire, welding, tackwelding, providing concrete cover blocks, spacers, placing the reinforcement cage in pile casing/bore and other cost of tools and plants, materials, labours, carting the steel from store to piling site and return of unused steel to the Owners storage point, etc. 8.02.11 Plasticiser/Admixture when used as directed by the Engineer shall be included in piling rates. 8.01.12 The quoted rate for piling shall include for all quality assurance requirements, but not limited to providing for technical inspection, transportation of samples to laboratory, testing samples, maintaining and submitting all test records, etc. 8.01.13 The quoted rate for boring in separate borehole shall be inclusive of performing of SPT at regular intervals as specified and collecting rock cores from boreholes, upto the depth as specified shall be inclusive of transporting to laboratory, testing and reporting of the results. 8.01.14 Unit rate for low integrity test shall be inclusive of mobilization of the entire set of equipment, computer readout, printer, and equipment which may not have been included in the description but are essential for the satisfactory completion of the work as per internationally accepted practice. The rate quoted shall be inclusive of repeatability of test, preparation of pile top surface etc. 8.02.00 Measurement 8.02.01 Piling length shall be measurement by linear measurement from pile cut-off level to the tip of pile in meters upto second place of decimal separately for each diameter and capacity of pile. The length of pile to be cast above cut off level, as per specification, and as approved by Engineer, shall be considered for cement reconciliation only. Theoretical diameter of piles shall be considered for reconciliation of cement consumption. No extra payment shall be made for the length from existing ground to cut-off level.	



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- 8.02.02 Reinforcement steel shall be measured for reconciliation purpose only and the measurement shall be done for providing and placing reinforcement in piles, by weight in tones, up to third place of decimal in the following manner:
- i) The weight shall be arrived at by multiplying the actual length measured alongwith standard hooks, rings or spirals, spacers, cranks, bends, authorized laps, etc. by sectional weight. These shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS code's sectional weight. Nothing extra shall be payable to the contractor on account of difference in weight, if any, due to different methods adopted for issue and measurement.
 - ii) Standard hooks, cranks, bend, authorized laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tones.
 - iii) Dowels, neither shown on the drawings nor instructed by the Engineer, but required for construction facilities shall not be measured.
- 8.02.03 Breaking off of piles, due to subsequent change in design cut off level, shall be measured separately. This shall be measured in cubic metres upto second place of decimal. This will be payable only when the pile is cast and on the basis of written instruction of the Engineer for lowering of COL.
- 8.02.04 Measurements for the item of boring in a separate borehole shall be measured in metres from ground level upto the depth as specified, upto second place of decimal. Item of work of boring in soil and coring in rock shall be measured separately for the actual length of boring in soil and coring in rock.
- 8.02.05 The item for pile integrity test shall be measured in terms of no. of piles tested.



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ANNEXURE-A

Specific Requirements for Bored Cast-in-situ RCC Piles

A1.0 Minimum cement concrete grade M-25

Minimum cement content 400 Kg/M³

A1.1 Safe load

Diameter of Pile

Diameter of Pile (mm)	Vertical/ Compression (MT)	Horizontal/ Lateral (MX)	Pull out/Tension (MT)
*	*	*	*
*	*	*	*

A2. Installation criteria

The installed pile(s) shall satisfy the following criteria.

A2.1 In Soil/weathered Rock

- Minimum length of the pile shall be _____* m below COL.
- The pile shall be terminated after penetrating through the strata having SPT penetration less than ____* cm for ____* blows, for a minimum length of _____* times the diameter of the pile.

A2.2 In Rock

- Piles shall be installed and socketed into the rocks for a length (socketing length) equal to _____* times the pile diameter subject to a minimum of _____* meter below the socketing horizon.
- Socketing horizon shall consist of rock strata having minimum uniaxial compressive strength of _____* kg/sq.cm.

A3. Average cut-off level for tender design and initial load test can be assumed as _____* m below ground level.

