BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS GROUP
SUBCONTRACTS MANAGEMENT
6TH FLOOR, BHEL SADAN,
PLOT NO. 25, SECTOR 16A, NOIDA,
DISTT. – GAUTAM BUDDH NAGAR (U.P.) - 201301

TENDER DOCUMENTS

FOR

EXECUTION AND HANDING OVER OF "CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU."

CUSTOMER

TAMILNADU GENERATION AND DISTRIBUTION CO. LTD. (TANGEDCO)

TENDER SPEC. NO.: TBSM/KODAYAR/CIVIL/TENDER/25-26

DATE: 18.04.2025

TRANSMISSION BUSINESS GROUP

SUBCONTRACTS MANAGEMENT

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BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS GROUP

SECTOR-16A, NOIDA -201301

e-mail: akmeena@bhel.in

NOTICE INVITING TENDER

REF.: TBSM/KODAYAR/CIVIL/TENDER/25-26 **DATE: 18.04.2025**

SUB: TENDER FOR "CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU".

Dear Sirs,

1. **Sealed tenders are invited for the following:**

NAME OF WORK	DATE OF COMPLETION	EARNEST MONEY DEPOSIT	TENDER SUBMISSION DATE AND TIME	TENDER OPENING DATE & TIME
CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU	30.09.2025	NIL	02.05.2025 11:00 hrs.	02.05.2025 16:00 hrs. (Technical bid only)

2. Bidder **has** to submit offer directly through E-PROCURMENT MODE. Bidder may visit **https://eprocurebhel.co.in**

Procedure for Submission of Tenders through e-tendering: The tender is also floated online through our E-Procurement Site https://eprocurebhel.co.in . The bidder may respond by submitting their offer online in our e-Procurement platform at https://eprocurebhel.co.in

Offers are invited in two-parts only.

Documents Comprising the e-Tender

The tender shall be submitted online EXCEPT EMD (which shall be submitted in physical form (as described in NIT cl. No.1) above as mentioned below:

a) Technical Bid (Un priced Tender)

All Technical details (e.g. Eligibility Criteria requested (as mentioned below)) should be attached in e-tendering module, failing which the tender stands invalid & may be REJECTED. Bidders shall furnish the following information along with technical tender (preferably in pdf format):

i) Earnest money Deposit (EMD) furnished in accordance with NIT Clause.

ii) Technical Bid (without indicating any prices).

b) Price Bid:

i) Prices are to be quoted in the attached Price Bid format online on e-tender portal.

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

c) Uploading of the price bid in prequalification bid or technical bid may RESULT IN REJECTION of the tender.

d) Tenders shall be uploaded with all relevant PDF/zip format. The relevant tender documents should be uploaded by an authorized person having Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION digital signature certificate (DSC).

3. **Tender must be accompanied by the prescribed amount of Earnest Money Deposit (EMD) in the manner described in "Annexure to the Conditions of contract for civil work "which shall be part of the Technical Bid.**

   In case of E-Tenders, no paper bids shall be accepted, therefore, the scanned copy of the Banker's Cheque/ Demand Draft/ Pay Order/ Details of payment made through Electronic Fund Transfer/ Fixed Deposit Receipt (FDR) / Bank Guarantee should be uploaded in the E-Procurement Portal and hard copy of the same should reach to following address at before the due date and time of bid submission. BHEL shall not be responsible for postal or any other delays in this regard.)

TO,
Ashok Kumar Meena
Sr. DGM (TBSM)
BHARAT HEAVY ELECTRICALS LIMITED,
TRANSMISSION BUSINESS GROUP,
6th Floor, BHEL SADAN, Plot no.: **-** 25, Sector- 16A, Noida,
Distt. – Gautam Buddh Nagar, UP-201301
TELEPHONE: 0120-6748545, 9831038136
E-mail: akmeena@bhel.in

4. **Bidders may please note that no other mode of bid submission shall be considered for evaluation apart from Clause no. 2 to 3 mentioned above.**
5. The prospective bidders who have downloaded the tender documents from our website are requested to send their acknowledgement and willingness to participate in the tender to the undersigned, through fax or email.
6. Offers should be strictly in accordance with the Tender Specifications and General Instructions to Tenderer enclosed herewith.
7. BHEL shall be resorting to Reverse Auction (RA) (Guidelines as available on www.bhel.com) for this tender. RA shall be conducted among the techno-commercially qualified bidders as per RA Guidelines.

Price bids of all techno-commercially qualified bidders shall be opened and same shall be considered for RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their price bid along with applicable loading, if any, shall be considered for ranking."

8. The contractor shall give his explicit confirmation without any deviations to the HSE (Health, Safety and Environment) requirements as per enclosed specification No. TBSM/HSE/NIT-01, Rev-02, Date 31.01.2024. Contactors are also required to furnish details as per Annexure (HSE) to NIT along with their offer. Offers received without compliance & data about HSE requirements are liable to be rejected.
9. All documents submitted with the offer shall be signed and stamped in each page by authorized representative of the bidder.
10. Clarifications, if any, can be obtained from the undersigned but such requests should be submitted well before the due date for submission of tenders. Due date for submission and opening of tenders will not be extended on such grounds.
11. Please note that wherever there is a contradiction between the 'ANNEXURE TO CONDITIONS OF CONTRACT FOR CIVIL WORKS' and 'Conditions of contract for civil works', the 'ANNEXURE TO CONDITIONS OF CONTRACT FOR CIVIL WORKS' clauses shall be governing and binding on the contractor.
12. Drawings & FQP enclosed with the NIT (if provided) are for tender purpose only. Drawings & FQP may get change during execution stage and work to be carried as per latest RFC drawings & Field Quality Plan (FQP).
13. Construction/ RFC drawing/ Fronts shall be furnished progressively as per project requirement and no claim towards idling charges/ project overheads etc. borne by the contractor on account of non-availability of drawings/ fronts shall be entertained.
14. Completion period of the work has been envisaged under best possible conditions. Any changes/ deviation during execution shall be dealt as per relevant clauses mentioned in general/ special conditions of contract for civil works.
15. *"In case this tender is awarded to first time contractor*, then the bidder shall be eligible to qualify for the next tender of similar work# of BHEL, TBG; only after successful executing of 50% (fifty percent) of this work prior to the date of next tender (in which bidder desires to quote) and on satisfactory performance feedback by BHEL site Incharge."*

    ** First time contractor: The bidders who have not successfully executed more than 50% (fifty percent) of awarded similar work by BHEL (TBG/ ISG/Power Sector/Any BHEL Unit) in last 5 years from date of NIT.*

    The bidders who have taken any order from BHEL under 1st time category, and desires to further participate in BHEL tenders, needs to submit a certificate/ undertaking mentioning the reason of not executing 50% of awarded work, hence the criteria under 1st time bidder shall not be applicable to them. The certificate/ undertaking shall be duly certified by Site In charge of BHEL

    # Similar work: Similar to nature of work of the tender under consideration.

16. The offers of the bidders who are under suspension as also the offers of the bidders, who engage the services of the banned firms, shall be rejected. The list of banned firms is available on BHEL web site www.bhel.com.
17. Integrity commitment, performance of the contract and punitive action thereof:

    18.1. Commitment by BHEL:

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

18.2. Commitment by Bidder/ Supplier/ Contractor:

18.2.1. The bidder/ supplier/ contractor commits 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.

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

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

If any bidder/ supplier/ contractor during pre-tendering/ tendering/ post tendering/ award/ execution/ post-execution stage indulges in mal-practices, cheating, bribery, fraud or and other misconduct or formation of cartel so as to influence the bidding process or influence the price or acts or omits in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 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".

18. Also, offer of the bidders who are suspended (under hold/ delist) for business dealings by BHEL, TBG shall not be considered. Please note that lifting/ restoration of suspension (Ban/Hold/ De-list) of business dealing is not automatic after expiry of specified suspension period. Hence, vendor shall be considered as suspended for business till suspension is lifted by BHEL in writing on specific request of the vendor as per extant guidelines.

19. BHEL Fraud Prevention Policy, "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."

20. Offers will be scrutinized based on the qualifying requirements and only those who are technically and financially capable to execute the Job and who fulfil the Pre-Qualifying Requirements (PQR) are eligible to quote against the above NIT. However, final acceptance of the bidder/ offer shall be subject to acceptance of our customer.

21. The evaluation currency for this tender shall be INR.

22. The Submission of EMD is compulsory for subject tender. In case requisite Amount of EMD not submitted by the bidder before tender opening or along with offer, the offer shall not be considered for evaluation and the offer shall be rejected.

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

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

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

24. Technical Bid will be opened in the office of undersigned. If required, technical discussions will be held with only those bidders who have taken any deviations. The price bids will be opened subsequently, after Technical Bids of all the bidders have been evaluated and freezed. Bidders should quote their most competitive rates as there will not be any price negotiation. However, if felt necessary by BHEL, price negotiation will be held with lowest bidder (L-1) only. **IT WOULD BE PREFERRED THAT YOUR OFFER IS WITHOUT ANY DEVIATION w.r.t. TENDER SPECIFICATIONS AND THE SAME MAY BE CLEARLY MENTIONED ON THE COVERING LETTER ACCOMPANYING THE TECHNICAL BID.** Offers with deviations are likely to be rejected.

25. In case any adverse information is received concerning performance, capability or conduct of the bidder after issue of tender enquiry, BHEL reserves the right to reject the offer at any stage as deemed fit.

26. **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

Sl no.	IEM	E- mail
1	Shri Otem Dai, IAS (Retd.)	iem1@bhel.in
2	Shri Bishwamitra Pandey, IRAS (Retd.)	Iem2@bhel.in
3.	Shri Mukesh Mittal, IRS (Retd.)	Iem3@bhel.in

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

(c) Please refer Section-8 of the 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 e-mail 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): -

1) Name: - Ajay Kumar Chowdhary Department: - TBG, Subcontracting Address: - BHEL/ TBG, Noida Phone: - 01206748129 E mail: - akchowdhary@bhel.in	2) Name: - Ashok Kumar Meena Department: - TBG, Subcontracting Address: - BHEL/ TBG, Noida Phone: - 01206748545 E mail: - akmeena@bhel.in

27. Any materials (if required) for civil works have to be procured from Customer approved sources only. It will be the bidder's responsibility to get the approval of materials and vendors for materials.

28. The purchase preference for central P.S.U.s shall be given as per the prevailing Government policy.

29. Work schedule and the deployment of manpower and T&P resources committed by the contractor in their offer, to match the scheduled completion, shall be submitted by contractor and mutually agreed with site In-charge immediately after the award of work. Further, the contractor shall mobilise at site within two weeks of award of work.

30. In case an offer is not being submitted by the prospective bidders against this tender, they may send their "regret" letter to this office, for information.

31. Details of qualifying work(s) executed by the bidder will be forwarded to the principal employer for verification of the work with respect to completion, commencement & completion date and value of the work executed. Performance feedback of the bidder will also be sought from the principal employer.

32. The bidder representative may be called for discussion with the committee. His originals may be verified by the committee. In addition to above their organisation chart and detail list of manpower, tools & plants and technically capability will be discussed and ascertained by the committee.

33. **Conflict of Interest among bidders/Agents:** -

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

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

1. *The principal manufacturer directly or through one Indian agent on his behalf; and*
2. *Indian/foreign agent on behalf of only one principal;*

or

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

Thanking you,

Yours faithfully,
For and on behalf of BHEL,

(Ashok Kumar Meena)
Sr. DGM /TBSM

TO BE FILLED BY TENDERER OVER THEIR LETTERHEAD

ANNEXURE - X

REF.: TBSM/KODAYAR/CIVIL/TENDER/25-26 **DATE: 18.04.2025**

SUB: TENDER FOR "CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU."

It is certified that General Instructions and Information for tenderer have been read/ complied/ agreed to and each page of tender offer has been initialled and stamped.

Also It is being declares that we (……Bidder Name ……) will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competiveness or to introduce cartelization in the bidding process.

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

(Signature of Tenderer)

Name and Designation of Authorised person (s)
Signing the tender on behalf of the tenderer

(TO BE FILLED BY TENDERER OVER THEIR LETTERHEAD)

ANNEXURE – Y

REF.: TBSM/KODAYAR/CIVIL/TENDER/25-26 **DATE: 18.04.2025**

SUB: TENDER FOR "CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU."

Subject: Declaration confirming knowledge about Site conditions

I/We, _____ hereby declare and confirm that we have visited the Project Site with reference to above 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. Also, we have acquired information about availability of manpower, construction material, water, electricity etc.

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.

(Signature of Tenderer)

Name and Designation of Authorised person (s)
Signing the tender on behalf of the tenderer

ANNEXURE – Z

REF.: TBSM/KODAYAR/CIVIL/TENDER/25-26 **DATE: 18.04.2025**

SUB: TENDER FOR "CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU."

Subject: Authorization of representative who will participate in the Online Reverse Auction Process:

1	NAME & DESIGNATION OF OFFICIAL	
2	POSTAL ADDRESS (COMPLETE)	
3	TELEPHONE NOS. (LAND LINE & MOBILE BOTH)	
4	FAX NO.	
5	E-MAIL ADDRESS	
6	NAME OF PLACE / STATE / COUNTRY, WHEREFROM S/HE WILL PARTICIPATE IN THE REVERSE AUCTION	

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP, NOIDA
PRE-QUALIFYING REQUIREMENTS

REF.: TBSM/KODAYAR/CIVIL/TENDER/25-26 **DATE: 18.04.2025**

SUB: TENDER FOR "CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU."

Tenders (Under two-part bid system) are invited from competent contractors for subject works. Only those who are technically and financially capable to execute the Job and who fulfil the Pre-Qualifying Requirements [PQR] given under are eligible to quote against the above NIT. Tenderers should submit their offer as per the procedure specified in tender documents. The PQR of contractor for tender submission shall be is as under:

Sl. No.	Criteria	Description
A	Turn Over	Bidders should have a minimum average annual turnover (Annual Gross Revenue from operations/ Gross operating income as incorporated in the profit & loss account excluding Other Income) of **Rs. 29,71,734/-** for last three fin. years i.e. **(2021-22, 2022-23 & 2023-24)** and should submit audited balance sheet and Profit & Loss Account Sheet of these years. The audited financial statements must be signed by the owner and the auditor. Auditors seal, Name, Membership No., Firm Registration No. & firm name (if applicable), UDIN and the capacity in which he is signing (Proprietor/Partner), must be mentioned on the Profit & Loss A/c and Balance Sheet. In case of proprietorship and partnership firms where Audited Profit & Loss A/c and Balance Sheet is not mandatory as per extant rules, CA certificate certifying turnover and profit for the required financial years must be submitted. CA certificate must be on his letter head mentioning his/her name, Membership No., Firm Registration No. & firm name (if applicable), UDIN, capacity in which he is signing (Proprietor/Partner), date and place of signing.
B	Profit & Networth	Bidder should have earned profit in at least one financial year during the period of last three Financial Years as per Sl. No. A above and Net worth of the Bidder based on the latest Audited Accounts as furnished for 'A" above should be positive. Net worth = Paid up share capital + Reserves. (Net worth is required to be evaluated in case of companies)
C	Similar Work*	Bidder should have successfully completed **civil works of Switchyard or Power Plant or Industry or Infrastructure which involves predominantly concrete work during last seven years ending on 28.02.2025** and should be either of the following: i. Three similar jobs costing (except service tax/GST) not less than **₹ 39,62,312/-** each. OR

		ii. Two similar jobs costing (except service tax/GST) not less than **₹ 49,52,891/-** each. OR iii. One similar job costing (except service tax/GST) not less than **₹ 79,24,625/-**

Note:

1. The Bidder shall submit the Contract Agreement/Work Order/LOI along with BOQ and Performance/completion/execution certificate issued by customer/contractor along with technical bid in support of qualification.
2. Only those work credentials will be considered that already completed and completion certificate available for that work.
3. In order to technically qualify in this tender, bidder should meet all criteria i.e. A, B & C mentioned above.
4. If the job is completed in the last seven years period, as specified above, even if it has been started earlier, the same will also be considered meeting the qualifying requirements.
5. Consortium/ JV bidding is not allowed.
6. BHEL reserves the right to:
   (a) Accept or reject any bid received at its discretion without assigning any reasons whatsoever.
   (b) Postpone the above-mentioned date, split and distribute the work among more than one bidder without assigning any reason whatsoever.
   (c) May ask for further qualification during techno commercial scrutiny of bids received.
   (d) May ask for further proofs including TDS certificates/ Form 26AS/ Final bill/ payment detail for the said job for cross- verification.
7. BHEL shall not be responsible for any delay, loss, damage for bids sent by post.
8. BHEL shall not be liable for any expenses incurred by bidder in preparation of bid irrespective of whether it is accepted or not.
9. Quotations received from bidders who do not fulfil the PQR shall be summarily rejected without any further evaluation and information to bidders.
10. Canvassing i.e. soliciting favour, seeking advantage etc. in any form is strictly prohibited and any bidder found to have engaged in canvassing shall be liable to have his bid rejected summarily.
11. If the bidder deliberately gives any wrong information in his tender to create in circumstances for the acceptance to his bid, BHEL reserves the right to reject such application.
12. Bidder's selection is subject to approval of BHEL's customer for this work. The approval/acceptance of bidders from Customer is mandatory requirement for subject tender.
13. All corrigenda, addenda, amendments and clarifications to this Tender will be hosted in web page, www.bhel.com and https://eprocurebhel.co.in and not in the newspaper. Bidders shall keep themselves updated with all such amendments.

PROJECT INFORMATION

1.0 CUSTOMER:

M/s TAMILNADU GENERATION AND DISTRIBUTION CO. LTD. (TANGEDCO)

2.0 PROJECT LOCATION AND DETAILS:

TENDER FOR "EXECUTION AND HANDING OVER OF CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU."

SITE ADDRESS:

110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I,
TANGEDCO/110 KV, KODAYAR IN TAMIL NADU.

3.0 CONTACT PERSON: FOR CONTRACTUAL ISSUES

Ashok Kumar Meena
Sr. DGM (TBSM)
SUBCONTRACTS MANAGEMENT,
TRANSMISSION BUSINESS GROUP,
Plot No. 25, Sector-16A, Noida,
Distt. Gautambudh Nagar, UP-201301

PHONE: 0120-674-8545/ 9831038136
E-mail: **akmeena@bhel.in**

CONTACT PERSON: FOR ENGINEERING ISSUES

Vishal Garg
Sr. Manager (TBEM-Civil)
TRANSMISSION BUSINESS GROUP,
Plot No. 25, Sector-16A, Noida,
Distt. Gautambudh Nagar, UP-201301

PHONE: 0120- 674- 8461 / 9028561000
E-mail: **vishal_garg@bhel.in**

CONTACT PERSON: FOR CONTRACT EXECUTION ISSUES

Sanjeev Kumar
Sr. DGM (Sector Head-TBSS)
TRANSMISSION BUSINESS GROUP
PE & SD Building,
R.C. Puram, Hyderabad-502032

PHONE: 8330923898
E-mail: **ksanjeev @bhel.in**

HSE CONDITIONS
at a GLANCE (for bidders)



Health Safety and Environment Management

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS GROUP

Transmission Business Group, Noida

DOCUMENT CONTROL			
Document number:	**TBG/HSE/NIT-01**		
Issue number:	00	Issue date:	08.01.2020
Revision number:	01	Revision date :	22.10.2021
Revision number:	02	Revision date :	31.01.2024

	Prepared by	Approved and Issued for use by
Name	Arvind Kumar Pandey	RS Pathwar
Designation	Sr. Engineer	Dy. General Manager
Signature	-sd-	-sd-
Date	31.01.2024	31.01.2024

Doc. copy issue no. :	Doc. copy issue date :

	Name	Designation	Signature
Issued to :			
Issued by :			

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS GROUP

BHEL TBG through its long experience and policy, has developed a culture to consider wellbeing of the society, protection of environment and occupational health and safety of its workers first. TBG has also a culture of transparency in all its business activities. In line to this culture, this NIT annexure is prepared as a peeping window in to the TBG HSE requirements which need to be 100% complied by the successful bidders while executing the contract. Interested bidders should go through these HSE conditions:

1. BHEL HSE Policy



In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/ substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, contractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

Atul Sobti
Chairman & Managing Director

June 5, 2018

Creating BHEL of tomorrow

2. Legal Compliances:

a. Statutory Provisions: All the sub-contractors are to comply with client specific rules and procedures, the National legislations and codes, in particular the following or their revised versions:

Srl. No	Acts/Rules Name	Srl. No	Acts/Rules Name
1	The Factories Act 1948, Amendment Act 1947	11	Contractor labour Act, 1970 (Regulation and abolition)
2	The Environment Act 1986	12	Provident fund Act, 1952
3	Workmen's Compensation Act, 1923	13	Payment of gratuity Act, 1972
4	Building and Other Construction Workers (Regulation of employment and condition of service) Act, 1996	14	Indian Explosives Act and the explosives Rules 2008
5	Buildings and Other Construction Workers Welfare Act, 1996	15	The Gas Cylinder Rules, 2016, Static and Mobile Pressure Vessels (Unfired) Rules 2016
6	Payment of wages Act, 2017 Equal remuneration Act,	16	The Indian Electricity Act 2003 and Indian Electricity Rules 2005
7	Minimum wages Act.1948	17	The Atomic Energy Act, 2015
8	Employers liability Act, 1938	18	The atomic energy (Radiation Protection) Rules. 2004
9	Industrial dispute Act, 1947	19	National Fire Protection Association (NFPA),
10	maternity benefit amendment act 2017	20	National Building Code of India 2016 etc.

b. Indian Standard (IS) Codes related to HSE

All the sub-contractors are to comply with client specific rules and procedures, the National legislations and codes in particular the following or their revised versions:

Srl	IS Code	Applies on
1	IS: 4081 -1986	Safety code for Blasting and Related Drilling operations
2	IS: 3764 -1992	Safety code for excavation work

3	IS: 5121 -1969	Safety code for pilling and other deep foundations
4	IS: 2750 -1964	Specification for steel scaffoldings
5	IS: 3696 (Part-I)-1987	Safety code for scaffolds and Ladders: Part- I Scaffolds
6	IS: 3696 (Part-II) -1991	Safety code for scaffolds and Ladders: Part –II Ladders
7	IS: 4082 -1977	Recommendations on stacking and storage of construction materials at site (First revision)
8	IS: 4130-1976	Safety code for demolition of building (First revision)
9	IS: 4912-1978	Safety requirements for floor and wall openings, railings and toe boards (First revision)
10	IS: 5916- 1970	Safety code for constructions involving use of hot bituminous materials
11	IS: 7205 -1974	Safety code for erection of structural steel work
12	IS: 7969 -1975	Safety code for handling and storage of building materials
13	IS: 8989 -1978	Safety code for erection of concrete framed structures
14	IS: 7293 -1974	Safety code for working with construction machinery
15	IS: 2212 -1991	Pipe lines –Identification –Colour code
16	IS: 5216 -1982	Recommendations on safety procedures &practices in Electrical works (Part -I &II)
17	IS: 875 -1964	Code of practice for structural safety of buildings and loading standards
18	IS: 10386 -1983	General aspects Part-1 -1983, Part-2 -1982, Part-6 -1983, Part-10 -1983- Amenities, Protective clothing and equipment, construction, storage, handling, detection and Safety measures for gases, chemicals and flammable liquids
19	IS: 10500-2012	Drinking water (Specification)
20	IS: 10291 -1982	Code of dress in civil engineering works
21	IS: 2925-1984	Safety helmets
22	IS: 1179-1967	Welding helmets
23	IS: 7524 -1979 (Part-I)	Safety goggles
24	IS: 9167 -1979	Ear muff /Ear plugs
25	IS: 6994 -1973 (Part-I)	Canvas hand gloves, Cotton hand gloves, Chrome leather gloves
26	IS: 4770 -1991	Rubber hand gloves tested for 15,000 volts
27	IS: 3521 -1999	Full body safety harness
28	IS: 11057 -1984	Specification for Industrial safety nets

29	IS: 13415 -1992	Protective Barriers in & around buildings (Code of safety)
30	IS: 13416 -1992	Preventive measures against Hazards at work places-Recommendations part-I Falling materials hazards Prevention part-I
31	IS: 13416 -1992	Preventive measures against Hazards at work places-Recommendations part-II Fall Prevention
32	IS: 15298 -2011 (Part 1&2)	Personal Protective Equipment -Safety shoes
33	IS: 12254 -1993	Poly vinyl chloride (PVC) industrial boots
34	IS: 5557:2004	Industrial and Protective Rubber knee and Ankle boots
35	IS: 2878 -2004	Co2 Type fire extinguisher
36	IS: 2171 -1999	Dry chemical powder fire extinguisher
37	IS: 13849 – 1993	Fire extinguisher for ABC fires
38	IS: 10204-2001	Mechanical Foam type extinguisher (Foam used shall conform to IS: 4989 -1974 and Co2 cartridge shall conform to IS: 4947 -1985)
39	IS: 3786 -1983	Methods for computation of Frequency rate and Severity rates for Industrial injuries and classification of Industrial accidents (First revision)

c. The Sub-contractors need to

- Attend HSE familiarization program at TBG-HQ with his site management team. This will be a half day long awareness session on HSE requirements and compliances which the agency is supposed to fulfil during contract execution at site. The session shall be taken by TBG HSE department on intimation by TBSM. **(Rev-01)**
- Request for issuance of Form-V in their name from customer on behalf of BHEL
- Get the Labour license registration from concerned Labour office.
- Get the BOCW Registration done along with the labour license.
- Get their labourers registered under BOCW for benefits provided by the office.
- Maintain Seven registers of labours as per BOCW requirement.
- Ensure payment of wages to labours not less than the current minimum wages applicable in the premises.
- Ensure PF deduction of labourers and submission of proof to BHEL office (Wage sheet, ECR & Challan copies) duly signed.
- Submit Labour Payment Certificate by 10th of Every month.
- File timely returns, get renewals done and submit a copy to BHEL office.

- Get Workmen's Compensation policy before the start of work, covering all the labourers and staff,
  - Policy should clearly mention the project name and location,
  - should be as per labour class and wage.
  - Should cover all the height workers with clear mention of Max. height.
  - Policy should be submitted to BHEL office and renewal before expiry.
- Issue employment card to every worker.

3. Labour Welfare and Medical Facilities

a. Labour Welfare

1. Declaration of normal working hours and weekly off day, Payment day & intervals
2. Paid rest days & holidays.
3. Payment of overtime @ twice the normal wage rate.
4. No labour shall be allowed overtime >12 hrs/week, limited to 48 hrs/month.
5. Rest and lunch area.
6. Separate Male/Female Toilets and Lavatories, clearly marked in local Language and provided with signage.
7. Cold and clean drinking water facility suitable to strength and near workplace
8. Creche for children of female workers as per BOCW requirements
9. Arranging labour accommodation in hygienic environment with the facilities of Water (Drinking, Sanitation), washing and bathing area, toilets in sufficient nos., clean and safe camps and surrounding, access road, well illuminated camp and roads, mode of contact, transport facility, first aid centre, 24x7 Security etc.
10. Cooking and eating place to be maintained in hygienic condition
11. General awareness of health and hygiene.

b. Medical facilities and Health centres

- Availability of first aid box at every work location and agency office, with contents as per BOCW requirement.
- Emergency vehicle (four-wheeler) at work place
- Availability of stretchers in emergency vehicle and in office.
- Trained first aider
- Medical check-up for all the supervisors and workers including cooks, at the time of induction and annually thereafter.
- Tetanus Vaccination for all in every six months.
- Identification and tie-up with nearby reputed hospital(s) and display of their contact number in Emergency contact list.

4. House Keeping & Storage

Housekeeping is a continuous process and is the part of work. Agencies shall maintain safe and presentable housekeeping all the time in their respective areas, common work locations and passage areas. Roads, passages, staircases, entrance/exit gates shall always be maintained obstruction free. No material shall be left or stacked at the roof edges. Agency shall make arrangements to remove scraps on regular basis and dispose them at a space provided by customer, clearly fenced and marked by the sub-contractor as **"SCRAP YARD"**. Suitable arrangement like dedicated housekeeping team and tractor/hydra should be identified for this work.

Construction materials like shuttering materials, staging materials, cables, re-bars, cements bags, earthing flats and rods, FF pipes, surplus soil etc should be stored/stacked properly such that it should neither pose threat to safety of man nor should obstruct the free movement of man and machineries.

Every sub-contractor should have separate and well-maintained storage area for his own materials, T&Ps, PPEs and BHEL issued materials. Consumables like diesel, cotton, grease, oil, paint, admixtures and other fire potential materials should be stored separately with suitable firefighting facility.

Fire capacity of store area to be assessed and accordingly fire extinguishers shall be planned suiting the class and capacity of fire. Sand heaps may also be stacked in open store yards suitably to use in case of fires.

5. Site Safety

a. Induction and others safety trainings

Every sub-contractor shall make arrangement to provide induction training as per BHEL and/or customer requirement on a pre-approved and fixed module to all its new inductees irrespective of class or grade of appointment/hire. He shall also arrange the required facilities for induction training such as board, marker, dummy, posters/banners with all the mandatory PPEs.
Sub-contractor shall also arrange for periodic trainings on fire-fighting, first aid, CPR, importance and use of PPEs, electrical safety, hot work safety, Height work safety, confined space, deep excavations and barricading, concreting work safety etc.

b. Appointment of Safety Officer/Supervisor

Every sub-contractor shall appoint full time **safety officer(s)** as per **Schedule VIII** of **BOCW Act-1996**. The safety officer so appointed, shall not be assigned any duty/work other than assisting in fulfilment of legal and contractual obligations at site. He shall perform his duties in line to meet the requirements of TBG HSE MANAGEMENT SYSTEMS, such as ensuring daily TBT, conducting induction and other HSE training and awareness programs, organising HSE campaigns, health check-ups, periodic mock drills, reporting & record keeping and other such compliances as per **HSE Plan for Site Operation (TBG/HSEP-14)** on regular basis. **(Rev-01)**, **(Rev-02)**

c. Safety organisation, Safety committees and meetings

Safety officer shall report directly to the head of the projects of the sub-contractor management. There shall be some appointed or nominated **safety stewards** from each sub-group like shuttering, bar-bending, concreting, brick work, material handling, structure erection, cable laying, pipe work, maintenance, batching plant, housekeeping, etc.

A **safety committee** shall be formed including members from different agencies, BHEL and customer covering at-least 50% participation from workers. Safety committee shall meet on weekly basis or as may be decided by customer, outcomes shall be complied as committed.

d. Personal Protective Equipment.

Unless mentioned otherwise, there will be three mandatory PPEs- Safety shoes, Safety Helmet and Reflective jackets conforming to relevant IS codes as mentioned above. Every person entering in the project premises shall use above mandatory PPEs.
There will be other PPEs too, based on the work requirement like: Twin lanyard full body harness, fall arresters and life lines for height workers, Face shield for welders and grinders, Induction helmets and Electrical resistant shoes with FRP/PVC toe for electricians and commissioning engineers, Gum boots for concrete workers and manual excavators, Goggle for gas cutters and grinders, Aprons for welders, shoulder pads for material handlers, Hand gloves – Leather for binders/welders/grinders, certified Rubber gloves for electricians, PVC for concrete/cement

handlers, cotton-housekeeping team/brick coolies/erectors, cable laying men and other material handlers. Dust mask for cement handlers.

e. Material Handling

BHEL as a policy discourages continuous manual handling. Material handling contributes a major portion in the project and hence proper means (mechanical/ electrical powered) should be deployed appropriately for this work. Cranes/Faranas/hydras should not be used for material transportation for long distances(>100m), if such movement is un-avoidable, it must be accompanied by a trained signal man. Long materials should be guided by tagline. Roads for material movement should be free from obstructions. Lifting appliances must be in good condition and must have test/inspection certificates.
Lifting tackles like- D-shackles, chains, ropes, slings, belts shall be periodically inspected and shall have valid test certificate and/or third-party inspection certificates.
Painted/galvanized structures/materials to be lifted by adequate capacity nylon belts only.
If a machine undergoes a major maintenance, fresh TPI shall be required before use. Hydraulic/pneumatic machines shall be free from leakages. Daily checklist to be filled and witnessed by the concerned supervisor before start of the work.

f. Vehicle/Machinery Documents and other safety requirements

- Crawler mounted boom cranes/Tyre mounted telescopic cranes/tower cranes
  1. Valid third-party inspection certificate.
  2. Valid Insurance policy
  3. Registration Certificate (if applicable)
  4. Valid Pollution under control (PUC) (if applicable)
  5. Fitness certificate from RTO (if applicable)
  6. Operator's valid license, experience and/or competence certificate.
  7. Swing horn
  8. Reverse horn
  9. Boom aviation light
  10. Approved Load chart (inside cabin)
  11. Fire extinguisher (inside cabin)
  12. First aid kit (inside cabin)
  13. Boom angle indicator
  14. Hook Latch
  15. Reflector strips on around cabin and on boom

- Loader backhoe (JCB), crawler excavators (Poclain), Hydra,
  1. Valid third-party inspection certificate.
  2. Valid Insurance policy
  3. Registration Certificate (if applicable)
  4. Valid Pollution under control (PUC) (if applicable)

5. Fitness certificate from RTO (if applicable)
6. Operator's valid commercial license, experience and/or competence certificate.
7. Reverse horn
8. Approved Load chart (inside cabin) (Hydra)
9. Fire extinguisher (inside cabin)
10. First aid kit (inside cabin)
11. Hook Latch (Hydra)
12. Reflector strips on around cabin and on boom

- Tipper, Transit mixtures (TM), Self-loading concrete mixture (Ajax Fiori), Tractors
    1. Valid third-party inspection certificate.
    2. Valid Insurance policy
    3. Registration Certificate
    4. Valid Pollution under control (PUC)
    5. Fitness certificate from RTO
    6. Operator's valid commercial Heavy license, experience and/or competence certificate.
    7. Reverse horn
    8. Fire extinguisher (inside cabin)
    9. First aid kit (inside cabin)
    10. Reflector strips on around cabin and on body

Note: 1. Tractors may be allowed with Light Commercial/non-commercial license on customer's consent.

- Cars, Taxis, scooters, motor cycles and other public carriers
    - Valid 2/4-wheeler license (as applicable- commercial/non-commercial)
    - Registration Challan
    - Valid Insurance
    - Pollution under control

g. Man-lifts (Cherry pickers), Scissors Lifts

1. Trained operator with experience/competence certificate and license
2. Valid third-party inspection certificate.
3. Valid Insurance policy
4. Registration Certificate (if applicable)
5. Valid Pollution under control (PUC) (if applicable)
6. Swing horn
7. Reverse horn
8. Boom aviation light
9. Fire extinguisher (inside cabin)
10. First aid kit (inside cabin)
11. Reflector strips on around cabin and on boom

Note:

1. No one shall ride man-lift bucket without safety belt, safety shoes, helmet and reflective jacket.
2. Not more than 3 persons at a time will board in bucket of man-lift (without any heavy materials) including operator.
3. Operator will not leave the machine while persons are elevated and working.
4. No one other than the authorised operator will operate the man lifts/Scissors lifts.

h. Excavation

Prior permission/clearance from customer is a must for excavations in areas where underground service services such as gas/water/oil/chemical/electrical lines may be routed. Due precautions shall be taken during excavation in such area. Excavations near water bodies (ponds/canals etc.) shall be done with sand/soil bags ready to plug water from accidental damaged/burst of edges. All the excavations shall be done by either step cutting (min. 600mm step at every 1.5m depth) or slope cutting at 1:2(X:Y axis) (or greater depending upon the soil condition). Where step cutting/slope cutting is not possible due to space constraints, shoring/shuttering or sheet piling to be used to check collapse of soil.

Excavated soil shall be stacked away from edge of the pit, at-least 1.5 meters or half of the depth whichever is higher. Height of the stack shall not exceed 2m in height.

Ramps shall be provided for access of the workers in large pits and ladder of metal/good built for small pits. Ladders shall be of sufficient length protruding at least 1m above the ground level.

Pumps of adequate capacity shall be available for pumping out of water. No lone worker shall be allowed to work in any excavation. Overloaded vehicle shall not be allowed near excavated pits.

i. Bar bending and Binding

Bar bending machine shall be installed under shed/roof. It shall be properly earthed and maintained for operation. Housekeeping of the area shall be team's responsibility on daily basis. All be bar benders shall be given hand gloves (leather/cotton) in addition to mandatory PPEs. Scrap shall be segregated and moved to scrap yard on regular basis. Bar bending station shall be located away from Main plying roads/passages. The station shall be well illuminated, shall have a maintained first aid kit and potable water. Station shall be located in such a way that the movement of the material be minimised.

j. Concreting

No electric vibrators shall be allowed to use. All the concrete workers shall be issued gum boots, safety helmets, reflective jackets and PVC hand gloves. Free fall of concrete from chute shall not exceed 1m in height. Heavy machineries/ vehicles shall be kept at least 2m away from the edge. Emergency vehicle shall be available near concreting work. Late night works shall be avoided, if it is unavoidable, a prior permission from BHEL/Customer is mandatory.

k. Welding, Gas Cutting & other hot works

Welding: Only experienced welders should be deployed for welding jobs. Welders shall be provided with apron, hand gloves, arm pads, leg pads, face shield and safety shoes. Welding leads shall be joint less and insulated. Power input point shall be fully covered at machine.

Gas cutting: If LPG is being used, domestic cylinder is strictly prohibited inside the project premises, (not allowed for site kitchen too). Hose pipes shall be in good condition without cracks, cuts, punctures or joints. Ends should be clamped with worm clamps. Dial gauges shall be of good quality and duly calibrated. Flash back arresters is a must for both oxygen/acetylene or LPG/Oxygen combination. Cylinders shall be stored, transported and used in vertical position only. When not in use, they shall be capped. Empty and filled cylinders to be stored separately with distinct marking.
Cylinders shall neither be rolled on the ground nor thrown during loading/unloading.