A4. A protocol shall be signed between BHEL site and contractor regarding,

Strata at the founding depth

Installation criteria



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Socketing depth

Density of bentonite before concreting

Slump of concrete.

Time interval between end of boring and start of concreting,

* Values shall be indicated separately depending upon subsoil strata of the site.



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ANNEXURE-B

List of Equipments

Sl.No	Description	Capacity No.
1.	Piling Rigs	
2.	Chisel	3 T min 6 T max
3.	High pressure Mud Pumps	10 HP min 25 HP max
4.	Bentonite mixing plants	
5.	Concrete batching plant	
6.	Soil testing equipments	

Note:

1. The no. and capacity of the piling equipment varies for each work.
2. Additional equipments shall be mobilized if required as per the directions of the Engineer to match the work schedule at no extra cost to the Owner.



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ANNEXURE-C

Bentonite suspension used for piling work shall satisfy the following requirements

- a) Liquid limit of bentonite when tested in accordance with IS: 2720(Part V) shall be more than 300 percent and less than 450 percent.
- b) Sand content of the bentonite powder shall not be greater than 7 percent.
- c) Bentonite solution should be made by mixing it with fresh water using pump for circulation. The density of the freshly prepared bentonite suspension shall be between 1.034 and 1.10 gm/ml depending upon the pile dimensions and type of soil in which the pile is to be installed. However, the density of bentonite suspension after mixing with deleterious materials in the pilebore may be upto 1.25 gm/ml.
- d) The Marsh viscosity when tested by a Marsh cone shall be between 30 to 60 seconds.
- e) The differential free swell shall be more than 540 percent.
- f) The pH value of the bentonite suspension shall be between 9 and 11.5.



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ANNEXURE-D

PILE DATA

1. Reference No. Location (Co-ordinates) _____ area.
2. Sequence of Piling
3. Pile diameter & Type
4. Working level (Platform level)
5. Cut off level (COL)
6. Actual length below COL
7. Pile termination level
8. Top of finished concrete level
9. Date and time of start and completion of boring.
10. Depth of Ground water table in the vicinity.
11. Type of soil at pile tip
12. Method of boring operation
13. Details of drilling mud as used:
 - i) Freshly supplied mud
 - Liquid limit -
 - Sand content -
 - Density -
 - Marsh viscosity -
 - Swelling index -
 - pH value -
 - ii) Contaminated mud
 - Density -
 - Sand content -



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14. SPT* N values in soil (from the nearest bore hole).
+UCS** value in rock (from the nearest bore hole).

* Standard penetration Test
** Unconfined compression strength
15. Chiseling if any, from..... m to m
16. Date and time of start and completion of concreting.
17. Method of placing concrete
18. Concrete quantity
Actual

Theoretical
19. Ref. Number of test cubes
20. Grade and slump of concrete
21. Results of test cubes
22. Reinforcement details:
Main Reinforcement
No. _____
Dia. _____
Depth _____
Stirrups: Type
No. _____
Dia. _____
Spacing _____
23. Any other information regarding obstructions, delay and other interruption to the sequence of work.



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TABLE -1

FREQUENCY OF SAMPLING AND TESTING

SI. No	Type of material work	Nature of Test/ characteristics	Method of Test & frequency	No. of test	Acceptance Criteria
1.	Pilebore size a) diameter b) length		Physical measurement	each pile	as per specification
2.	Founding level	to establish socketing horizon/ and or founding level & upto depth 5m below founding level.	in separate borehole meant for the purpose a) SPT in soils/ weathered rock b) Core & UCS value of rock	1 borehole for 100-150 piles or group of 150 Sqm	Annexure - B
3.	Bentonite (Mud) properties. a) Basic properties of bentonite before use. b) Contaminated mud from pile bore bottom before concreting	Liquid Limit, Marsh Viscosity, Specific gravity, sand content, swelling index, pH value. Density, sand content	in lab in lab	As per Cl. 5.7 Each Pile	As per Annexure C As per annexure C
4.	Position and Alignment	-	Physical or any Approved method	Each Pile	As per Cl. 4.3
5.	Cleaning of pilebore	-	As per Cl. 5.8	Each Pile	Pilebore be free from bored materialcuttings debris/sludge
6.	Reinforcement (R/F) Spacing of longitudinal R/F cover laps binding of laterals		Physical inspection and measurement	each cage	As per approved design
7.	Concrete a) Workability b) Cubes	Slump cone test Compressive Strength test	Each pile As per spec.	As per Cl. 5.5 As per Cl. 5.5	As per specification. As per IS: 456
8.	Materials like aggregate, sand etc.	As per technical specification for concrete and relevant IS codes			
9.	Pile head		Physical	each pile	



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SITE LEVELLING & GRADING WORKS

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



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**GENERAL TECHNICAL SPECIFICATION
FOR
SITE LEVELLING AND GRADING**

1.00 GENERAL

This specification cover the works to be carried out for “**Site Levelling and Grading Works including Slope Protection**” etc for the entire plant and associated areas. The specified formation level(s) shall be achieved either by excavation or by raising with controlled fill with excavated/borrowed earth as the case may be.

2.00 SCOPE

2.01 The scope include all works involved in levelling the site to the lines, grades, cross sections and dimensions as shown on the approved drawings and/or as directed by the engineer including site clearance, setting out, earth work in excavation, stacking, loading, transportation, unloading, dewatering, drainage, filling, watering, compaction, turfing on slopes (if required), lighting, disposal of residual/surplus earth etc. It also include supplying and providing all labour, materials, supervision, services, equipments, tools and plants, testing and all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work etc.

2.02 All tools and plants, equipments and machineries to be used in this work shall be of standard quality and manufactured by reputed concerns conforming to Indian Standard (IS) codes or equivalent thereof.

2.03 Work to be provided by the Contractor

The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision, services including as required under statutory labour regulations, materials, equipments, tools and plants, approaches, transportation etc required for the completion of the work.

b) Preparation and submission of detailed scheme of all operations required for executing the work (material handling, placement, services, approaches etc) to the engineer for approval.

c) Carrying out sampling and testing on fill materials/fills to assess the quality/moisture content/degree of compaction and submission of the test results whenever required by the engineer.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc.



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2.04 Work to be provided by others

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

2.05 Codes and Standards

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) codes unless specified otherwise.

IS: 1200 Methods of measurement of building and civil engineering works,
Part-1: Earthwork

IS: 2720 Method of test for soils (Relevant parts)

IS: 3764 Excavation work- Code of safety

IS: 4081 Safety code for blasting and related drilling operations

IS: 4701 Code of practice for earthwork on canals

IS: 6922 Criteria for safety and design of structures subject to underground
Blasts

In case of conflict between this specification and those (IS codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by the specification or/and by the IS codes, any other standard practice as may be specified by the engineer shall be followed.

2.06 Conformity with Designs

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

3.00 MATERIALS

All materials required for the work shall be of best variety and approved by the engineer.

3.01 Materials for Excavation

For the purpose of identifying the various strata met during the course of excavation, the following classification is to be followed.



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a) Soil

It include all type of soil including laterite, moorum etc with/without any percentage of kankars which can be excavated by normal means such as shovel, pick axe, crow bar, spade etc and those which do not fall under **clause 3.01 (b)** and (c) etc.

b) Soft Rock

It include the rocks (including weathered rock) which are removable by splitting with the help of crow bar, pick axe, wedges, pavement breakers, pneumatic tools, hammers or such implements etc and not requiring blasting (for excavation) in the opinion of the engineer.

c) Hard Rock

It includes the rocks, which require blasting for excavation in the opinion of the engineer. Where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other method as approved by the engineer. The mere fact that the contractor resorts to blasting shall not classify the soft rock under hard rock.

However, the engineer's decision on the type of strata encountered during excavation shall be the final and binding on the contractor.

3.02

Materials for Filling

Any coarse grained or fine grained low plastic soil free from vegetation, roots, shingle, salts, organic matters, sod and any other harmful chemicals shall be used for filling. The contractor shall test the fill material to establish its suitability and submit the results to the engineer for approval. Fill material shall be got approved by the engineer. The following type of materials shall not be used for filling.