Grinding: Grinder shall be given clear glass face shield, apron, safety shoes, ear muffs and hand gloves. Grinder machines shall have wheel guard. Plug tops to be used for power connection preferably three wire type. Only trained persons shall be allowed to use grinders, abrasive cutters. Electrical connection shall be free from cuts, joints etc.

l. Erection & Height Work

Only trained filters and experienced helpers shall be engaged in erection work. Step bolts of lattice towers shall be checked for full tightness with spring washers before use. Height pass shall be issued to the identified group of erectors who have passed medical test and have working experience at height. Name of such workers shall be displayed at appropriate place. These workers only shall be allowed to work at height. Height work shall not be permitted in high wind/bad weather condition, during raining or in night/dark.

m. Electrical Safety

BHEL usually provided single point power source and sub-contractors draw power from there. Otherwise agencies make their own arrangement for construction power like DG sets etc. Sub-contractors shall submit their load requirement (amperage & phase) to BHEL before start of work. Accordingly, they shall make arrangements to draw power and distribution arrangements too in a safe way. MCCBs and HRC fuses to be put in circuit for short circuit and overload protections and RCCBs of 30mA sensitivity to be put at each distribution panel for human safety. Earthing pits shall be installed at each distribution point and maintained below three Ohm resistivity which shall be inspected randomly. The distribution points shall be clean, free from vegetation and water logging, easily accessible and covered/protected from three sides and top for rain. Earthing of DBs shall be done by 25x3mm GI flats connected from proper earth pits. Insulation mat, PVC Sheet/Wooden plank to be placed before DBs as platform. DB Sheds shall be legibly marked with name of agency, contact no of electrician and SLD of that DB. Only industrial plugs and sockets shall be allowed. Three wire (Phase, neutral and earth) system shall be used for tools, lights and machineries and two wire power draws shall be strictly prohibited. PTW and LOTO system shall be maintained to work on LT system. Name and contact no of authorised electricians who will be responsible of electrical power facility maintenance shall be submitted to BHEL by Agencies. Unauthorised sharing of power from one agency to other is strictly prohibited. Electricians shall use standard PPEs and insulated

tools only. Standard and tested/certified discharge rods to be used in the areas where there is a possibility of residual current or induction charge. The induction rod to be connected to the earth first and removed in the last. Induction helmets only to be used in the charged area. Electricians to be provided with electrical resistant safety shoes having FRP/PVC toe.

n. Dust Gases and fumes

Sub-contractor shall make arrangements to avoid accumulation of dust fumes and gases. Cement handlers inside store or at batching plant and gravel spreader shall be given effective nose masks and jaggery (at least 200g per person per day). DG sets and other machineries like cranes excavators etc. shall have valid and effective PUC certificate and shall have maintained engine with silencer. No IC engine operated machine shall be used in confined and covered area like hall, sheds, store etc. where accumulation due to lack of ventilation can increase to harmful levels. Dedicated arrangements (tanker or tractor with sprinkler) shall be made by the sub-contractors (individual or jointly) to continuously subside the dusts arising out of the movement of the vehicle's roads/passages. Welding activities near roof accumulates harmful gases. Welders in such positions shall be provided with effective masks conforming to IS standards.

o. Vehicular Traffic

Speed limits defined within the premises shall strictly be followed by the drivers/commuters of construction as well as other vehicles.
Every construction machinery, man-lift shall display the name, contact no and passport size photograph of the authorised operator (There can be one or more authorised operators).
No one other than operator and co-operator shall sit inside the cabin of any construction machine while it is working.
Construction machineries (tractor, trucks, tippers, JCBs, hydra, Fassi cranes etc. shall never be used as mode of public transport. Machineries like Ajax Fiori and hydra shall not be driven in back direction except for small distances. No overloaded vehicle shall be permitted entry in the project premises.
Over speeding shall be reported and driver/operator shall be barred from entry or shall be penalised.
Drunken drivers shall be barred from entry in the project.
Carrying harmful weapons like knives (>6"), guns etc. shall permanently disqualify the person from entry in project premises.

p. Barricading and floor openings

Every pit deeper than 4 feet (1.2m) shall be barricaded immediately after excavation and will remain barricaded till backfilling.

Pits/trenches drains near roads, passages whether temporary or permanent shall be hard barricaded and well illuminated. Roof edges and openings shall be strictly hard barricaded and illuminated. Height works like masonry works, structure erection, erection by cranes, Lattice tower/beam erection areas shall be barricaded to restrict entry. Areas under charging/commissioning shall be barricaded and caution boards shall be displayed on newly charged areas.

q. Scaffold & Ladder

No bamboo/wooden scaffold shall be allowed to be used. Only tubular steel scaffolds with couplers conforming to the relevant IS codes shall be allowed with base plates. Standard steel or wooden planks to be used as platforms and no packing materials shall be used. All the platforms shall be built with provisions of **top rail at 1m height, mid rail at 0.5m height and toe boards of min 6" height** at floor level. Minimum width of platform shall be 900mm and if wheel barrow is to be used then 1200mm. Means of access to be provided in the form of ladders, ramps or staircase. Multilevel work platforms or those platforms having passage underneath shall be provided with safety net, screen or canopy at each level for protection from falling objects. Platforms shall be free from concrete, debris or other materials. Platforms shall not extend out of the putlogs and shall be secured and fastened. Decking shall be made non-skidding.
Scaffolds under erection shall be tagged **"RED"**, under repair/maintenance/inspection shall be tagged **"YELLOW"** and ready for use shall be tagged **"GREEN"**

Only metal ladders in the construction site and FRP ladders in charged areas shall be allowed. Ladders made from packing materials shall not be used. Ladders shall be securely fixed at bottom, top and long ladders at middle points too at an interval not more than 2400mm and must have a landing at every 6m. Inclination angle should be approximately 1:4 (X:Y) or 75deg. Ladder must extend at least 1m above the platform/access area. Gap between two rungs shall not exceed 300mm. Portable ladder should not be more than 4m in length. Minimum width of the ladder shall not be less than 300mm.

Use of Mobile aluminium scaffold is preferably advisable for erection of transformers/reactors.

r. Illumination

The sub-contractor shall ensure that the areas such as work stations, buildings, batching plants, passages/roads, stores, rest areas, power sources, staircases etc. are illuminated sufficiently to make safe work conditions at site and shall not be less than the relevant IS standards. Excavations/ below ground level structures near passages/roads shall also be sufficiently illuminated.

s. Safety banners/posters, caution boards

Sub-contractors shall display boards and banners in sufficient quantity having safety signs, slogans, important messages, pictures, cautions at prominent locations to promote safety and spread awareness for important precautions such as "Deep Excavation Ahead", Speed Limit", "Charged Area", "Do not operate", "Hard hat area", "No smoking Zone" etc. Boards containing messages of Emergency contacts, First aid facility, rates of minimum wages, working hours, rest day etc. should be displayed at specific areas.

t. Waste management and disposal

Sub-contractor shall make suitable and effective arrangement to remove waste material from site on regular basis and store them in an identified and safe location. Disposal of wastes shall also be done as per manufacturer's instructions or as per the guidelines laid by legal authorities. Re-bars, Cement bags, packing material (wooden/metal/plastic/paper), paint, oil, grease, cables (armour, sheathing, insulation),

civil debris, metal chips, GI sheet scraps, batteries etc. are the common waste materials. Sub-contractor shall arrange disposal of the hazardous wastes/materials in conformance to the legal and contractual requirements only.

u. Inspection of PPEs, T&Ps, Machineries and lifting appliances

All the PPEs, T&P and lifting appliances purchased newly by sub-contractors shall have test certificates which shall be submitted to BHEL office periodically or on demand. There shall be at least monthly joint inspection schedule for inspection of healthiness of all the PPEs, T&Ps and lifting appliances. All the lifting appliances shall be tested and examined by a competent person before taking into use for the first time or after it has undergone any alterations or repairs liable to affect its strength or stability

and also once at least in every twelve months. To confirm quality of the PPEs as per the relevant IS codes, BHEL may ask sub-contractors to get any or all types of PPEs tested through NABL approved lab as per relevant IS codes. At any stage, the 100% cost of such tests shall be in the scope of respective sub-contractors.

v. Cable Laying

Sub-contractor shall ensure cable trenches free from water, mud, debris, snakes, Scorpios, lizards before start of the work in trenches. Cable drum rollers shall be used to pull cables out of drums to avoid twisting of cables. Hand gloves, Safety shoes/gum boots, reflective jackets, safety helmets shall be provided to the workers. Cable laying area shall be well illuminated.

w. Fire Protection

Every sub-contractor has to maintain their working area, store and office area free from bushes. Stacking of flammable materials like wood, paper, plastic, paint, oil, grease, fuel, cotton, gases etc. at isolated place disconnected from other storage and office areas. Adequate arrangements of firefighting means like suitable extinguishers, fire/water buckets, water tanks, sand dunes etc. shall be made by the agency depending upon the fire capacity assessed or as per MSDS. Fire drills and trainings on how to operate fire extinguishers and how to react in case of fire breakouts shall be the part of regular training program. Guards and store persons must be a regular participant of such training programs. A list of trained firefighting persons and periodicity of such training programs shall be submitted to BHEL by every agency and same to be adhered. Sufficient number of fire extinguishers with suitable class shall be placed at such locations where there can be fire hazard like stores, pantry, office, DG set, electrical distribution panels etc.

x. Fencing of exposed rotating parts

Exposed rotating parts poses great threat to the person in vicinity. Such parts need to be fenced/covered. Guards are mandatory of grinders, abrasive cutters. Flywheels of the engines of heavy machines, Diesel engines, DG sets need to be covered. Electric winch machines, pulleys, chains, shafts, exhaust fans at reachable height, table fans, need to be caged/fenced. Such fencing/guard shall not be removed while machinery is in operation.

y. Emergency preparedness response plan and periodic mock drills.

Sub-contractor shall comply JSA (Job Safety Analysis) and arrange to mitigate the effects of identified possible hazards. He shall also define following in response to emergency preparedness:
An emergency assembly point and put a board of the same with information to all in induction training.
Have facility of ambulance or tie-up with nearest hospital for service in minimum possible time (Max-30min) if there is not ambulance inside the premises.
Ensure availability of emergency vehicle with driver all the time at site during work.
Conduct mock-drills on possible risks like electrocution, fall from height, fire, heat stroke etc., record responses and take photographs to submit in BHEL office. Stretchers availability in emergency vehicle or at work place should be well accessible. Provide fire extinguishers of right type at right place in right quantity with information to all. Display emergency contact nos. to various risk locations and at office, service building or at major work locations. Provide first aid training by doctors for and display names of such trained first aiders and fire fighters. Rescue kit with trained staff or man lift or both to rescue a man hanging by safety belt at height. Provide running water tap near chemical storage and handling points. Agencies shall follow emergency response plan prepared by BHEL in each area of work, store and office.

z. Safety reports & Reporting of accidents

BHEL will provide ''formats and checklists'' for the purpose of records/documents pertaining to the compliance of aforesaid clauses. Agencies shall be responsible for strict adherence and compliance for timely generation and fill-up of the checklists and reports. These shall be submitted on weekly and monthly basis as specified in the formats.

Agency shall also promote such an environment that the near misses, incidents and accidents are reported by every person, whosoever witnesses them. These shall help in analysing the trend and taking measures in reducing/stopping the accidents/incidents. Initial reporting can be in any form-by call, SMS, WhatsApp, e-mail, letter etc.
Major and fatal accidents or high potential incidents shall be investigated for route cause and outcomes shall be immediately implemented to check recurrences.

6. General conditions and penalty clauses

Following are the general conditions:

PPEs shall not only bear the ISI mark but also be conforming to the required standards, 100% compliance of the PPEs is mandatory.
Over speeding of vehicles shall attract penalty/notice and recurrence will attract debarring from entry into project premises.
Hiding of facts like incidents, accidents, fake/forged reports/certificates shall also attract penalty/ notice or both. Only approved third party agencies shall be allowed to inspect the machines, T&Ps. Reports shall directly be sent to BHEL/customers by the third parties.

Insurance and TPIs to be renewed before expiry. Machines, T&Ps shall not be allowed to work if renewal delayed. Continuity of WC policy to be maintained religiously by the respective agencies.

Agency shall submit the status report of his labour license, BOCW registration, WC Policy, insurance & TPI validity on monthly basis with list of machineries and T&Ps

Sub-contractors shall also maintain a buffer stock of all the PPEs in at least 20% excess to the present strength of the work force.

If construction power is not drawn as per the guidelines laid in clause no. 5(m), given above, BHEL may take-up this work at the risk and cost of the agency and/or may withhold a sum of min. Rs. 50,000/- (Rs. Fifty Thousand) or more as the site in-charge deems fit till the system is aligned as per aforesaid requirement.

Agencies shall be responsible for the compliance of the above requirements. Failure in one or more clauses/area shall attract a notice or monitory penalty or a combination of above.

Monitory penalty will be

- Rs. 1000/- per person/incident per day for non-conformity in above areas.
- A Major/severe accident shall attract a penalty of Rs. 2,00,000/- per head
- Fatality or permanent disability with total loss of earning capacity, if any, will attract a penalty of Rs. 5,00,000/- (Rs. Five Lakh).
- Further fatality/permanent disability shall attract double the last penalty imposed on the agency.
- Above penalties are exclusive of medical expenses of the victim or compensation to the family through insurance policy (WC Policy or group insurance).
- **Penalties imposed by customer shall be fully transferable to the sub-contractor. In the event of above cases, penalties shall be imposed whichever will be higher.**
- Evaluation of agency's performance on HSE compliance shall be done as per BHEL guide lines/system.

Revision History

Revision Date	Revision No.	Old Text	New Text	Reason	Revised by (with sign)
03.05.2019	00	N/A	Full Document	New Release	
12.10.2021	01	Nil	Attend HSE familiarization program at TBG-HQ with his site management team. This will be a half day long awareness session on HSE requirements and compliances which the agency is supposed to fulfil during contract execution at site. The session shall be taken by TBG HSE department on intimation by TBSM. (at page no. 5)	For better understanding of HSE requirements to agency. (HSE Review meeting dated 23.08.2021)	
12.10.2021	01	Edition	Inclusion of penalty provisions in case of non-deployment of safety person(page-8)	Introduction of HSEP-14	
17.01.2024	02	Edition	Appointment and duties of qualified safety officer (Page-8)	As per BOCW 1996	

-:End of Document:-

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SECTION- A

GENERAL INSTRUCTIONS TO TENDERERS

SECTION - A

GENERAL INSTRUCTIONS & INFORMATION FOR TENDERER

A.1.0: PROCEDURE FOR SUBMISSION OF TENDERS

Bidder **has** to submit offer directly through E-PROCURMENT MODE. Bidder may visit **https://eprocurebhel.co.in**

Procedure for Submission of Tenders through e tendering : The tender is also floated online through our E-Procurement Site https://eprocurebhel.co.in . The bidder may respond by submitting their offer online in our e-Procurement platform at https://eprocurebhel.co.in
Offers are invited in two-parts only.
Documents Comprising the e-Tender
The tender shall be submitted online EXCEPT EMD (which shall be submitted in physical form (as described in NIT cl. No.1) above as mentioned below:

a. Technical Bid (Un priced Tender)
All Technical details (eg. Eligibility Criteria requested (as mentioned below)) should be attached in e-tendering module, failing which the tender stands invalid & may be REJECTED. Bidders shall furnish the following information along with technical tender (preferably in pdf format):
i. Earnest money Deposit (EMD) furnished in accordance with NIT Clause 4.0
ii. Technical Bid (without indicating any prices).

b. Price Bid:
i. Prices are to be quoted in the **attached Price Bid format online on e-tender portal**.
ii. The price should be quoted for the accounting unit indicated in the e-tender document.
iii. Note: It is the responsibility of tenderer to go through the Tender document to ensure furnishing all required documents in addition to above, if any. Any deviation would result in REJECTION of tender and would not be considered at a later stage at any cost by BHEL.
iv. A person signing (manually or digitally) the tender form or any documents forming part of the contract on behalf of another shall be deemed to warrantee that he has authority to bind such other persons and if, on enquiry, it appears that the persons so signing had no authority to do so, the purchaser may, without prejudice to other civil and criminal remedies, cancel the contract and hold the signatory liable for all cost and damages.
v. A tender, which does not fulfil any of the above requirements and/or gives evasive information/reply against any such requirement, shall be liable to be ignored and rejected.

c. Uploading of the price bid in prequalification bid or technical bid may **RESULT IN REJECTION** of the tender.
d. Tenders shall be uploaded with all relevant PDF/zip format. The relevant tender documents should be uploaded by an authorized person having Class 3- SHA2- 2048 BIT- SIGNING & ENCRYPTION digital signature certificate (DSC).

A.2.0: PROCEDURE FOR EVALUATION OF PRICE BIDS:

The following shall be Evaluation *Procedure* of the prices offered: -

Payment terms, Completion Schedule and other contractual terms & conditions shall be as per Tender Specifications.

No deviations are acceptable. Offers with deviations are likely to be rejected.

However, if the bidder insists on any technical or commercial deviations from the specifications and / or tender conditions, **the price implication, if any, of withdrawing the deviations must be submitted along with the price bid in a separate sealed envelope** super-scribed "Price implication for withdrawal of deviations". No price implication for withdrawal of deviation shall be accepted at a later date, after opening of technical bid.

The offers of new vendors may not be considered even after opening of price bid if the vendor is not found suitable on final assessment.

A.3.0 This tender specification as a whole, furnishing all the details and other documents as required in the following pages, shall be duly signed & sent in a sealed cover superscribing the name of work as given in the tender enquiry.

A.4.0 The tender shall be addressed to: OFFICER INVITING THE TENDER AS INDICATED IN THE TENDER ENQUIRY.

A.5.0 DELETED

A.6.0 Tenders shall be opened by the concerned officers of BHEL at the time, date and venue as specified in the tender notice.

A.7.0 The tenderer shall closely pursue all the clauses, specifications and drawings indicated in the Tender Documents before quoting. Should the tenderer have any doubt about the meaning of any portion of the Tender Specifications or find discrepancies/omission in the drawings or the tender documents issued are incomplete or shall require clarification on any of the technical aspect, scope of work etc. he shall at once contact the authority inviting the tender for clarification before the submission of the tender.

A.8.0 Before tendering, the tenderer are advised to inspect the site of work & the environments and be acquainted with the actual working and other prevalent conditions, facilities available, position of material and labour. No claim will be entertained later on the grounds of lack of knowledge.

A.9.0 Tenderer must fill up all the schedules and furnish all the required information as per the instructions given in various sections of the tender specification. Each and every page of the Tender Specification must be SIGNED AND SUBMITTED ALONG WITH THE OFFER by the Tenderer in token of complete acceptance thereof. The information furnished shall be complete by itself.

A.10.0 The tenderer shall quote the rates in English Language and international numerals. Total price offered should be entered in figures as well as in words. In case of difference in price between words & figures, the price in words will be treated as valid price. For the purpose of the tender, the metric system of units shall be used.

A.11.0 All entries in the tender shall either be typed or be written in ink. Erasers and overwriting are not permitted and may render such tender liable to summary rejection. All cancellations and insertions shall be duly attested by the tenderer.

A.12.0 **DATA TO BE ENCLOSED:**

A.12.1 An attested copy of the Power of Attorney, in case the tender is signed by an individual other than the sole proprietor, shall be attached.

A.12.2 IN CASE OF INDIVIDUAL: His full name, experience, address and nature of business.

OR

IN CASE OF PARTNERSHIP FIRMS: The names of all the partners with address and their experience. A copy of the partnership deed/instrument of partnership duly certified by the Notary shall be enclosed.

OR

IN CASE OF COMPANIES: Date & place of registration including date of commencement certificate in case of Public Companies and the nature of business carried on by the company. Certified copies of Memorandum and Articles of Association are also to be furnished. Also indicate names, addresses and experience of the Directors.

A.12.3 Three years financial turn over (certified), present commitments with all orders in hand, value of total order, value completed, and balance with completion dates as per ANNEXURE-A.

A.12.4 **ORGANIZATION CHART & METHODS STATEMENT:**

The organization pattern and the manpower that are totally available with him & that will be deployed by the tenderer for this work in the form of month wise and category wise deployment plan duly indicating the number of Engineers, Supervisors, Skilled and Unskilled Workers etc. as per proforma at ANNEXURE-B shall be submitted. Work schedule (detail bar chart) and a methods statement showing how the contractor proposes to mobilise (considering the difficulties in work that may be encountered) and complete the jobs giving an idea of extent of proposed mechanisation for the execution of the jobs shall also be submitted along with ANNEXURE-B.

A.12.5 A list of machines, tools and tackles that the tenderer is having and those that will be deployed on this job giving proof of ownership or any tie-up of equipment as per proforma enclosed at ANNEXURE-C.

A.12.6 Analysis of unit rate quoted as per proforma enclosed at ANNEXRE-D.

A.12.7 Declaration sheet as per proforma enclosed at ANNEXURE-E.

A.12.8 Check-list as per proforma enclosed at (ANNEXURE-F).

A.12.9 Certificate from Schedule Bank to prove his financial capacity to undertake the work or Solvency Certificate from the concerned Government Authority.

A.12.10 A certificate of Income Tax / Sales Tax verification from the appropriate authority in the forms prescribed duly indicating annual turnover. These certificates shall be valid for one year from the date of issue or for the period prescribed therein for all tenders submitted during the period.

A.12.11 In addition to the above, the particulars required elsewhere in the tender documents.

A.12.12 NOTE: In terms of clauses A.12.1 to A.12.11 above, all the data required to be enclosed with the tender need to be furnished neatly typed, signed & stamped in the given formats only (in the form of separate sheets) failing which the tender may be considered as incomplete and is liable for rejection. Documentary proof wherever necessary also need to be enclosed.

A.13.0 **EARNEST MONEY DEPOSIT:** **For EMD Clause Please refer Annexure to GCC for Civil work**

Every tender must be accompanied by the prescribed amount of Earnest Money Deposit (EMD) mentioned in NIT

1. Mode of EMD deposit:

EMD can be submitted in any one of the following modes:

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

ii) Electronic Fund Transfer credited in BHEL account (before tender opening). Details of BHEL account mentioned in tender document.

iii) Banker's cheque/Pay order/Demand Draft, in favour of `BHEL' and payable at New Delhi (Along with offer)

iv) Fixed Deposit Receipt (FDR) issued by schedule Banks/Public Finance Institutions as defined in the companies ACT (FDR should be in the name of the contractor, a/c BHEL

v) In case total EMD amount is more than Rs. 2 Lakh, the amount in excess of Rs. 2 lakh may be accepted in the form of Bank Guarantee from scheduled bank. The Bank Guarantee in such cases shall be valid for at least six months.

No other form of EMD remittance shall be acceptable to BHEL.

2. Forfeiture of EMD

EMD by the bidder will be forfeited as per NIT conditions, if

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

ii) The contractor fails to deposit the required Security deposit or commence the work within the period as per LOI/contract.

3. EMD by the tenderer shall be withheld in case any action on the tenderer is envisaged under the provision of extant “Guidelines on Suspension of business dealing with supplier/contractors” and forfeited/ released based on the action as determined under these guidelines.

4. In the case of unsuccessful bidders, the Earnest Money will be refunded to them within a reasonable time after award of work.

5. EMD shall not carry any interest.

6. EMD of successful bidder shall be retained as part of Security Deposit.

7. Bidders may please note that “One Time EMD” provision stands deleted. Hence, bidders who have deposited Rs. 2 Lakh as `One Time EMD' with BHEL are also required to submit the requisite amount of EMD.

8. **No MSE benefits shall be given to MSEs bidder for WORKS CONTRACT. Please refer clause no. P (facilities provided to MSEs) for detail.**

A.14.0 **AUTHORIZATION AND ATTESTATION:**

Tenders shall be signed by persons duly authorized/empowered to do so. Certified copies of such authority & relevant documents shall be submitted along with the tenders.

A.15.0 **VALIDITY OF OFFER:**

THE OFFER SHALL BE KEPT OPEN FOR ACCEPTANCE FOR A MINIMUM PERIOD OF **FOUR MONTHS** FROM THE DATE OF OPENING OF TENDERS. In case BHEL calls for negotiations, such negotiations shall not amount to cancellation or withdrawal of the original offer which shall be binding on the tenderer.

A.16.0 **EXECUTION OF CONTRACT:**

The successful tenderer's responsibility under this contract commences from the date of issue of the Letter of Intent by BHEL. The successful tenderer shall be required to execute an agreement in the prescribed form as per ANNEXURE-G with BHEL within a reasonable time after the acceptance of his tender and in any case before submitting the first bill for payment. The expenses for completion, stamping and registration of the agreement with prescribed authority if necessary, shall be borne by the contractor.

A.17.0 **SECURITY DEPOSIT:** **For Security Deposit clause Please refer Annexure to GCC for Civil work**

Security Deposit means the security provided by the Contractor towards fulfilment of any obligations in terms of the provision of the contract.

1. Upon acceptance of Tender, the successful Tenderer should deposit the required amount of Security Deposit for satisfactory completion of work. **The total amount of Security Deposit will be 5% of the Contract Value. EMD of the successful tenderer shall be converted and adjusted towards the required amount of Security Deposit.**

2. Mode of Security deposit:

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

"Bidders agrees to submit performance security required for execution of the contract within the time period mentioned. In case of delay in submission of Performance security, enhanced performance security which would include interest (SBI rate + 6%) for the delayed period, shall be submitted by the bidder. Further, if performance security is not submitted till such time the first bill becomes due, the amount of performance security due shall be recovered as per terms defined in NIT / Contract, from the bills along with due interest".

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

i) Cash (as permissible under the extant Income Tax Act)

ii) Local cheques of scheduled banks (subject to realization) / Pay Order / Demand Draft / Electronic Fund Transfer, in favour of BHEL.

iii) Bank Guarantee from Scheduled Banks / Public Financial Institutions as defined in the Companies Act. The Bank Guarantee format for Security Deposit is enclosed.

iv) Fixed Deposit Receipt issued by Scheduled Banks / Public Financial Institutions as defined in the Companies Act. The FDR should be in the name of the contractor, A/C BHEL and duly discharged on the back.

v) Securities available from Indian Post Offices such as National Savings Certificates, Kisan Vikas Patras etc. (Certificates should be held in the name of Contractor furnishing the security and duly endorsed/hypothecated/pledged, as applicable, in favour of BHEL and duly discharged on the back).

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

3. Submission of Security Deposit:

i) At least 50 % of the required Security Deposit, including the EMD, shall be submitted before start of work. Balance of the Security Deposit can be submitted by way of deduction of 10% of the gross amount progressively from each running bills of the contractor till the total amount of the required Security Deposit is collected.

ii) If the value of work done at any time exceeds the contract value, the amount of Security Deposit shall be correspondingly enhanced and the additional Security Deposit shall be immediately deposited by the Contractor or it shall be recovered from payment/s due to the Contractor.

iii) The recoveries made from running bills (cash deduction towards balance SD amount) can be released against submission of equivalent Bank Guarantee in acceptable form, but only once, before completion of work, at the discretion of BHEL.

4. The BG shall be submitted only through the Banker. Along with the BG, the Bank shall also furnish a letter of confirmation (in the prescribed formats enclosed with general conditions of contract).

5. The validity of the Bank Guarantee furnished towards Security Deposit shall be up to three months more than the period of completion of work as stipulated in the LOI and the same will be kept valid by proper renewal till the completion of the work.

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

7. Conditions for acceptance of bank guarantees

Contractors are advice to obtain Bank Guarantee preferably from any of the following BHEL consortium banks

Sl. No.	Nationalized Bank	Sl. No.	Public Sector Banks
1	Allahabad bank	20	IDBI
2	Andhra bank		
3	Bank of Baroda		**Foreign bank**
4	Canara Bank		
5	Corporation bank	21	CITI Bank N.A
6	Central bank of India	22	Deutsche Bank AG
7	Indian Bank	23	The Hongkong and Shanghai Banking Corporation Limited
8	Indian Overseas Bank	24	Standard Chartered Bank
9	Oriental bank of Commerce	25	J P Morgan
10	Punjab National Bank		
11	Punjab & Sindh Bank		**Private bank**
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
19	Vijaya Bank		

Bank Guarantees from Banks outside BHEL's consortium shall be as below:

The Bank Guarantees of all Public sector banks can be accepted (in addition to consortium banks)

The Bank Guarantees of Co-operative banks shall not be accepted.

Bank Guarantees of other than consortium bank and public sector bank can be accepted subject to an overall exposure limit (at New Delhi) of Rs. 10 crores for banks with networth of more than Rs. 500 crores as on last balance sheet date and Rs 5 crores for banks with net worth between Rs. 350 to Rs 500 crores (A certificate and copy of latest Balance Sheet to be given by the Bank at the time of submission of Bank Guarantees).

In case of private sector banks a clause to be incorporated in the text of Bank Guarantee that it can be enforceable by being presented at any branch of the bank.

In case of foreign vendors the bank guarantees issued by foreign banks may be confirmed by our consortium bank in India.

In case of Bank Guarantees given by Non-Consortium banks (Private sector or Public sector), the Bank Guarantees are to be enforceable in New Delhi or the town/ city in which the sector office is located.

1. **RETURN OF SECURITY DEPOSIT:**

If the contractor duly performs and completes the work in all respects to the entire satisfaction of BHEL and presents an absolute "No demand certificate", returns properties belonging to BHEL, taken, borrowed or hired by him for carrying out the said works, and furnishes performance bond BG in the prescribed proforma as per ANNEXURE-J, Security Deposit will be released to the contractor after deducting all costs, expenses and other amounts that are to be paid to BHEL under this contract or other contracts entered into with the contractor. It may be noted that in no case the Security Deposit shall be refunded/released prior to passing of final bill.

A.18.0 No interest shall be payable by BHEL on EMD, Security Deposit or on any money due to the contractor.

A.19.0 **REJECTION OF TENDER & OTHER CONDITIONS:**

A.19.1 The decision of acceptance of tender will rest with BHEL which does not bind itself to accept the lowest tender or any tender and reserves to itself full rights for the following without assigning any reasons whatsoever:

(a) To reject any or all of the tenders.
(b) To split up the work amongst two or more Tenderer.
(c) To award the work in part.
(d) In either of the contingencies stated in (b) and (c) above to modify the time for completion suitably.

A.19.2 Conditional and unwitnessed tenders, tenders containing absurd or unworkable rates & amounts, tenders which are incomplete or otherwise considered defective and tenders not in accordance with the tender conditions, specifications etc. are liable to be rejected.

A.19.3 In case of any adverse information is received concerning performance, capability or conduct of the tenderer after issue of tender enquiry, BHEL reserves the right to reject the offer at any stage as deemed fit.

A.19.4 Offers with inadequate Tools & Plants, Manpower Deployment Plan, Method Statement are liable for rejection.

A.19.5 In case the present commitments of the tenderer is such that award of further work is likely to affect performance in the work under this tender, its offer is liable for rejection.

A.19.6 Offers from tenderer are liable for rejection if the tenderer is not found suitable after preliminary/ final assessment by BHEL.

A.19.7 If a tenderer expires after the submission of his tender or after the acceptance of his tender, BHEL may at its discretion, cancel such tender. If a partner of a firm expires after the submission of the tender or after the acceptance of the tender, BHEL may cancel such tender at its discretion unless the firm retains its character.

A.19.8 BHEL will not be bound by any Power of Attorney granted by the tenderer or by changes in the composition of the firm made subsequent to the execution of the contract. BHEL may, however, recognise such Power of Attorney and changes after obtaining proper legal advice, the cost of which will be chargeable to the contractor concerned.

A.19.9 If the tenderer deliberately gives wrong information in his tender, BHEL reserves the right to reject such tender at any stage or to cancel the contract, if awarded, and forfeit the Earnest Money/Security Deposit/any other moneys due.

A.19.10 Canvassing in any form in connection with the tender is strictly prohibited and the tenders submitted by the contractors who resorts to canvassing are liable to be rejected.

A.19.11 Should a tenderer or contractor or in the case of a firm or company of contractors/ one or more of its Partners/ Share holders/ Directors have a relation or relations employed in BHEL, the authority inviting tender shall be informed to the fact along with the offer, failing this, BHEL may, at its sole discretion reject the tender or cancel the contract and forfeit the Earnest Money/ Security Deposit.

A.19.12 The successful tenderer should not sub-contract the part or complete work detailed in the tender specifications without written permission of BHEL. The tenderer is solely responsible to BHEL for the work awarded to him.

A.19.13 NO DEVIATIONS ARE ACCEPTABLE. OFFERS WITH DEVIATIONS ARE LIKELY TO BE REJECTED. HOWEVER, IF THE BIDDER INSISTS ON ANY TECHNICAL OR COMMERCIAL DEVIATIONS FROM THE SPECIFICATIONS AND / OR TENDER CONDITIONS, **THE PRICE IMPLICATION, IF ANY, OF WITHDRAWING THE DEVIATIONS MUST BE SUBMITTED ALONG WITH THE PRICE BID IN A SEPARATE SEALED ENVELOPE** SUPER-SCRIBED "PRICE IMPLICATION FOR WITHDRAWAL OF DEVIATIONS". NO PRICE IMPLICATION FOR WITHDRAWAL OF DEVIATION SHALL BE ACCEPTED AT A LATER DATE, AFTER OPENING OF TECHNICAL BID.

ANNEXURE - A

DETAILS OF WORK EXECUTED/BEING EXECUTED

A) WORK EXECUTED

Sl. No.	Financial Year	Customer	Description of work	Total order value	Remarks

B) WORK BEING EXECUTED

Sl. No.	Customer	Description of work	Total Value	Value of the portion completed	Actual start date	Expected completion date	Remarks

(SIGNATURE OF TENDERER)
WITH STAMP

ANNEXURE - B

(A) **PROPOSED MANPOWER (ENGINEERS/ SUPERVISORS) RESOURCES FOR EXECUTION OF WORK**

Sl. No.	Name of the staff	Qualification	Experience in years	Remarks

(B) **MONTH WISE MANPOWER DEPLOYMENT PLAN**

Sl. No.	Category	Indicate No. of persons to be deployed in each month								
		1st	2nd	3rd	4th	5th	6th	7^{th}	8^{th}	and so on

(C) **Total man days planned to be deployed for the work ..... Man days**

(SIGNATURE OF TENDERER)
WITH STAMP

ANNEXURE - C

(A) **STATUS OF TOOLS, PLANTS & INSTRUMENTS**

Sl. No.	Name of Equipment	Quantity owned	Registration No.	Documents enclosed for proof of Ownership / tie-up	Present Location	Quantity proposed to be deployed for this job

B) **MONTH WISE TOOLS, PLANTS & INSTRUMENTS DEPLOYMENT PLAN**

Sl. No.	Description of Tools, Plants & Instruments	Indicate Nos. to be deployed in each month							
		1st	2nd	3rd	4th	5th	6th	7th	and so on

(SIGNATURE OF TENDERER)
WITH STAMP

ANNEXURE - D

ANALYSIS OF UNIT RATE

Sl. No.	Description	Percentage of the unit rate	Remarks
01.	Salary and wages for staff and works		
02.	Materials a) ..... b) ..... c) ..... d)		
03.	Depreciation and maintenance for Tools and Plants		
04.	Depreciation and maintenance for other items		
05.	Establishment and administrative expenses of site		
06.	Overheads		
07.	Profit		

(SIGNATURE OF TENDERER)
WITH STAMP

ANNEXURE - E

DECLARATION SHEET

I ..... hereby certify that all the information and data furnished by me with regard to this Tender Specification No..... are true and complete to the best of my knowledge. I have gone through the specification, conditions and stipulations in detail and agree to comply with the requirements and intent of specifications.

I further certify that I am the duly authorised representative of the under mentioned tenderer and a valid power of attorney to this effect is also enclosed.

TENDERER'S NAME AND ADDRESS

AUTHORISED REPRESENTATIVE'S SIGNATURE WITH NAME AND ADDRESS

ANNEXURE - F

CHECKLIST & SCHEDULE OF GENERAL PARTICULARS

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

1.	Name & Address of the Tenderer	:	
2.	Phone/Fax No. (Office)	:	
3.	email ID	:	
4.	Name & designation of the official of the tenderer to whom all the references shall be made	:	
5.	Tenderer's Proposal No. & date	:	
6.	Whether EMD submitted (by cash/ Bank Guarantee/Bank Draft)	:	By.....
7.	Validity of offer/rates quoted for six months from the date of opening of tender	:	Yes/No
8.	Attested copy of power of attorney as per Clause-A.12.1	:	Yes/No
9.	Solvency Certificate submitted as per Clause-A.12.9	:	Yes/No
10.	Income Tax/Sales Tax Certificate submitted as per Clause-A.12.10	:	Yes/No
11.	Details of work executed/being executed as per Annexure-A	:	Yes/No
12.	Month wise & Category wise manpower deployment plan as per Annexure-B	:	Yes/No
13.	Status of Tools, Plants and Instruments & their month wise deployment plan as per Annexure-C	:	Yes/No
14.	Analysis of unit rate quoted as per Annexure-D	:	Yes/No
15.	Declaration sheet as per Annexure-E	:	Yes/No
16.	Request for registration (for new tenderers) submitted	:	Yes/No

Date ..... (SIGNATURE OF TENDERER)
WITH STAMP

WITNESS : (Signature with full particulars)

1.

2.

ANNEXURE - G

PROFORMA FOR C O N T R A C T A G R E E M E N T

CONTRACT NO. :
LETTER OF INTENT NO. :
WORK ORDER NO. :

1. The Contract Agreement entered into the day of ....., 20... (..... day of .....two thousand and……. ....) at New Delhi, between M/S BHARAT HEAVY ELECTRICALS LIMITED, TRANSMISSION BUSINESS GROUP, New Delhi , having it's Registered Office at BHEL House, Siri Fort, New Delhi - 110 049 (hereinafter called the FIRST PARTY which expression shall include their executors, administrators, successors and permitted assigns)

AND

M/S ..... (hereinafter called the SECOND PARTY which expression shall include their executors, administrators, successors and permitted assigns).

2. And whereas the FIRST PARTY called for the offer for the work of..... as per approved specifications, drawings and quality plan at ..... as per Tender Specification No..... , dated .....

3. Whereas the SECOND PARTY submitted their offer No. ..... dated ..... against above.

4. Whereas the FIRST PARTY has accepted the offer referred to above & issued Letter of Intent No....., dt..... and also detailed Work Order No...., dt .....

5. Whereas the SECOND PARTY has agreed to work as Sub-Contractor of the FIRST PARTY on the conditions specified in the Tender Specifications at a contract price of Rs..... (Rupees.....) at .....

6. Now, therefore it is hereby mutually agreed to by and between the parties hereto as under :

   a) The SECOND PARTY shall execute the works of ..... at ..... on the conditions specified in Tender Specifications of FIRST PARTY and Letter of Intent referred to herein before at a total contract price of Rs..... (Rupees .....)

   b) That the SECOND PARTY shall organise all activities and mobilisation of facilities so that the work specified herein before is completed by .....as per the time bound programme mentioned in the Tender Specifications.

c) That all disputes arising out of or relating to this agreement shall be referred to the sole Arbitrator as per arbitration clause mentioned in the Tender Specifications. The Arbitrator from time to time with the consent of the parties enlarge the time for making and publishing award without reference to the court for the purpose.

d) That the jurisdiction in all suits or claims arising out of this agreement shall be of New Delhi Courts only.

e) The Following documents shall form part of this agreement: -

i)

ii)

iii)

iv)

v)

vi)

7. Deviation Limit : The contract value is subject to deviations depending upon the actual requirement within plus or minus 30%. Quantities of individual items may vary to any extent or may get deleted.

8. Terms of Payment : The terms of payment applicable to this contract shall be those covered under Point No.... of Work Order dt. ..... and as per Tender Specifications.

9. Abandoning the work : In the event of the SECOND PARTY abandoning the work, FIRST PARTY reserves the right to get the unfinished work done at the risk and cost of the SECOND PARTY.

10. All other terms and conditions shall be as stipulated in the Tender Documents.

11. This contract agreement consists.... pages.

IT WITNESS WHEREOF, the parties have signed this agreement on the date, month and year first above written in presence of

For and on Behalf of
(FIRST PARTY)

WITNESS (WITH ADDRESS)

For and on Behalf of
(SECOND PARTY)

1.
2.

ANNEXURE - H

PROFORMA FOR BANK GUARANTEE (FOR SECURITY DEPOSIT)

1. In consideration of the Bharat Heavy Electricals Limited, having its Registered Office at BHEL House, Siri Fort, New Delhi-110 049 through its Unit/Division at Industry Sector-TBG, New Delhi hereinafter called BHEL, having agreed to exempt..... (hereinafter called "the said contractor(s)") from the demand, under the terms and conditions of the LOI/WO, dated ... made between BHEL and M/s..... for the work ..... of (Name of work) (hereinafter called "the said Agreement") of Security Deposit / mobilisation advance for the due fulfilment by the said contractor(s) of the terms and conditions contained in the said Agreement, on production of Bank Guarantee for Rs.... (Rupees..... only). We, ... (indicate the name of the Bank) (hereinafter referred to as "Bank") at the request of the contractor(s) do hereby undertake to pay to BHEL an amount not exceeding Rs..... against any loss or damage caused to or suffered or would be caused to or suffered by BHEL, by reason of a breach by the said contractor(s), of any of the terms of conditions contained in the said agreement.

2. We, ... (indicate the name of the Bank) do hereby undertake to pay the amounts due and payable under this guarantee without any demur, merely on a demand from BHEL, stating that the amount claimed is due by way of loss or damage caused to or would be caused to or suffered by BHEL by reason of breach by the said contractor(s) of any of the terms or condition(s) failure to perform the said agreement or by reason of the contractor(s) failure to perform the said agreement. Any such demand made on the Bank shall be conclusive as regards the amount due and payable by Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs.....

3. We, ... (Indicate the name of the Bank) undertake to pay BHEL any money so demanded not withstanding any dispute or disputes raised by the Contractor(s) in any suit or proceeding pending before any court or Tribunal relating there to, our liability under these presents being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the contractor(s) shall have no claim against us for making such payment.

4. We, ...(indicate the name of the Bank) further agree that the guarantee herein after contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement & that it shall continue to be enforceable till all the dues of BHEL under or by virtue of the

said agreement have been fully paid and its claims satisfied or discharged or till BHEL certifies that the terms and conditions of the said agreement have been fully and properly carried out by the said contractor(s) & accordingly discharges this guarantee. Unless a demand or claim under this guarantee is made on us in writing on or before..... we shall be discharged from all liability under this guarantee thereafter.

5. We,.....(indicate the name of the Bank) further agree with BHEL that BHEL shall have the fullest liberty without our consent & without affecting in any manner our obligations hereunder to vary any of the terms & conditions of the said agreement or to extend time performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by BHEL against the said contractor(s) and to forbear or enforce any of the terms and conditions relating to the said agreement & we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said contractor(s) or for any forbearance, act or omission on the part of BHEL or any indulgence by BHEL to said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effected of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

7. We, ...(indicate the name of the Bank) lastly undertake not to revoke this guarantee during its currency except with the previous consent of BHEL in writing.

Dated the ..... Day of .....20...

For .....(indicate the name of the Bank)

WITNESS : 1)

2)

(SIGNATURE OF BANK REPRESENTATIVE WITH SEAL)

NOTE

1. The above format is drawn upon the model form jointly evolved by the Reserve Bank of India, the Indian Banks Association and the Ministry of Finance, Government of India as circulated by Indian Banks Association, Bombay vide their letter No. LA/14-61/808, dated 01.05.1980.

2. As such no deviations are acceptable.

ANNEXURE – I

PROFORMA FOR PERFORMANCE GUARANTEE

(to be used in appropriate value non - judicial stamp paper)

1. This deed of guarantee made this ..... day of ..... 20… by ..... Bank Limited ..... in favour of Bharat Heavy Electricals Limited having their registered office at BHEL House, Siri Fort, New Delhi - 110 049.

2. Whereas M/s ..... (hereinafter called the CONTRACTOR / SELLER have entered into a Contract bearing No. ..... dated..... (hereinafter called the CONTRACT) for supply / civil works /erection, testing and commissioning of M/s Bharat Heavy Electricals Limited (hereinafter called the COMPANY).

3. And whereas the said CONTRACT Inter - alia provides that the CONTRACTOR / SELLER shall pay to the COMPANY a sum of Rs. ..... only towards Performance Guarantee in the form and manner therein specified.

4. And whereas the SELLER / CONTRACTOR have approached ..... Bank Limited (hereinafter referred to as the GUARANTOR) and at their request and in consideration of the arrangement arrived at between the CONTRACTOR and the GUARANTOR, the GUARANTOR has agreed to give the Guarantee as hereinafter mentioned in favour of the COMPANY.

NOW THIS DEED WITNESSES AS FOLLOWS:

5. The GUARANTOR by the hand of Mr. ..... and its lawfully and fully constituted attorney and do hereby guarantee the due and faithful performance of the said CONTRACT and do hereby irrevocably undertake and promise to pay the COMPANY without any demur merely on demand made by them a sum not exceeding Rs. ..... only in case the COMPANY sustains any loss or damage by reason of any breach, default by the CONTRACTOR / SELLER of any of the terms, conditions, stipulations or undertakings or any one of them contained in the said CONTRACT and the tender documents attached hereto and for payment of any moneys payable by the CONTRACTOR / SELLER to the COMPANY under the terms and conditions of the said CONTRACT. The decision of the COMPANY regarding the breach, default, loss, damage and payment shall be conclusive and binding in the GUARANTOR, irrespective of the fact whether the CONTRACTOR / SELLER admits or denies such claims or questions its correctness in any court, tribunal or arbitration proceedings or before any other authority.

6. The COMPANY shall have the fullest liberty without effecting in any way the liability of the GUARANTOR under this guarantee, from time to time to vary any of the terms and conditions of the CONTRACT or extend time by the SELLER / CONTRACTOR or to postpone for any time and from time to time any of the powers exercisable by its against the SELLER / CONTRACTOR and either to enforce or forbear from enforcing any of terms and conditions governing the CONTRACT or securities available to the COMPANY and the GUARANTOR shall not be released from its liability under these presents by any exercise by the COMPANY of the liberty with reference to the matters aforesaid or by reason of time being given to the SELLER or any other forbearance, act or omission on the part of the COMPANY or any indulgence by the COMPANY to the SELLER / CONTRACTOR or of any other matter or thing whatsoever which under the law relating to sureties, would but for this provision have the effect of so releasing the GUARANTOR / CONTRACTOR from its liability under this Guarantee.

7. This Guarantee shall remain in full force and effect and the GUARANTOR shall be liable under the same irrespective of any concession or time being granted by the COMPANY to the CONTRACTOR in or for fulfilling the said CONTRACT and this Guarantee shall remain in full force irrespective of any change in terms and conditions, stipulations or any variations in the terms of CONTRACT irrespective of whether notice of such change and / or variation is given to the GUARANTOR or not and the claim to receive such notice of any change and or variation of the terms / or conditions of the CONTRACT is hereby specially waived by the GUARANTOR.

8. The GUARANTEE herein contained shall not be determined, prejudiced or effected by the liquidation or winding up or insolvency of or change in the constitution of the CONTRACTOR but shall in all respects and for all purposes be binding and operative until all payments or all moneys due or that may hereafter become payable to the COMPANY are paid in respect of any liability or obligation of the CONTRACTOR under the CONTRACT.

9. The GUARANTOR further agree that the Guarantee herein contained shall remain in full force and effect during the period that would be taken for the commencement of the CONTRACT till end of the CONTRACT and its claim satisfied or discharged and till the COMPANY certified that the terms and conditions of the CONTRACT have been fully and properly carried out by the SELLER and accordingly discharges this guarantee, subject, however, that the COMPANY shall have no claim under this Guarantee after ..... months from the date of completion of the Guarantee has been served on the

GUARANTOR before the expiry of the said period in which case the same shall be enforceable against GUARANTOR not withstanding the fact that the same is enforced after expiry of said period.

The GUARANTOR undertake not to revoke this Guarantee during the period it is in force except with the previous consent of the COMPANY in writing and agree that any liquidation or winding up or insolvency or dissolution or any change in the constitution of the SELLER or the GUARANTOR shall not discharge the GUARANTOR's liability here under.

It shall not be necessary for the COMPANY to proceed against the SELLER before proceeding against the GUARANTOR and the Guarantee herein contained shall be enforceable against them not withstanding any security which the company may have obtained or obtained from the SELLER shall at the time when proceedings are taken against the GUARANTOR here under be outstanding or unrealized.

The GUARANTOR hereby declare that it has power to execute this Guarantee and the executant has full powers to do so on its behalf under the proper authority granted to him/them by of the GUARANTOR.

10. Not withstanding anything herein before contained, our liability under this Guarantee is restricted to Rs. ..... (Rupees .... only) and will expire on ..... and unless a claim in writing is presented to us or an action or suit to enforce the claim is filed against us, within six months from the date, all our rights shall be forfeited and we shall be relieved and discharged from all our liabilities thereunder.

IN WITNESS whereof the ..... (Bank) have hereunto set and subscribed their hands the day, month and year first above written.

SIGNED FOR AND ON
BEHALF OF THE BANK

WITNESS:

NAME AND ADDRESS **SIGNATURE**

1.

2.

ANNEXURE - J

REVISED PRICE OFFER IN LIEU OF WITHDRAWAL OF DEVIATIONS/ CLARIFICATIONS OFFERED BY BHEL

Sl. No.	Clause Ref.	Description of Deviation/ Clarification	Whether Increase/ Decrease in Price	Unit Rate (if applicable)	Total Increase/ Decrease	Remarks

NOTE: Total increase or decrease in total price shall be indicated either in percentage or in value (Rs.).

(SIGNATURE OF TENDERER)
WITH STAMP

ANNEXURE - K

LIST OF LABORATORY TEST EQUIPMENTS

SL. NO.	DESCRIPTION OF APPARATUS	CODE REF.
01.	VICATS APPARATUS	IS-5513
02.	LE-CHATELIER'S TEST APPARATUS	IS-5514
03.	MOULD (CEMENT)	IS-10086
04.	CEMENT MORTAR MOULD VIBRATOR	IS-10078
05.	CONCRETE CUBE MOULDS	IS-10086
06.	COMPR. STRENGTH TEST M/C	IS-2505
07.	CONCRETE SLUMP CONE	IS-7320
08.	COARSE AGGR. SIEVES	IS-383
09.	FINE AGGR. SIEVES	IS-383
10.	AGGR. IMPACT TEST M/C	IS-9377
11.	(a) SOIL CORE COMPACTOR	IS-2720
	(b) PROCTOR COMPACTION	IS-29
12.	REBOUND HAMMER	
13.	THEODOLITE	
14.	DUMPY LEVEL WITH STAFF	
15.	OVEN	
16.	PHYSICAL BALANCE	
17.	AIR ENTERTAINMENT METER	ST-1199

(SIGNATURE OF TENDERER)
WITH STAMP

ANNEXURE - L

(On Banks Letter Head)

To:

DGM (Finance)
Transmission Business Group,
2nd floor, Bharat Heavy Electricals Limited,
Integrated office Complex, Lodhi Road,
New Delhi 110 003

Ref & Date :

Sub : Confirmation of Bank Guarantee no. <<BG No. >>

We are a Scheduled Bank other than Co-operative Bank under the RBI Act 1934. The aforesaid BG No. << BG No. >> for Rs. <<BG Amount>>/ (In Words Also) and valid upto <<validity date>> is issued by us on behalf of M/s <<Beneficiary's Name>> in favour of BHARAT HEAVY ELECTRICALS LTD. – TRANSMISSION BUSINESS GROUP.
The format of the Bank Guarantee is strictly as per the format prescribed by M/s BHEL and the stamp paper forming part of the BG are as per the state rules extant.

The signatories to the Bank Guarantee are duly authorised.

Thanking You,

For and On Behalf of
Name of the Bank & Seal

(Please Sign Here)

SECTION-B

GENERAL TERMS AND CONDITIONS

SECTION - B
GENERAL TERMS AND CONDITIONS

B.1.0 The following terms shall have the meaning hereby assigned to them except where the context requires otherwise:-

B.1.1 BHEL (or B.H.E. Ltd.) shall mean Bharat Heavy Electricals Limited, a Company registered under Indian Companies Act 1956, with its Registered Office at BHEL House, Siri Fort, New Delhi-110 049 or its Authorised Officers or its Engineers or other employees authorised to deal with any matters with which these persons are concerned.

B.1.2 "GENERAL MANAGER" shall mean the Officer in Administrative charge of the Contracting Unit of BHEL.

B.1.3 “ENGINEER" OR "ENGINEER-IN-CHARGE" shall mean Engineer deputed by BHEL. The term includes "Deputy General Manager, Construction Manager, Resident Engineer, Assistant Site Engineer of BHEL/at the site as well as the officers in charge at Head Office.

B.1.4 “SITE” shall mean the place or places at which the plants/equipment are to be erected and services are to be performed as per the specification of this tender.

B.1.5 "CLIENTS OF BHEL" or "CUSTOMER/OWNER" shall mean the organization to whom BHEL is responsible for this work.

B.1.6 "CONTRACTOR" shall mean the individual, firm or Company who enters into this Contract with BHEL and shall include their executors, administrators, successors and assigns.

B.1.7 "CONTRACT” or "CONTRACT DOCUMENT” shall mean and include the agreement, the work order, the accepted appendices of rates, Schedules of Quantities, if any, General Terms and Conditions of Contract, Special Conditions of Contract, Instructions to Tenderers, the drawings, the Technical Specifications, the Special Specifications, if any, the tender documents and the Letter of Intent\Accepting Letter issued by BHEL. Any conditions or terms stipulated by the tenderer in the tender documents or subsequent letters shall not form part of the Contract unless specifically accepted in writing by BHEL in the Letter of Intent and incorporated in the Agreement.

B.1.8 "GENERAL CONDITIONS OF CONTRACT" shall mean the "Instructions and Information for Tenderers and General terms and Conditions" pertaining to the work detailed.

B.1.9 TENDER SPECIFICATIONS" shall mean the Special Conditions, Technical Specifications, Appendices, Site Information and drawings pertaining to the work for which the tenderers are required to submit their offer. Individual Specification Numbers will be assigned to each tender specification.

B.1.10 "TENDER DOCUMENTS" shall mean the General Conditions of Contract and Tender Specifications.

B.1.11 "LETTER OF INTENT" shall mean the intimation by a letter/telegram/telex/ fax to the tenderer that the tender has been accepted in accordance with provisions contained in the letter. The responsibility of the contractor commences from the date of issue of this letter and all the terms and conditions of contract are applicable from this date.

B.1.12 "COMPLETION TIME" shall mean the period by date specified in the Letter of Intent/Work Order or date mutually agreed upon for handing over of the erected equipment/plant which are found acceptable by the Engineer being of required standard and conforming to the specifications of the contract.

B.1.13 "ZERO DATE" shall mean the planned commencement date of work under this tender and shall be date of issue of Letter of Intent.

B.1.14 "PLANT" shall mean and connote the entire assembly of the plant and equipment covered by the contract.

B.1.15 "EQUIPMENT" shall mean all equipment, machineries, materials, structural, electricals and other components of the plant covered by the contract.

B.1.16 "TESTS" shall mean and include such test or tests to be carried out by the contractor as are prescribed in the contract or considered necessary by BHEL, in order to ascertain the quality, workmanship, performance and efficiency of the contracted work or part thereof.

B.1.17 "APPROVED" "DIRECTED" or "INSTRUCTED" shall mean approved, directed or instructed by BHEL.

B.1.18 "WORK OR CONTRACT WORK" shall mean and include supply of all categories of labour, specified consumables, tools and tackles required for complete and satisfactory site transportation, handling, stacking, storing, civil and electrical works, erection, testing and commissioning of the equipment to the entire satisfaction of BHEL.

B.1.19 "SINGULAR AND PLURAL" etc. words carrying singular number shall also include plural and vice versa, where the context so requires. Words imparting masculine gender shall be taken to include the feminine gender and words imparting persons shall include any Company or Association or Body or Individuals, whether incorporated or not.

B.1.20 "HEADINGS" The headings in these General Conditions are solely for the purpose of facilitating reference and shall not be deemed to be part thereof or be taken into consideration in the interpretation of construction thereof or the contract.

B.1.21 "MONTH" shall mean calendar month.

B.1.22 "WRITING" shall include any manuscript typewritten or printed statement under the signature or seal as the case may be.

B.2.0 **LAW GOVERNING THE CONTRACT AND COURT JURISDICTION:**

The Contract shall be governed by the Law for the time being enforce in the Republic of India. The Civil Court at Delhi having ordinary Original Civil Jurisdiction shall alone have exclusive jurisdiction in regard to all claims in respect of this contract.

B.3.0 **ISSUE OF NOTICE:**

The contractor shall furnish to the Engineer, the name, designation and address of his authorised agent and all complaints, notices, communications and references shall be deemed to have been duly given to the Contractor, if delivered to the Contractor or his authorised agent and shall be deemed to have been so given in the case of posting on the day on which they would have reached such address in the ordinary course of post or at which they were so delivered or left.

B.4.0 **USE OF LAND:**

No land belonging to BHEL or its customer under temporary possessions of BHEL shall be occupied by the contractor without the written permission of BHEL.

B.5.0 **COMMENCEMENT OF WORK:**

B.5.1 The contractor shall commence the work within fifteen days of Letter of Intent or the time indicated in the Letter of Intent/Work Order and shall proceed with the same with due expedition without delay.

B.5.2 If the successful tenderer fails to commence the work within the stipulated time, BHEL, at its sole discretion will have the right to cancel the Letter of Intent/Contract. His Earnest Money and/or Security Deposit will stand forfeited without any further reference to him without prejudice to any and all of BHEL's other rights and remedies in this regard.

B.5.3 All the works shall be carried out under the direction and to the satisfaction of BHEL/Customer/Owner.

B.5.4 The transported equipment, erected/constructed plant or work performed under the contract, as the case may be, shall be taken over when it has been completed in all respect and/or satisfactorily put into operation at site.

B.6.0 **MEASUREMENT OF WORK AND MODE OF PAYMENT:**

B.6.1 All payments due to the contractor shall be made only by "Account Payee Cheques".

B.6.2 For progress/running bill payments, the contractor shall present detailed measurement sheets in triplcate duly indicating all relevant details based on technical documents, protocols & material test reports and connected drawings for the work done during the calendar month/period under different categories in line with terms of payment & as per Letter of Intent. The basis of arriving at the quantities/weights shall be the relevant documents and drawings released by BHEL. These measurement sheets shall be prepared jointly with Engineers of BHEL and signed by all parties.

B.6.3 The measurement sheets will be checked by the Engineer and quantities & percentage eligible for payment under different groups shall be decided by him. The abstract of quantities and percentage so arrived at based on the terms of payment shall be entered in the Measurement Book & signed by both the parties. Where required counter signature of Customer/Owner shall have to be taken.

B.6.4 Based on the above quantities, contractor shall prepare the bills in the prescribed proforma and work out the financial value. These will be entered in the measurement Book and signed by both the parties. Payment shall be made by BHEL after effecting the recoveries due from the Contractor.

B.6.5 All recoveries due from the contractor for the month/period shall be effected in full from corresponding running bills unless specific approval from Competent Authority is obtained to the Contrary.

B.6.6 Measurement shall be taken jointly by person duly authorised by BHEL, Owner and the Contractor.

B.6.7 The Contractor shall bear the expenditure involved, if any, in taking the measurements & testing of materials to be used in the works. The Contractor shall without extra cost to BHEL, provide all the assistance with appliances and other things necessary for measurement.

B.6.8 If at any time due to any reason whatsoever, it becomes necessary to remeasure the work done, in full or in part, the expenses towards such re-measurement shall be borne by contractor.

B.6.9 Passing of bills covered by such measurement does not amount to acceptance by BHEL of the completion of the work measured. Any left out work has to be completed by the Contractor, as directed by BHEL.

B.6.10 Final measurement bill shall be prepared in the proforma prescribed for the purpose, based on the certificate issued by the Engineer that the entire work as stipulated in the tender specification has been completed in all respects to the entire satisfaction of BHEL.

The contractor shall give unqualified "No claim" and "No Demand" certificates. All the tools and tackles loaned to him should be returned in condition satisfactory to BHEL. The abstract of final quantities and financial values shall also be entered in the Measurement Book and signed by both the parties. The final bill shall be paid after completion of all the defects/deficiencies etc. pointed out by BHEL. The Contractor should submit all the original documents such as material consumption, site order book etc. maintained at site. After payment of final bill, only guarantee obligation percentage value shall remain unpaid, which shall be released in accordance with Clause A.17.7.

B.7.0 **RIGHTS OF BHEL:**

Refer Annexure to GCC for Civil works

B.8.0 **RESPONSIBILITY OF THE CONTRACTOR IN RESPECT OF LOCAL LAWS, EMPLOYMENT OF WORKERS ETC:**

The following are the responsibilities of the Contractor in respect of observance of local laws, employment of personnel, payment of taxes etc.

B.8.1 As far as possible, unskilled workers shall be engaged from the local areas in which the work is being executed. In case of any necessity is felt by the contractor to bring labourers from out side State, provisions of law governing such immigration by the concerned State are to be followed.

B.8.2 The Contractor at all times during the currency of this contract, shall in all his dealings with the local labour for the time being employed on or in connection with the work, have due regard to all local festivals, religious and other customs.

B.8.3 The contractor shall comply with all State and Central Laws, Statutory Rules, Regulations etc., such as: The payment of wages to, The Minimum Wages Act, The Workmen Compensation Act, The Employees Liability Act, The Industrial Dispute Act, The Employees Provident Fund Act, Employees State Insurance Scheme, The Contract Labour (Regulations and Abolition) Act 1970 and other Acts, Rules & Regulations for labour as may be enacted by the Government during the tenure of the contract and having in force or jurisdiction at site. The Contractor shall give to the local Governing Body, Police and other concerned Authorities all such notice as may be required under law.

B.8.4 The contractor, as required, will obtain independent license under the Contract Labour (Regulations & Abolition) Act 1970 from the concerned authorities based on the certificate (Form-V) issued by the Principal Employer/Customer.

B.8.5 The Contractor shall pay all taxes, fees, license charges, deposits, duties, tolls, royalty, commissions or other charges which may be Leviable on account of any of his operations connected with this contract. The Contractor is responsible to furnish documentary evidence towards GST Registration of the State wherein the site is located and any other documents as per GST Act which may be be required from time to time by BHEL.The contractor should have to get the contract registered immediately after award of works as per rules and regulations of the State Government. The contractor shall file regular return as per statute of the State/Centre and should provide all information to BHEL as required for the assessment of the project concerned. In case BHEL is forced to make any of such payments, BHEL shall recover the same from the contractor either from moneys due to him or otherwise as deemed fit.

B.8.6 Arrangements for the periodical visits of inspection agencies such as Electrical Inspector etc. to site, inspection certificates etc. will have to be made by the contractor at his cost. The contractor will also meet all expenses in connection with his welder's qualification/ re-qualification tests etc.

B.8.7 The contractor shall be responsible for provision of health and sanitary arrangements {more particularly described in the Contract Labour (Regulation & Abolition) Act 1970} & safety precautions as may be required for safe and satisfactory execution of the contract.

B.8.8 The Contractor shall be responsible for proper accommodation including adequate medical facilities for the personnel employed by him.

B.8.9 The Contractor shall be responsible for the proper behaviour and observance of all regulations by the staff employed by him.

B.8.10 The contractor shall ensure that no damage is caused to any person/property of other parties working at site. If any such damage is caused, it shall be the responsibility of the contractor to make good the losses or compensate them.

B.8.11 All the properties/equipment/components of BHEL/its customer loaned with or without deposit, to the contractor, shall remain the properties of BHEL/its customer. The contractor shall use such properties for the purpose of execution of this contract. All such properties/equipment/components shall be taken in to good condition unless notified to the contrary by the contractor within 48 Hrs. The Contractor shall return them in good conditions as and when required by BHEL/ its customer. In case of non-return, loss, damage repairs etc., the cost thereof, as may be fixed by the Engineer, will be recovered from the contractor.

B.8.12 It shall not be obligatory on the part of BHEL to supply any tools and tackles or materials other than those specifically agreed to be given by BHEL. However, depending upon availability/possibility, BHEL/its customer's equipment and other materials may be made available to the contractor on payment of the hire charges as fixed by them, subject to the conditions laid down by BHEL/its Customer from time to time. Unless paid in advance, such hire and other charges shall be recovered from out of dues to the contractor or Security Deposit in one instalment. In case, BHEL provide the material like steel etc. for Subcontractors / Suppliers, handling charges @ 15% per annum or 1.25% per month or part thereof will be recovered from the contractor in addition to the actual procurement cost of material. The period for imposing handling charges is to be reckoned from the date of making payment/LR for lifting material to / by Subcontractor from authorized source, whichever is earlier to

a) The date of LR for dispatch of finished product by the supplier / fabricator.
b) Till date of consumption by the contractor as recorded in the MB.

B.8.13 The Contractor shall fully indemnify and keep indemnified BHEL/its customer against all claims of whatsoever nature arising during the course of execution of this contract.

B.8.14 In case the contractor is required to undertake any work outside the scope of this contract, the amount payable shall be as may be mutually agreed upon.

B.8.15 Any delay in completion of works or non-achievement of periodical targets, due to reasons attributable to the contractor, will have to be compensated by the contractor either by increased manpower and resources or by working extra hours or more than one shift at no extra cost to BHEL.

B.8.16 The contractor shall execute the work under the conditions usual to such construction work and in conjunction with numerous other operations at site and proceed in a manner that shall help in the progress of work at site as a whole.

B.8.17 The contractor will be directly responsible for payment of wages to his workmen. A pay roll sheet giving details of all payments made to the workmen duly signed by the contractor's representative should be furnished to BHEL, with each running account bill.

B.8.18 In case of any class of work for which there is no specification laid down in the contract, such work shall be carried out in accordance with the instructions and requirements of the Engineer.

B.8.19 No levy, payment or charges made or imposed shall be impeached by reason of any clerical error or by reason of any mistake in the amount levied, demanded or charged.

B.8.20 No idle labour charges will be admissible in the event of any stoppage of work resulting in the contractor's workmen being rendered idle due to any reason any time.

B.8.21 The contractor shall take all reasonable care to protect the materials and the work till such time the place/equipment has been taken over by BHEL/its customer.

B.8.22 The contractor shall not stop work or abandon the site for whatsoever reason or dispute, excepting for force majeure conditions. All problems/disputes shall be separately discussed and settled without affecting the progress of work. Stoppage or abandonment of work, other than under force majeure conditions, shall be treated as breach of work of contract and dealt with accordingly.

B.8.23 The contractor shall keep the area of work clean and shall remove debris etc. while executing day-to-day work. Upon completion of work, the contractor shall remove from the vicinity of works, all scrap, packing materials, rubbish, unused and other materials and deposit them in places specified by the Engineer. The contractor will also demolish all the hutments, sheds, offices etc. constructed & used by him and shall clean the debris. In the event of his failure to do so, the same will be arranged to be done by the Engineer and the expenses recovered from the contractor.

B.8.24 The contractor shall execute the work in the most substantial and workman like manner in the stipulated time. Accuracy of work and timely execution shall be the essence of this contract. The contractor shall be responsible to ensure that the quality, assembly and workmanship conform to the dimensions and clearance given in the drawings and/or as per instructions of the Engineers.

B.8.25 The contractor shall furnish progress reports on work at regular intervals as required by the Engineer.

B.9.0 RESPONSIBILITIES OF CONTRACTOR IN RESPECT OF SAFETY OF MEN, EQUIPMENT, MATERIAL AND ENVIRONMENT:

B.9.1 All safety rules and codes applied by BHEL/its customer at site shall be observed by the contractor and his workmen without exception. The contractor shall be responsible for the safety of the equipment/materials and work to be performed by him and shall maintain all lights, fencing guards, signs etc. or other protections necessary for the purpose. Contractor shall also take such additional precautions as may be indicated from time to time by the Engineer, with a view to prevent pilferage, accidents, fire hazards etc. and suitable number of clerical staff, watch and ward, store keepers to take care of equipment, materials and construction tools & tackles shall be posted at site by the contractor till the completion of the work under this con tract. The contractor shall arrange for such safety devices as are necessary for this type of work & carry out the requisite site tests of handling equipment, lifting tools, tackles etc. as per usual standards and practices.

B.9.2 The contractor shall provide to its work force & ensure the use of required personal protective equipment as found necessary & as directed by the authorised BHEL officials.

i) Safety helmets conforming to IS-2925 : 1984.
ii) Safety belts conforming to IS-3521 : 1983.
iii) Safety shoes conforming to IS-1989 : 1978.

iv) Eye and face protection devices conforming to IS-8520 : 1977 and IS-8940 : 1978.

v) Hand and body protection devices conforming to IS-2573 : 1975, IS-6994 : 1973, IS-8807 : 1978 and IS-8519 : 1977.

B.9.3 All tools, tackles, fitting appliances, material handling equipment, scaffolds, cradles, safety nets, ladders, equipment, etc. used by the contractor shall be of safe design and construction and maintained in good condition. However BHEL officials shall have the right to ban use of any of them or get them tested at their discretion. All electrical equipment, connections & wiring for construction power, its distribution & use shall conform to the relevant requirements of Indian Electricity Act and Rules. Only electricians licensed by the appropriate statutory authority shall be employed by the contractor to carry out electrical works.

B.9.4 All electrical appliances including portable electric tools used by contractor shall have safe plugging system to source of power and be appropriately earthed.

B.9.5 The contractor shall not use any hand lamp energised by electric power with supply voltage of more than 240 volts. For work in confined spaces, lighting shall be arranged with power source of not more than 240 volts.

B.9.6 Where it becomes necessary to provide and/or store petroleum products, explosives, chemicals and liquid or gaseous fuel or any other substance that may cause fire or explosion, the contractor shall be responsible for carrying out such provision and/or storage in accordance with the rules and regulations laid down in the relevant Government Acts, such as Petroleum Act, Explosive Act, Petroleum & Carbides of Calcium Manual of the Chief Controller of Explosives, Government of India etc. Prior approval of the authorised BHEL official at the site shall also be taken by the contractor in all such matters.

B.9.7 The contractor shall arrange at his cost appropriate illumination as required at all work spots for safe working, when natural day light may not be adequate for clear visibility.

B.9.8 In case of a fatal or disabling injury/accident to any person at construction sites pertaining to this work, the victim and/or his/her dependents shall be compensated by the contractor as per statutory requirements. However, if considered necessary, BHEL shall have the right to impose appropriate financial penalty on the contractor & recover the same from payments due to the contractor for suitably compensating the victim and/or his/her dependents.

Before imposing any such penalty, appropriate enquiry shall be held by BHEL giving opportunity to the contractor to present his case.

B.9.9 In case of any damage to property due to lapse by the contractor, BHEL shall have the right to recover the cost of such damages from the payments due to the contractor.

B.9.10 In case of any delay in the completion of a job due to mishaps attributable to lapses by the contractor, BHEL shall have the right to recover cost of such delay from the payments due to the contractor, after notifying the contractor suitably and giving him opportunity to present his case.

B.9.11 If contractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the contractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions regarding safety issued by the authorised BHEL official, BHEL shall have the right to take the corrective steps at the risk and cost of the contractor after giving appropriate notice indicating the steps that would be taken by BHEL.

B.9.12 The contractor shall submit report of all accidents, fires, property damaged and dangerous occurrences connected with his area of work or caused due to his action/inaction, to the authorised BHEL official immediately after such occurrence, but in any case not later than 12 hours of the occurrence.

B.9.13 During the course of construction, alteration or repairs scrap lumbers with protruding nails, sharp edges etc. and all other debris including combustibles scrap shall be kept cleared from working areas, passage ways and stairs in and around site.

B.9.14 Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally/negligently dropped, struck or permitted to strike each other violently. When cylinders are transported by powered vehicles, they shall be secured in a vertical position.

B.9.15 The contractor shall be responsible for the safe storage of his radioactive sources if same have been permitted to use.

B.9.16 All contractor's supervisory personnel and sufficient number of workmen shall be trained for fire fighting and first aid duties and shall be assigned specific duties. Enough number of such trained personnel must be available during the tenure of the contract.

B.9.17 Contractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, construction/erection site, other temporary structures, labour colony area etc. Access to such fire protection equipment shall be easy and kept open at all times. Compliance of the above requirement under fire protection system at project site shall in no way relieve the contractor of any of his responsibilities and liabilities to fire accident occurring. In the event of fire safety measures being not to BHEL's satisfaction, BHEL shall have option to provide the same and recover the cost plus incidentals from contractor's bills and/or impose penalty as deemed fit by the Engineer.

B.9.18 Before commencing the work, the contractor shall appoint/nominate a responsible officer to supervise implementation of all safety measures and liaison with BHEL Engineer at site.

B.9.19 If safety record of the contractor in execution of the awarded job is to the satisfaction of Safety Department of BHEL, issue of an appropriate certificate to recognise the safety performance of the contractor may be considered by BHEL after completion of the job.

B.10.0 **CONSEQUENCES OF CANCELLATION:**

B.10.1 Whenever BHEL exercises its authority to terminate the contract / withdraw a portion of work, the work may be got completed by any other means at the contractor's risk and cost provided that in the event of the cost of completion (as certified by the Engineer which shall be final and binding on the contractor) being less than the contract value, the advantage shall accrue to BHEL. If the cost of completion exceeds the money due to the Contractor under the Contract, the Contractor shall either pay the excess amount demanded by BHEL or the same shall be recovered from the contractor. This will be in addition to the forfeiture of Security Deposit & recovery of liquidated damages as per relevant clauses.

B.10.2 In case BHEL completes the work under the provisions of this clause, the cost of such completion to be taken into account for determining the excess cost to be charged to the contractor shall consist of cost of materials purchased and/or labour provided by BHEL with an addition of such percentage to cover supervision and establishment charges as may be decided by BHEL.

B.11.0 **INSURANCE:**

B.11.1 BHEL/its customer shall arrange for insuring the project materials/properties of BHEL/its customer covering the risks during storage, construction, erection and commissioning.

B.11.2 It shall be the sole responsibility of the Contractor to insure his workmen against risks of accident and injury while at work as required by the relevant rules and to pay compensation, if any, to them as per Workmen's Compensation Act. The Contractor shall also insure his staff against accidents. The work will be carried out in a protected area and all the rules and regulations of BHEL/its client in the project area which are in force from time to time will have to be followed by the contractor.

B.11.3 If due to negligence and/or non-observance of safety and other precautions any accident/injury occurs to any other person/public, the contractor shall pay necessary compensation and other expenses, if so decided by the appropriate authority.

B.11.4 It shall be the responsibility of the contractor to provide security and insurance claim related information/reports etc. for the equipment/material belonging to BHEL/its customer and handed over to the contractor for transportation/erection/construction till these are taken over by BHEL after erection/construction or are returned to BHEL/its customer's store.

B.11.5 If due to Contractor's carelessness, negligence, non-observance of safety precautions, improper security arrangements or due to non-compliance of paper work needed for lodging insurance claim, damage to BHEL/its Customer's property and/or personnel should occur, and if BHEL is unable to recover its claim from the Insurance Company, the deficit will be recovered from the Contractor.

B.12.0 **STRIKES & LOCKOUTS:**

B.12.1 The Contractor will be solely responsible for all disputes & other issues connected with his workmen. In the event of the contractor's workmen resorting to strike or the contractor resorting to lockout & if the strike or the lockout so declared is not settled within a period of one month, BHEL shall have the right to get the work executed by employing its own men or through other agencies or both. The cost incurred by BHEL in this regard shall be recovered from the Contractor.

B.12.2 For any purpose whatsoever, the employees of the contractor shall not be deemed to be in the employment of BHEL/its Customer.

B.13.0 **FORCE MAJEURE:**

B.13.1 The following shall amount to force majeure conditions:-

Acts of God, Act of any Government, war, Sabotage, riots, civil Commotion, Police Action, Revolution, Flood, Fire Cyclone, Earthquake, Epidemic & other similar causes over which the contractor has no control.

B.13.2 If the contractor suffers delay in the due execution of the contract, due to delays caused by force majeure conditions, as defined above, the agreed time of completion of the work covered by this contract may be extended by a reasonable period of time in consultation and after agreement of BHEL's clients/owner, provided that on the occurrence of any such contingency, the Contractor immediately reports to BHEL in writing the causes of delay. The Contractor shall not be eligible for any compensation on this account.

B.14.0 **GUARANTEE:**

The guarantee and defect liability period shall be 12 months from the date of commissioning of switchyard or handing over of entire civil works, whichever is later.

B.15.0 **ARBITRATION:**

(i) Except as provide elsewhere in this Contract, in case amicable settlement is not reached between the Parties, 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 relation to interpretation of any provision of the Contract; or, in any manner touching upon the contract, then, either Party may, by a notice in writing to the other Party refer such dispute or difference to the sole arbitration of an arbitrator appointed by Head of the BHEL Unit/Region/Division issuing the Contract.

The Arbitrator shall pass a reasoned award and the award of the Arbitrator shall be final and binding upon the Parties.

Subject as aforesaid, the provisions of Arbitration and Conciliation Act 1996 (India) or statutory modifications or re-enactments thereof and the rules made thereunder and for the time being in force shall apply to the arbitration proceedings under this clause. The seat of arbitration shall be New Delhi.

The cost of arbitration shall be borne as per the award of the Arbitrator.

Subject to the arbitration in terms of clause L above, the court at New Delhi shall have exclusive jurisdiction over nay matter arising out of or in connection with this Contract.

Notwithstanding the existence or 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 except where the contract has been terminated by either Party in terms of this contract.

(iI) In the event of 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 as mentioned in DPE OM No.4(1)/2013-DPE9GM)/ FTS-1835 dated 22.05.2018.

SECTION-C

SPECIAL CONDITIONS OF CONTRACT

SECTION - C-1

SPECIAL CONDITIONS OF THE CONTRACT

C-1.0 **INSTRUCTIONS TO TENDERERS:**

C-1.1 The tenderers are advised to physically visit the site and fully acquaint themselves with site conditions, transportation routes, various distances etc. No claim will be entertained by BHEL on ground of lack of knowledge and the contractor's rates shall be deemed to have taken this into account.

C-1.2 All temporary structures, hutments etc. set up by the contractor or their workmen during execution shall be removed prior to submission of final bill by the contractor.

C-1.3 The contractor in the event of this work awarded to him, shall establish an office at site and keep posted an authorised, responsible officer with a valid power of attorney for the purpose of the contract. Any order or instructions of the "Engineer" or his duly authorised representatives, communicated to the contractor's representative at site will be deemed to have been communicated to the contractor at his official address.

C-1.4 The contractor is required to commence the work within two weeks from the date of issue of Letter of Intent or as indicated in the LOI/Work Order, failing which the LOI/contract is liable to be cancelled and EMD/SD shall be forfeited.

C-1.5 BHEL reserves the right to split up the work and to award to more than one contractor or award only a part of the work to a contractor.

C-2.0 **PERFORMANCE BOND:**

The contractor shall submit Bank Guarantee of an approved Nationalised Bank as per BHEL proforma for an amount equal to 2.5% of the contract value as performance bond to get his balance 2.5% payment released at the discretion of the engineer as per the general conditions of contract. The performance Bank Guarantee shall remain valid up to successful completion of performance and guarantee tests of the station and taking over of the plant by BHEL/client of BHEL. Not withstanding the provisions of any other clause(s) of General Conditions of Contract, the contractor shall continue

to be responsible to execute all such works of repair, rectification and making good of defects, imperfections of other faults as may be required of the contractor in writing by the Engineer for the period as stated above. The proforma for submission of the BG shall be as per Annexure I.

Above clause no. C-2.0 shall be read in conjunction with clause no. C-29.5.2.

C-3.0 **SITE DRAINAGE:**

All water which may accumulate on the site during the progress of the works, or in trenches and excavations, including monsoon period shall be removed by the contractor from the site to the satisfaction of the Engineer at the contractor's expense.

C-4.0 **EXECUTION OF THE WORK:**

C-4.1 The work will be executed in a workman like manner and to the entire satisfaction of the Engineer and as per technical specifications of this tender, IS Codes, CPWD specifications etc. as applicable. In case of conflict regarding interpretations the decision of the Engineer shall be final and binding.

C-4.2 The Engineer will communicate or confirm his instructions to the contractor in respect of the execution of the work in a "Site Order Book" maintained at his office and confirm issue of such instructions by signing the relevant entries in this book. Such entries will rank as order or notices in writing within the intent and meaning of these conditions.