- a) Materials from swamps, marshes and bogs
- b) Expansive clays
- c) Peat, logs, sod and perishable materials
- d) Materials susceptible to combustion
- e) Any material or industrial and domestic produce which will adversely affect other materials of work
- f) Materials from prohibited areas

The earth available by cutting the high grounds within the project site and the materials (if) available from the road excavation or any other excavation under the same contract shall be used for filling depending upon its suitability as fill material. Filling with excavated rock (in the project site) shall be done only with



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the written permission of the engineer in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as far as possible and the mixture shall then be used for filling. In case the earth required for filling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. He shall obtain and submit the necessary clearances/permissions from the concerned authorities to the engineer for the borrow areas/materials acquired.

4.00

QUALITY CONTROL

All works shall conform to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Filling	(a) On quality of fill material (b) On moisture content of fill material (c) On degree of compaction achieved

5.00

EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of approaches, dewatering (if any), drainage and compaction etc within 15 days of award of the contract to the engineer for approval.

5.01

Site Clearance

Before the commencement of earthwork, the entire area of cutting and filling shall be cleared of all trees, stumps, bushes, grasses, vegetation etc with their roots, fences, logs, rubbish, water, slush etc. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below the existing ground level or 300mm below the formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The trees shall be cut in to suitable pieces as instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and



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rubbish shall be burnt or removed and disposed off to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timbers, fire woods etc shall be the property of owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

5.02

Setting Out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for the ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. The contractor shall take spot levels of the area (with respect to the bench mark/ available source as provided by the engineer) to be excavated or to be filled at an interval of not more than 10m or as directed by the engineer before starting any earth work and shall be submitted to the engineer for prior approval.

5.03

Excavation

Levelling by excavation shall be carried out where the existing ground levels are higher than the specified formation level. Excavation shall include removal of all materials whatever nature as may be and whether wet or dry shall be carried out exactly in accordance with the line, levels, grades and curves shown on the approved drawings and/or as directed by the engineer. All excavations shall be done to the minimum dimensions as required. The contractor shall obtain prior approval of the engineer for the method he proposes to adopt for excavation in different types of strata including dimensions, side slopes and dewatering if any, stacking or disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. **Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.**

The rough excavation may be carried up to a maximum depth of 150mm above the final formation level. The balance shall be excavated with special care and the final surface shall be compacted by rolling with 6 passes of 8 to 10 tonne roller. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The contractor shall be paid for the extra excavation and filling at the appropriate items of work.



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If the excavation is done to a depth greater than that shown on the drawing or as directed by the engineer due to the contractor's fault, the excess depth shall be filled up to the required level with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer at the own risk and cost of the contractor.

Suitable slope in cutting as per the requirements and as directed by the engineer shall be adopted to withhold the face of earth. The contractor shall be held responsible for any damage to any part of the work caused by the collapse of the side of excavations.

5.03.01 Excavation in Hard Rock

Excavation in hard rock shall normally be done with blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces.

5.03.02 Blasting

a) General

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to

transport the explosives as and when required for the work in a safe manner to the work spot.

Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.



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b) Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

c) Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well-ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine.

Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine. Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

* not to put their feet on the clean floor unless the magazine shoes on.



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* not to touch the magazine shoes on ground outside the clean floor.

* not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

d) Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

e) Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities. Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed



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from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be

present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.



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5.03.04

Restrictions on Blasting

- a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
- b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
- c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
- d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
- e) The last blast shall not be more than 0.50 m in depth.
- f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

5.04

Sorting of Excavated Materials

The excavated material shall be carefully sorted for use in filling the areas in the project site by removing roots, grasses, organic matters and other objectionable materials and be sorted out into different types of materials for use and as directed by the engineer. The excavated material which is not considered fit for filling purpose shall be immediately removed and disposed at such a place and in such a manner as will be directed by the engineer. The material found unusable should be got approved by the engineer before actually disposing it off. The useful materials that cannot be used directly shall be heaped in separate area as stock piles. Stockpiles shall be of regular size as far as possible for ease of measurement. The materials heaped shall be utilised as and when required and as directed by the engineer. The cost of complete item of earthwork includes the cost of rehandling of the materials and temporarily heaped and reused.