C-5.0 **INSPECTION AND STAGE APPROVAL OF THE WORK:**

C-5.1 BHEL/BHEL's Client or the owner or his duly authorised representative shall have at all reasonable times access to the contractor's premises of works and shall have the power to inspect drawings or any portion of the work, examine the materials and workmanship and shall have the authority to reject any work. This would be implemented through joint inspection by the representatives of the owner and BHEL and in the form the joint protocol without any extra claim of time and amount.

C-5.2 All work embracing more than one process shall be subject to examination and approval at each stage thereof and the contractor shall give due notice in writing to the Engineer when each stage is ready. In default of such notice being received, Engineer shall be entitled to approve the quality and extent thereof at any time he may choose and in the event of any dispute, the decision of the Engineer thereon shall be final and conclusive.

C-6.0 **COMPLETION OF WORK:**

C-6.1 The works shall be completed to the entire satisfaction of the Engineer and in accordance with the completion schedule as specified & agreed in the contract, and all unused stores and materials, tools, plant and equipment, temporary buildings and things shall be removed and the site work cleared of rubbish and all waste materials and delivered up clean and tidy to the satisfaction of the Engineer at the contractor's expenses.

C-6.2 BHEL shall have power to take over from the contractor from time to time such sections of the work as have been completed to the satisfaction of the Engineer. Such works however shall not be treated as have been completed until the entire works are executed to the satisfaction of the Engineer. The Guarantee period shall commence only after handing over the entire works.

C-7.0 **UNCOVERING AND ADJUSTMENT OF ERRORS:**

The contractor shall uncover any part of the works and/or make openings in or through the same as the Engineer may from time to time direct for his verification and shall reinstate and make good such part to the satisfaction of the Engineer. If any such part has been covered up or put out of view after being approved by the Engineer and is subsequently found on uncovering to have been executed in accordance with the contract, the expenses of uncovering and/or making opening in or through, reinstating and making good the same shall be borne by BHEL. In any other case all such expenses shall be borne by the contractor.

C-8.0 **DISCREPANCIES AND ADJUSTMENT OF ERRORS:**

C-8.1 The several documents forming the contract are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small scale drawings & figures dimensions in preference to scale & special conditions in preference to general conditions.

C-8.2 In case of discrepancies between schedule of quantities, the specification and/or the drawings the following order of preference shall be observed :

a) Description in Schedule of Quantities.
b) Special Conditions.
c) Drawings.
d) Technical Specifications.
e) General Conditions of Contract.

C-8.3 If there are varying or conflicting provisions made in any one document forming part of the contract, the Engineer shall be the deciding authority with regard to the document.

C-8.4 Any error in the description, quantity in schedule of quantities or any omission there from shall not vitiate the contract or release the contractor from the execution of the whole or any part of the works comprised therein according to the drawings and specifications or from any of his obligations under the contract.

C-8.5 If on check there are found to be differences between the rates given by the contractor in words and figures or in the amount worked out by him in the schedule of quantities and general summary, the same shall be adjusted in accordance with the following rules :

a) In the event of discrepancies between description in words and figures quoted by tenderer, the description in words shall prevail.

b) In event of an error occurring in the amount column of schedule of quantities as a result of wrong extension of the unit rate and the quantity, the unit rate shall be regarded as firm and extension shall be amended on the basis of the rates.

c) All errors in totalling in the amount column and in carrying forward totals shall be corrected.

d) The totals of sections of bill of quantities amended shall be carried over to the general summary and the tendered sum amended accordingly. The tendered sum so altered shall, for the purpose of tender, be substituted for the sum originally tendered and considered for acceptance instead of the original sum quoted by the tenderer. Any rounding of quantities or in sections of bill of quantities or in general summary, by the tenderer, shall be ignored.

C-8.6 If neither drawings nor specifications contain any mention of minor details of construction which in the opinion of the Engineer, whose decision shall be final and conclusive, are reasonable and obviously and fairly intended for satisfactory completion of work, such details shall be provided by the contractor without any extra cost, as if they were specially mentioned and shall be deemed to be included in the contract.

C-9.0 **DEVIATIONS:**

C-9.1 The contractor shall not make any alternation in, addition to or omission from the work as described in the tender documents except in pursuance of the written instructions of the Engineer. No such deviation from the work described in the tender documents shall be valid unless the same has been specially confirmed and accepted by the Engineer in writing and incorporated in the contract.

C-9.2 The engineer may deviate, either by way of addition or deletion, from the work so described, provided that the contract sum be not thereby varied on the whole by more than the percentage set out in the tender documents. The value of all additions and deletions shall be added to or deleted from the contract sum.

C-9.3 Any objections by the contractor to any matter concerning the order shall be notified by him in writing to the Engineer within 7 (seven) days from the date of such order, but under no circumstances shall the work be stopped (unless so ordered by the Engineer) owing to differences or controversy that may arise from such an objection. In the absence of such a notification of objection by the contractor, he will be deemed to have accepted the order and conditions stated therein.

C-10.0 **VALUATION OF DEVIATIONS:**

C-10.1 If the rates for the additional, altered or substituted work are specified in the contract for the work either in the same section or in the other section of the BOQ of the same work, the contractor is bound to carryout the additional, altered or substituted work at the same rates as are specified in the contract for the work.

C-10.2 For item which are required for successful completion of work but not covered in the BOQ:- if items are available in DSR -2016, then valuation shall be done at DSR rate (DSR 2016) along with applicable % as per contract and same shall be binding to the bidder.

C10.2.1 EXTRA/ ADDITIONAL ITEMS OF WORK

If any extra or additional items, which are not incorporated in the BOQ schedule, have to be executed by the contractor, the rate of such extra or additional work shall be as per the following:

C10.2.2 If the items are not covered under price schedule, the rates have to be agreed upon mainly on the basis of prevailing market rates for which all documentary evidences as required by BHEL shall have to be produced by the contractor. Decision of BHEL in such cases shall be final and binding on the contractor.

C-10.2.3 Under no circumstances the contractor shall suspend the work on the plea of non- settlement of rates falling under the clause or claim any compensation on that account.

C-10.2.4 BHEL reserves the right to carry out such extra/additional items of work through any other contractor or in such a manner as he considered advisable.

C-10.2.5 The contractor, on receipt of drawing from BHEL, shall inform BHEL (within 15 days) the rate / rates of item/items for carrying out the extra/additional item of work. This shall be supported by analysis of rates including prevailing market rates.

C--10.2.6 If the rate for additional, altered or substituted work is available in DSR 2016 then the rate shall be settled as per clause no. C-10.2.

C-10.3 Variation in quantity of work: - There may be variations in the individual item in the schedule during actual execution of the work. However, tendered unit rates shall remain firm up to a variation of ± 30% of the total value of the contract irrespective of variations in the quantity of individual items.

C-11. RECORD AND MEASUREMENT:

C-11.1 All items having a financial value shall be entered in BHEL measurement book so that a complete record is obtained of all works performed under the contract.

C-11.2 Work which fails to be measured in details shall be measured physically without reference to any local custom that may obtain excepting where it may otherwise be directed in the tender documents. The measurements shall be taken jointly by any person duly authorised on the part of BHEL and the contractor.

C-11.3 The contractor shall, without extra charge, provide assistance with appliances and other things necessary for measurement and shall bear all the cost of measurement of his work.

C-11.4 Measurement shall be entered in BHEL measurement book and signed and dated by both parties at the site on completion of measurement. If the contractor objects to any of the measurements recorded on behalf of BHEL, a note to that effect will be made in BHEL measurement book or against the item or items objected to and such note shall be signed and dated by both the parties engaged in taking the measurement.

C-11.5 If, as result of such objection, it becomes necessary to remeasure the work wholly or in part, the expense of such measurement shall be borne by the contractor.

C-11.6 If the contractor's representative fails to attend when required, the engineer shall have power to proceed by himself to take measurements & in that case these measurements shall be accepted by the contractor as final.

C-11.7 The contractor shall, once in every month, submit to the Engineer details of his claims for the work done by him up to and including the previous month, which are not covered by this contract agreement in any of the following respects:

a) Deviations from items and specifications provided in the contract documents.
b) Extra item/new items of work.
c) Quantities in excess of those provided in the contract schedule.
d) Items in respect of which rates have not been settled.

C-11.8 Contractor should, in addition, furnish a clear certificate to the effect that the claims submitted by him as aforesaid cover all his claims and that no further claims shall be raised by him in respect of the work done up to and including the period under report.

C-12.0 **CONTRACTOR'S SUPERVISION:**

C-12.1 The contractor shall either himself supervise the execution of the contract or shall appoint a competent agent approved by the Engineer to act in his stead.

C-12.2 The contractor, shall employ an engineer/agent having qualification in Civil Engineering from a recognised Institute for any work with a contract value exceeding Rs. Two Lakhs.

C-12.3 If the contractor fails to appoint a suitable engineer/agent as aforesaid, the Engineer shall have full powers to suspend the execution of work & stop payment of any amount that may have become due until such date as a

suitable engineer/agent is appointed and the contractor shall be held responsible for the delay caused to the work & no extension of time on this account shall be given to him.

C-12.4 Orders given to the contractor's engineer/agent shall be considered to have the same force as they had been given to the contractor himself.

C-12.5 The contractor or his agent shall be in attendance at the site during all working hours and shall superintend the execution of work with such additional assistance in each trade as the Engineer may consider necessary.

C-12.6 The contractor or his agent shall attend, when required and without making claim for doing so, either the office of the Engineer or work site to receive instructions.

C-12.7 The Engineer shall have full powers, and without assigning any reason, to require the contractor immediately to cease to employ in connection with this contract any agent, servant or employee whose continued employment, in his opinion, undesirable.

C-13.0 **LABOUR AND SUPERVISION STAFF:**

C-13.1 The contractor shall engage experienced supervisory staff and specially skilled labour for work under this contract.

C-13.2 The contractor shall have to make his own arrangement for maintenance of his T and P so as to minimise the down time.

C-13.3 The supervisory staff employed by the contractor shall ensure proper out-turn of the work and discipline on the part of the labour put on the job. The contractor in general should see that the works are carried out in a safe and proper manner and in coordination with the staff employed directly by BHEL or other contractors of BHEL or its client.

C-13.4 It shall be the responsibility of the contractor to ensure safe working, taking due precautions to avoid any accident and damage to other equipment and personnel. He shall be liable for all accidents, damages etc. to personnel and equipment etc. during the execution of the work.

C-13.5 The work shall be executed under the usual conditions like rain, insufficient space, improper approach roads etc. affecting major construction work and in conjunction with numerous other operations at site. The contractor and his personnel shall cooperate with the others and proceed in a manner that shall

not delay or hinder the progress of work as a whole nor claim any compensation on such grounds.

C-13.6 The contractor will arrange necessary accommodation for his supervisory and workmen at his own cost. However, BHEL will approach customer for accommodation for contractor's staff and labour on chargeable basis, if possible.

C-14.0 **PLANT AND EQUIPMENT AT SITE:**

C-14.1 The contractor shall, at his own expenses, supply all tools, plant and equipment (hereinafter referred as T and P), testing instruments and consumables required for the execution of the contract.

C-14.2 All tools, plant & equipment brought to the site shall become the property of the BHEL & shall not be removed from the site without the written approval of the Engineer. When the work is finally completed or the contract is terminated for reasons other than the default of the contractor, he shall forthwith remove from the site all tools, plant, equipment etc. (other than those as may have been provided by BHEL) and upon such removal, the same shall revert in & become the property of the contractor.

C-15.0 **COMPLIANCE TO REGULATIONS AND BY LAWS:**

C-15.1 The contractor shall confirm to the provisions at any statute relating to the work and regulations and bylaws of any local authority and of any water and lighting companies or undertaking with whose system the work is proposed to be connected. He shall before making any variation from the drawings or the specifications that may be necessitated for such connections give the Engineer, notice specifying the variation proposed to be made & the reasons thereof & shall not carry out any such variation until he has received instructions from the Engineer in respect thereof. The contractor shall be bound to give all notices required by statute, regulations or by laws as aforesaid and to pay all fees and taxes payable to any authority in respect thereof.

C-16.0 **MATERIALS OBTAINED FROM EXCAVATION:**

C-16.1 Materials of any kind obtained from excavation on the site shall remain in property of BHEL & shall be disposed of as the Engineer may direct, at no extra cost.

C-17.0 **TREASURE, TROVE, FOSSILS, ETC:**

All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the site shall be the absolute property of BHEL and the contractor shall take reasonable precautions to prevent his workmen or any other person from removing or damaging any such article or thing, shall immediately upon discovery thereof and before removal acquaint the Engineer with such discovery and carry out the Engineer's directions as to the disposal of the same.

C-18.0 **PROTECTION AND SECURITY:**

The contractor shall provide and maintain at his own expenses all lights, guards, fencing and Watch & Ward when and where necessary or required by Engineer for the protection and security of the works or for the safety and convenience of those employed on the works or the public.

C-19.0 **SITE OFFICE AND STORES:**

C-19.1 BHEL shall provide to the restricted extent, open space as made available to BHEL by its customer in as is where is basis for site office and stores, free of charge.

C-19.2 The contractor shall provide, construct and maintain at his own expenses the site office, material testing laboratory, stores & shall make his own arrangements for water, sanitation, access roads, electrification and cleanliness required for proper and efficient execution of work. The planning, setting and construction of these buildings shall have the approval of the Engineer & the contractor shall keep them tidy, clean and in sanitary condition to the satisfaction of Engineer.

C-19.3 After completion of work the contractor shall promptly dismantle, the distribution and other facilities that may have been erected, at his own cost and clear the area to the satisfaction of the Engineer and hand over the same to the Engineer.

C-20.0 **POWER & WATER :-** **DELETED**

C-20.1 The Construction Power shall be provided at one point on chargeable basis and recovery shall be made on actuals at the rate prevailing at the time of drawl of

power from RA bills as per Customer/BHEL norms. The contractor shall have to make their own arrangements, at their cost for distribution to various locations for their works including proper switch/fuse units, distribution boards, cables, poles etc. to ensure safety of men and equipment. Where required, the contractor shall employ diesel operative equipment in addition to electric operated ones to ensure timely completion of work.

In case BHEL is not able to supply power, contractor has to make his own arrangement and take a separate connection for all construction works.

BHEL shall not be responsible for any inconvenience caused due to any failure of lighting and power supply and no compensation for delay in works can be claimed by the contractor due to such non-supply on the grounds of idle labour, machinery or any other grounds. The contractor should ensure that the work in critical areas is not held up in the event of lighting and power breakdown and for the same he should have some stand by arrangement at his cost. In the event of breakdown in the electric supply, if the progress of work is hampered, it will be the responsibility of the contractor to step up the progress after restoration of electric supply so that over all progress of work is not affected. The contractor shall make proper arrangement of illumination at work place while working in late hours or in darkness.

C-20.2 Unless stated otherwise in the scope, The contractor shall make his own adequate arrangement for procuring clear water to be used in works at his own cost. However, water if available may be supplied to the contractor at one point on chargeable basis and recovery shall be made on actuals at the rate prevailing at the time of drawl of water from RA bills as per Customer/BHEL norms.

C-21.0 **TEMPORARY WORKSHOP, STORES, CONSUMABLES ETC:**

The contractor shall during the progress of work, provide, erect and maintain at his own expenses all necessary temporary workshops, stores, consumables, offices etc. required for the proper and efficient execution of the work. The planning, setting & erection of these buildings shall have the approval of the Engineer and the contractor shall at all time keep them tidy & in a clean and sanitary condition on to the entire satisfaction of the Engineer.

C-22.0 **MATERIALS:**

C-22.1 The contractor shall at his own expenses, provide all materials required for the work. All materials to be provided by the contractor shall be in conformity with the specifications laid down in the contract & the contractor shall, if

requested by the Engineer, furnish proof to the satisfaction of the Engineer that the materials so comply.

C-22.2 The contractor shall, at his own expenses and without delay, supply to the Engineer samples of materials proposed to be used in the works. The Engineer shall within seven days of supply of samples or within such further period as he may require, intimate to the contractor in writing, whether samples are approved by him or not. If samples are not approved, the contractor shall forthwith arrange to supply to the Engineer for his approval fresh samples complying with the specifications laid down in the contract. Any delay in approval of samples (original or fresh ones) shall not make the contractor eligible for any compensation.

C-22.3 The Engineer shall have full powers to require removal of any or all of the materials brought to site by the contractor which are not in accordance with the contract specifications or do not conform in character or quality to samples approved by him. In case of default on the part of contractor in removing rejected materials, the Engineer shall be at liberty of have them removed by other means. The Engineer shall have full powers to procure other proper materials to be substituted for rejected materials and in the event of the contractor refusing to comply, he may cause the same to be supplied by other means. All costs, which may attend upon such removal and/or substitution shall be borne by the contractor**.** In such cases, handling charges @ 15% per annum or 1.25% per month or part thereof will be recovered from the contractor in addition to the actual procurement cost of material. The period for imposing handling charges is to be reckoned from the date of making payment / LR for lifting material to / by Subcontractor from authorized source, whichever is earlier to

a) The date of LR for dispatch of finished product by the supplier / fabricator.
b) Till date of consumption by the contractor as recorded in the MB.

C-22.4 The contractor shall indemnify BHEL, its representative or employees against any action, claim or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties or other charges which may be payable in respect of any article or materials or part thereof included in the contract. In the event of any claim being made or action being brought against BHEL or any agent, servant or employee of BHEL in respect of any such matters as aforesaid, the contractor shall immediately be notified thereof, provided that such indemnity in complying with the specific directions issued by BHEL but the contractor shall by any royalties or other charges payable in respect of any such use, the amount so

paid being reimbursed to the contractor only if the use was the result of any drawings and/or specifications issued after submission of the tender.

C-22.5 All charges on account of octroi, royalty and all other taxes & duties on materials obtained for the works from any source shall be borne by the contractor.

C-22.6 The Engineer shall be entitled to have tests carried out as specified in the contract for any materials supplied by the contractor other than those for which, as stated above, satisfactory proof has already been furnished, at the cost of the contractor & the contractor shall provide at his expenses all facilities which the Engineer, may require for the purpose. If no test are specified in the contract, and such tests are required by the engineer, the contractor shall provide all facilities required for the purpose and the charges for these tests shall be by the contractor only. The cost of materials consumed in tests shall be borne by the contractor in all cases except when otherwise provided.

C-23.0 **GENERAL:**

C-23.1 Material required for works, shall be stored by the contractor only at places approved by the Engineer. Proper storage and safe custody of material including construction stores shall be the responsibility of the contractor for which no charges shall be claimed by the contractor.

C-23.2 BHEL's officials concerned with the contract shall be entitled at any time to inspect and examine any materials intended to be used in or on the works, either on the site or at factory or workshop or other place(s) where such materials are assembled, fabricated, manufactured or at any place(s) where these are laying or from which these are being obtained and the contractor shall give such facilities as may be required for such inspection and examination.

C-23.3 All materials brought to the site shall become and remain the property of BHEL and shall not be removed off the site without the prior written approval of the engineer. But whenever the works are finally completed and advance, if any, in respect of any such material is fully recovered, the contractor shall at his own expense forthwith remove from the site all surplus material originally supplied by him and upon such removal, the same shall revert in and become the property of the contractor.

C-24.0 **DELAY AND EXTENSION OF TIME:**

If, in the opinion of the Engineer, the work is delayed

i) by reason of abnormally bad weather, or

ii) by reason of serious loss or damage by fire, or

iii) by reason of civil commotion, local combination of workmen, strike or lockout, affecting any of the trades employed on the work, or

iv) by delay on the part of the agency or tradesman engaged by the BHEL in executing work not forming part of the contract, or

v) by reason of any other cause which in the absolute discretion of the Engineer is beyond the contractor's control, then in any such case, the Engineer (or higher authority) may make fair and reasonable extension in the completion dates of the individual items of work of the contract as whole. Such extension which will be communicated to the contractor by the Engineer in writing shall be final and binding on the contractor. No other claim in this respect for compensation, idle labour or otherwise howsoever is admissible. Upon the happening of any such event causing delay the contractor shall immediately give notice thereof in writing to the Engineer but shall nevertheless use constantly his best endeavour to prevent or make good the delay and shall do all that may reasonably be required to the satisfaction of the Engineer to proceed with the work.

Above clause No. C-24.0 stands deleted. Please refer Annexure to conditions of contract for civil

C-25.0 **COMPENSATION/ PENALTY FOR DELAY IN COMPLETION:**

If the contractor fails to complete the works within the specified contractual period or extension of time granted by the Engineer, the BHEL shall have the right to deduct liquidated damage/penalty @ 0.5% of the contractual value per week of delay or part thereof, subject to a maximum of 10% of the contract value . Once the maximum limit of delay is reached (i.e. 20 week of delay) BHEL may consider termination of the contract and forfeit the Security deposit without prejudice to the other remedies under the contract. Amended/ revised contract value (Excluding ORC, Extra Works, Supplementary/ Additional Items and PVC) shall be considered for calculating LD/ penalty.

C-26.0 PRICE VARIATION:

DELETED

DELETED

Above clause No. C-26.0 stands deleted. Please refer Annexure to conditions of contract for civil works.

C-27.0 **OVER RUN CHARGES:**

C-27.1 DELETED

Above clause No. C-27.0 stands deleted. Please refer Annexure to conditions of contract for civil works.

C-28.0 **OCTROI AND OTHER DUTIES:**

C-28.1 All charges on account of Octroi and/or other duties on materials obtained for the work shall be borne by the contractor.

C-29.0 **TERMS OF PAYMENT:**:

C-29.1 The contractor shall be paid monthly running bill to a maximum of 95% (retaining 5% from each running bill) of value of the works actually executed on site provided the work has been executed to the satisfaction of the Engineer. ~~The payment for tender work shall be admitted progressively on completion of work. However, work is to be executed as per time schedule prescribed by Engineer-In-Charge. In case of delay due to contractor, payment made equivalent to amount of work done in tower, equipment and trenches will be withheld from successive bills~~. From payable amount recoveries such as security deposit, income tax etc. would be made as per rule. The certificate of the Engineer regarding such approval and passing of sums so payable shall be final and conclusive against the contractor

C-29.2 The Engineer shall after a measured bill allow and certify payment to the contractor on the basis of abstract measurement bill submitted by contractor. However, the usual recoveries would be effected from bill.

C-29.3 Any certificate relating to the work done may be modified by any subsequent interim certificates or by the final certificate and no certificate of the Engineer supporting an advance payment shall of itself be conclusive evidence that any work or materials to which it relates are in accordance with the contract.

C-29.4 All intermediate payments shall be regarded as advance against the final payment only and shall not be considered as an admission of the due performance of the contract or any part thereof in any respect of the occurring of any claim whatsoever. Such intermediate payments shall not conclude, determine or effect in any way the powers of the Engineer as to the final settlement and adjustment of the account of otherwise, or in any way vary of affect the contract. To this affect the contractor shall submit the final bill, which shall contain the complete up-to-date measurements for the total work done.

C-29.5 The conditions for the release of last 5% retention money shall be as follows:

C-29.5.1 2.5% payment shall be released along with the final bill on completion of total work as certified by BHEL site.

C-29.5.2 Balance 2,5% of payment shall be released on completion of guarantee period. However these retention money can be released on submission of B.G. of equivelent amount valid till guarantee period.

The contractor shall guarantee the work under the scope of the contract for a period of 12 months from the date of start of the guarantee period as certified by BHEL site (i.e completion of total work under the scope and or taking over by BHEL/owner),and shall rectify free of cost all defects due to faculty supply or work done. In case the contractor fails to repair/ replace the defective work within the time specified by BHEL, BHEL may proceed to undertake such repair/replace such defective work at contract's risk and cost without prejudice to any other right and recover the sum from security deposit/BG/ any dues.

Above clause No. C-29.5.2 shall be read in conjunction with clause no. C-2.0.

C-29.6 Income Tax at the prevailing rate on gross value of work done and applicable surcharge shall be deducted from the running account bills unless exempted by the Income Tax Office.

C-29.7 **The prices to be quoted by bidder should be EXCLUSIVE of GST**

Please refer Annexure to conditions of contract for civil works for detail terms and conditions of taxes & duties.

C-30.0 **CEMENT AND STEEL: (Pl. also refer Annexure to conditions of contract for civil works for issue of Cement and steel in case of BHEL supply as mentioned in BOQ)**

C-30.1 The theoretical quantity of cement to be used in works shall be calculated on the basis of the designed mix concrete and as per CPWD norms for all the other items based on latest edition in use in CPWD works Delhi at the time of submitting tender.

C-30.2 The theoretical weight of reinforcing steel shall be derived on the basis of sectional weights as per relevant Indian Standards & the lengths for purpose of consumption/reconciliation and payment. No claim shall be entertained from the contractor as such for the difference in theoretical/actual weight of steel during reconciliation or payment for fixing.

C-30.3 Clogging of cement and rusting of steel should be avoided to the maximum extent possible without hampering the continuity of construction/erection. In case due to any cause, attributable to contractor such clogging of cement and/or rusting of steel occurs rendering the same unusable, the contractor shall remain responsible to make good the loss at his own cost.

C-30.4 The contractor shall plan & arrange procurement of steel, cement and other materials as required every month in consultation with the Engineer. Failing compliance to this requirements, further execution of work of the contractor by the BHEL may be suspended and no compensation for delay in the execution of the work or suspension of the works caused on account of the above shall be entertained.

C-30.5 No materials shall be issued to the contractor except for those specified in Section C-22.0. Contractor shall maintain record of day to day issue and consumption of materials at site like cement, bitumen, lead, paint etc. The contractor will have to make his own arrangements at his own cost for procurement of all materials as required for the works and of such quality as per specification and acceptable to the Engineer.

C-30.6 In case any additional expenditure is incurred in work arising out of the faulty execution of such work by the contractor, such additional expenditure shall be borne by the contractor.

C-31.0 **QUALITY ASSURANCE:**

C-31.1 The contractor has to establish at site the field testing facilities for testing of civil construction materials & concrete cubes and other works as required under the approved Field Quality Plan of BHEL/its customer for ensuring the proper quality, grade and strength of the materials used in the construction. If further test is required by the Engineer to be carried from outside laboratory, the cost of the same shall be borne by contractor (copies of the Field Quality Plan & other Inspection & Test procedures to be followed shall be issued after mobilisation by the sub-contractor).

C-31.2 The contractor has to arrange for calibration of all test equipment/instruments brought by him as per the requirement of BHEL calibration procedure as directed by the Engineer. The test certificates/calibration certificates shall have to be submitted. BHEL site shall control use of these equipment/ instruments by allotting control number and permitting use of only those equipment/ instruments which are under calibrated status.

C-32.0 **CLEARANCE OF SITE AND REPAIRS:**

C-32.1 The contractor has to clear the site/area where mechanical and electrical erection work is to be commenced/or in progress. The contractor shall remove construction materials and equipment lying in the vicinity and causing

obstruction in the erection work within 24 hours notice. In case, he fails to clear the site, this will be done at his risk and cost by BHEL. For the works executed by the contractor, the deficiencies pointed out must be attended within specified period.

C-33.0 **PROTECTION OF WORK:**

C-33.1 The contractor shall have total responsibility of protecting his works till it is finally taken over by the Engineer. No claim will be entertained by the Engineer for any damage or loss to the contractor's works and the contractor shall be responsible for the complete restoration of damaged works to its original condition to comply with specifications and drawings. Should any such damage to the contractor's works occur because of other party not under his supervision or control, the contractor shall make his claim directly with the party concerned. The contractor shall not cause any delay in the repair of such damaged works because of any delay in the resolution of such disputes. The contractor shall proceed to repair the work immediately and no cause thereof will be assigned pending resolution of such disputes.

C-34.0 **RECORD FOR MATERIALS CONSUMED:**

C-34.1 The contractor has to maintain and furnish to the Engineer the record of materials procured and consumed in the works for each activity. The statement showing the theoretical vis-s-vis actual consumption of specified materials, such as structural/reinforcement steel, cement, bitumen, lead, paint etc. shall be enclosed along with the running bills submitted by the contractor. Contractor has to also furnish the test results of the concrete cubes, bricks, stone aggregate and other materials used in work as per IS specifications along with the running bills.

C-35.0 **SECURED ADVANCE ;**

C-35.1 DELETED

a)
b)
c)
d)
e)
f)

C-35.2

DELETED

Above clause No.C-35.0 stands deleted. Please refer Annexure to conditions of contract for civil works

ANNEXURE TO CONDITIONS OF CONTRACT FOR CIVIL WORKS

The following terms and conditions shall form a part of the tender document. If any discrepancies found between below mentioned clauses and clauses in the Conditions of Contract for Civil Works, Doc.No.-TB-Civil-GCC, Rev-02, the clauses mentioned in this annexure shall prevail.

A. Condition of Contract for Civil works (DOC. NO. – TB-Civil-GCC, Rev-02):

A.1. GENERAL INSTRUCTION

A.1.1. **All pages of the tender documents shall be duly signed, stamped and submitted along with the offer in token of complete acceptance thereof.** The information furnished shall be complete by itself. The tenderer is required to furnish all the details and other documents as required in the following pages.

A.1.2. Tenderers are advised to study all the tender documents carefully. Any submission of tender by the tenderer shall be deemed to have been done after careful study and examination of the tender documents and with the full understanding of the implications thereof. Should the tenderers have any doubt about the meaning of any portion of the Tender Specification or find discrepancies or omissions in the drawings or the tender documents issued are incomplete or shall require clarification on any of the technical aspect, the scope of work etc., tenderer shall at once, contact the authority inviting the tender well in time (so as not to affect last date of submission) for clarification before the submission of the tender. Tenderer's request for clarifications shall be with reference to Sections and Clause numbers given in the tender documents. The specifications and terms and conditions shall be deemed to have been accepted by the tenderer in his offer. Non-compliance with any of the requirements and instructions of the tender enquiry may result in the rejection of the tender.

A.2. PROCEDURE FOR SUBMISSION OF SEALED TENDERS

A.2.1. Bidders may please refer Cl no. 02 to Cl no. 03 of the Notice inviting tender.

A.2.2. The tenders received after the specified time of their submission shall be treated as 'Late Tenders' and shall not be considered under any circumstances.

A.2.3. Tenders shall be opened by the officers concerned of BHEL at the time, date and venue as specified in the tender enquiry. Tenderer or their authorized representative may witness the bid opening.

A.2.4. The tenderer shall closely pursue all the clauses, specifications and drawings indicated in the Tender Documents before quoting. Should the tenderer have any doubt about the meaning of any portion of the Tender Specifications or find discrepancies/omission in the drawings or the tender documents issued are incomplete or shall require clarification on any of the technical aspect, scope of work etc. he shall at once contact the authority inviting the tender for clarification before the submission of the tender.

A.2.5. Before submission of offer, the tenderer is advised to inspect the work & the environments and be well acquainted with the actual working and other prevalent conditions, facilities available, sourcing of material and labour, means of transport and access to site, accommodation, etc. No claim will be entertained later on the grounds of lack of knowledge on any of these conditions/ resources.

A.2.6. Tenderer must fill up all the schedules and furnish all the required information as per the instructions given in various sections of the tender specification. Each and every

page of the Tender Specification must be SIGNED AND SUBMITTED ALONG WITH THE OFFER by the Tenderer in token of complete acceptance thereof the information furnished shall be complete by itself.

A.2.7. The tenderer shall quote the rates in English Language and international numerals. Total price offered should be entered in figures as well as in words. For the purpose of the tender, the metric system of units shall be used.

A.2.8. The tenderer shall quote a percentage above/ below/At Par the rates shown in the "Bill of Quantities Cum Price Schedule (Annexure-I)" of subject tender.

A.2.9. The quoted percentage will apply to the individual items of "Annexure-I i.e. Bill of Quantity Cum Price Schedule" uniformly.

A.2.10. All entries in the tender shall either be typed or be written legibly in ink. Erasing and overwriting are not permitted and may render such tender liable for rejection. All cancellations and insertions shall be duly attested by the tenderer.

A.2.11. The tenderer must provide the registered e-mail of their registered office along with the addresses and authorised phone/mobile nos.

A.3. **ADJUSTMENT PRICE DISCREPANCY (IES): - Not Applicable being e procurement.**

A.4. **EVALUATION OF TECHNICAL BIDS**

A.4.1. Technical Bids submitted by the tenderer will be opened first and evaluated for fulfilling the Pre-Qualification criteria and other conditions in NIT/Tender documents, based on documentary evidences submitted along with the offer.

A.4.2. In case the same qualifying experience is claimed by more than one bidder due to subletting of work by main contractor to subcontractor (s) then following conditions shall be applicable.

A.4.2.1. For labour + consumable contract without material and T&P:

Benefit of work experience shall be given to the subcontractor who has actually executed job and not to the contractor offloaded down the line.

A.4.2.2. For contract with complete scope i.e. with materials, T&P, labour and consumable:

i) Benefit of work experience shall be given to the subcontractor who has actually executed job and not to the contractor offloaded down the line.
ii) If the contractor offloads the labour and/or T&P portion only, benefit of work experience shall be given to the main contractor and not to the subcontractor who has executed only as labour supply contractor

The bidder's qualification shall be subject to submission of documentary proof. BHEL reserves the right to ask for further proofs including submission of TDS certificates/ for the said job.

A.4.3. In case the qualifying experience is claimed by private organizations based on Work Order and completion certificates from another private organization, BHEL reserves the right to ask for further proofs including submission of TDS certificates/ form 26AS /bills for the said job.

A.4.4. Credentials of all the bidders participating in open tender will be scrutinized thoroughly by the nominated committee w.r.t. the pre-qualifying requirement for the tender.

A.4.5. Details of qualifying work(s) executed by the bidder will be forwarded to the principle employer for verification of the work with respect to completion, commencement & completion date, scope and value of the work executed. Performance feedback of the bidder will also be sought from the principle employer.

A.4.6. BHEL may conduct onsite verification of at least one of the qualifying works to verify completion of the work and evaluate capability and performance of the bidder.

A.4.7. The bidder representative may be called for the discussion with the committee. His originals may be verified by the committee. In addition to above their organization chart and detailed list of manpower, tools & plants and technical capability may be discussed and ascertained by the committee.

A.5. **EVALUATION OF PRICE BIDS**

A.5.1. Price Bids of unqualified bidders shall not be opened.

A.5.2. The offers will be evaluated on the basis of total price basis (refer "BILL OF QUANTITY AND PRICE SCHEDULE) as shown in the price bid.

A.5.3. Reasons for rejection of the bid shall be intimated in due course after issue of LOI/LOA to successful bidder and receipt of unconditional acceptance of LOI /LOA from the successful bidder.

A.5.4. In case of electronic Reverse Auction, the unqualified bidders shall not be allowed to participate in reverse auction.

A.6. **DOCUMENTS TO BE ENCLOSED:**

Full information shall be given by the tenderer in respect of the following.

A.6.1. Tenders shall be signed by persons duly authorized/empowered to do so. An attested copy of the Power of Attorney to be submitted in all cases except where the sole proprietor is the signatory to the tender documents.

A.6.2. ***PERMANENT ACCOUNT NUMBER:***

Certified copies of Permanent Account Numbers as allotted by Income Tax Department for the Company / Firm / Individual Partners, etc. shall be furnished along with tender.

A.6.3. **AUDITED BALANCE SHEET AND INCOME TAX RETURN:**

Copy of Audited Balance sheets and income tax return for last Five financial years (financial years as specified in PQR).

A.6.4. **SOLVENCY CERTIFICATE:**

If asked in NIT, bidder should submit solvency certificate (not older than 12 months from date of tender notification) issued by any scheduled bank.

A.6.5. **DOCUMENT RELATED TO INCORPORATION OF BUSINESS ENTITY:**

A.6.5.1. **IN CASE OF INDIVIDUALTENDERER:**

His/her full name, address and place & nature of business.

A.6.5.2.***IN CASE OF PARTNERSHIP FIRMS:***

The names of all the partners with address. A copy of the partnership deed/instrument of partnership duly certified by the Notary shall be enclosed.

A.6.5.3.***IN CASE OF COMPANIES:***

Date & place of registration including date of commencement certificate in case of Public Companies and the nature of business carried on by the company. Certified copies of Memorandum and Articles of Association are also to be furnished.

A.6.6. Offer forwarding letter over the letterhead.

A.6.7. *Declaration sheets (As per Prescribed format) over the letter head*.

A.6.8. *No Deviation certificates (As per Prescribed format) over the letterhead.*

A.6.9. **GST Registration certificate: -**

All the data required to be enclosed with the tender need to be furnished neatly typed, signed & stamped in the given formats only (in the form of separate sheets) failing which the tender may be considered as incomplete and is liable for rejection. Documentary proof wherever necessary also need to be enclosed.

A.7. **VALIDITY OF OFFER**

The rates in the Tender shall be kept valid for acceptance for a minimum period of **Four Months** from latest due date of offer submission (including extension(s), if any). In case BHEL (Bharat Heavy Electricals Limited) calls for negotiations, such negotiations shall not amount to cancellation or withdrawal of the original offer which shall be binding on the tenderer.

A.8. **REJECTION OF TENDER & OTHER CONDITIONS:**

A.8.1. The decision of acceptance of tender will rest with BHEL which does not bind itself to accept the lowest tender or any tender and reserves to itself full rights for the following without assigning any reasons whatsoever:

a) To reject any or all of the tenders.

b) To split up the work amongst two or more Tenderer as per NIT

c) To award the work in part as per NIT

d) In either of the contingencies stated in (b) and (c) above to modify the time for completion suitably.

A.8.2. Conditional tenders, unsolicited tenders, containing abnormally low/ unworkable rates

& amounts, tenders which are incomplete or not in the form specified or defective or have been materially altered or not in accordance with the tender conditions, specifications etc. are liable to be rejected.

A.8.3. Tenders are liable to be rejected in case of unsatisfactory performance of the tenderer with BHEL, or tenderer under suspension (hold / banning / delisted) by any unit / region / division of BHEL or tenderers who do not comply with the latest guidelines of Ministry / Commissions of Govt. of India. BHEL reserves the right to reject a bidder in case it is observed that they are overloaded and may not be in a position to execute this job as per the required schedule in line with 'NIT'. The decision of BHEL will be final in this regard.

A.8.4. In case of any adverse information is received concerning performance, capability or conduct of the tenderer after issue of tender enquiry or opening of tender or award of work, BHEL reserves the right to reject the offer at any stage as deemed fit.

A.8.5. Offers with inadequate Tools & Plants, Manpower Deployment Plan, and Method Statement are liable for rejection.

A.8.6. If a tenderer who is a proprietor expires after the submission of his tender or after the acceptance of his tender, BHEL may at its discretion, cancel such tender. If a partner of a firm expires after the submission of the tender or after the acceptance of the tender, BHEL may cancel such tender at its discretion unless the firm retains its character.

A.8.7. BHEL will not be bound by any Power of Attorney granted by the tenderer or by changes in the composition of the firm made subsequent to the execution of the contract. BHEL may, however, recognise such Power of Attorney and changes after obtaining proper legal advice, the cost of which will be chargeable to the contractor concerned.

A.8.8. If the tenderer deliberately gives wrong information in his tender, BHEL reserves the right to reject such tender at any stage or to cancel the contract, if awarded, and forfeit the Earnest Money/Security Deposit/any other moneys due.

A.8.9. Canvassing in any form in connection with the tender is strictly prohibited and the tenders submitted by the tenderer who resorts to canvassing are liable to be rejected.

A.8.10. In case the Proprietor, Partner or Director of the Company / Firm submitting the Tender, has any relative or relation employed in BHEL, the authority inviting tender shall be informed to the fact as per specified format along with the offer, failing this, BHEL may, at its sole discretion reject the tender or cancel the contract and forfeit the Earnest Money/ Security Deposit.

A.8.11. The successful tenderer should not sub-contract the part or complete work detailed in the tender specifications without written permission of BHEL's Site In charge/ Sector Head. For this the contractor shall submit request application to site in charge supported by credentials (financial and technical) and resource mobilization schedule of such sub-contractor. Such request is to be considered in consultation with end user/ultimate customer (if applicable) and subject to satisfactory credentials, fund flow arrangement between them, HSE and other contractual and statutory obligations. The tenderer is solely responsible to BHEL for the work awarded to him.

A.8.12. Unsolicited discount received after the due date and time of Bid Submission shall not be considered for evaluation. However, if the party who has submitted the unsolicited discount/rebate becomes the L-I party, then the awarded price i.e. contract value shall be worked out after considering the discount so offered.

A.8.13. BHEL shall not be liable for any expenses incurred by the bidder in the preparation of the tender irrespective of whether the tender is accepted or not.

A.9. **NO DEVIATIONS ARE ACCEPTABLE: -**

Offers with deviations are likely to be rejected. However, if the bidder insists on any technical or commercial deviations from the specifications and / or tender conditions, **the price implication, if any, of withdrawing the deviations must be submitted along with the price bid in a separate sealed envelope** super-scribed "**PRICE IMPLICATION FOR WITHDRAWAL OF DEVIATIONS**". No price implication for withdrawal of deviation shall be accepted at a later date, after opening of technical bid.

A.10. Consortium/ JV bidding is not allowed under this NIT.

B. **EARNEST MONEY DEPOSIT**

NOT APPLICABLE

C. **SECURITY DEPOSIT**

Security Deposit means the security provided by the Contractor towards fulfilment of any obligations in terms of the provision of the contract.

C.1. Upon acceptance of Tender, the successful Tenderer should deposit the required amount of Security Deposit for satisfactory completion of work. **The total amount of Security Deposit will be 5% of the Contract Value. EMD of the successful tenderer shall be converted and adjusted towards the required amount of Security Deposit.**

C.2. **Mode of Security deposit:**
The security Deposit should be furnished **before start of the work** by the contractor.

"Bidders agrees to submit performance security required for execution of the contract within the time period mentioned. In case of delay in submission of Performance security, enhanced performance security which would include interest (Repo rate + 4%) for the delayed period, shall be submitted by the bidder.

Further, if performance security is not submitted till such time the first bill becomes due, the amount of performance security due shall be recovered as per terms defined in NIT / Contract, from the bills along with due interest".

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

i) Cash (as permissible under the extant Income Tax Act)

ii) Local cheques of scheduled banks (subject to realization) / Pay Order / Demand Draft / Electronic Fund Transfer, in favour of BHEL.

iii) Bank Guarantee from Scheduled Banks / Public Financial Institutions as defined in the Companies Act. The Bank Guarantee format for Security Deposit shall be in the prescribed formats enclosed with general conditions of contract.

iv) Fixed Deposit Receipt issued by Scheduled Banks / Public Financial Institutions as defined in the Companies Act. The FDR should be in the name of the contractor, A/C BHEL and duly discharged on the back.

v) Securities available from Indian Post Offices such as National Savings Certificates, Kisan Vikas Patras etc. (Certificates should be held in the name of Contractor furnishing the security and duly endorsed/hypothecated/pledged, as applicable, in favour of BHEL and duly discharged on the back).

vi) Insurance Surety Bonds

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

C.3. **Submission of Security Deposit:**

i) At least 50 % of the required Security Deposit, including the EMD, shall be submitted before start of work. Balance of the Security Deposit can be submitted by way of deduction of 10% of the gross amount progressively from each running bills of the contractor till the total amount of the required Security Deposit is collected.

ii) In case of delay in submission of performance security, enhanced performance security which would include interest (Repo rate + 4%) for the delayed period, shall be submitted by the bidder.

iii) If the value of work done at any time exceeds the contract value, the amount of Security Deposit shall be correspondingly enhanced and the additional Security Deposit shall be immediately deposited by the Contractor or it shall be recovered from payment/s due to the Contractor.

iv) The recoveries made from running bills (cash deduction towards balance SD amount) can be released against submission of equivalent Bank Guarantee in acceptable form, but only once, before completion of work, at the discretion of BHEL.

C.4. The BG shall be submitted only through the Banker. Along with the BG, the Bank shall also furnish a letter of confirmation (in the prescribed formats enclosed with general conditions of contract).

C.5. The validity of the Bank Guarantee furnished towards Security Deposit shall be up to three months more than the period of completion of work as stipulated in the LOI and the same will be kept valid by proper renewal till the completion of the work.

C.6. BHEL reserves the right of forfeiture of Security Deposit in addition to other claims and penalties in the event of the contractor's failure to fulfil any of the contractual obligations or in the event of termination of contract as per terms and conditions of the contract. BHEL reserves the right to set off the Security Deposit, against any claims of any other contracts with BHEL.

C.7. **Conditions for acceptance of bank guarantees**

Contractors are advice to obtain Bank Guarantee preferably from any of the following BHEL consortium banks

Sl. No.	Name of Bank	Sl. No.	Name of Bank
1	State Bank of India	11	Punjab National Bank
2	Canara Bank	12	Union Bank of India
3	IDBI Bank Limited	13	Yes Bank Limited
4	ICICI Bank Limited	14	RBL Bank Ltd.
5	HDFC Bank Limited	15	Standard Chartered Bank
6	Axis Bank	16	Indian Overseas Bank
7	IndusInd Bank Limited	17	Kotak Mahindra Bank Limited
8	Bank of Baroda	18	Federal Bank Limited
9	Exim Bank	19	Hongkong and Shanghai Banking Corporation Ltd
10	Indian Bank		

Bank Guarantees from Banks outside BHEL's consortium shall be as below:

The Bank Guarantees of all Public sector banks can be accepted (in addition to consortium banks)

The Bank Guarantees of Co-operative banks shall not be accepted.

Bank Guarantees of other than consortium bank and public sector bank can be accepted subject to an overall exposure limit (at New Delhi) of Rs. 10 crores for banks with net worth of more than Rs. 500 crores as on last balance sheet date and Rs 5 crores for banks with net worth between Rs. 350 to Rs 500 crores (A certificate and copy of latest Balance Sheet to be given by the Bank at the time of submission of Bank Guarantees).

In case of private sector banks, a clause to be incorporated in the text of Bank Guarantee that it can be enforceable by being presented at any branch of the bank.

In case of foreign vendors, the bank guarantees issued by foreign banks may be confirmed by our consortium bank in India.

In case of Bank Guarantees given by Non-Consortium banks (Private sector or Public sector), the Bank Guarantees are to be enforceable in New Delhi or the town/ city in which the sector office is located.

C.8. **Return of Security Deposit:**

If the contractor duly performs and completes the work in all respects to the entire satisfaction of BHEL and presents an absolute "No demand certificate", returns properties belonging to BHEL, taken, borrowed or hired by him for carrying out the said works, and furnishes performance bond BG in the prescribed proforma, Security Deposit will be released to the contractor after deducting all costs, expenses and other amounts that are to be paid to BHEL under this contract or other contracts entered into with the contractor.

It may be noted that in no case the Security Deposit shall be refunded/released prior to passing of final bill.

D. **Bank Account Details for submission of EMD/ Security Deposit through electronic fund transfer mode.**

NAME OF THE COMPANY	**BHARAT HEAVY ELECTRICALS LTD**
ADDRESS OF THE COMPANY	**TRANSMISSION BUSINESS GROUP, 5TH FLOOR, BHEL TOWER, PLOT NO. 25, SECTOR-16A, NOIDA – 201301 (U.P.)**
NAME OF BANK	**STATE BANK OF INDIA**
NAME OF BANK BRANCH	**CAG-II NEW DELHI (17313)**
CITY	**NEW DELHI**
ACCOUNT NUMBER	**00000030206227732**
ACCOUNT TYPE	**CASH CREDIT**
IFSC CODE	**SBIN0017313**

E. **Overall Quantity variation**-

The individual quantity can vary to any extent or may be deleted for which no compensation will be payable to the contractor and the rates will remain firm. Also the rate of each item remains firm as long as the variation in the total value of work executed under the contract including extra items (if any) remains within **plus/minus 30 percent of the contract value**. In case the actual value of executed work including extra work on completion of work becomes less than 70% of the basic/original contract value than the following method shall be adopted.

The actual executed value shall be raised by 7% (For arriving at the final payment against work executed) subject to the condition that total value of work executed plus increase by 7% as above shall be limited to 70% of the basic/original contract value. The rate quoted shall be firm irrespective of any upward variation in the contract price.

It is further clarified that the enhancement/rate revision on the basic rate as per PVC clause shall not be accounted for the purpose of operating this clause.

F. **Clause No. C.29.7 "INCOME TAX/SALES TAX/WORKS TAX/VAT" stands deleted. Now this clause shall be read as below.**

F.1. All taxes (except GST), duties, charges, royalties, cess and any other levies by Central/ State/local authorities for the execution of the contract shall be borne by the contractor and shall not be payable extra.
Any increase of the same at any stage during execution of the contract shall be borne by the contractor.
Quoted price of the same shall be inclusive of all such requirements.

F.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.

F.3. Contractors have to make their own arrangement at their cost for completing the formalities, if required with relevant taxation authorities, for bringing their material, plant and machinery at site for the execution of the contract. Road permits / way bill, if required shall be arranged by the contractor.

F.4. Contractor 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 contractor on BHEL for this project / work

However, in case contractor submits GST Registration of a state other than the state wherein the site is located, then contractor has to submit an undertaking that contractor is not liable to take registration in the state wherein the site is located as per the provision of Place of Supply under CGST/SGST/IGST Act.

BHEL will not be held responsible for any non-compliance of the Contractor in respect of GST laws as framed from time to time.

F.5. Contractor shall comply with all statutory amendment/notifications in this respect

Contractor shall submit the tax invoice complying with GST Invoice Rules (Section 31 of GST Act & Rules referred thereunder).

In case of raising any Supplementary Tax Invoice (Debit / Credit Note), contractor shall issue the same containing all the details as referred in Section 34 read with Section 31 of GST Act & Rules referred there under.

Contractor shall comply with the Time Limit prescribed under the GST Law and rules thereof for raising the Tax Invoice

F.6. Goods and Service Tax (GST) will be reimbursed to the Contractor subject to the following conditions: -

I. Submission of valid GST Compliant Tax Invoice as per the GST Invoice Rules.
II. The Invoice raised by the Contractor should indicate the BHEL GST Registration Number.)
III. Contractor shall upload the invoices raised on BHEL in IFF/GSTR-1 within the prescribed time as given in the GST Act.
IV. Invoice raised and uploaded in IFF/GSTR-1 by the Contractor should be available to BHEL in FORM GSTR-2B electronically through the common portal
V. Confirmation of payment of such GST to the Government through filing of GSTR-3B of corresponding month/quarter.

F.7. The GST amount should get reflected within prescribed time limit in the GSTN for BHEL to avail the input credit. If the GST Credit is reversed/ denied/ delayed to BHEL due to non-receipt/delayed receipt of Services and/or tax invoice or due to expiry of timeline prescribed in GST law or due to any other factor for availing such Input Tax Credit (ITC) or for any other reason arising out of the act directly attributable to the Contractor, GST amount shall be recoverable from Contractor from any dues payable to the Contractor along with any interest levied/ leviable on BHEL.

F.8. Statutory variation, if any, on account of GST will be payable by BHEL at actuals on submission of documentary evidence.

F.9. TDS under Income Tax Act/ GST Act shall be deducted as per applicable rates unless Exemption certificate, if applicable, from the appropriate Authority is furnished to BHEL along with the Invoice.

F.10. **New Taxes & duties (Introduced after tender opening date):**
If any new tax or duty is levied by the Central/State Government/Municipality/Local Authority and becomes directly applicable on items specified in the Bill of Quantities, full reimbursement shall be made subject to submission of documentation as per statute.

G. **Clause C-27.0 of "Over run charges"** under special conditions of contract is now deleted. ***No overrun charges are payable under the contract***.

H. **Clause C-35.0 "secured advance"** under special conditions of contract is now deleted. ***No advance on materials shall be payable under the contract***.

I. **Clause C-26.0 "Price Variation"** under special conditions of contract is now deleted. ***The Price Variation Clasue is not applicable for this NIT.***

J. **<u>Issue of Material by BHEL:</u>**

A	**ISSUE OF MATERIAL BY BHEL (IF APPLICABLE AS PER BOQ AND SCOPE)**
i)	**Issue of Cement:**
1	Not Applicable
ii)	**Issue of Steel:**
1	**The steel shall be issued, if applicable as per BOQ,to the contractor on the following basis:** i. Structural Steel: Weighment basis (Unit – MT) ii. Reinforcement Steel and Earthing Rod: Weighment basis (Unit-MT) iii. MS Rails: Weighment Basis (Unit-MT)
2	All the steel (structural, reinforcement, earthing rod/GI flats, GI foundation bolts, etc.) issued by BHEL shall be properly accounted for. The total quantity of steel required for the work will be calculated from the approved Bar Bending schedule, fabrication drawings, approved laps, chairs and lugs etc. The measurement for payment as well as for accounting shall be based on the sectional weights as indicated in the relevant IS/BS/EN code specifications. In case any such sectional weights are not available in the above documents, the manufacturer recommendation/BHEL instruction shall be binding.
3	The steel issued to the contractor shall be mainly in standard length and sections as received from the supplier. However, the contractor shall be bound to accept the steel in length as available in the stores/consignment and no claims for extra payment because of issue of non-standard length will be entertained.
4	The contractor shall satisfy himself of the quality and quantity of the materials at the time of taking delivery from BHEL. No claims whatsoever will be entertained by BHEL because of quality or quantity after the materials are taken by the contractor from BHEL.
5	The contractor shall submit to BHEL well in advance of before Three month from requirement, a statement indicating estimated quantity of cement and steel required during a quarter.
6	The contractor must note that cement and steel required for the contractor's enabling job like store/ site office/batching plant/temporary woks etc. shall be arranged by the contractor at his own cost. All temporary structures constructed/installed/erected are to be dismantled and removed as per instruction of BHEL

7	Bidder to give requirement of Material in BHEL Scope well in advance of before Three month from requirement. Any delay in raising the requirement of these item leading to delay in placement of order, will be Contractor responsibility and its attributable delay in erection will be responsibility of Bidder only.
B	**HANDLING OF MATERIALS ISSUED BY BHEL:**
1	All materials issued by BHEL shall be stacked, stored above ground level **by use of concrete or wooden sleepers. No materials shall remain on ground at any time**. All concrete or wooden sleepers required for stacking the materials shall be arranged by contractor (successful bidder of this package) at his own cost within the quoted rates. All other equipments like winches, D-Shackles, slings of various sizes, max puller, pulley blocks, jacks, trucks, trailers etc. required for such handling of steel from BHEL stores/storage yard etc. shall be arranged by contractor within quoted/accepted rates. All materials stored by contractor shall be in accordance to standards/specifications and instruction of BHEL. Utilization of these material shall also be done in such a manner so that wastage on account of long storage/storage beyond shelf life can be avoided. Any loss/damage of material on this account will be attributable to the contractor.
2	If material is supplied before mobilisation of contractor, the contractor shall take delivery of the materials from the designated place within the project premises at his own cost and store the same at his stores as per standard norms. After mobilisation of contractor, the consignment received at BHEL site can directly be diverted to the work site following issuance procedure of BHEL. Quantity of such direct issues shall be as per the Challan/dispatch document/LR received with the consignment. In such cases, Contractor shall do unloading of materials from trucks/lorry at their own cost.
3	The Open land for such purposes as available shall be provided by BHEL on free of cost basis. Temporary barbed wire fencing of the open storage yard is to be done by the contractor and is included under the scope of his work. Contractor shall also remove grass, bushes, trees etc. wherever required off the land provided to him and shall make proper continuous up keeping of the open yard /land by removing grass, bushes trees etc. and same is included under the scope of his work & No extra payment shall be made to the contractor in this regard. The bidder shall make complete arrangement of necessary security personnel to safeguard all such materials in his custody. Materials issued will be used only for construction of permanent works. The contractor shall take care of material issued by BHEL and shall protect the same from theft, damage and weathering. In case, due to any cause attributable to the contractor, such loss/theft/rusting of steel occurs, then such quantity of steel shall be recovered from the interim payment at the penal rate specified in the tender.
C	**RECONCILIATION OF MATERIALS ISSUED BY BHEL**
	a) The contractor shall submit a reconciliation statement of cement and steel issued to the contractor with each RA Bill. **b)** At the time of submission of bills, the contractor shall properly account for the material issued to him as specified herein to the satisfaction of BHEL certifying that the balance material is available in the contractor custody at site. **c)** At the time of submission of bills, if it is noticed by BHEL that the wastage is high and calls recovery at the penal rate, then, BHEL will proceed for recovery for the excess wastage as per penal recovery rates as specified. **d)** If at any point of time, BHEL finds there is a difference in physical and theoretical balance, where the contractor fails to provide necessary reconciliation, the decision of penal recovery/withhold of amount at penal rate by BHEL shall be final and binding to the contractor till proper records are submitted to and verified by BHEL. **e)** The reference drawings for actual material consumption to be used for the

	purpose of reconciliation shall be drawings prepared by the BHEL and drawings approved by BHEL for fabrication works and such other drawings approved by BHEL. This shall also include the bar bending schedule prepared by the contractor and approved by BHEL.
D	**RETURN OF MATERIALS ISSUED BY BHEL**
1	**Return of Cement:** Not applicable
2	**Return of Reinforcement Steel and Structural Steel including Scrap:** All surplus steel and all wastage materials will be taken back on weighment basis. Surplus, unused and untampered steel shall be sorted section-wise and returned separately at a place directed by BHEL/Engineer within the project area. For return of such materials, contractor will not be entitled to any handling and incidental charges. All wastage / scrap (including melting scrap, wastage, and unusable scrap) shall be promptly returned to the stores and a receipt obtained for material accounting purposes. Scrap for reinforcement steel and structural steel shall be returned separately.
E	**SCRAP AND SERVICEABLE MATERIALS:**
	All structural steel of length above 2 Meter except M.S Plate shall be considered as serviceable materials provided the materials is in good and acceptable condition. Structural steel in length less than 2 Meter Shall be treated as scrap.
	Plates having both side greater than 1 Meter OR if any side is less than 1 Meter but greater than 0.5 Meter and the total area is equal or greater than 2 sq. Meter shall be considered as serviceable material.
	All pipe measuring 2 Meter and above in length shall be treated serviceable materials provided they are in good and acceptable condition. Pipe in less than 2 Meter length shall be treated as Scrap.
	All TMT measuring 3 Meter and above in length shall be treated as serviceable material provided they are in good acceptable condition. TMT in less than 3 Meter shall be treated as scrap.
F	**CONSUMPTION AND WASTAGE OF MATERIAL ISSUED BY BHEL**
1.1	**Cement Consumption:** Not Applicable
1.2	**Cement Wastage:** Not applicable
2.1	**Reinforcement Steel, MS earthing rod Consumption** The theoretical consumption of various sections and/or diameter of reinforcement and earthing rod steel shall be based on approved construction drawing and bar bending schedule. Weight shall be calculated considering the sectional weights as per Indian standards. No extra cost shall be payable to the contractor for any deviation in weights for the different procedures adopted for issue and calculation of the theoretical consumption including rolling tolerances. a) Actual consumption = Issue – Surplus. b) Surplus = un-tampered, unused, uncut Quantity of steel **including serviceable material** returned by the contractor to BHEL store along-with relevant documents. c) Wastage = Actual consumption – Theoretical consumption.
2.2	**Reinforcement Steel, MS earthing rod Wastage** a) **Allowable Wastage:** (+3%) of the theoretical consumption shall be considered as allowable wastage. b) Wastage and scrap shall be as per actual weighment basis.

Sl no.	**Reinforcement steel & MS earthing rod**	**Basis of issue & penal recovery**

	R1	Theoretical consumption (without considering wastage and scrap or loss)	Free
	R2a	Wastage limited to plus three percent (+3%) of aforesaid theoretical consumption (R1) towards allowable wastage and returned to BHEL Store.	Free
	R2b	Wastage limited to plus three percent (+3%) of aforesaid theoretical consumption (R1) towards allowable wastage but not returned to BHEL Store.	Penal rate
	R3	Wastage beyond **THREE** percent (+3%) of the theoretical consumption above (R1).	Penal rate

3.1 **Structural Steel (Rolled Sections and Plates etc.) Consumption**

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

a) Actual consumption = Issue – Surplus.
b) Surplus = un-tempered, unused, uncut quantity of steel **including serviceable material** returned by the contractor to BHEL store.
c) Wastage = Actual consumption – Theoretical consumption.

3.2 **Structural Steel Wastage**

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

b.

Sl no	**Structural steel including SS plate**	**Basis of issue & penal Recovery**
S1	Theoretical consumption (without considering any wastage, scrap or loss) as per specification & drg.	Free
S2a	Wastage limited to plus four percent (+4%) of aforesaid theoretical consumption (S1) towards allowable wastage (including invisible wastage limited to 0.5%) and return to BHEL Store.	Free
S2b	Wastage limited to plus four percent (+4%) of aforesaid theoretical consumption (S1) towards allowable wastage (including invisible wastage limited to 0.5%) but not returned to BHEL Store.	Penal rate
S3	Wastage beyond **four** percent (4%) of the aforesaid theoretical consumption (S1).	Penal rate

G **RECOVERY FOR MATERIAL ISSUED BY BHEL**

Any loss of material due to theft/damage/unaccounted loss shall be recovered at penal rates.

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

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

PENAL RATE FOR MATERIAL ISSUED BY BHEL

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

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

Sl. No.	Items	Penal Rate (Rs.)
1	Cement (PPC/OPC/PSC)	Not Applicable
2	Reinforcement Steel	Not applicable
3	MS Earthing Rod	**Rs. 86,400/-** per MT (Excl. GST & other taxes)
4	Structural Steel	Not applicable

K. **RESPONSIBILITY OF CONTRACTOR IN RESPECT OF STATUTORY RULES / REGULATIONS PERTAINING TO BOCW.**

It shall be mandatory for the contractor to comply with Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Act, 1996 and Rules of 1998 read with Building and other Construction Workers welfare Cess act, 1996 and Cess Rules.

It shall be the sole responsibility of the contractor to apply for a license to the Competent Authority under the Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Act, 1996 and Rules of 1998 read with Building and other Construction Workers welfare Cess act, 1996 and Cess Rules and obtain proper certificate thereof by specifying the scope of its work. It shall also be responsibility of the contractor to furnish a copy of such certificate of license / permission to BHEL within 2 months from date of start of work at site or along with 1st RA bill whichever is earlier.

It shall be the responsibility of the sub-contractor to furnish the receipts / challans towards deposit of the cess together with the number, name and other details of beneficiaries (building or construction workers) engaged by the sub-contractor during the preceding month.

The onus shall lie on the contractor to register with the authorities and provide the details of the amount remitted to the authorities. In case the contractor fails to comply with the BOCW act, no payments shall be released to the contractor.

In case the customer owns the responsibility of compliance of BOCW act and deducts the amount from BHEL, the same shall be deducted from the RA bills of the contractor.

In the event of any penalty or other implication due to non-compliance of statutory obligation the same shall be on contractor's account.

L. **Clause No. C.24.0 (Delay and Extension of Time) of Conditions of Contract for Civil Works has been modified as below**

If, in the opinion of the Engineer, the work is delayed

(i) by reason of abnormally bad weather, or

(ii) by reason of serious loss or damage by fire, or

(iii) by reason of civil commotion, local combination of workmen, strike or lockout, affecting any of the trades employed on the work, or

(iv) by delay on the part of the agency or tradesman engaged by the BHEL in executing work not forming part of the contract, or

(v) By reason of any other cause which in the absolute discretion of the Engineer is beyond the contractor's control, then in any such case, the Engineer (or higher authority) may make fair and reasonable extension in the completion dates of the individual items of work of the contract as whole. Such extension which will be communicated to the contractor by the Engineer in writing shall be final and binding on the contractor. No other claim in this respect for compensation, idle labour or otherwise howsoever is admissible. Upon the happening of any such event causing delay the contractor shall immediately give notice thereof in writing to the Engineer but shall nevertheless use constantly his best endeavour to prevent or make good the delay and shall do all that may reasonably be required to the satisfaction of the Engineer to proceed with the work.

(vi) In case of delay in completion of work BHEL reserve the right to grant time extension under the following options depending upon the performance of the vendor:

a) Time extension without levy of LD in case it is found that delay is not attributable to the vendor

b) Time extension with deduction of applicable LD in line with Liquidity Damage clause if the delay is solely attributable to the vendor.

c) In case facts of delay is not settled, BHEL reserve the right to grant provisional time extension for delay in completion of total work or part thereof and running/ interim payments to the vendor will be released without deduction of LD subject to submission of additional Bank guarantee equivalent to maximum LD amount valid till completion of work under their scope and grant of final time extension.

During provisional time extension period ORC/ PVC shall not be payable to the contractor. The Final Delay analysis shall be prepared on completion of the work. In case of delay is not attributable to contractor as per final delay analysis the ORC/ PVC shall be released along with the final bill without any interest charges attributable to BHEL.

In case of delay attributable to contractor, LD shall be deducted for that period in line with clause "Compensation/ LD/ Penalty for delay in execution" of conditions of contract and balance ORC/ PVC (if any) shall be released along with the final bill without any interest charges attributable to BHEL.

PVC/ ORC shall be governed by respective clauses in the NIT.

M. **<u>RIGHTS OF BHEL</u>: - The Clause No. B.7.0 "RIGHTS of BHEL" of Conditions of contract for Civil works stands deleted. Now the modified clause shall be read as below: -**

BHEL reserves the following rights in respect of this contract during the original contract period or its extensions if any, as per the provisions of the contract, without entitling the contractor for any compensation.

1. To withdraw any portion of work and/or to restrict/alter quantum of work as indicated in the contract during the progress of work and get it done through other agencies to suit BHEL's commitment to its customer or in case BHEL decides to advance the date of completion due to other emergent reasons/ BHEL's obligation to its customer.
In case of inadequate manpower deployed by the contractor, BHEL reserves the right to deploy additional manpower through any other agency for expediting activities in the interest of the project. Supplied manpower shall be put on job by the contractor and payments and other statutory compliances related to manpower shall be the contractor's

responsibility. In case of contractor's failure to fulfil his obligations in respect of such manpower, BHEL reserves the right to take necessary action as per contract conditions.

2. <u>Breach of Contract, Remedies and Termination</u>

2.1. The following shall amount to breach of contract:

I. Non-supply of material/ non-completion of work by the Supplier/Vendor within scheduled delivery/ completion period as per contract or as extended from time to time.

II. The Supplier/Vendor fails to perform as per the activity schedule and there are sufficient reasons even before expiry of the delivery/ completion period to justify that supplies shall be inordinately delayed beyond contractual delivery/ completion period.

III. The Supplier/Vendor delivers equipment/ material not of the contracted quality.

IV. The Supplier/Vendor fails to replace the defective equipment/ material/ component as per guarantee clause.

V. Withdrawal from or abandonment of the work by the Supplier/Vendor before completion as per contract.

VI. Assignment, transfer, subletting of Contract by the Supplier/Vendor without BHEL's written permission resulting in termination of Contract or part thereof by BHEL.

VII. Non-compliance to any contractual condition or any other default attributable to Supplier/Vendor.

VIII. Any other reason(s) attributable to Vendor towards failure of performance of contract. In case of breach of contract, BHEL shall have the right to terminate the Purchase Order/ Contract either in whole or in part thereof without any compensation to the Supplier/Vendor.

IX. Any of the declarations furnished by the contractor at the time of bidding and/ or entering into the contract for supply are found untruthful and such declarations were of a nature that could have resulted in non-award of contract to the contractor or could expose BHEL and/ or Owner to adverse consequences, financial or otherwise.

X. Supplier/Vendor is convicted of any offence involving corrupt business practices, antinational activities or any such offence that compromises the business ethics of BHEL, in violation of the Integrity Pact entered into with BHEL has the potential to harm the overall business of BHEL/ Owner.

Note- Once BHEL considers that a breach of contract has occurred on the part of Supplier/Vendor, BHEL shall notify the Supplier/Vendor by way of notice in this regard. Contractor shall be given an opportunity to rectify the reasons causing the breach of contract within a period of 14 days.

In case the contractor fails to remedy the breach, as mentioned in the notice, to the satisfaction of BHEL, BHEL shall have the right to take recourse to any of the remedial actions available to it under the relevant provisions of contract.

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

LD against delay in executed work shall be calculated in line with relevant LD clause of GCC, for the delay attributable to contractor. For limiting the maximum value of LD, contract value shall be taken as Executed Value of work till termination of contract.

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

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

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

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

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

v) LD shall be calculated in line with **LIQUIDATED DAMAGES/PENALTY** clause of the Contract for the delay attributable to contractor taking "X" as Contract Value and "T2" as period of delay attributable to contractor.

2.2 **Remedies in case of Breach of Contract is established:**

i) Wherein the period as stipulated in the notice issued under clause "**BREACH OF CONTRACT, REMEDIES AND TERMINATION"** of GCC has expired and Contractor has failed to remedy the breach, BHEL will have the right to terminate the contract on the ground of "Breach of Contract" without any further notice to contractor.

ii) Upon termination of contract, BHEL shall be entitled to recover an amount equivalent to 10% of the Contract Value for the damages on account of breach of contract committed by the Contractor. This amount shall be recovered by way of encashing the security instruments like performance bank guarantee etc available with BHEL against the said contract. In case the value of the security instruments available is less than 10% of the contract value, the balance amount shall be recovered from other financial remedies (i.e. available bills of the contractor, retention amount, from the money due to the Contractor etc. with BHEL) or the other legal remedies shall be pursued.

iii) wherever the value of security instruments like performance bank guarantee available with BHEL against the said contract is 10% of the contract value or more, such security instruments to the extent of 10% contract value will be encashed. In case no security instruments are available or the value of the security instruments available is less than 10% of the contract value, the 10% of the contract value or the balance amount, as the case may be, will be recovered in all or any of the following manners:

iv) In case the amount recovered under sub clause (a) above is not sufficient to fulfil the amount recoverable then; a demand notice to deposit the balance amount within 30 days shall be issued to Contractor.

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

a. from dues available in the form of Bills payable to defaulted Contractor against the same contract.

b. If it is not possible to recover the dues available from the same contract or dues are insufficient to meet the recoverable amount, balance amount shall be recovered from any money(s) payable to Contractor under any contract with other Units of BHEL including recovery from security deposits or any other deposit available in the form of security instruments of any kind against Security deposit or EMD.

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

vi) It is an agreed term of contract that this amount shall be a genuine pre-estimate of damages that BHEL would incur in completion of balance contractual obligation of the contract through any other agency and BHEL will not be required to furnish any other evidence to the Contractor for the purpose of estimation of damages.

vii) In addition to the above, imposition of liquidated damages, debarment, termination, de-scoping, short-closure, etc., shall be applied as per provisions of the contract.

Note:

1) The defaulting contractor shall not be eligible for participation in any of the future enquiries floated by BHEL to complete the balance work. The defaulting contractor shall mean and include:

(a) In case defaulted contractor is the Sole Proprietorship Firm, any Sole Proprietorship Firm owned by same Sole Proprietor.

(b) In case defaulted contractor is The Partnership Firm, any firm comprising of same partners/ some of the same partners (but not including any new partner); or sole proprietorship firm owned by any partner(s) as a sole proprietor.

3. In case Contractor fails to deploy the resources as per requirement informed by BHEL in writing to expedite the work, BHEL can deploy own/hired/otherwise arranged resources and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC.

4. To terminate the contract or to restrict the quantum of work and pay for the portion of work executed in case BHEL's contract with their customer are terminated for any reason, whatsoever.

5. Whenever any Claim or Claims for payment of any sum of money(s) arises under this or any other contract against the contractor, BHEL shall be entitled to withhold and also have a lien to retain such sum of money(s) in whole or in part from any money(s) payable to contractor and/or security deposits furnished or deducted in cash from the bills of contractor, (if any) under this contract. In the event of the securities or the amounts payable to Contractor, being insufficient to cover BHEL claims, then BHEL shall be entitled to withhold and have a lien to the extent of such claims from any sum or sums found payable or which at any time thereafter may become payable to the contractor under this or any other contract with BHEL.

a) Claim or Claims for payment of any sum of money(s) arising from the Contractor under this or any other contract against the contractor, shall mean, the sum of money(s) actually incurred by BHEL in fulfilling the contractual responsibilities of contractor under the contract, to which he has failed to fulfil plus applicable overheads (@ 5%) along with interest as applicable under the Contract on total amount (i.e. money actually incurred plus overheads)

b) It is an agreed term of the contract that, the sum or sums of money so withheld or retained under the lien by BHEL will be kept withheld or retained as such by BHEL till the claims arising out of this or any other contract are finally adjudicated wither through Arbitration or a Court of competent jurisdiction as the case may be in accordance with the terms of contract. Intimation given by the BHEL Engineer regarding withholding of such money(s) shall be considered as sufficient and relevant date for all purposes. No Interest shall be payable on such sum(s) of money which becomes due or as the case may be adjudged to be due from BHEL to Contractor, whether under contract or otherwise.

c) Where the contractor is a partnership firm, BHEL shall be entitled to withhold and also have a lien to retain towards such claims in whole or in part, from any other money(s) payable to any partner, whether in his individual capacity or otherwise.

d) If any money(s) shall, as a result of any claim or application made under the relevant provisions of any Labour Welfare Act and/ or Rules, including but not limited to Contract Labour Regulation & Abolition Act, Minimum Wages Act, Payment of Gratuity Act, BOCW (RE&CS) Act, Provident Fund Act, Employee State Insurance Act, be directed to be paid by the BHEL, such money shall be deemed to be moneys payable to the BHEL by the Contractor.

e) Where the Contractor fails to repay to BHEL such moneys along with applicable overheads (@ 5%) and interest, as aforesaid within seven days of being demanded, BHEL shall be entitled to recover the same from Contractor's bills/ Security Deposit or any other money(s) payable to Contractor under this Contract or any other Contract with BHEL.

6. While every endeavor will be made by BHEL to this end, yet BHEL cannot guarantee uninterrupted work due to conditions beyond its control. The Contractor will not be normally entitled for any compensation/extra payment on this account unless otherwise specified elsewhere in the contract.

7. BHEL may permit or direct contractor to demobilize and remobilize at a future date as intimated by BHEL in case of following situations for reasons other than Force majeure conditions and not attributable to contractor:

   i) suspension of work(s) at a Project either by BHEL or Customer,
   or

   ii) where work comes to a complete halt or reaches a stage wherein worthwhile works cannot be executed and there is no possibility of commencement of work for a period of not less than three months

   In such cases, charges towards demobilization and remobilization shall be as decided by BHEL after successful remobilization by contractor at site, and decision of BHEL shall be final and binding on the contractor. After remobilization, all conditions as per contract shall become applicable. In case Contractor does not remobilize with adequate resources or does not start the work within the period as intimated, then BHEL reserves the right to terminate the contract and effect remedies under Clause "**Remedies in case of Breach of Contract"** In case of any conflict, BHEL decision in this regard shall be final and binding on the contractor.

8. In the unforeseen event of inordinate delay in receipt of materials, drawings, fronts etc. due to which inordinate discontinuity of work is anticipated, BHEL on its own or contractor's request at its discretion may consider to short close the contract in any of the following cases:

   a) The balance works (including but not limited to Trial Operation, PG Test etc.) are minor vis a vis the scope of work envisaged as per the contract.

   b) There has been no significant work in past 6 months OR no significant work is expected in next 6 months (example in Hydro projects or in projects where work has stopped due to reasons beyond the control of BHEL).

   c) The balance works cannot be done within a reasonable period of time as they are dependent on unit shut down or on other facilities of customer or any other such reasons not attributable to the contractor.

At the point of requesting for short closure, contractor shall establish that he has completed all works possible of completion and he is not able to proceed with the balance works due to constraints beyond his control. In such a case, the estimated value of the unexecuted portion of work (or estimated value of services to be provided for carrying out milestone/stage payments like Trial Operation/PG Test etc.) as decided by BHEL, shall however be reduced from the final contract value.

Note: The Contractor shall not be eligible for any compensation on account of Quantity Variation arising out of short-closure of contract as per clause above.

N. **LIQUIDATED DAMAGES/PENALTY**

In case the contractor fails to complete the work within the time specified in the tender specification or any extension thereof subject to force majeure condition, the contractor shall be liable to pay by way of LD/Penalty a sum equal to the half percent of the contract price including PVC, per calendar week or part thereof by which the completion of work is delayed, subject to ceiling of 10 % of the contract price. Once the maximum limit of delay is reached (i.e. 20 week of delay) BHEL may consider termination of the contract and forfeit the Security deposit without prejudice to the other remedies under the contract.

Amended/ revised contract value (excluding Extra Works, Supplementary /Additional Items) shall be considered for calculating LD/ penalty.

O. **PERFORMANCE MONITORING:**

The Contractors performance shall be continuously monitored during execution of work at site.

In case of contractor's performance is found not satisfactory during the execution of work at site, BHEL may take alternate remedial measures and may not consider the contractor for further tenders, if the contractor performance is not improved in spite of opportunities given by BHEL.

P. **FACILITIES PROVIDED TO MSEs**

Vide office memorandum F.No.21(8)/2011-MA dated 09.11.2016, Office of AS&DC, Ministry of MSME has issued clarification regarding definition of Goods and Services under the Public Procurement Policy of MSEs order-2012, In accordance with the Public Procurement Policy for MSEs order-2012 and OM regarding definition of Goods and Services issued by Ministry of MSME, it is clarified that benefits as envisaged in Public Procurement Policy for MSEs Order 2012 are to be provided in respect of the procurements related to the Goods and Services produced and provided by Micro and Small Enterprises (MSEs) only and **no benefits is to be given in Case of Works Contracts**.

Q. **BOCW (TAXES, DUTIES & LEVIES):**

Q.1	**BUILDING & OTHER CONSTRUCTION WORKERS (REGULATION OF EMPLOYMENT AND CONDITIONS OF SERVICE) ACT, 1996 (BOCW Act) AND RULES OF 1998 READ WITH BUILDING & OTHER CONSTRUCTION WORKERS CESS Act, 1996 & CESS RULES, 1998.**
	In case any portion of work involves execution through building or construction workers, then compliance to the above titled Acts shall be ensured by the contractor and contractor shall obtain license and deposit the cess under the Act. In the circumstances it may be ensured as under: -

Q.1.1	It shall be the sole responsibility of the contractor in the capacity of employer to forthwith (within a period of 15 days from the award of work) apply for a licence to the Competent Authority under the BOCW Act and obtain proper certificate thereof by specifying the scope of its work. It shall also be responsibility of the contractor to furnish a copy of such certificate of licence / permission to BHEL within a period of one month from the date of award of contract.
Q.1.2	It shall be the sole responsibility of the contractor as employer to ensure compliance of all the statutory obligations under these act and rules including that of payment / deposit of 1% cess on gross payment made for value of work involving building or construction workers engaged by the contractor within a period of one month from the receipt of payment.
Q.1.3	It shall be the responsibility of the sub-contractor to furnish the receipts / challans towards deposit of the cess together with the number, name and other details of beneficiaries (building workers) engaged by the sub-contractor during the preceding month.
Q.1.4	It shall be the absolute responsibility of the sub-contractor to make payment of all statutory payments & compensations to its workers including that is provided under the Workmen's Compensation Act, 1923.
Q.1.5	The contractor shall, however ensure before deposit of any BOCW cess, that customer is not depositing the same in order to avoid excess deposit of cess.
Q.1.6	The contractor shall bear cost of BOCW cess either by way of deposit or through recovery by BHEL in case the same is deposited by the customer.
Q.1.7	In case of failure in above mentioned compliances, BOCW Cess @ 1% as well as applicable penalty as specified in BOCW Act/Rules shall be deducted from the contractor.