5.05

Disposal of Surplus/ Waste Materials

Surplus and other waste materials shall be removed and disposed of from the construction site to the area demarcated by the engineer. No material shall be wasted unless approved by the engineer.

5.06

Earth Work in Filling

Levelling by raising with controlled fill of approved excavated/borrowed earth shall be carried out where the existing ground levels are lower than the specified formation level. After clearing site as per clause 5.01, the original ground shall be compacted by rolling subject to a minimum 6 passes of 8 to 10 tonne roller. The approved earth/fill material shall then be spread in horizontal layers not exceeding 300mm in compacted thickness. Each layer shall be watered and thoroughly compacted with proper moisture content and such equipments as may be required to obtain a minimum of 95% of its maximum dry density as



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determined by standard Proctor's test as per IS: 2720 part-VII or 85% of relative density as per IS:2720 part-XIV as specified. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The fill material shall be tested for its optimum moisture content and maximum dry density as per IS: 2720, part-VII. Moisture content shall be checked at the source of supply in accordance with IS:2720 part- II and if found less than that required for proper compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from the hose line or from the truck-mounted water tank etc making due allowance for evaporation losses and the fill material be thoroughly mixed by means of harrows, rotary mixers or by any other suitable approved method until the layer is uniformly wet. **Flooding shall not be permitted for watering purpose under any circumstances.** If the material delivered is too wet, it shall then be dried by aeration and exposure to the sun till the moisture content is suitable for compaction. Should circumstances arise owing to wet weather the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended. Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the layers before compaction. For each of the above tests on the fill material, one sample for every 10,000cu.m shall be tested. Additional samples shall be tested whenever there is a change of source or type of material.

Before start of filling, the contractor shall submit the engineer his proposal for the methodology to be adopted for compaction. The compaction equipments as approved by the engineer shall only be employed to compact the different type materials encountered during construction. If directed by the engineer, the contractor shall demonstrate the efficacy of the plant he intends to use by carrying out compaction trials. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The compacted layer shall be tested for its dry density as per IS:2720, part-XXVIII or XXIX as directed by the engineer. Samples shall be taken at the rate of one sample for every 10,000sq.m area of each compacted layer. In addition random checks shall be carried out in compacted layers by means of Proctor needle penetration test. Contractor shall submit all the test results to the engineer immediately after completion of the tests. A sample shall be deemed to have passed the test when the dry density of the compacted fill is equal to or more than 95% of its maximum dry density. When field density measurements reveal any soft areas in the fills, further compaction shall be carried out as directed by the engineer. If in spite of that, the specified compaction is not achieved, the material in the soft areas shall be replaced with approved material compacted to the density requirements and satisfaction of the engineer.

Subsequent layers shall be placed only after the finished layer has been tested and accepted by the engineer.

Where the filling is to be done across low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed



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layer of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

5.07

Dewatering and Drainage

It shall be ensured that the area to be excavated/filled shall be free from water. The contractor shall remove the water (if any) by pumping or by any other means as approved by the engineer. At all times, the surface of cutting/filling during execution shall be maintained at such a cross fall as will shed water and prevent ponding. All existing drains/channels (if any) in the work area shall be suitably diverted by the contractor before taking up any excavation or filling. These diversions shall be such that it shall ensure effective disposal of water without any accumulation or flooding within the project site and in adjoining areas.

5.08

Finishing Operations

Finishing operation shall include the work of shaping and dressing the excavated/filled ground to the required grades, levels, lines, side slopes, crosssections and dimensions as shown on the approved drawings or as directed by the engineer.