R. **TERMS OF PAYMENT:**

R.1. The contractor shall be paid monthly running bill to a maximum of **95% (retaining 5% from each running bill)** of value of the works actually executed on site provided the work has been executed to the satisfaction of the Engineer. From payable amount recoveries such as security deposit, income tax etc. would be made as per rule. The certificate of the Engineer regarding such approval and passing of sums so payable shall be final and conclusive against the contractor.

R.2. The Engineer shall after a measured bill allow and certify payment to the contractor on the basis of abstract measurement bill submitted by contractor. However, the usual recoveries would be effected from bill.

R.3. Any certificate relating to the work done may be modified by any subsequent interim certificates or by the final certificate and no certificate of the Engineer supporting an advance payment shall of itself be conclusive evidence that any work or materials to which it relates are in accordance with the contract.

R.4. All intermediate payments shall be regarded as advance against the final payment only and shall not be considered as an admission of the due performance of the contract or any part thereof in any respect of the occurring of any claim whatsoever. Such intermediate payments shall not conclude, determine or effect in any way the powers of the Engineer as to the final settlement and adjustment of the account of otherwise, or in any way vary of

affect the contract. To this affect the contractor shall submit the final bill, which shall contain the complete up-to-date measurements for the total work done.

R.5. The conditions for the release of **last 5% retention money** shall be as follows:

R.5.1. 2.5% payment shall be released along with the final bill on completion of total work as certified by BHEL site.

R.5.2. Balance 2.5% of payment shall be released on completion of guarantee period. However, this retention money can be released on submission of B.G. of equivalent amount valid till guarantee period.

R.6. The contractor shall guarantee the work under the scope of the contract for a period of 12 months from the date of start of the guarantee period as certified by BHEL site (i.e. completion of total work under the scope and or taking over by BHEL/owner), and shall rectify free of cost all defects due to faculty supply or work done. In case the contractor fails to repair/ replace the defective work within the time specified by BHEL, BHEL may proceed to undertake such repair/replace such defective work at contract's risk and cost without prejudice to any other right and recover the sum from security deposit/BG/ any dues.

S. **Construction Water and Electricity:**

The Construction Power shall be provided at one point on chargeable basis and recovery shall be made on actual meter reading (meter to be installed by contractor at his cost) at the rate prevailing (as per the prevailing tariff) at the time of drawl of power from RA bills as per Customer/BHEL norms. The contractor shall have to make their own arrangements, at their cost for distribution to various locations for their works including proper switch/fuse units, distribution boards, cables, poles etc. to ensure safety of men and equipment. Where required, the contractor shall employ diesel operative equipment in addition to electric operated ones to ensure timely completion of work.

The contractor shall have to make their own arrangements, at their cost for distribution to various locations for their works including proper switch/fuse units, distribution boards, cables, poles etc. to ensure safety of men and equipment. Where required, the contractor shall employ diesel operative equipment in addition to electric operated ones to ensure timely completion of work.

In case BHEL is not able to supply power, contractor has to make his own arrangement and take a separate connection for all construction works.

BHEL shall not be responsible for any inconvenience caused due to any failure of lighting and power supply and no compensation for delay in works can be claimed by the contractor due to such non-supply on the grounds of idle labour, machinery or any other grounds. The contractor should ensure that the work in critical areas is not held up in the event of lighting and power breakdown and for the same he should have some stand by arrangement at his cost. In the event of breakdown in the electric supply, if the progress of work is hampered, it will be the responsibility of the contractor to step up the progress after restoration of electric supply so that over all progress of work is not affected. The contractor shall make proper arrangement of illumination at work place while working in late hours or in darkness.

T. **MEASUREMENT OF WORK AND MODE OF PAYMENT:**

T.1. All payments due to the contractors shall be made by e mode only, unless otherwise found operationally difficult for reasons to be recorded in writing.

T.2. For progress running bill payments: - The Contractor shall present detailed measurement sheets in triplicate, duly indicating all relevant details based on technical documents and connected drawings for work done during the month/period under various categories in line with terms of payment as per contract. The basis of arriving at the quantities, weights shall be relevant documents and drawings released by BHEL. These measurement sheets shall be prepared jointly with BHEL Engineers and signed by both the parties.

T.3. These measurement sheets will be checked by BHEL Engineer and quantities and percentage eligible for payment under various groups shall be decided by BHEL Engineer. The abstract of quantities and percentage so arrived at based on the terms of payment shall be entered in Measurement Book by BHEL Engineers and signed by both the parties.

T.4. These measurement sheets will be checked by BHEL Engineer and quantities and percentage eligible for payment under various groups shall be decided by BHEL Engineer. The abstract of quantities and percentage so arrived at based on the terms of payment shall be entered in Measurement Book and signed by both the parties.

T.5. Based on the above quantities, contractor shall prepare the bills, along with statutory documents, in prescribed format and work out the financial value. These will be entered in Measurement Book and signed by both the parties. Payment shall be made by BHEL after effecting the recoveries due from the contractor.

T.6. All recoveries due from the contractor for the month/period shall be effected in full from the corresponding running bills unless specific approval from the competent authorities is obtained to the contrary.

T.7. Measurement shall be restricted to that portion of work for which it is required to ascertain the financial liability of BHEL under this contract.

T.8. The measurement shall be taken jointly by persons duly authorized on the part of BHEL and by the Contractor.

T.9. The Contractor shall bear the expenditure involved if any, in making the measurements and testing of materials to be used/ used in the work. The contractor shall, without extra charges, provide all the assistance with appliances and other things necessary for measurement.

T.10. If at any time due to any reason whatsoever, it becomes necessary to re-measure the work done in full or in part, the expenses towards such re measurements shall be borne by the contractor unless such re measurements are warranted solely for reasons not attributable to contractor.

T.11. Passing of bills covered by such measurements does not amount to acceptance of the completion of the work measured. Any left out work has to be completed, if pointed out at a later date by BHEL.

T.12. Final measurement bill shall be prepared in the final bill format prescribed for the purpose based on the certificate issued by BHEL Engineer that entire works as stipulated in tender specification has been completed in all respects to the entire satisfaction of BHEL. Contractor shall give unqualified “No Claim” Certificate. All the tools and tackles loaned to him should be returned in satisfactory condition to BHEL. The abstract of final quantities and financial values shall also be entered in the Measurement Books and signed by both parties to the contract. The Final Bill shall be prepared and paid within a reasonable time after completion of work.

U. **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.

V. CLOSING OF CONTRACTS

The Contract shall be considered completed and closed upon completion of contractual obligations and settlement of Final Bill or completion of Guarantee period whichever is later. Upon closing of Contract, BHEL shall issue a performance/ experience certificate as per standard format, based on specific request of Contractor as per extant BHEL guidelines through the online portal available at https://siddhi.bhel.in only.

W. SUSPENSION OF BUSINESS DEALINGS

BHEL reserves the right to take action against Contractors who either fail to perform or Tenderers/Contractor who indulge in malpractices, by suspending business dealings with them in line with BHEL guidelines issued from time to time.
The offers of the bidders who are under suspension as also the offers of the bidders, who engage the services of the banned firms / principal / agents, shall be rejected. The list of banned firms is available on BHEL web site www.bhel.com.
If any bidder / supplier / contractor during pre-tendering / tendering / post tendering / award / execution / post-execution stage indulges in any act, including but not limited to, 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 tampers the tendering process 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, or does anything which is actionable under the Guidelines for Suspension of Business dealings, 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. Guidelines for suspension of business dealings is available in the webpage:
http://www.bhel.com/vender_registration/vender.php.

X. SETTLEMENT OF DISPUTE

If any dispute or difference of any kind whatsoever shall arise between BHEL and the Supplier/Vendor, arising out of the contract for the performance of the work whether during the progress of contract termination, abandonment or breach of the contract, it shall in the first place referred to Designated Engineer for amicable resolution by the parties. Designated Engineer (to be nominated by BHEL for settlement of disputes arising out of the contract) who within 60 days after being requested shall give written notice of his decision to the contractor. Save as hereinafter provided, such decision in respect of every matter so referred shall forthwith be given effect to by the Supplier/Vendor who shall proceed with the work with all due diligence, whether he or BHEL desires to resolve the dispute as hereinafter provided or not.

If after the Designated Engineer has given written notice of this decision to the party and no intention to pursue the dispute has been communicated to him by the affected party within 30 days from the receipt of such notice, the said decision shall become final and binding on the parties. In the event the Supplier/Vendor being dissatisfied with any such decision or if amicable settlement cannot be reached then all such disputed issues shall be resolved through **conciliation in terms of the BHEL Conciliation Scheme 2018** as per Clause “Conciliation” of GCC.

X.1. **Conciliation:**

Any dispute, difference or controversy of whatever nature howsoever arising under or out of or in relation to this Agreement (including its interpretation) between the Parties, and so notified in writing by either Party to the other Party (the "Dispute") shall, in the first instance, be attempted to be resolved amicably in accordance with the conciliation procedure as per BHEL Conciliation Scheme 2018. 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 for conduct of conciliation proceedings" (as available in www.bhel.com)).

Note: Ministry of Finance has issued OM reference No. 1/2/24 dated 03.06.2024 regarding "Guidelines for Arbitration and Mediation in Contracts of Domestic Public Procurement. In the said OM it has been recommended that Government departments/

Entities/agencies are to encourage mediation under the Mediation Act. 2023 . The said Act has not yet been notified by the Government. Therefore, the clause **"Settlement of Disputes"** shall be modified accordingly as and when the Mediation Act 2023 gets notified.

X.2. **ARBITRATION:**

X.2.1. 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 **"Conciliation"** herein above 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, refer the disputes to Arbitral Institution i.e. **"India International Arbitration Centre (IIAC) Delhi"** and such dispute to be adjudicated by Sole Arbitrator appointed in accordance with the Rules of said Arbitral Institution.

X.2.2. A party willing to commence arbitration proceeding shall invoke Arbitration Clause by giving notice to the other party in terms of section 21 of the Arbitration & Conciliation Act, 1996 (hereinafter referred to as the 'Notice') before referring the matter to arbitral institution. The Notice shall be addressed to the **Executive Director, TBG, BHEL, Noida**, executing the Contract and shall contain the particulars of all claims to be referred to arbitration with sufficient detail and shall also indicate the monetary amount of such claim including interest, if any.

X.2.3. After expiry of 30 days from the date of receipt of aforesaid notice, the party invoking the Arbitration shall submit that dispute to the Arbitral Institutions and that dispute shall be adjudicated in accordance with their respective Arbitration Rules. The matter shall be adjudicated by a Sole Arbitrator who shall necessarily be a Retd Judge having considerable experience in commercial matters to be appointed/nominated by the respective institution. The cost/expenses pertaining to the said Arbitration shall also be governed in accordance with the Rules of the respective Arbitral Institution. The decision of the party invoking the Arbitration for reference of dispute to a specific Arbitral institution for adjudication of that dispute shall be final and binding on both the parties and shall not be subject to any change thereafter. The institution once selected at the time of invocation of dispute shall remain unchanged.

X.2.4. The fee and expenses shall be borne by the parties as per the Arbitral Institutional rules.

X.2.5. The Arbitration proceedings shall be in English language and the seat and venue of Arbitration shall be **Delhi**.

X.2.6. Subject to the above, the provisions of Arbitration & Conciliation Act 1996 and any amendment thereof shall be applicable. All matters relating to this Contract and arising out of invocation of Arbitration clause are subject to the exclusive jurisdiction of the Court(s) situated at **Delhi**.

X.2.7. Notwithstanding any reference to the Designated Engineer or Conciliation or Arbitration herein, a. the parties shall continue to perform their respective obligations under the Contract

unless they otherwise agree. Settlement of Dispute clause cannot be invoked by the Contractor, if the Contract has been mutually closed or 'No Demand Certificate' has been furnished by the Contractor or any Settlement Agreement has been signed between the Employer and the Contractor.

X.2.8. The Mechanism of resolution of disputes through arbitration shall be available only in the cases where the value of the dispute is less than Rs. 10 Crores.

X.2.9. In case the disputed amount (Claim, Counter claim including interest is Rs. 10 crores and above, the parties shall be within their rights to take recourse to remedies other than Arbitration, as may be available to them under the applicable laws after prior intimation to the other party. Subject to the aforesaid conditions, provisions of the Arbitration and Conciliation Act, 1996 and any statutory modifications or re-enactment thereof as amended from time to time, shall apply to the arbitration proceedings under this clause.

X.2.10. In case, multiple arbitrations are invoked (whether sub-judice or arbitral award passed) by any party to under this contract, then the cumulative value of claims (including interest claimed or awarded) in all such arbitrations shall be taken in account while arriving at the total claim in dispute for the subject contract for the purpose of clause X.2.9. Disputes having cumulative value of less than 10 crores shall be resolved through arbitration and any additional dispute shall be adjudicated by the court of competent jurisdiction.

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. 05/0003/2019-FTS-10937 dated 14-12-2022 as amended from time to time.

Y. PROGRESSIVE PAYMENT/ FINAL PAYMENT:

Y.1. Running Account Bills (RA Bills)

i) These are for interim payments when the contracts are in progress. The bills for such interim payments are to be prepared by Contractor in prescribed formats (RA Bill forms).

ii) Payments shall be made according to the extent of work done as per measurements taken up to the end of the calendar month and in line with the terms of payments described in the Tender documents.

iii) Recoveries on account of electricity, water, statutory deductions etc. are made as per terms of contract.

iv) Full rates for the work done shall be allowed only if the quantum of work has been done as per the specifications stipulated in the contract. If the work is not executed as per the stipulated specifications, BHEL may ask the contractor to redo the work according to the required specifications, without any extra cost.

v) The contractor shall submit his monthly RA bills with all the details required by BHEL on specified date every month covering progress of work in all respects and areas for the previous calendar month.

vi) Mode of payment and measurement of work completed shall be as per relevant clauses of General Conditions of Contract

vii) Release of payment in each running bill including PVC Bills where ever applicable will be as per stages of progressive pro rata payments.

viii) The contractor will be eligible for payment of RA Bills within 30 days of submission of running bill complete in all respects with all documents. It is the responsibility of the

contractor to make his own arrangements for making timely payments towards labour wages, statutory payments, outstanding dues etc. and other dues in the meanwhile.

All documents like HR Clearance, Quality and Safety Compliances etc. required for processing the RA Bills should be submitted along with RA Bills.

ix) BHEL shall release payment through Electronic Fund Transfer (EFT)/RTGS. In order to implement this system, Contractor to furnish details pertaining to his Bank Accounts where proceeds will be transferred through BHEL's banker, as per prescribed formats.

For MSMEs, at the time of submission of first RA bill, the subcontractor has to declare whether it is registered on RXIL portal and wishes to receive the proceeds through RXIL portal throughout the contract duration

Y.1.1. **Documents required for RA Bill:**

a) GST Complied Invoice of the work done as per approved BOQ.
b) Jointly signed Measurement sheet, Abstract (for civil works), WAM -6 for RA Bill.
c) Validity of Bank Guarantees as applicable under the contract.
d) Labour Payment Certificate
e) Material Reconciliation statement
f) Test Report of the material as per FQP
g) Royalty challan for material used (for civil works)
h) Power of Attorney for representative signing MBs etc, if not submitted earlier.
i) HR compliance documents (like PF, ESI, Wage sheets etc.)
j) Any other documents as per customer/statutory requirement

Note :

Site in charge has to certify that all the above required documents have been received and verified and document sl no. a) to d) duly verified are to be sent to Finance alongwith RA bills.

Y.2. **Final Bill:**

Y.2.1. Final Bill' is used for final payment on closing of Running Account for works or for single payment after completion of works. 'Final Bill' shall be submitted as per prescribed format after completion of works as per scope, material reconciliation, removal of temporary structures, return of scrap/surplus material of BHEL. BHEL shall settle the final bills after deducting all liabilities of Contractor to BHEL.

Y.2.2. **Documents required for Final Bill:**

a) GST Complied Invoice of the work done as per approved BOQ.
b) Jointly signed Measurement sheet, Abstract (for civil works), WAM -7, WAM-10 (if applicable)
c) Valid Bank Guarantees as applicable under the contract.
d) Labour Payment Certificate
e) 'No claim' certificate from the contractor.
f) Deviation statement showing the Executed quantities and quantities as per the contract.
g) Material Reconciliation statement
h) Submission of As Built Drawings
i) Submission of balance royalty challan/Clearance from Mining dept. (for civil works)
j) Material Reconciliation statement duly approved by BHEL
k) Power of Attorney for representative signing MBs etc, if not submitted earlier.
l) HR compliance documents (like PF, ESI, Wage sheets etc.)
m) Compliance report from BHEL/Customer for completion of punch points
n) Final Delay Analysis.
o) Any other documents as per customer requirement/statutory requirement.

Note :

Site incharge has to certify that all the above required documents have been received and verified and document sl no. a) to f) duly verified are to be sent to Finance alongwith Completion certificate.

Z. **Royalty:**

The contractor shall pay the Royalty of sand, aggregate and earth material used for the project and the contractor has to submit the Royalty certificate to BHEL along with the RA bills.

AA. **LIMITATION ON LIABILITY:**

Notwithstanding anything to the contrary in this Contract or LOA or any other mutually agreed document between the parties, the maximum liability, for damages, of the contractor, its servants or agents, shall under no circumstances exceed an amount equal to the Price of the Contract or the Work Order. The Contractor shall not in any case be liable for loss of profit or special, punitive, exemplary, indirect or consequential losses whatsoever. This shall not be applicable on the recoveries made by Customer from BHEL on account of Contractor, any other type of recoveries for workmanship, material, T&P etc. due from the contractor.

NOTE: All other terms and conditions of GCC shall remain unchanged.

PROFORMA OF BANK GUARANTEE (in lieu of SECURITY DEPOSIT)

In consideration of Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at BHEL House, Siri Fort, New Delhi-110049 through its Unit at BHEL, Transmission Business Group, Noida (name of the Unit) having agreed to exempt _____(Name of the Vendor / Contractor / Supplier) with its registered office at_____[1] (hereinafter called the said "Contractor" which term includes supplier), from demand under the terms and conditions of the Contract reference No._____ dated _____ [2] valued at Rs……[3](Rupees ……) (hereinafter called the said Contract), of Security Deposit for the due fulfilment by the said Contractor of the terms and conditions contained in the said Contract, on production of a Bank Guarantee for Rs……..[4] (Rupees…….only),

We _____(indicate the name and address of the Bank) having its Head Office at _____(address of the head Office) (hereinafter referred to as the Bank), at the request of _____ [Contractor(s)], being the Guarantor under this Guarantee, do hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer, an amount not exceeding Rs._____without any demur, immediately on demand from the Employer and without any reservation, protest, and recourse and without the Employer needing to prove or demonstrate reasons for its such demand

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

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor(s) in any suit or proceeding pending before any Court or Tribunal or Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

The payment so made by us under this guarantee shall be a valid discharge of our liability for payment hereunder and the Contractor(s) shall have no claim against us for making such payment.

We, further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied & the Employer certifies that the terms and conditions of the said Contract have been fully and properly carried out by the said contractor(s) or acceptance of the final bill or discharge of this guarantee by the Employer, whichever is earlier. This guarantee shall initially remain in force up to and including_____[5] and shall be extended from time to time for such period as may be desired by the Employer. Unless a demand or claim under this guarantee is made on us in writing on or before the _____[6] , (3 months more than the present date of validity of Bank Guarantee) we shall be discharged from all the liability under this guarantee thereafter.

We, _____ (indicate the name of the Bank) further agree with the Employer that

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

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

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

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

Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed…… [4]
b) This Guarantee shall be valid up to ……[5]
c) Unless the Bank is served a written claim or demand on or before _____[6] all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

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

Date _____ Day of _____

for___(indicate the name of the Bank)__

(Signature of Authorised signatory)

[1] ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.

[2] DETAILS ABOUTTHE NOTICE OF AWARD/CONTRACTREFERENCE

[3] CONTRACT VALUE

[4] BG AMOUNTIN FIGURES AND WORDS

[5] VALIDITY DATE (At least 3 months more than completion period)

[6] DATE OF EXPIRY OF CLAIM PERIOD (At least 3 months more than the present date of validity of BG)

Notes:

1 The expiry of claim period shall be at least 3 months more than the validity date. It may be ensured that the same is in line with the agreement/ contract entered with the Vendor.

2 The BG should be on Non-Judicial Stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG was executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Vendor/Contractor/Supplier /Bank issuing the guarantee.

3 In Case of Bank Guarantees submitted by Foreign Vendors:

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

b) **From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**

b.1. In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank's (BHEL's Consortium Bank) branch in India. It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

b.2. In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at sl.no. b.1 will required to be followed.

INDEMNITY BOND

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

This Indemnity Bond executed by <_____name of company> having their Registered Office at <_____> in favour of M/s Bharat Heavy Electricals Limited, a Company incorporated under the Companies Act, 1956, having its Registered Office at BHEL House, Siri Fort, Asiad, New Delhi - 110049 through its unit - TBG, 5th Floor, BHEL Sadan, Plot No. 25, Sector-16A, Noida-201301 (UP). (Hereinafter referred to as the Company)

And whereas the Company has entered into a Contract with M/s_____, the executants of this Deed (hereinafter referred to as the Contractor) as its contractor in respect of the work of "_____".

AND WHEREAS under the provisions of GCC further stipulates that the Contractor shall indemnify the Company against all claims of whatever nature arising during the course of execution of Contract including defects liability period of <_____Months > i.e till <_____>

Now this deed witness that in case the Company is made liable by any Authority including Court to pay any claim or compensation etc. in respect of all labourers or other matters at any stage under or relating to the Contract with the Contractor , the Contractor hereby covenants and agrees with the Company that they shall indemnify and reimburse the Company to the extent of such payments and for any fee, including litigation charges, lawyers' fees, etc, penalty or damages claimed against the Company by reason of the Contractor falling to comply with Central/States Laws, Rules etc, or his failure to comply with Contract (including all expenses and charges incurred by the Company).

The Contractor further indemnifies the Company for the amount which the Company may be liable to pay by way of penalty for not making deductions from the Bills of the Contractor towards such amount and depositing the same in the Government Treasury.

The Contractor further agree that the Company shall be entitled to withhold and adjust the Security Deposit and/or withhold and adjust payment of Bills of Contractor pertaining to this Contract against any payment which the Company has made or is required to make for which the Contractor is liable under the Contract and that such amount can be withheld, adjusted by the Company till satisfactory and final settlement of all pending matters and the Contractor hereby gives his consent for the same.

The Contractor further agrees that the terms of indemnity shall survive the termination or completion of this contract.

The contractor further agrees that the liability of the contractor shall be extended on actual basis notwithstanding the limitations of liability clause, in respect of :

1. breach of terms of contract by the contractor
2. breach of laws by the contractor
3. breach of Intellectual property rights by the contractor
4. breach of confidentiality by the contractor

Nothing contained in this deed, shall be construed as absolving or limiting the liability of the Contractor under said Contract between the Company and the Contractor. That this Indemnity Bond is irrevocable and the condition of the bond is that the Contractor shall duly and punctually comply with the terms and the conditions of this deed and contractual provisions to the satisfaction of the Company.

In witness where of M/s _____ these presents on the day, month and year first, above written at _____ by the hand of its signatory Mr._____.

Signed for and on behalf of
M/s _____

Witness:

1.

2.

Form WAM 6

BHARAT HEAVY ELECTRICALS LIMITED
DIVISION.....
Running Account Bill
(Para 4.3.1 of Works Accounts Manual)

Departmental Bill No.

Name of the Contractor — Date:

Name of the Work: — Division: — Sub-Division:

Sanctioned Estimate: — Date of written order to commence the Work: — Period of work covered in this bill:

Code No.: — Date of commencement of work:

Contract Agreement No.: — Dated: — Due date of completion as per agreement

Date of approval of Competent Authority for time extension as applicable (copy to be enclosed).

I. ACCOUNT OF WORK EXECUTED

Adhoc payment for work not previously measured **			Item No. of work	Description of work	Quantity as per agreement	Quantity executed upto date	Rate	Unit	Payment on the basis of actual measurement upto date	Quantity executed since last RA bill	Payment on the basis of actual measurement since last running account bill	Remarks
Total as per last running account bill	Since last running account bill	Total upto date										
1	2	3	4	5	6	7	8	9	10	11	12	13

** 1. Whenever payment is made on adhoc basis without actual measurements the amount in whole rupees should be entered in columns 1 to 3 only and not in columns 7 to 12

2. Whenever there is an entry in column 12 on the basis of actual measurement, the whole of the amount previously paid without detailed measurement should be adjusted by a minus entry in column 2 equivalent to the amount shown in column 1, so that the total upto date in column 3 may become nil.

Total value of work done upto date (A) -------

Deduct value of work shown on the last Running Account Bill (B) -------

Net value of work done since last Running Account Bill (C) -------

Rupees (in words) ..... Only

Note :
Wherever adhoc payments to contractors against running bills are made in accordance with the extant Works Policy, the amount so paid shall be adjusted.

II. MEMORANDUM OF PAYMENTS

			I	II
1.	Total value of work actually measured as per Account No. I, Column 10	(A)	----------	----------
2.	Total upto date adhoc payment for work covered by approximate or plan measurements as per Account I, Col. 3	(B)	----------	----------
4.	Total upto date payments [(A)+(B)]	(C)	----------	----------
5.	Total amount of payments already made as per entry (D) of last Running Account Bill No. ..... dated ..... forwarded to the Accounts Department on	(D)		----------
6.	Balance [(C) - (D)]			----------
7.	Payments now to be made:		----------	
	a) by cash / cheque		----------	
	b) by deduction for value of materials supplied by BHEL vide Annexure A attached		----------	
	c) by deduction for hire of tools and plant vide Annexure B attached		----------	
	d) by deduction for other charges vide Annexure C attached		----------	
	e) by deduction on account of security deposit		----------	
	f) by deduction on account of Income Tax			----------

Note :	Amounts relating to items 4 to 6 above should be entered in column II and those relating to item 7 in column I. The amount shown against item 6 and the total of item 7 should agree with each other.

III. CERTIFICATE OF THE ENGINEER IN CHARGE

1	The measurements on which the entries in column 7 to 12 of Part I of this Bill (Account of work executed) are based were made by ---------- and are reorded at pages - ---------- of Measurement Book No. ---------- (Name and Designation)
2	Certified that the methods of measurement are correct and the work has been carried out in accordance with the terms and conditions, schedules, specifications and drawings etc. forming part of the contract agreement, subject to deviations included in the deviation statement (Annexure D)
3	Certified that in addition to and quite apart from the quantities of work actually executed as shown in column 10 of Part I, some work has actually been done in connection with several items and the value of the such work is, in no case, less than the adhoc payments as per column 3 of Part I, made or proposed to be made, for the convenience of the contractor in anticipation of, and subject to the results of, detailed measurement which will be made as soon as possible.
4	Certified that measurements by Engineer-incharge and test check of prescribed percentage of measurements by the concerned superior authorities has been carried out.
5	Certified that there are no pending recoveries from the contractor on account of chargeable items (e.g T&P, consumables, material, etc.) issued either by BHEL or by the customer and other recoveries like power, water, quarter, tax liability towards declaration forms etc.
6	Certified that with regard to the free issues, regular reconciliation is being done, completed upto ---------- and there are no recoveries pending from the contractor on account of such issues in excess of requirement for execution of work as per contract.
7	Certified that there is no pending recovery for damaged material issued free of cost.
8	Certified that the contractor has fulfilled all the requirements as per contract with reference to statutory obligations (PF, ESI, Minimum Wages, BOCW, Insurance etc.), support services such as service manpower, computer system , T&P etc

Signature of Contractor

Date:

Signature of Engineer in Charge

Designation:

Date:

IV. CERTIFICATE OF THE SENIOR ENGINEER

1	Certified that the measurements have been check measured to the prescribed extent by .... at site and also by the undersigned and the relevant entries have been initialed in the Measurement Book. (vide pages .....) (Name and Designation)
2	Certified that all the measurements recorded in the measurement book have been correctly billed for
3	Certified that all recoverable amounts in respect of materials tools and plant etc. and other charges have been correctly made vide annexures A to C attached.

Certified for payment * of Rs. ..... (Rupees ..... only)

*** Here specify the net amount payable.**

Date: **Signature of Senior Engineer**

V. ENTRIES TO BE MADE IN THE FINANCE DEPARTMENT

Code No.:

Accounts Bill No. ---------- dated ----------

Entered in Journal Book vide entry No. ---------- dated ----------

Passed for ---------- Rs.----------

Less Deductions ---------- Rs.----------

Net amount payable ---------- Rs.----------

(Rupees ---------- only)

Payable to Shri / M/s ---------- by cheque / cash

Entered in Contractors ledger No. ---------- Page ----------

	ALLOCATION	
Estimate No :	Debit	Credit
	(Gross amount)	(Deductions)
Name of Work :		
Account code head		
Total		

Assistant
Date:

Accountant
Date:

Finance Executive
Date:

Form WAM 6 (Contd.)

ANNEXURE A

Statement showing details of materials issued to the contractor Shri / M/S..... in respect of Contract Agreement / Work Order No.....Dated..... and covered by the agreement

Sl.No.	Stores Issue Voucher No. and date	Issue voucher No. and date allotted by stores to the SIV	Description of material issued issued to the contractor	Quantity issued		Quantity actually incorporated in the work	Balance quantity with contractor		If recoverable from the contractor				
				Free	Chargeable		Free	Chargeabl	Rate at which recoverable	Amount recoverable	Amount recovered upto previous bill	Balance now recovered	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14
						Total							

Certified that …….. (balance quantity of free issue material as per Col. 8 above) is physically available with the Contractor.

Signature of Contractor
Date:

Signature of Engineer in Charge
Date:

Signature of Senior Engineer
Date:

ANNEXURE B

Statement showing tools and plant issued to the contractor Shri/M/s..... in respect of Contract Agreement No.....Dated.....

Sl. No.	Description of Tools and Plant Issued	Period for which issued	Rate at which recovery is to be made	Amount recoverable	Amount recovered upto previous bill	Balance Recovered now	Remarks
1	2	3	4	5	6	7	8
			TOTAL				

Signature of Contractor
Date :

Signature of Engineer in Charge
Date :

Signature of Senior Engineer
Date:

Form WAM 6 (Contd.)

ANNEXURE C

Statement showing details of other recoveries to be made from the contractor Shri/M/s----------in respect of contract Agreement No. .....Dated .....

S. No.	Particulars	Unit	Quantity	Rate	Amount recoverable	Amount recovered up to previous bill	Amount now recovered	Remarks
1	2	3	4	5	6	7	8	9
1	Water charges							
2	Electricity charges							
3	Seignorage charges							
4	Medical charges							
5	Cost of empty gunny bags and empty containers not returned							
6								
7								
8								
	TOTAL							

Signature of Contractor
Date :

Signature of Engineer in Charge
Date :

Signature of Senior Engineer
Date:

ANNEXURE D
DEVIATION STATEMENT

Name of the Contractor:

Contract Agreement No

Name of Work:

Date:

S. No.	Description of Item	Unit	Quantity as per agreement	Quantity as executed	Quantity further anticipated	Total quantity anticipated on completion	Rate as per agreement	Rate as executed	Amount as per agreement	Amount as executed	Amount further anticipated	Total Amount anticipated on completion	Difference		Reason for deviation with authority, if any
													Excess	Savings	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Signature of Engineer in Charge
Date :

Signature of Senior Engineer
Date :

Form WAM 7

BHARAT HEAVY ELECTRICALS LIMITED
DIVISION.....
.....And Final Bill
(Para 4.3.2 of Works Accounts Manual)

Departmental Bill No:
Date:
Name of the Contractor: Division: Sub-Division:
Name of the Work: Date of Written order to commence the work:

Sanctioned Estimate: Date of commencement of the Work:
Contract Agreement/ Work Order No: Dated: Due date of completion as per Agreement:
Date of actual completion of the work:

I. ACCOUNT OF WORK EXECUTED

Adhoc payment for work not previously measured **			Item no. of the agreement / work order	Description of work	Quantity as per agreement	Quantity executed upto date	Rate	Unit	Payment on the basis of actual measurement upto date	Quantity since last running account bill	Payment on t he basis of actual measurement since last running account bill	Remarks
Total as per last running account bill	Since last running account bill	Total upto date										
1	2	3	4	5	6	7	8	9	10	11	12	13

** Whenever there is an entry in column 12 on the basis of actual measurement, the whole of the amount previously paid without detailed measurement should be adjusted by a minus entry in column 2 equivalent to the amount shown in column 1, so that the total upto date in column 3 may become nil.

Total value of work done upto date	(A)	-------
Deduct value of work shown on the last Running Account Bill	(B)	-------
Net value of work done since last Running Account Bill	(C)	-------

Rupees (in words) ..... Only

Form WAM 7 (Contd.)

II. MEMORANDUM OF PAYMENTS

1	Total value of work actually measured as per Account No. I column 10		(A)	----------
2	Deduct amount of payments already made as per last running account bill No. ..... dated		(B)	----------
3	Payment now to be made [(A) - (B)]		(C)	----------
4	Deduct amounts recoverable from the contractor on account of :			
	a) Materials supplied by BHEL vide Annexure A attached	----------		
	b) Hire of tools and plant vide Annexure B attached	----------		
	c) Other charges vide Annexure C attached	----------		
	d) Income Tax	----------		
	Total Deductions			----------
5	Balance			----------
6	Refunds of Security Deposit			----------
7	Net amount to be paid to the contractor			----------

Net value Rupees (in words) ..... Only

I/ We hereby certify that I/We have performed the work as per the terms and conditions of Contract Agreement/Work Order No.....Dated.....for which payment is claimed as above and that I/We have no further claim under this agreement/work order.

Signature of the Contractor

Date:

III CERTIFICATE OF THE ENGINEER IN CHARGE

1. The measurements on which the entries in columns 7 to 11 of Part I of this bill (Account of work executed) are based were made by.....
.....are recorded at pages.....of measurement book No..... (Name and Designation)
2. A statement showing the quantities of stores issued to the contractor (whether free or on recovery basis) and their disposal is attached.

Date:

Signature of Engineer incharge

Designation:

Form WAM 7 (Contd.)

IV CERTIFICATE OF THE SENIOR ENGINEER

1. Certified that I have personally inspected the work and that the work has been physically completed on the due date in accordance with the terms and conditions, schedules, specifications and drawings etc., forming part of the contract agreement, subject to the deviations noted in Deviation Statement (Annexure D).
2. Certified that the measurements have been check measured to the prescribed extent by..... ..... and by the undersigned at site and the relevant entries have been initiated in the measurement book (vide pages.....) (Name and Designation)
3. Certified that the methods of measurement are correct.
4. Certified that the measurements have been technically checked with reference to contract drawings, deviations etc.
5. Certified that the measurements recorded in the measurement book have been correctly billed for at the contract rates or approved rates.
6. Certified that all recoverable amounts in respect of stores, tools and plant, water, electricity charges etc. have been correctly made vide Annexures A to C and that there are no other demands outstanding against the contractor on this contract.
7. Certified that the issues of all stores as per statement attached (whether charged to the contractor or direct to the work) have been technically checked and represent fair and reasonable issues for the items of work executed vide Annexure E.
8. Certified that all statutory requirements including PF, ESI, Minimum wages, Insurance, GST, BOCW, etc. are complied with by the Contractor. This should be duly backed by the relevant documents.

Certified for payment of * Rs.....(Rupees.....only).

***Here specify the net amount payable**

Signature of Senior Engineer

Date

IV ENTRIES TO BE MADE IN THE FINANCE DEPARTMENT

Account code head	Debit (Gross Amount)	Credit (Deductions)
TOTAL		

Passed for.....Rs.....
Less Deductions.....Rs.....
Net Amount Payable.....Rs.....
(Rupees.....only)

Assistant

Date:

Accountant

Date:

Finance Executive

Date:

Form WAM 7 (Contd.)

ANNEXURE A
Part I

Statement showing details of materials issued to the contractor Shri / M/S.....in respect of Contract Agreement / Work Order No.....Dated..... and covered by the agreement.

Sl.No.	Stores Issue Voucher No. and date	Issue voucher No. and date allotted by stores to the SIV	Description of material issued issued to the contractor	Quantity issued	Quantity actually incorporated in the work	Whether recoverable from the contractor or supplied free	If recoverable from t he Contractor				
							Rate at which recoverable	Amount recoverable	Amount recovered upto previous bill	Balance now recovered	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
						Total					

Signature of Contractor
Date:

Signature of Engineer in Charge
Date:

Signature of Senior Engineer
Date:

ANNEXURE A
Part II

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

Sl.No	Stores Issue Voucher No.and Date	Issue Voucher No. and date allotted by stores to the SIV	Description of material issued to the contractor	Quantity issued	Quantity actually incorporated in the work	Issue Rate	Amount recoverable	Amount recovered upto previous bill	Balance now recovered	Remarks
1	2	3	4	5	6	7	8	9	10	11

TOTAL
Add Departmental Charges
Add GST (Wherever applicable)
GRAND TOTAL

Signature of Contractor
Date:

Signature of Engineer-in-Charge
Date:

Signature of Senior Engineer
Date:

Note: Cost of materials recovered in this bill should be shown against item 4 (a) of the memorandum of payments. The amounts of taxes and departmental charges recovered in this bill should be incorporated in Annexure C.

Form WAM 7 (Contd.)

ANNEXURE B

Statement showing tools and plant issued to the contractor Shri /M/S.....in respect of contract Agreement / Work Order No.....Dated.....

Sl.No.	Description of Tools and Plant Issued	Period for which issued	Rate at which recovery is to be made	Amount recoverable	Amount recovered upto previous bill	Balance now recovered	Remarks
1	2	3	4	5	6	7	8
			TOTAL				

Signature of Contractor
Date

Signature of Engineer-in-Charge
Date

Signature of Senior Engineer
Date

ANNEXURE C

Statement showing details of other recoveries to be made from the contractor Shri/M/s..... In respect of Contract Agreement / Work Order No.....Dated.....

Sl.No.	Particulars	Unit	Quantity	Rate	Amount recoverable	Amount recovered upto previous bill	Amount now recovered	Remarks
1	2	3	4	5	6	7	8	9
1	Water charges							
2	Electricity charges							
3	Medical charges							
4	Cost of empty gunny bags and empty containers not returned							
5								
6								
7								
			TOTAL					

Signature of Contractor
Date

Signature of Engineer in Charge
Date

Signature of Senior Engineer
Date

Form WAM 7 (Contd.)

ANNEXURE D

DEVIATION STATEMENT

Name of the Contractor: Contract Agreement/Work Order No.

Name of the Work: Date:

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

Signature of Engineer in Charge Signature of Senior Engineer

Date: Date:

ANNEXURE E

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

Name of the Work:

ON RECOVERY BASIS

SL. No.	Description of material	Unit	Quantity actually issued	Quantity actually incorporated in the work	Balance	Particulars of disposal of balance	Quantity to be issued as per approved data for work actually done	Variation in consumption (difference between colum 5 & 8)		Rate chargeable for excess/short consumption, if any	Amount Recoverable for excess/short consumption, including materials not returned, if any	Remarks
								More	Less			
1	Cement											
2	Bricks											
3	Wood											
4	Asbestos Sheet											
5	Iron Material											
6												
7												

Signature of Contractor Signature of Engineer in Charge Signature of Senior Engineer

Date: Date: Date:

Note

1. The quantities shown in columns 4 and 5 above should tally with those shown in columns 5 & 6 respectively of Annexure A (Part I and II)
2. Data statement of theoretical consumption should be attached in support of quantity specified in column 8.

Form WAM 7 (Contd.)

ANNEXURE F

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

Name of the Work:

FREE OF COST

Sl.No	Stores Issue Voucher No.	Description of material	Unit	Quantity issued	Quantity required as per data	Quantity consumed in the work	Balance (if any)	Nature of disposal for the balance	Rate chargeable for material not returned	Amount recoverable for material not returned	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of Contractor
Date:

Signature of Engineer in Charge
Date:

Signature of Senior Engineer
Date:

ANNEXURE G

QUESTIONNAIRE TO BE ANSWERED BY THE ENGINEER IN CHARGE AND SENIOR ENGINEER

(Correct particulars and answers to be recorded)

1. Name of the Work:
2. Name of the Contractor:
3. Date of commencement of the Work:
4. Contract agreement /Work Order No. and date:
5. Reference to the supplementary Agreement No. if any:
6. Whether administrative approval and technical sanction has been accorded by the competent authority? If so, cite reference?
7. Whether sanction of the competent authority and financial concurrence of the Finance Department for award of the work has been accorded? If so, cite reference.
8. Whether the work has been completed in time? If not whether penalty has been levied or sanction of the competent authority for extension of time granted and communicated to the Finance Department with reasons for grant of extension? (Due and actual date of completion of the work and reference to letter No. and date granting the extension of time should be given).
9. (a) Whether the rates allowed in the bill have been checked with the contract agreement?

   (b) Whether the rates for extra/supplemental items have been approved by the competent authority and the sanction communicated to the Finance Department together with rate analysis? If so, cite reference
10. Whether deviations have been approved by the competent authority? If yes, give reference to the approval; if not, give reasons.
11. Whether the rates of recovery of stores issued to the contractor which are not provided for in the contract agreement have been settled in consultation with Finance?
12. Whether discrepancies pointed out by the Finance department in the stores statement have been reconciled and accepted by the Finance Department?
13. Whether materials issued to the contractor in excess of the theoretical requirements have been returned to the Stores department and the No. and date of such returned stores vouchers have been shown in Stores statement? If not, whether the cost of such excess materials has been recovered at the prescribed rate? Whether consumption statements in respect of materials chargeable to the work have been attached to the bill?
14. Whether consumption of materials shown has been technically checked by Senior Engineer?
15. Whether materials issued and used in the work is not less than that required for consumption in work according to our specifications? If consumption is less, whether necessary recovery has been made in the bill?
16. Whether measurements have been checked by the Engineer and Senior Engineer to the extent required and certificates of check recorded in the measurement books?
17. Whether contractor has signed the bill and the measurement books without reservations? If not, whether reasons have been intimated to the Finance Department?
18. Whether arithmetical calculations have been checked and certificate recorded in the measurement books by a person other than the one who calculated initially?
19. Whether any work was done at the risk and cost of the contractor and whether such cost has been recovered from him? Give particulars.
20. Whether all advance payments on running accounts have been recovered?
21. Whether all the recoveries due for services given to the contractor like rent of accommodation, water charges, electricity charges have been recovered and whether payments made by the company on behalf of the contractor have been adjusted?
22. Whether the files containing abstracts from measurement books/standard measurement books have been completed/updated?
23. Whether hire charges for tools & plant have been recovered and the statement of hire charges with full details attached?
24. Whether the certificate of workmanship and completion of work according to specifications, drawings etc. is recorded by Engineer Incharge/Senior Engineer and whether recoveries have been made for defective works, if any?
25. Whether all corrections in the bill/measurement books etc. have been neatly made and attested and there are no overwriting?
26. Whether final measurements have been taken as soon as possible after completion of the work and the certificate of completion issued? If not, whether reasons for delay have been recorded and communicated to finance department?
27. In respect of quantities reduced in the final bill as compared to the running payment, whether adequate reasons have been recorded and communicated to finance department?
28. Whether the expenditure has been classified correctly according to heads of account recorded in the sanctioned estimate?
29. Whether the work has been completed within the estimated cost? If not, what is the percentage of excess over the sanctioned estimate/ administrative approval? In case the excess is beyond the competency of the Senior Engineer, what action has been taken for obtaining the approval of the authority competent to sanction the excess?
30. (a) If the contractor has furnished bank guarantee in lieu of cash security deposit towards proper execution of works and guarantee against defects during the maintenance period, whether the period of currency of the bank guarantee covers the entire maintenance period?

    (b) If not whether security deposit has been proposed to be recovered from the final bill?
31. Whether all the previous audit objections raised on running account bills have been settled? If so, cite references.

Signature of Engineer in Charge
Date:

Signature of Senior Engineer
Date:

ANNEXURE TO MODEL CONCILIATION CLAUSE FOR CONDUCT OF CONCILIATION UNDER THE BHEL CONCILIATION SCHEME, 2018

BRIEF PROCEDURE FOR CONDUCT OF CONCILIATION PROCEEDINGS

1. The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof and as provided herein:

2. The party desirous of resorting to Conciliation shall send an invitation/notice in writing to the other party to conciliate specifying all points of Disputes with details of the amount claimed. The party concerned shall not raise any new issue thereafter. Parties shall also not claim any interest on claims/counter-claims from the date of notice invoking Conciliation till the conclusion of the Conciliation proceedings.

3. The party receiving the invitation/notice for Conciliation shall within 30 days of receipt of the notice of Conciliation intimate its consent for Conciliation along with its counter-claims, if any.

4. The Conciliation in a matter involving claim or counter-claim (whichever is higher) up to Rs 5 crores shall be carried out by sole Conciliator nominated by BHEL while in a matter involving claim or counter-claim (whichever is higher) of more than Rs 5 crores Conciliation shall be carried out by 3 Conciliators nominated by BHEL.

5. The Parties shall be represented by only their duly authorized in-house executives/officers and neither Party shall be represented by a Lawyer.

6. The first meeting of the IEC shall be convened by the IEC by sending appropriate communication/notice to both the parties as soon as possible but not later than 30 days from the date of his/their appointment. The hearings in the Conciliation proceeding shall ordinarily be concluded within two (2) months and, in exceptional cases where parties have expressed willingness to settle the matter or there exists possibility of settlement in the matter, the proceedings may be extended by the IEC by a maximum of further 2 months with the consent of the Parties subject to cogent reasons being recorded in writing.

7. The IEC shall thereafter formulate recommendations for settlement of the Disputes supported by reasons at the earliest but in any case within

15 days from the date of conclusion of the last hearing. The recommendations so formulated along with the reasons shall be furnished by the IEC to both the Parties at the earliest but in any case within 1 month from the date of conclusion of the last hearing.

8. Response/modifications/suggestions of the Parties on the recommendations of the IEC are to be submitted to the IEC within time limit stipulated by the IEC but not more than 15 days from the date of receipt of the recommendations from the IEC.

9. In the event, upon consideration, further review of the recommendations is considered necessary, whether by BHEL or by the other Party, then, the matter can be remitted back to the IEC with request to reconsider the same in light of the issues projected by either/both the Parties and to submit its recommendations thereon within the following 15 days from the date of remitting of the case by either of the Parties.

10. Upon the recommendations by the Parties, with or without modifications, as considered necessary, the IEC shall be called upon to draw up the Draft Settlement Agreement in terms of the recommendations.

11. When a consensus can be arrived at between the parties only in regard to any one or some of the issues referred for Conciliation the draft Settlement Agreement shall be accordingly formulated in regard to the said Issue(s), and the said Settlement Agreement, if signed, by the parties, shall be valid only for the said issues. As regards the balance issues not settled, the parties may seek to resolve them further as per terms and conditions provided in the contract.

12. In case no settlement can be reached between the parties, the IEC shall by a written declaration, pronounce that the Conciliation between the parties has failed and is accordingly terminated.

13. Unless the Conciliation proceedings are terminated in terms of para 22 (b), (c) & (d) herein below, the IEC shall forward his/its recommendations as to possible terms of settlement within one (1) month from the date of last hearing. The date of first hearing of Conciliation shall be the starting date for calculating the period of 2 months.

14. In case of 3 members IEC, 2 members of IEC present will constitute a valid quorum for IEC and meeting can take place to proceed in the matter after seeking consent from the member who is not available. If necessary, videoconferencing may be arranged for facilitating participation of the members. However, the IEC recommendations will be signed by all members. Where there is more than one (1) Conciliator, as a general rule they shall act jointly. In the event of differences between the Members of IEC, the decision/recommendations of the majority of the Members of IEC shall prevail and be construed as the recommendation of the IEC.

15. The Draft Settlement Agreement prepared by the IEC in terms of the consensus arrived at during the Conciliation proceedings between the Parties shall be given by the IEC to both the parties for putting up for approval of their respective Competent Authority.

16. Before submitting the draft settlement agreement to BHEL's Competent Authority viz. the Board Level Committee on Alternative Dispute Resolution (BLCADR) for approval, concurrence of the other party's Competent Authority to the draft settlement agreement shall be obtained by the other party and informed to BHEL within 15 days of receipt of the final draft settlement agreement by it. Upon approval by the Competent Authority, the Settlement Agreement would thereafter be signed by the authorized representatives of both the Parties and authenticated by the members of the IEC.

17. In case the Draft Settlement Agreement is rejected by the Competent Authority of BHEL or the other Party, the Conciliation proceedings would stand terminated.

18. A Settlement Agreement shall contain a statement to the effect that each of the person(s) signing thereto (i) is fully authorized by the respective Party(ies) he/she represents, (ii) has fully understood the contents of the same and (iii) is signing on the same out of complete freewill and consent, without any pressure, undue influence.

19. The Settlement Agreement shall thereafter have the same legal status and effect as an arbitration award on agreed terms on the substance of the dispute rendered by an arbitral tribunal passed under section 30 of the Arbitration and Conciliation Act, 1996.

20. Acceptance of the Draft Settlement Agreement/recommendations of the Conciliator and/or signing of the Settlement Agreement by BHEL shall

however, be subject to withdrawal/closure of any arbitral and/or judicial proceedings initiated by the concerned Party in regard to such settled issues.

21. Unless otherwise provided for in the agreement, contract or the Memorandum of Understanding, as the case may be, in the event of likelihood of prolonged absence of the Conciliator or any member of IEC, for any reason/incapacity, the Competent Authority/Head of Unit/Division/Region/Business Group of BHEL may substitute the Conciliator or such member at any stage of the proceedings. Upon appointment of the substitute Conciliator(s), such reconstituted IEC may, with the consent of the Parties, proceed with further Conciliation into the matter either de-novo or from the stage already reached by the previous IEC before the substitution.

22. The proceedings of Conciliation under this Scheme may be terminated as follows:
    a. On the date of signing of the Settlement agreement by the Parties; or,
    b. By a written declaration of the IEC, after consultation with the parties, to the effect that further efforts at conciliation are no longer justified, on the date of the declaration; or,
    c. By a written declaration of the Parties addressed to the IEC to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,
    d. By a written declaration of a Party to the other Party and the IEC, if appointed, to the effect that the Conciliation proceedings are terminated, on the date of the declaration.
    e. On rejection of the Draft Settlement Agreement by the Competent Authority of BHEL or the other Party.

23. The Conciliator(s) shall be entitled to following fees and facilities:

Sl No	**Particulars**	**Amount**
1	Sitting fees	Each Member shall be paid a Lump Sum fee of Rs 75,000/- for the whole case payable in terms of paragraph No. 27 herein below.
2	Towards drafting of settlement agreement	In cases involving claim and/or counter-claim of up to Rs 5crores. Rs 50,000/- (Sole Conciliator)

Sl No	Particulars	Amount
		In cases involving claim and/or counter-claim of exceeding Rs 5 crores but less than Rs 10 crores. Rs 75,000 (per Conciliator) In cases involving claim and/or counter-claim of more than Rs 10 crores. Rs 1,00,000/- (per Conciliator) Note: The aforesaid fees for the drafting of the Settlement Agreement shall be paid on Signing of the Settlement Agreement after approval of the Competent Authority or Rejection of the proposed Settlement Agreement by the Competent Authority of BHEL.
3	Secretarial expenses	Rs 10,000/- (one time) for the whole case for Conciliation by a Sole Member IEC. Where Conciliation is by multi member Conciliators –Rs 30,000/- (one time)- to be paid to the IEC
4	Travel and transportation and stay at outstation i) Retired Senior Officials of other Public Sector Undertakings (pay scale wise equivalent to or more than E-8 level of BHEL)	As per entitlement of the equivalent officer (pay scale wise) in BHEL.
	Others	As per the extant entitlement of whole time Functional Directors in BHEL.

Sl No	Particulars	Amount
		Ordinarily, the IEC Member(s) would be entitled to travel by air Economy Class.
5	Venue for meeting	Unless otherwise agreed in the agreement, contract or the Memorandum of Understanding, as the case may be, the venue/seat of proceedings shall be the location of the concerned Unit / Division / Region / Business Group of BHEL. Without prejudice to the seat/venue of the Conciliation being at the location of concerned BHEL Unit / Division / Region / Business Group, the IEC after consulting the Parties may decide to hold the proceedings at any other place/venue to facilitate the proceedings. Unless, Parties agree to conduct Conciliation at BHEL premises, the venue is to be arranged by either Party alternately.

24. The parties will bear their own costs including cost of presenting their cases/evidence/witness(es)/expert(s)on their behalf. The parties agree to rely upon documentary evidence in support of their claims and not to bring any oral evidence in IEC proceedings.

25. If any witness(es) or expert(s) is/are, with the consent of the parties, called upon to appear at the instance of the IEC in connection with the matter, then, the costs towards such witness(es)/expert(s) shall be determined by the IEC with the consent of the Parties and the cost so determined shall be borne equally by the Parties.

26. The other expenditures/costs in connection with the Conciliation proceedings as well as the IEC's fees and expenses shall be shared by the Parties equally.

27. Out of the lump sum fees of Rs 75,000/- for Sitting Fees, 50% shall be payable after the first meeting of the IEC and the remaining 50% of the Sitting Fees shall be payable only after termination of the conciliation proceedings in terms of para 22 hereinabove.

28. The travelling, transportation and stay at outstation shall be arranged by concerned Unit as per entitlements as per Serial No. 3 of the Table at para 23 above, and in case such arrangements are not made by the BHEL Unit, the same shall be reimbursed to the IEC on actuals limited to their entitlement as per Serial No. 4 of the Table at Para 23 above against supporting documents. The IEC Member(s) shall submit necessary invoice for claiming the fees/reimbursements.

29. The Parties shall keep confidential all matters relating to the conciliation proceedings. Confidentiality shall extend also to the settlement agreement, except where its disclosure is necessary for purposes of its implementation and enforcement or as required by or under a law or as per directions of a Court/Governmental authority/ regulatory body, as the case may be.

30. The Parties shall not rely upon or introduce as evidence in any further arbitral or judicial proceedings, whether or not such proceedings relate to the Disputes that is the subject of the Conciliation proceedings:
    a. Views expressed or suggestions made by the other party in respect of a possible settlement of the Disputes;
    b. admissions made by the other party in the course of the Conciliator proceedings;
    c. proposals made by the Conciliator;
    d. The fact that the other Party had indicated his willingness to accept a proposal for settlement made by the Conciliator.

31. The Parties shall not present the Conciliator(s) as witness in any Alternative Dispute Resolution or Judicial proceedings in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.

32. None of the Conciliators shall act as an arbitrator or as a representative or counsel of a Party in any arbitral or judicial proceeding in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.

33. The Parties shall not initiate, during the Conciliation proceedings, any arbitral or judicial proceedings in respect of a Disputes that is the subject matter of the Conciliation proceedings except that a Party may initiate arbitral or judicial proceedings where, in his opinion, such proceedings are necessary for preserving his rights including for preventing expiry of period of limitation. Unless terminated as per the provisions of this Scheme, the Conciliation proceedings shall continue

notwithstanding the commencement of the arbitral or judicial proceedings and the arbitral or judicial proceedings shall be primarily for the purpose of preserving rights including preventing expiry of period of limitation.

34. The official language of Conciliation proceedings under this Scheme shall be English unless the Parties agree to some other language.

Format 2 to BHEL Conciliation Scheme, 2018

FORMAT FOR SEEKING CONSENT FOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,

M/s. (Stakeholder's name)

Sub: Resolution of the Disputes through conciliation by Independent Expert Committee (IEC).

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Sir,

With reference to above referred Contract/MoU/Agreement/LOI/LOA, you have raised certain Disputes/claims. Vide your letter dated____ you have requested BHEL to refer the Disputes/claims to IEC for Conciliation.

We are enclosing herewith Format (3) for giving consent and the terms and conditions of BHEL Conciliation Scheme, 2018 governing conciliation through IEC. You are requested to give your unconditional consent to the said terms and conditions of the Scheme by returning the same duly sealed and signed on each page. On receipt of your consent, matter will be put to the Competent Authority for consideration and decision.

Please note that BHEL has also certain claims against you (if applicable). BHEL reserves its right to agree or not to agree conciliation of the said disputes through BHEL and this letter is being issued without prejudice to BHEL's rights and contentions available under the contract and law.

Yours faithfully,

Representative of BHEL

Format 3 to BHEL Conciliation Scheme, 2018

FORMAT FOR GIVING CONSENT BY CONTRACTOR/VENDOR/CUSTOMER/COLLABORATOR/CONSORTIUM PARTNERSFOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,

BHEL

.....

Sub: Resolution of Disputes through Conciliation by Independent Expert Committee (IEC).

Ref: Contract/MoU/Agreement/LOI/LOA No & date____

With reference to above referred contract, our following bills/invoices/claims submitted to BHEL are still unpaid giving rise to Disputes:

SL. no.	Claim Description	Bill submitted to BHEL (no. and date)	Amount of the bill/claim	Amount received from BHEL	Outstanding Amount

Accordingly we request you to kindly refer the Disputes in respect of above claims to IEC for Conciliation.

We hereby agree and give our unconditional consent to the terms and conditions of BHEL Conciliation Scheme, 2018 governing conciliation through IEC. We have signed the same on each page and enclosed it for your consideration.

Yours faithfully,

(Signature with stamp)

Authorized Representative of Contractor
Name, with designation
Date

Format 5 to BHEL Conciliation Scheme, 2018

STATEMENT OF CLAIMS/COUNTER CLAIMS TO BE SUBMITTED TO THE IEC BY BOTH THE PARTIES

1. Chronology of the Disputes

2. Brief of the Contract/MoU/Agreement/LOI/LOA

3. Brief history of the Disputes:

4. Issues:

5. Details of Clam(s)/Counter Claim(s):

Sl. No.	**Description of claim(s)/Counter Claim**	**Amount (in INR)Or currency applicable in the contract**	**Relevant contract clause**

6. Basis/Ground of claim(s)/counter claim(s) (along with relevant clause of contract)

Note– *The Statement of Claims/Counter Claims may ideally be restricted to maximum limit of 20 pages. Relevant documents may be compiled and submitted along with the statement of Claims/Counter Claims. The statement of Claims/Counter Claims is to be submitted to all IEC members and to the other party by post as well as by email.*

BILL OF QUANTITY CUM PRICE SCHEDULE

Name of Project: 110kV Switchyard for RMU Kodayar Power House at Kodayar
Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
1	Earth work in excavation in all types of soil including ash which can be excavated by any means including setting out, levelling, dewatering (but excluding special type of dewatering viz. well point method), shoring & strutting (wherever required), dressing the sides & bottom, all lifts, ramming/compacting the excavated bottom, stacking, disposal of surplus excavated materials within a lead upto 1Km, spreading/levelling of disposed materials etc all complete for following depths below ground level. Depth from ground level but not exceeding 2.5 m	270	cum	160.292	43278.71
2	Earth work in excavation in soft rock (rock without any recovery of exacavated materials in the form of hard stone/boulder) including weathered rock which can be excavated by means of crow bar, pick axe, pneumatic rock breaker attachment with excavator machine etc but does not require chiselling or blasting including setting out, levelling, dewatering (wherever required), shoring & strutting (wherever required), dressing the sides & bottom, all lifts, ramming/compacting the excavated bottom, stacking, disposal of surplus excavated materials within a lead upto 1 Km, spreading / levelling of disposed materials etc all complete for following depths below ground level. Depth from ground level but not exceeding 2.5 m	800	cum	396.110	316887.76
3	Earth work in excavation upto any depth below ground level in hard rock requiring chiselling including wedging, line drilling, pre shearing etc as required for grading, setting out, levelling, dewatering (wherever required), dressing the sides & bottom, all lifts, stacking/disposal of surplus excavated material within a lead upto 1 Km, spreading / levelling of disposed materials etc all complete as per specification, drawing and as directed by the engineer-in-charge. Depth from ground level but not exceeding 2.5 m	135	cum	1038.827	140241.60
4	Earthwork in Back filling upto any depth below ground level around foundations, plinths, trenches, drains etc to proper grade and level in layers not exceeding 200 mm thickness using/with selected materials from compulsorily excavated earth available within a lead upto 1 Km and compacted as specified including re-excavation of stacked earth, watering, ramming/compaction by manual/mechanical means, dressing etc all complete.for the following. Each layer compacted so as to achieve at least 95% maximum dry density as per IS- 2720 (Part-VII)	135	cum	138.573	18707.29
5	Extra over ST No. 1,2,3 & 4 for carriage of material/earth for every 500m or part thereof beyond an initial lead of 1km. Carriage for disposal of serviceable/unserviceable material/ earth	500	cum	12.499	6249.25
6	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20cm in depth including consolidating each deposited layer by ramming,watering etc.and disposing of surplus excavated soil as directed within a lead of 100m. All kinds of soil for Pipes, cables etc, not exceeding 80mm dia.	5	RM	138.050	690.25
7	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20cm in depth including consolidating each deposited layer by ramming,watering etc.and disposing of surplus excavated soil as directed within a lead of 100m. All kinds of soil for Pipes, cables etc. exceeding 80mm dia. but not exceeding 300 mm dia.	5	RM	225.450	1127.25
8	Supplying, filling and compacting in plinth & foundation with Jamuna/local sand as per drawing under floors, foundation, drain, cable trench etc including watering, ramming, consolidating and dressing etc all complete as per Technical Specification.	5	cum	810.820	4054.10
9	Supplying, filling, watering and compacting to Minimum 90% Proctor Density **63mm downgraded hard stone aggregate** including filling of interstics with sand for under floors, foundations, roads, cable trenches, drains, etc. including royalty, carriage etc. all complete, for all leads and lift with all labour, material, tools, tackles, equipments, safeguards & incidentals as necessary as per specification and direction - of - Engineer -in- charge.	5	cum	2955.492	14777.46
10	Supplying chemical emulsion in sealed containers including delivery as specified.Chloropyriphos emulsifiable concentrate of 20%	5	litre	157.450	787.25

BILL OF QUANTITY CUM PRICE SCHEDULE

Name of Project: 110kV Switchyard for RMU Kodayar Power House at Kodayar
Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
11	Diluting and injecting chemical emulsion for POST-CONSTRUCTIONAL anti- termite treatment (excluding the cost of chemical emulsion) : Along external wall where the apron is not provided using chemical emulsion @ 7.5 litres / sqm of the vertical surface of the substructure to a depth of 300 mm including excavation channel along the wall &rodding etc. complete: With Chlorpyriphos/ Lindane E.C. 20% with 1% concentration.	5	RM	16.800	84.00
12	Diluting and injecting chemical emulsion for POST-CONSTRUCTIONAL anti- termite treatment (excluding the cost of chemical emulsion) : Along the external wall below concrete or masonry apron using chemical emulsion @ 2.25 litres per linear metre including drilling and plugging holes etc. With Chlorpyriphos/ Lindane E.C. 20% with 1% concentration.	5	RM	24.300	121.50
13	Diluting & injecting chemical emulsion for PRE-CONSTRUCTIONAL ANTI-TERMITE treatment and creating a continuous chemical barrier under and all around the column pits, wall trenches, basement excavation, top surface of plinth filling, junction of wall & floor, along the external perimeter of building, expansion joints, over the top surface of consolidated earth on which apron is to be laid, surroundings of pipes and conduits, etc complete as per specifications (Plinth area of the building at ground floor only shall be measured for payment).	5	Sqm	131.900	659.50
14	Applying a coat of residual petroleum bitumen of grade of VG-10 or 85/25 grade of approved quality using 1.7kg per square metre on damp proof course after cleaning the surface with brushes and finally with apiece of cloth lightly soaked in kerosene oil.	5	Sqm	88.050	440.25
15	Extra for providing and mixing super plasticizer cum water proofing cement additive conforming to IS: 9103 along with meeting limt on permeability as given in Is 2645 in Cement Concrete work in doses by weight of cement as per manufacturer's specification.	5	1 kg per 50 kg of cement	41.730	208.65
16	Providing and laying in position cement concrete of specified grade including Yard PCC but excluding the cost of centering and shuttering: 1:4:8 (1 Cement : 4 coarse sand : 8 graded stone aggregate 40 mm nominal size).	55	cum	7155.869	393572.80
17	Providing and laying in position cement concrete of specified grade including Yard PCC but excluding the cost of centering and shuttering: 1:3:6 (1 Cement : 3 coarse sand : 6 graded stone aggregate 40 mm nominal size).	60	cum	7509.366	450561.95
18	Providing and laying in position cement concrete of specified grade including Yard PCC but excluding the cost of centering and shuttering: 1:3:6 (1 Cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).	5	cum	7616.436	38082.18
19	Providing and laying in position cement concrete of specified grade including Yard PCC but excluding the cost of centering and shuttering: 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size)	15	cum	8037.716	120565.74
20	Providing & fixing in position M30 precast cement concrete covers or perforated covers wherever necessary at various elevations in all kinds of work including moulding, formwork, mixing, laying out, compacting and curing, storing, transportation, erection without damage, setting in position with cement and sand mortar, grouting etc all as per specs, drawings and directions of Engr-in-Charge but excluding the cost of reinforcement, inserts, edge angles, etc.	5	cum	12598.217	62991.09
21	Grouting of block outs, pockets, foundations, bolts holes and underside of base plates using non-shrink cum plasticizer grouting compound. The Minimum strength shall be M35 including placing, curing, cleaning, surface preparation, testing, etc. complete with labour, materials, equipment, handling, testing, etc. all complete as per specifications, drawings and instructions of the Engineer.	5	cum	33837.142	169185.71

BILL OF QUANTITY CUM PRICE SCHEDULE

Name of Project: 110kV Switchyard for RMU Kodayar Power House at Kodayar
Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
22	Providing and laying in position machine batched and machine mixed design mix M-30 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. All works up to plinth level	295	cum	9058.121	2672145.72
23	Providing and laying in position machine batched and machine mixed design mix M-30 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. All works above plinth level to floor V level	15	cum	9110.526	136657.89
24	Extra for providing richer mixes at all floor levels.Providing M-35 grade concrete instead of M-25 grade BMC/RMC.	5	cum	236.974	1184.87
25	Providing and mixing approved Bipolar Concrete penetrating corrosion inhibiting admixture phenolic base (customer approved) in concrete as per detail specification of manufacturer etc all complete. Payment shall be made per cum of concrete	310	cum	1080.193	334859.92
26	FORMWORK: Providing, fixing and removing formwork at all elevations for all structures, as per specifications and including all labour, material, scaffoldings and centereing etc. complete as per drawing, specifications and as per direction of engineer in charge for the following: Fairface form work with good quality water proof ply wood of minimum 12mm thickness and smooth surface **below finished ground floor** level for foundations/Substructures, footings, base of columns, walls, columns, pilasters, beams, mass concrete, trenches etc.including chamfering of edges as per drawing, specification and instruction of engineer in charge.	1085	Sqm	744.590	807880.15
27	FORMWORK: Providing, fixing and removing formwork at all elevations for all structures, as per specifications and including all labour, material, scaffoldings and centereing etc. complete as per drawing, specifications and as per direction of engineer in charge for the following: Fairface form work with good quality water proof ply wood of minimum 12mm thickness and smooth surface **above finished ground floor** level for columns, beams, suspended floors, roofs, lintels, cantilevers, staircases, landings, balconies, etc. including chamfering of edges as per drawing.for all heights as per specification, drawing and instruction of engineer in charge.	335	Sqm	920.772	308458.65
28	Steel reinforcement of grade Fe-500/500D TMT bars as per Technical specification Supply Portion: Reinforcement Steel shall be of SAIL/TATA/RINL or Customer approved make & source including transportion to site. (Refer mode of measurement for supply, storage and payment purpose)	23000	Kg	72.838	1675279.75
29	Steel reinforcement of grade Fe-500/500D TMT bars as per Technical specification.Erection Portion: This item includes straightening, cutting, bending, binding, (i/c cost of binding wire), welding, placing in position, chairs & laps etc. all labour & material complete at all level and heights. (Note: Rates are also includes unloading, storage, watch and ward etc for BHEL/Contractor supplied Reinforcement). (Refer mode of measurement for payment purpose)	23000	Kg	11.000	253000.00
30	Structural steel work welded in built up sections like edge protection angles, pipes, insert plates welded with lugs & framed work, chequered plate including providing, cutting, hoisting, fixing in position/ embedding in concrete and applying a priming coat of approved steel primer all complete.	1000	Kg	111.761	111760.98

BILL OF QUANTITY CUM PRICE SCHEDULE

Name of Project: 110kV Switchyard for RMU Kodayar Power House at Kodayar
Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
31	Steelwork welded in built up sections/framed work including providing, cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc., as required. In gratings, rails ,mono rails (including mono rails for crane support and lifting arrangment in the building at all height), frames, ladders, stair railings, gates (including pipes), rails, ISMB, ISMC and similar works.	1000	Kg	117.852	117851.61
32	Supply & fixing hot dip Galvanising after surface preparation as per ISO 8501-1 for steel work of gratting, rung ladder, Handrail, edge protection angles, pipes, insert plates and applying a priming coat of approved primer all complete. (Mass of Zinc Coating= 810 gm/ sqm)	500	Kg	122.492	61246.00
33	Brick work with common burnt clay F.P.S. bricks as per Technical Specification of class designation 7.5 in foundation and plinth, toe wall including weep holes: Cement mortar 1:6 (1 cement : 6 coarse sand)	15	cum	12413.200	186198.00
34	Brick work with common burnt clay F.P.S.bricks as per Technical Specification of class designation 7.5 in superstructure above plinth level up to floor V level, toe wall in all shapes and sizes including weep holes : Cement mortar 1:6 (1 cement : 6 coarse sand)	5	cum	14324.823	71624.12
35	Half brick masonry with common burnt clay F.P.S. bricks as per Technical specification of class designation 7.5 in foundations and plinth in.cement mortar 1:4 (1 cement : 4 coarse sand)	5	Sqm	1765.114	8825.57
36	Half brick masonry with fly ash lime bricks conforming to IS:12894 as per Technical specification of class designation 7.5 in superstructure above plinth level up to floor V level. Cement mortar 1:4 (1 cement :4 coarse sand)	5	Sqm	1334.200	6671.00
37	Extra for providing and placing in position 2 Nos. 6mm dia. M.S. bars at every third course of half brick masonry.	5	Sqm	48.210	241.05
38	6mm cement plaster to ceiling of mix1:3 (1 cement : 3 fine sand)	10	Sqm	240.575	2405.75
39	12mm cement plaster on the wall/ concrete surface in the mix:1:6 (1 cement: 6 fine sand)	40	Sqm	253.500	10140.00
40	12mm cement plaster finished with a floating coat of neat cement in the mix:1:4 (1cement :4 fine sand)	5	Sqm	264.734	1323.67
41	15 mm cement plaster on the rough side of single or half brick wall of mix : 1:6 (1 cement: 6 fine sand)	5	Sqm	327.638	1638.19
42	18mm cement plaster at all level & height in two coats with under layer 12mm thick cement plaster 1:5 (1 cement :5 coarse sand) finished with a top layer of 6mm thick 1:3 cement plaster(1cement : 3 coarse sand)	40	Sqm	393.165	15726.60
43	Extra for providing and mixing water proofing material in cement plaster work in proportion recommended by the manufacturer	5	Per bag of 50 KG cement used in mix	44.120	220.60
44	Repair to plaster of thickness 12mm to 20 mm in patches of area 2.5 sqm and under, including cutting the patch in proper shape, raking out joints and preparing plastering the wall/concrete surface with white cement based polymer modified self curing mortar, including disposal of rubbish, all complete as per the direction of Engineer-In- Charge.	10	sqm	393.165	3931.65
45	Neat cement punning	5	Sqm	39.550	197.75
46	Add for plaster drip course/ groove in plastered surface or moulding to R.C.C. projections.	5	RM	34.150	170.75
47	Finishing RCC/walls with water proofing cement paint of gray color/ approved color by customer at all levels and heights: New work (Two or more coats applied @ 3.84 kg/10 sqm).	40	Sqm	56.210	2248.40
48	Painting with black anti-corrosive bitumastic paint of approved brand and manufacture to give an even shade:Two or more coats on new work	50	Sqm	63.500	3175.00
49	White washing with lime to give an even shade:Three or more coats on new work.	40	Sqm	16.970	678.80
50	Preparation and consolidation of sub grade with power road roller of 8 to 12 tonne capacity after excavating earth to an average of 22.5 cm depth,dressing to camber and consolidating with road roller including making good the undulations etc and re-rolling the sub grade and disposal of surplus earth lead upto 50 metres.	50	sqm	90.100	4505.00
51	Extra for compaction of earthwork in embankment under optimum moisture conditions to give at least 95% of the maximum dry density (Proctor density)	50	cum	10.700	535.00

BILL OF QUANTITY CUM PRICE SCHEDULE

Name of Project: 110kV Switchyard for RMU Kodayar Power House at Kodayar
Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
52	Suppling and stacking at site:90 mm to 45 mm size stone aggregate	10	cum	1278.690	12786.90
53	Suppling and stacking at site:63 mm to 45 mm size stone aggregate	5	cum	1386.530	6932.65
54	Suppling and stacking at site:53 mm to 22.5 mm size stone aggregate	5	cum	1475.020	7375.10
55	Suppling and stacking at site:Stone screening 13.2 mm nominal size (type A)	5	cum	1439.660	7198.30
56	Suppling and stacking at site:Stone screening 11.2 mm nominal size (type B)	5	cum	1398.190	6990.95
57	Suppling and stacking at site:moorum	5	cum	563.010	2815.05
58	Laying, spreading and compacting stone aggregates of specified sizes to WBM specifications in uniform thickness, hand picking, rolling with 3-wheeled road / vibratory roller 8-10 tonne capacity in stages to proper grade and camber, applying and brooming requisite type of screening/ binding materials to fill up interstices of coarse aggregate, watering and compacting to the required density etc., all complete. (Payment will be made for compacted layers only. Stone aggregates, screenings & moorum to be paid separately.).	5	cum	449.100	2245.50
59	Providing and placing in position dowel bar, 16mm dia MS Rod including PVC pipe in Expansion joint as well as in transverse joint for Road work	5	RM	305.615	1528.08
60	Providing and placing in position suitable PVC water stops conforming to IS 12200 or equivalent for construction/expansion joints between two RCC members and fixed to the reinforcement with binding wire before pouring concrete etc. complete. Serrated with central bulb (230mm wide, 5mm thick)	5	RM	263.583	1317.92
61	Providing and placing in position suitable PVC water stops conforming to IS 12200 or equivalent for construction/expansion joints between two RCC members and fixed to the reinforcement with binding wire before pouring concrete etc. complete. Serrated with central bulb (230mm wide, 6mm thick)	5	RM	316.300	1581.50
62	Providing and fixing at or near ground level factory made kerb stone of M-25 grade cement concrete in position to the required line, level and curvature, jointed with cement mortar 1 : 3 (1 Cement : 3 coarse sand) including making joints with or without grooves (thickness of joints except at sharp curve shall not to more than 5mm), including making drainage opening wherever required complete tec. as per direction of Engineer-in-charge (length of finished kerb edging shall be measured for calculation of qty. for payment). (Precast C.C. kerb stone shall be approved by Engineer-in-charge).	5	sqm	925.859	4629.29
63	Providing and laying 60mm thick faciory made cement concrete interlocking paver block of M -30 grade made by block making machine with strong vibratory compaction, of approved size, design & shape, laid in required colour and pattern over and including 50mm thick compacted bed of coarse sand, filling the joints with line sand etc. all complete as per the direction of Engineer-in-charge.	5	Sqm	1056.000	5280.00
64	Supplying & installation of bitumen impregnated fibre board confirming to IS 1838 as joint filler at joints in concrete including nailing, coating of both faces with coal tar pitch/bitumin etc. all complete: 12mm wide joints	1	Sqm	724.000	724.00
65	Providing and laying polythene sheet of 125 microns between the PCC and RCC slab in road/ pavement works all complete as per direction of Engineer-in-Charge)	40	sqm	14.605	584.20
66	Supplying and filling in position hot applied bitumin sealing compund (Grade A) confirming to IS 1834 including cleaning, mixing, heating, pouring/injecting sealing compound in gaps in joints including application of primer etc. all complete for 20mm X 25mm	1	RM	92.333	92.33
67	Fixing of foundation bolts in position with help of proper templates (to be supplied by contractor) including nuts and washers all complete as per drawings & directions of Engr-in-Charge. Note: 1.) Weight of the template shall not be measured for payment purpose. 2.) The Dia and Length of BHEL Supplied Foundation bolt may vary upto 80mm & 2.4 metre respectivelly. 3.) Rates are also includes Unloading, storage, watch and ward etc for BHEL supplied Foundation Bolt.	4500	Kg	30.563	137534.36