5.09

Turfing

Turfing shall be provided at the slopes and other locations as shown on the drawings or as directed by the engineer. The turf shall be of approved quality of grass. The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically free from weeds or other undesirable matter. The grass on the sod shall have a length of approximately 50mm and the sod shall be free of any

debris. Thickness of the sod shall be as uniform as possible with 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that all the dense root system of the grasses are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than about 300mm x 250mm size but not so large so that it is convenient to handle and transport without damage.

The area to be sodded shall be previously constructed to the required slope and cross section. Prior to placing the sods, the slopes shall be **roughened** and wetted in order to have a satisfactory bond. The strips of sod shall be laid in close contact with each other and be tamped firmly in place so as to fill and close the joints between them. The turfing so laid shall be well watered and protected until final acceptance.

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5.10 Approaches

The contractor shall provide proper approaches for workmen and inspection.

5.11 Lighting

Full scale lighting are to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the edges of excavations and fills.

6.00 RATES AND MEASUREMENTS

6.01 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding sections in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.

6.02 Measurements

Method of measurements are specified in the proceeding sections. Where not so specified, the latest version of IS:1200, Part-1 shall be applicable.

a) The length, breadth and depth shall be measured correct to the nearest centimetre if measurements are taken by tape. Rounding of numericals shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter correct to the nearest of two decimal places.

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in cutting shall be computed from these levels in cubic meter.



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c) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

d) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rocks so arrived shall be taken as soil.

e) For earth work in filling, the actual measurements of fill shall be calculated by taking levels of the original ground before start of the work but after site clearance and after compaction of fills. The quantity of earth work in filling shall be computed from these levels in cubic meter.

f) For turfing, the measurement shall be made on the finished work in square meter.



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ANTI-TERMITE TREATMENT

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



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**TECHNICAL SPECIFICATION
FOR
ANTI-TERMITE TREATMENT**

1.00.00 SCOPE

The scope of work is to set up a chemical barrier against attack by subterranean termites while the building is under construction.

2.00.00 EXECUTION

2.01.00 General

All work shall in general be executed as specified in IS: 6313 Part II-1981 and as per approved specification of the agency having special know-how for the job.

All necessary work to ensure uniform distribution and proper penetration of treatment of treating solution shall be done according to the instruction of the Engineer.

Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

2.02.00 Chemicals and Rate of Application

Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated.

Chemicals

**Concentration by Weight,
Percentage**

Chlorpyrifos Emulsifiable
(IS 8944 - 1978)

: 1.0

Heptachlor Emulsifiable

Concentrate (IS: 6439 - 1978)

: 0.5

Chlordane Emulsifiable

Concentrate (IS: 2682 - 1984)

: 1.0

2.02.01 Treatment of Column Pits, Wall Trenches and Basement Excavations

Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (upto a height of about 300 mm) for column pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / M² of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / M² of the vertical surface. Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by



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rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose.

2.02.02 Treatment of Top Surface of Plinth Filling

Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / M² of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces.

2.02.03 Treatment of Soil Surrounding Pipes, Wastes and Conduits

Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building.

2.02.04 Treatment of Expansion Joints

These shall receive special attention and shall be treated in a manner approved by the Engineer.

2.02.05 Treatment at Junction of the Wall and the Floor

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from ground level up to the level of the filled earth surface.

A small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor. Rod holes made in the channel up to the ground level 150 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation.

3.00.00 ACCEPTANCE CRITERIA

The Contractor shall give a 10-year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period.

4.00.00 RATES

Rates shall be of complete work per unit area as stated in the Schedule.

5.00,00 **METHOD OF MEASUREMENT**

Complete work of anti-termite treatment shall be measured for plinth area treated.

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6.00.00	This includes treatment, to foundations, walls, trenches, basements, plinth, burried pipes, conduits etc. The extended portions of foundation and like beyond plinth limit shall be the part of complete work. I.S. CODE Relevant code applicable for this Specification. IS: 6313 (Part-II) 1981 : Code of Practice of Anti-Termite Measures in Buildings Pre-constructional chemical treatment measures.	