BILL OF QUANTITY CUM PRICE SCHEDULE

Name of Project: 110kV Switchyard for RMU Kodayar Power House at Kodayar
Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
68	Providing and fixing **gate** made of medium duty MS pipe including all allied activities, all complete as per customer's specification, drawing and direction Engineer in charge. (Rate shall be inclusive of all labour, material items like medium duty pipe, fabrication, welding,primer, painting, Al-drops,GI pipe,fitting and fixture etc.)	750	KG	111.761	83820.74
69	Providing and laying Non Pressure NP-3 R.C.C. hume pipe including collars/spigot jointed with stiff mixure of cement mortar of mix 1:2 (1 cement : 2 fine sand) including testing of joints etc all complete as per drawing and specification excluding the cost of concrete, shuttering, reinforcement, brickwork, plaster on brickwork and painting.100mm dia	5	RM	532.533	2662.67
70	Providing and laying Non Pressure NP-3 R.C.C. hume pipe including collars/spigot jointed with stiff mixure of cement mortar of mix 1:2 (1 cement : 2 fine sand) including testing of joints etc all complete as per drawing and specification excluding the cost of concrete, shuttering, reinforcement, brickwork, plaster on brickwork and painting.250mm dia	5	RM	746.857	3734.29
71	Providing and laying Non Pressure NP-3 R.C.C. hume pipe including collars/spigot jointed with stiff mixure of cement mortar of mix 1:2 (1 cement : 2 fine sand) including testing of joints etc all complete as per drawing and specification excluding the cost of concrete, shuttering, reinforcement, brickwork, plaster on brickwork and painting.300mm dia	5	RM	968.254	4841.27
72	Providing and laying Non Pressure NP-3 R.C.C. hume pipe including collars/spigot jointed with stiff mixure of cement mortar of mix 1:2 (1 cement : 2 fine sand) including testing of joints etc all complete as per drawing and specification excluding the cost of concrete, shuttering, reinforcement, brickwork, plaster on brickwork and painting.450mm dia	5	RM	1660.110	8300.55
73	Providing and fixing weep holes in Retaining wall, drains, etc consisting of 100 mm dia HDPE pipe sleeves with single side covering for the pipe mouth with galvanised welded wire fabric of 20 mm sq. opening all complete.	5	each	246.800	1234.00
74	Providing and applying polysulphide based sealant conforming to IS:12118 in joints in concrete including cleaning of joints, raking out groove, application of primer, scaffolding etc. all complete for following size grooves: 50mmX25mm	1	RM	1471.333	1471.33
75	Providing and laying dry stone pitching of 230mm thickness for slope protection in cement mortar 1:6 including hammer, dressing, raking of joints, pointing, preparing the bedding suface and voids filling with stone aggregate etc all complete.	10	Cum	3199.500	31995.00
76	Dismantling complete concrete work for all types of structures at all levels including stacking of servicable material to a lead of 500 m and disposal of unservicable material, cutting of reinforcement, labour, equipment, safety precautions etc all complete as per drawings, specification and instructions of engineer in charge. Plain cement concrete of all grades	45	Cum	1454.900	65470.50
77	Dismantling complete concrete work for all types of structures at all levels including stacking of servicable material to a lead of 500 m and disposal of unservicable material, cutting of reinforcement, labour, equipment, safety precautions etc all complete as per drawings, specification and instructions of engineer in charge.Reinforced cement concrete of all grades	110	Cum	2221.613	244377.38
78	Dismantling and stacking within 50 metres lead, fencing angle posts or struts including all earth work and dismantling of concrete etc.in the base of fence	35	each	104.650	3662.75
79	Dismantling barbed wire or flexible wire rope in fencing including making rolls and stacking within 50 metres lead.	15	Kg	15.050	225.75
80	Dismantling of chain link fencing including dismantling of Fence post, G.I chain link fencing made of G.I wire etc all including including stacking and depositing the same to customer store as per direction of Engineer-In-Charge. (Dismantling of concrete shall be paid separetly.)	80	RM	247.060	19764.80

BILL OF QUANTITY CUM PRICE SCHEDULE

Name of Project: 110kV Switchyard for RMU Kodayar Power House at Kodayar
Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
81	Dismantling steel work in built up sections in angles, tees, flats and channels including all gusset plates, bolts, nuts, cutting rivets, welding etc. including dismembering and stacking within 50 metres lead.	100	Kg	2.400	240.00
82	Dismantling steel work manually/ by mechanical means in built up sections without dismembering and stacking within 50 metres lead as per direction of Engineer-in-charge.	100	Kg	1.600	160.00
83	Dismantling steel work in single sections including dismembering and stacking within 50 metres lead in:R.S. Joists	1000	Kg	1.400	1400.00
84	Dismantling steel work in single sections including dismembering and stacking within 50 metres lead in:Channels, angles, tees and flats	1000	Kg	0.950	950.00
85	Supplying and erecting in position 2.4 m high gavanised chain linked fencing conforming to IS 2761 of 10G hot dip galvanised steel wires woven in the form of zig-zag mesh giving an opening size of 50 mm square. GI barbed wire fencing of height of 600 mm confirming to IS 298 at top of chain link fencing shall be provided with 4 strands of barbed wire hot dip galvanised wire of 12G comprising of 2 ply of wires with barbs of 16G spaced at 100mm. Cost to include for GI hook bolts, rings & washers, hot dip galvanised tension wires, 25X6 mm GI flat stretcher bar at end posts, accessories etc. all complete. (Structural post shall be paid separately)	35	RM	2519.905	88196.67
86	Supply and fixing of GI barbed wire weighing 9.38 kg per 100 m (minimum), between the two fence posts fitted and fixed with G.I. staples, turn buckles etc. complete. Payment to be made per metre cost of total length of barbed wire used.	280	RM	11.450	3206.00
87	Demolishing cement mortar brick work/ Stone Masonary work manually/ by mechanical means including stacking of serviceable material and disposal of unserviceable material within 50 metres lead as per direction of Engineer-in-charge.	10	Cum	1976.667	19766.67
88	Supplying & fixing at site GI Angle iron post & strut of required size including bottom to be split and bent at right angle in opposite direction for min. 10 cm length and drilling holes upto 10 mm dia. etc. complete. Rate of Zinc coating shall not be less than 710g/m2 on steel posts.	1000	Kg	122.492	122492.38
89	Antiweed treatment in switchyard area including surface dressing of earth to an extent of ±200mm, rolling/compacted to the lines & grades using half ton roller/surface vibrator with suitable water sprinkling arrangement & micro levelling etc all complete as per Technical Specification.	800	Sqm	17.260	13808.00
90	Supplying and spreading approved quality stone aggregate of 40mm in size in switchyard as per drawing and specification all complete over PCC excluding the cost of PCC. This item also include Antiweed treatment in switchyard area including surface dressing of earth to an extent of ±200mm, rolling/compacted to the lines & grades using half ton roller/surface vibrator with suitable water sprinkling arrangement & micro levelling as per Technical Specification before gravelling.	5	cum	3840.286	19201.43
91	Laying of 40 mm dia MS Rod at a minimum depth of 600 mm measured from the top of **Finished Ground Level** and bringing out risers just below gravel level near the equipment foundations as per requirement including following works: - excavation - laying of MS rod - welding of rods - backfilling of soil and compaction for bringing out pig tail risers of 40 dia MS rod for equipments. Risers shall be raised from the earthmat (at 600 mm depth) to approx 150 mm below finished ground level to the nearest point of the equipment. This shall include all cutting, bending, welding, fixing, application of paints on cutting & welding surface, etc to the main earthmesh. - any other work necessary to complete the laying of earthmat (40 mm dia MS rod will be supplied by BHEL).	12	MT	18510.268	222123.22

BILL OF QUANTITY CUM PRICE SCHEDULE

Name of Project: 110kV Switchyard for RMU Kodayar Power House at Kodayar
Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
92	Fabrication & laying of Auxiliary Mat (of Size 900x900mm with spacing of 300mm) of 40 mm Dia MS Rods at a depth of 300 mm from top of FGL including excavation & backfilling as per Drg No. C/ENG/STD/EARTHINGS/09 SHEET # 4 - any other work necessary to complete the laying of earthmat. - welding of rods (refer Drg No. C/ENG/STD/EARTHINGS/09 SHEET # 1, Sheet # 2 , SHEET # 3 for Welding details of rods. (40 Diameter MS rod will be supplied by BHEL)	10	Nos.	2379.819	23798.19
93	Installation of Pipe Electrode(to be driven - 3.0 Mtr) as per Drg. No. C/ENG/STD/EARTHINGS/09 SHEET # 5 including following works: - excavation - installing the pipe electrode. - pipe electrodes in treated earth pit (as per IS) such as alternate layers of coke/ charcoal and salt or bentonite clay. - Backfilling and compaction - Cement Concrete pit with a ISI marked cast iron cover hinged to a cast iron frame to have an access to the joints. - any other work necessary to complete the work Remark :- Pipe Electrode assembly i.e. GI Pipe and funnel with wire mesh will be supplied by BHEL.	3	nos.	4900.9052	14702.72
94	Installing of 40 mm diameter Rod Electrode with test pit as per Drg. No. Drg. No. C/ENG/STD/EARTHINGS/09 SHEET # 6 including following works: - excavation - installing the rod electrode - backfilling and compaction - Cement Concrete pit with a ISI marked cast iron cover hinged to a cast iron frame to have an access to the joints. - any other work necessary to complete the work (40 mm dia MS rod will be supplied by BHEL).	22	Nos.	4613.1808	101489.98
95	Installing of 40 mm diameter Rod Electrode without test pit including following works: - excavation/hammering of rod in earth - installing the rode electrode - backfilling and compaction - any other work necessary to complete the work (40 mm dia MS rod will be supplied by BHEL).	3	Nos.	1153.2952	3459.89
96	Installation of 3/4 inch (20mm approx.) UPVC pipe(ISI Mark) for watering of above electrodes including following. -supply of UPVC pipe/taps/joints/bends/fittings etc.(ISI Mark) -excavation -laying/jointing/termination of pipe along with associated fittings -backfilling and compaction -fixing of pipe as per site requirement. -any other work necessary to complete the work.	200	mtr	77.761163	15552.23
				TOTAL AMOUNT	**9905781.24**

Validate Print Help

Percentage BoQ

Tender Inviting Authority: BHEL, TBG- Sub-Contracting Department, Sector 16A Noida, UP

Name of Work: CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU

Contract No: TBSM/KODAYAR/CIVIL/TENDER/25-26, DATE: 18.04.2025

Name of the Bidder/ Bidding Firm / Company :	

PRICE SCHEDULE

(This BOQ template must not be modified/replaced by the bidder and the same should be uploaded after filling the relevent columns, else the bidder is liable to be rejected for this tender. Bidders are allowed to enter the Bidder Name and Values only)

NUMBER #	TEXT #	NUMBER #	TEXT #	NUMBER	NUMBER #	TEXT #
Sl. No.	**Item Description**	**Quantity**	**Units**	**Estimated Rate in Rs. P**	**TOTAL AMOUNT Without Taxes in Rs. P**	**TOTAL AMOUNT In Words**
1	**2**	**4**	**5**	**6**	**53**	**55**
1	Total amount as per rates in BOQ (as per Annexure-I) for "CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU". - Excluding GST	1.000	Nos	9905781.00	**9905781.00**	INR Ninety Nine Lakh Five Thousand Seven Hundred & Eighty One Only
Total in Figures					**9905781.00**	INR Ninety Nine Lakh Five Thousand Seven Hundred & Eighty One Only
Quoted Rate in Figures			**Select**		**0.000**	INR Zero Only
Quoted Rate in Words					**INR Zero Only**	

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-417-607-003-KOD-PKG-I	Rev. No.	0	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION		SIGN			
TITLE	SPECIFICATION OF CIVIL WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT KODAYAR IN TAMIL NADU		NAME	VG	PNK	PLK
			DATE	27.03.2025	27.03.2025	27.03.2025
			GROUP	TBEM	W.O. No	86006

CUSTOMER	TAMIL NADU GENERATION AND DISTRIBUTION CO. LTD. (TANGEDCO)
PROJECT	110KV SWITCHYARD RMU OF KODAYAR POWER HOUSE-I AT KODAYAR, TAMIL NADU

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Rev No.	Date	Altered	Checked	Approved		REVISION DETAILS

Distribution	To	O/C	TBES			
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SECTION -1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

1.1.0 SCOPE

1.1.1 The scope of work under this specification is civil works for construction of 110KV Switchyard for RMU of Kodayar Power House-I being executed by BHEL on turnkey basis. The Customer is M/s TANGEDCO.

1.1.2 The Civil Works shall generally include, *but not limited to*, following:

(i.) Dismantling of Existing Yard Foundations /fence/Miscl other structures if required.
(ii.) Tower & Equipment Foundation Works
(iii.) Cable Trench Works & precast cover works, etc.
(iv.) Chain Link Fencing & Gate
(v.) Drainage Works
(vi.) Anti-weed treatment, Micro-Levelling, Yard PCC & Gravelling
(vii.) Culvert / Pipe Crossing Works for Cable Trenches/ Drains / Road
(viii.) Any other work required for the project.

1.1.3 The works to be performed in the above construction including **taking over of land from BHEL/Customer by Providing & locating boundary wall coordinates, level of earth using total station and verification of input data provided by BHEL/customer at site**, Dismantling of Existing Switchyard foundations/fence/Misc other structure/infrastructure etc if required for construction of new 110kV Switchyard, preparation of bar bending schedules, based on the drawings released for construction and getting the same approved by the Engineer-in-charge plus the execution of the work including providing of all labour, supervision, materials, scaffolding, power, fuel, construction equipment like hydraulic excavator, dozer, tipper, Power roller, Vibratory roller etc, tools and plants, supplies, transportation, all incidental items necessary for successful completion of the work including contractor's supervision and in strict accordance with the drawings and specifications and with inspection and testing standards. The nature of work shall include excavation & filling in all types of soil in open areas/nallas/ channels, to the required slopes, shapes, levels, elevations and profile, including trimming of bottom and slopes of excavation, loading/unloading, transporting excavated material, stacking serviceable material, disposal of unserviceable material in disposal areas, filling in low lying areas, bailing out rain (dewatering), pumping, removal of slush, preparing embankments/marginal banks, loosening, dressing, spreading material in layers, preparation & verification of contouring data/level of entire area/plot, excavation in all type of soil including dewatering, shoring, strutting, and filling under and around structures, backfilling with available excavated earth around completed structures, transportation & leveling and compaction of surplus earth in low lying area including clearing the land for development from plants & bush vegetation, removal of roots of trees & plants, Cable trench with pre-cast covers, disposal of surplus soil, steel or plywood with fin face formwork, providing necessary steel embedment and other inserts, drainage work, concreting, brickwork, flooring and finishing etc. all complete including all construction material (Cement, TMT, Structural Steel & other construction material etc)as per detailed specification, drawings and directions of Engineer-in-charge. All work shall be carried out based on Customer approved Field Quality Plan which will be provided during execution of work.

1.2.0 SPECIFIC TECHNICAL REQUIREMENT

All technical requirements shall be as per General Technical Specification (Refer SECTION D)/Customer Technical Specification (Refer SECTION C)/CPWD specification/IS Codes. **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.)**

1.3.0 BILL OF QUANTITIES

1.3.1 The Bill of Quantity shall be as per page 4 to page 10.

1.3.2 The quantities indicated in the 'Bill of Quantity' are indicative and can vary to any extent. Contractor shall not be entitled for any claim for any such variation in the quantities.

1.3.3 The provision of Bill of Quantity, specifications and drawings shall be read in conjunction with each other and in case of conflict amongst them, the clarification shall be obtained from the Engineer-in-charge whose decision shall be final and binding.

1.3.4 Site Visit:

Bidder is advised to visit the site for assessment of Site Conditions, availability of labour, Construction material, labour hut, Construction water etc before quoting.

1.3.5 Method of measurement:
Earthwork:

a. Excavation for foundation work shall be measured in cubic meters. The lateral dimensions to be considered for working out excavation quantity shall be the PCC dimension below the footing as per approved drawing. Backfilling & disposal quantities of foundation work shall be worked out based on the above dimensions only. Soil strata may be sandy soil with collapsible earth. However, the contractor shall maintain the required slope and working space as per the safety / statutory requirement and its cost is deemed to be included in the quoted rate. This clause shall be applicable for all types of soil and rock. Nothing extra shall be paid for slope cutting, etc.
b. Where rock and soil is mixed, the measurement of the excavation shall be made as per PCC dimensions. The rock shall be stacked and measured in stack. The net quantity of the rock shall be arrived at by applying deduction of 50% to allow for voids in stacks.
c. Where soil, soft rock, medium rock & hard rock are mixed, the measurement of the excavation shall be made as per PCC dimensions. Excavated materials comprising of the soft rock, medium rock and hard rock shall be stacked separately, measured in stacks, and each reduced by 50% to allow for voids to arrive at the quantity payable under soft rock, medium rock and hard rock. In no case, the sum of net quantities shall exceed the total quantity of the excavated materials.

d. Clause No. 2.1.0 of CPWD Specification Volume-I shall be followed for classification of soils.

Measurement of Reinforcement Steel:

a. **Supply portion**: Payment will be made to contractor for the actual quantity consumed in works and (Excluding wastages) entered in Measurement book. This shall be duly certified by Engineer-In-Charge. The contractor will have to submit the invoice, Manufacturer Test Certificate for the dia and quantity claimed for the payment. The contractor will have to submit the 3rd party test lab results also if applicable as per customer approved Field quality plan/ technical specification. The unit rate of supply shall be inclusive of the cost of wastage, supply at site, testing charges etc. No payment on account of wastage (cut piece, difference in weight against theoretical/ actual etc)/theft will be admissible. After reconciliation certified by EIC wastage steel pertaining to Contractor portion can be taken out by contractor subjected to meeting all contractual requirement of project.

b. Erection portion: Reinforcement shall be measured in meter including the length of hooks, overlap, chair, spacer bars, stays, hangers, couplings if any, separately for different diameters as actually used in work. From the length so measured, the weight of reinforcement shall be calculated in Kg on the basis of sectional unit weights as adopted by Indian Standards. Wastage, welded joints and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement. Cost of unloading, storage, watch & ward etc too are deemed to be include in the unit rates.

For other items, unless otherwise described in method of measurement as described in 'Method of Measurement of Building and Civil Engineering Works'-IS 1200 (Part I to XXV) latest edition of BIS shall be followed. In case the same is not available, the standard procedure adopted in CPWD shall be adopted. In all the above cases, the interpretation of BHEL will be final and binding to the contractor.

Name of Project: 110kV Switchyard for RMU Kodayar Power House at Kodayar
Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
1	Earth work in excavation in all types of soil including ash which can be excavated by any means including setting out, levelling, dewatering (but excluding special type of dewatering viz. well point method), shoring & strutting (wherever required), dressing the sides & bottom, all lifts, ramming/compacting the excavated bottom, stacking, disposal of surplus excavated materials within a lead upto 1Km, spreading/levelling of disposed materials etc all complete for following depths below ground level. Depth from ground level but not exceeding 2.5 m	270	cum	160.292	43278.71
2	Earth work in excavation in soft rock (rock without any recovery of exacavated materials in the form of hard stone/boulder) including weathered rock which can be excavated by means of crow bar, pick axe, pneumatic rock breaker attachment with excavator machine etc but does not require chiselling or blasting including setting out, levelling, dewatering (wherever required), shoring & strutting (wherever required), dressing the sides & bottom, all lifts, ramming/compacting the excavated bottom, stacking, disposal of surplus excavated materials within a lead upto 1 Km, spreading / levelling of disposed materials etc all complete for following depths below ground level. Depth from ground level but not exceeding 2.5 m	800	cum	396.110	316887.76
3	Earth work in excavation upto any depth below ground level in hard rock requiring chiselling including wedging, line drilling, pre shearing etc as required for grading, setting out, levelling, dewatering (wherever required), dressing the sides & bottom, all lifts, stacking/disposal of surplus excavated material within a lead upto 1 Km, spreading / levelling of disposed materials etc all complete as per specification, drawing and as directed by the engineer-in-charge. Depth from ground level but not exceeding 2.5 m	135	cum	1038.827	140241.60
4	Earthwork in Back filling upto any depth below ground level around foundations, plinths, trenches, drains etc to proper grade and level in layers not exceeding 200 mm thickness using/with selected materials from compulsorily excavated earth available within a lead upto 1 Km and compacted as specified including re-excavation of stacked earth, watering, ramming/compaction by manual/mechanical means, dressing etc all complete.for the following. Each layer compacted so as to achieve at least 95% maximum dry density as per IS- 2720 (Part-VII)	135	cum	138.573	18707.29
5	Extra over ST No. 1,2,3 & 4 for carriage of material/earth for every 500m or part thereof beyond an initial lead of 1km. Carriage for disposal of serviceable/unserviceable material/ earth	500	cum	12.499	6249.25
6	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20cm in depth including consolidating each deposited layer by ramming,watering etc.and disposing of surplus excavated soil as directed within a lead of 100m. All kinds of soil for Pipes, cables etc, not exceeding 80mm dia	5	RM	138.050	690.25
7	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20cm in depth including consolidating each deposited layer by ramming,watering etc.and disposing of surplus excavated soil as directed within a lead of 100m. All kinds of soil for Pipes, cables etc. exceeding 80mm dia. but not exceeding 300 mm dia.	5	RM	225.450	1127.25
8	Supplying, filling and compacting in plinth & foundation with Jamuna/local sand as per drawing under floors, foundation, drain, cable trench etc including watering, ramming, consolidating and dressing etc all complete as per Technical Specification.	5	cum	810.820	4054.10
9	Supplying, filling, watering and compacting to Minimum 90% Proctor Density **63mm downgraded hard stone aggregate** including filling of interstics with sand for under floors, foundations, roads, cable trenches, drains, etc. including royalty, carriage etc. all complete, for all leads and lift with all labour, material, tools, tackles, equipments, safeguards & incidentals as necessary as per specification and direction - of - Engineer -in- charge.	5	cum	2955.492	14777.46

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Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
10	Supplying chemical emulsion in sealed containers including delivery as specified.Chloropyriphos emulsifiable concentrate of 20%	5	litre	157.450	787.25
11	Diluting and injecting chemical emulsion for POST-CONSTRUCTIONAL anti-termite treatment (excluding the cost of chemical emulsion) : Along external wall where the apron is not provided using chemical emulsion @ 7.5 litres / sqm of the vertical surface of the substructure to a depth of 300 mm including excavation channel along the wall &rodding etc. complete: With Chlorpyriphos/ Lindane E.C. 20% with 1% concentration.	5	RM	16.800	84.00
12	Diluting and injecting chemical emulsion for POST-CONSTRUCTIONAL anti-termite treatment (excluding the cost of chemical emulsion) : Along the external wall below concrete or masonry apron using chemical emulsion @ 2.25 litres per linear metre including drilling and plugging holes etc. With Chlorpyriphos/ Lindane E.C. 20% with 1% concentration.	5	RM	24.300	121.50
13	Diluting & injecting chemical emulsion for PRE-CONSTRUCTIONAL ANTI-TERMITE treatment and creating a continuous chemical barrier under and all around the column pits, wall trenches, basement excavation, top surface of plinth filling, junction of wall & floor, along the external perimeter of building, expansion joints, over the top surface of consolidated earth on which apron is to be laid, surroundings of pipes and conduits, etc complete as per specifications (Plinth area of the building at ground floor only shall be measured for payment)	5	Sqm	131.900	659.50
14	Applying a coat of residual petroleum bitumen of grade of VG-10 or 85/25 grade of approved quality using 1.7kg per square metre on damp proof course after cleaning the surface with brushes and finally with apiece of cloth lightly soaked in kerosene oil.	5	Sqm	88.050	440.25
15	Extra for providing and mixing super plasticizer cum water proofing cement additive conforming to IS: 9103 along with meeting limt on permeability as given in Is 2645 in Cement Concrete work in doses by weight of cement as per manufacturer's specification.	5	1 kg per 50 kg of cement	41.730	208.65
16	Providing and laying in position cement concrete of specified grade including Yard PCC but excluding the cost of centering and shuttering: 1:4:8 (1 Cement : 4 coarse sand : 8 graded stone aggregate 40 mm nominal size).	55	cum	7155.869	393572.80
17	Providing and laying in position cement concrete of specified grade including Yard PCC but excluding the cost of centering and shuttering: 1:3:6 (1 Cement : 3 coarse sand : 6 graded stone aggregate 40 mm nominal size).	60	cum	7509.366	450561.95
18	Providing and laying in position cement concrete of specified grade including Yard PCC but excluding the cost of centering and shuttering: 1:3:6 (1 Cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).	5	cum	7616.436	38082.18
19	Providing and laying in position cement concrete of specified grade including Yard PCC but excluding the cost of centering and shuttering: 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size)	15	cum	8037.716	120565.74
20	Providing & fixing in position M30 precast cement concrete covers or perforated covers wherever necessary at various elevations in all kinds of work including moulding, formwork, mixing, laying out, compacting and curing, storing, transportation, erection without damage, setting in position with cement and sand mortar, grouting etc all as per specs, drawings and directions of Engr-in-Charge but excluding the cost of reinforcement, inserts, edge angles, etc.	5	cum	12598.217	62991.09
21	Grouting of block outs, pockets, foundations, bolts holes and underside of base plates using non-shrink cum plasticizer grouting compound. The Minimum strength shall be M35 including placing, curing, cleaning, surface preparation, testing, etc. complete with labour, materials, equipment, handling, testing, etc. all complete as per specifications, drawings and instructions of the Engineer.	5	cum	33837.142	169185.71

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Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
22	Providing and laying in position machine batched and machine mixed design mix M-30 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. All works up to plinth level	295	cum	9058.121	2672145.72
23	Providing and laying in position machine batched and machine mixed design mix M-30 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. All works above plinth level to floor V level	15	cum	9110.526	136657.89
24	Extra for providing richer mixes at all floor levels.Providing M-35 grade concrete instead of M-25 grade BMC/RMC.	5	cum	236.974	1184.87
25	Providing and mixing approved Bipolar Concrete penetrating corrosion inhibiting admixture phenolic base (customer approved) in concrete as per detail specification of manufacturer etc all complete. Payment shall be made per cum of concrete	310	cum	1080.193	334859.92
26	FORMWORK: Providing, fixing and removing formwork at all elevations for all structures, as per specifications and including all labour, material, scaffoldings and centereing etc. complete as per drawing, specifications and as per direction of engineer in charge for the following: Fairface form work with good quality water proof ply wood of minimum 12mm thickness and smooth surface **below finished ground floor** level for foundations/Substructures, footings, base of columns, walls, columns, pilasters, beams, mass concrete, trenches etc.including chamfering of edges as per drawing, specification and instruction of engineer in charge.	1085	Sqm	744.590	807880.15
27	FORMWORK: Providing, fixing and removing formwork at all elevations for all structures, as per specifications and including all labour, material, scaffoldings and centereing etc. complete as per drawing, specifications and as per direction of engineer in charge for the following: Fairface form work with good quality water proof ply wood of minimum 12mm thickness and smooth surface **above finished ground floor** level for columns, beams, suspended floors, roofs, lintels, cantilevers, staircases, landings, balconies, etc. including chamfering of edges as per drawing.for all heights as per specification, drawing and instruction of engineer in charge.	335	Sqm	920.772	308458.65
28	Steel reinforcement of grade Fe-500/500D TMT bars as per Technical specification Supply Portion: Reinforcement Steel shall be of SAIL/TATA/RINL or Customer approved make & source including transportion to site. (Refer mode of measurement for supply, storage and payment purpose)	23000	Kg	72.838	1675279.75
29	Steel reinforcement of grade Fe-500/500D TMT bars as per Technical specification.Erection Portion: This item includes straightening, cutting, bending, binding, (i/c cost of binding wire), welding, placing in position, chairs & laps etc. all labour & material complete at all level and heights. (Note: Rates are also includes unloading, storage, watch and ward etc for BHEL/Contractor supplied Reinforcement). (Refer mode of measurement for payment purpose)	23000	Kg	11.000	253000.00
30	Structural steel work welded in built up sections like edge protection angles, pipes, insert plates welded with lugs & framed work, chequered plate including providing, cutting, hoisting, fixing in position/ embedding in concrete and applying a priming coat of approved steel primer all complete.	1000	Kg	111.761	111760.98

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S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
31	Steelwork welded in built up sections/framed work including providing, cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc., as required. In gratings, rails ,mono rails (including mono rails for crane support and lifting arrangment in the building at all height), frames, ladders, stair railings, gates (including pipes), rails, ISMB, ISMC and similar works	1000	Kg	117.852	117851.61
32	Supply & fixing hot dip Galvanising after surface preparation as per ISO 8501-1 for steel work of gratting, rung ladder, Handrail, edge protection angles, pipes, insert plates and applying a priming coat of approved primer all complete. (Mass of Zinc Coating= 810 gm/ sqm)	500	Kg	122.492	61246.00
33	Brick work with common burnt clay F.P.S. bricks as per Technical Specification of class designation 7.5 in foundation and plinth, toe wall including weep holes: Cement mortar 1:6 (1 cement : 6 coarse sand)	15	cum	12413.200	186198.00
34	Brick work with common burnt clay F.P.S.bricks as per Technical Specification of class designation 7.5 in superstructure above plinth level up to floor V level, toe wall in all shapes and sizes including weep holes : Cement mortar 1:6 (1 cement : 6 coarse sand)	5	cum	14324.823	71624.12
35	Half brick masonry with common burnt clay F.P.S. bricks as per Technical specification of class designation 7.5 in foundations and plinth in.cement mortar 1:4 (1 cement : 4 coarse sand)	5	Sqm	1765.114	8825.57
36	Half brick masonry with fly ash lime bricks conforming to IS:12894 as per Technical specification of class designation 7.5 in superstructure above plinth level up to floor V level. Cement mortar 1:4 (1 cement :4 coarse sand)	5	Sqm	1334.200	6671.00
37	Extra for providing and placing in position 2 Nos. 6mm dia. M.S. bars at every third course of half brick masonry.	5	Sqm	48.210	241.05
38	6mm cement plaster to ceiling of mix1:3 (1 cement : 3 fine sand)	10	Sqm	240.575	2405.75
39	12mm cement plaster on the wall/ concrete surface in the mix:1:6 (1 cement: 6 fine sand)	40	Sqm	253.500	10140.00
40	12mm cement plaster finished with a floating coat of neat cement in the mix:1:4 (1cement :4 fine sand)	5	Sqm	264.734	1323.67
41	15 mm cement plaster on the rough side of single or half brick wall of mix : 1:6 (1 cement: 6 fine sand)	5	Sqm	327.638	1638.19
42	18mm cement plaster at all level & height in two coats with under layer 12mm thick cement plaster 1:5 (1 cement :5 coarse sand) finished with a top layer of 6mm thick 1:3 cement plaster(1cement : 3 coarse sand)	40	Sqm	393.165	15726.60
43	Extra for providing and mixing water proofing material in cement plaster work in proportion recommended by the manufacturer	5	Per bag of 50 KG cement used in mix	44.120	220.60
44	Repair to plaster of thickness 12mm to 20 mm in patches of area 2.5 sqm and under, including cutting the patch in proper shape, raking out joints and preparing plastering the wall/concrete surface with white cement based polymer modified self curing mortar, including disposal of rubbish, all complete as per the direction of Engineer-In- Charge	10	sqm	393.165	3931.65
45	Neat cement punning	5	Sqm	39.550	197.75
46	Add for plaster drip course/ groove in plastered surface or moulding to R.C.C. projections.	5	RM	34.150	170.75
47	Finishing RCC/walls with water proofing cement paint of gray color/ approved color by customer at all levels and heights: New work (Two or more coats applied @ 3.84 kg/10 sqm).	40	Sqm	56.210	2248.40
48	Painting with black anti-corrosive bitumastic paint of approved brand and manufacture to give an even shade:Two or more coats on new work	50	Sqm	63.500	3175.00
49	White washing with lime to give an even shade:Three or more coats on new work.	40	Sqm	16.970	678.80
50	Preparation and consolidation of sub grade with power road roller of 8 to 12 tonne capacity after excavating earth to an average of 22.5 cm depth,dressing to camber and consolidating with road roller including making good the undulations etc and re-rolling the sub grade and disposal of surplus earth lead upto 50 metres	50	sqm	90.100	4505.00

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S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
51	Extra for compaction of earthwork in embankment under optimum moisture conditions to give at least 95% of the maximum dry density (Proctor density)	50	cum	10.700	535.00
52	Suppling and stacking at site:90 mm to 45 mm size stone aggregate	10	cum	1278.690	12786.90
53	Suppling and stacking at site:63 mm to 45 mm size stone aggregate	5	cum	1386.530	6932.65
54	Suppling and stacking at site:53 mm to 22.5 mm size stone aggregate	5	cum	1475.020	7375.10
55	Suppling and stacking at site:Stone screening 13.2 mm nominal size (type A)	5	cum	1439.660	7198.30
56	Suppling and stacking at site:Stone screening 11.2 mm nominal size (type B)	5	cum	1398.190	6990.95
57	Suppling and stacking at site:moorum	5	cum	563.010	2815.05
58	Laying, spreading and compacting stone aggregates of specified sizes to WBM specifications in uniform thickness, hand picking, rolling with 3-wheeled road / vibratory roller 8-10 tonne capacity in stages to proper grade and camber, applying and brooming requisite type of screening/ binding materials to fill up interstices of coarse aggregate, watering and compacting to the required density etc., all complete. (Payment will be made for compacted layers only. Stone aggregates, screenings & moorum to be paid separately.).	5	cum	449.100	2245.50
59	Providing and placing in position dowel bar, 16mm dia MS Rod including PVC pipe in Expansion joint as well as in transverse joint for Road work	5	RM	305.615	1528.08
60	Providing and placing in position suitable PVC water stops conforming to IS 12200 or equivalent for construction/expansion joints between two RCC members and fixed to the reinforcement with binding wire before pouring concrete etc. complete. Serrated with central bulb (230mm wide, 5mm thick)	5	RM	263.583	1317.92
61	Providing and placing in position suitable PVC water stops conforming to IS 12200 or equivalent for construction/expansion joints between two RCC members and fixed to the reinforcement with binding wire before pouring concrete etc. complete. Serrated with central bulb (230mm wide, 6mm thick)	5	RM	316.300	1581.50
62	Providing and fixing at or near ground level factory made kerb stone of M-25 grade cement concrete in position to the required line, level and curvature, jointed with cement mortar 1 : 3 (1 Cement : 3 coarse sand) including making joints with or without grooves (thickness of joints except at sharp curve shall not to more than 5mm), including making drainage opening wherever required complete tec. as per direction of Engineer-in-charge (length of finished kerb edging shall be measured for calculation of qty. for payment). (Precast C.C. kerb stone shall be approved by Engineer-in-charge).	5	sqm	925.859	4629.29
63	Providing and laying 60mm thick faciory made cement concrete interlocking paver block of M -30 grade made by block making machine with strong vibratory compaction, of approved size, design & shape, laid in required colour and pattern over and including 50mm thick compacted bed of coarse sand, filling the joints with line sand etc. all complete as per the direction of Engineer-in-charge	5	Sqm	1056.000	5280.00
64	Supplying & installation of bitumen impregnated fibre board confirming to IS 1838 as joint filler at joints in concrete including nailing, coating of both faces with coal tar pitch/bitumin etc. all complete: 12mm wide joints	1	Sqm	724.000	724.00
65	Providing and laying polythene sheet of 125 microns between the PCC and RCC slab in road/ pavement works all complete as per direction of Engineer-in-Charge)	40	sqm	14.605	584.20
66	Supplying and filling in position hot applied bitumin sealing compund (Grade A) confirming to IS 1834 including cleaning, mixing, heating, pouring/injecting sealing compound in gaps in joints including application of primer etc. all complete for 20mm X 25mm	1	RM	92.333	92.33

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S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
67	Fixing of foundation bolts in position with help of proper templates (to be supplied by contractor) including nuts and washers all complete as per drawings & directions of Engr-in-Charge. Note: 1.) Weight of the template shall not be measured for payment purpose. 2.) The Dia and Length of BHEL Supplied Foundation bolt may vary upto 80mm & 2.4 metre respectivelly. 3.) Rates are also includes Unloading, storage, watch and ward etc for BHEL supplied Foundation Bolt.	4500	Kg	30.563	137534.36
68	Providing and fixing **gate** made of medium duty MS pipe including all allied activities, all complete as per customer's specification, drawing and direction Engineer in charge. (Rate shall be inclusive of all labour, material items like medium duty pipe, fabrication, welding,primer, painting, Al-drops,GI pipe,fitting and fixture etc.)	750	KG	111.761	83820.74
69	Providing and laying Non Pressure NP-3 R.C.C. hume pipe including collars/spigot jointed with stiff mixure of cement mortar of mix 1:2 (1 cement : 2 fine sand) including testing of joints etc all complete as per drawing and specification excluding the cost of concrete, shuttering, reinforcement, brickwork, plaster on brickwork and painting.100mm dia	5	RM	532.533	2662.67
70	Providing and laying Non Pressure NP-3 R.C.C. hume pipe including collars/spigot jointed with stiff mixure of cement mortar of mix 1:2 (1 cement : 2 fine sand) including testing of joints etc all complete as per drawing and specification excluding the cost of concrete, shuttering, reinforcement, brickwork, plaster on brickwork and painting.250mm dia	5	RM	746.857	3734.29
71	Providing and laying Non Pressure NP-3 R.C.C. hume pipe including collars/spigot jointed with stiff mixure of cement mortar of mix 1:2 (1 cement : 2 fine sand) including testing of joints etc all complete as per drawing and specification excluding the cost of concrete, shuttering, reinforcement, brickwork, plaster on brickwork and painting.300mm dia	5	RM	968.254	4841.27
72	Providing and laying Non Pressure NP-3 R.C.C. hume pipe including collars/spigot jointed with stiff mixure of cement mortar of mix 1:2 (1 cement : 2 fine sand) including testing of joints etc all complete as per drawing and specification excluding the cost of concrete, shuttering, reinforcement, brickwork, plaster on brickwork and painting.450mm dia	5	RM	1660.110	8300.55
73	Providing and fixing weep holes in Retaining wall, drains, etc consisting of 100 mm dia HDPE pipe sleeves with single side covering for the pipe mouth with galvanised welded wire fabric of 20 mm sq. opening all complete.	5	each	246.800	1234.00
74	Providing and applying polysulphide based sealant conforming to IS:12118 in joints in concrete including cleaning of joints, raking out groove, application of primer, scaffolding etc. all complete for following size grooves: 50mmX25mm	1	RM	1471.333	1471.33
75	Providing and laying dry stone pitching of 230mm thickness for slope protection in cement mortar 1:6 including hammer, dressing, raking of joints, pointing, preparing the bedding suface and voids filling with stone aggregate etc all complete.	10	Cum	3199.500	31995.00
76	Dismantling complete concrete work for all types of structures at all levels including stacking of servicable material to a lead of 500 m and disposal of unservicable material, cutting of reinforcement, labour, equipment, safety precautions etc all complete as per drawings, specification and instructions of engineer in charge. Plain cement concrete of all grades	45	Cum	1454.900	65470.50
77	Dismantling complete concrete work for all types of structures at all levels including stacking of servicable material to a lead of 500 m and disposal of unservicable material, cutting of reinforcement, labour, equipment, safety precautions etc all complete as per drawings, specification and instructions of engineer in charge.Reinforced cement concrete of all grades	110	Cum	2221.613	244377.38
78	Dismantling and stacking within 50 metres lead, fencing angle posts or struts including all earth work and dismantling of concrete etc.in the base of fence	35	each	104.650	3662.75

Name of Project: 110kV Switchyard for RMU Kodayar Power House at Kodayar
Name of Work: Civil work for 110kV Switchyard at Kodayar

S. No.	Description of Item	Quantity	Unit	Unit Rate Excl GST(Rs)	Amount Excl. GST (Rs)
79	Dismantling barbed wire or flexible wire rope in fencing including making rolls and stacking within 50 metres lead.	15	Kg	15.050	225.75
80	Dismantling of chain link fencing including dismantling of Fence post, G.I chain link fencing made of G.I wire etc all including including stacking and depositing the same to customer store as per direction of Engineer-In-Charge. (Dismantling of concrete shall be paid separetly.)	80	RM	247.060	19764.80
81	Dismantling steel work in built up sections in angles, tees, flats and channels including all gusset plates, bolts, nuts, cutting rivets, welding etc. including dismembering and stacking within 50 metres lead.	100	Kg	2.400	240.00
82	Dismantling steel work manually/ by mechanical means in built up sections without dismembering and stacking within 50 metres lead as per direction of Engineer-in-charge.	100	Kg	1.600	160.00
83	Dismantling steel work in single sections including dismembering and stacking within 50 metres lead in:R.S. Joists	1000	Kg	1.400	1400.00
84	Dismantling steel work in single sections including dismembering and stacking within 50 metres lead in:Channels, angles, tees and flats	1000	Kg	0.950	950.00
85	Supplying and erecting in position 2.4 m high gavanised chain linked fencing conforming to IS 2761 of 10G hot dip galvanised steel wires woven in the form of zig-zag mesh giving an opening size of 50 mm square. GI barbed wire fencing of height of 600 mm confirming to IS 298 at top of chain link fencing shall be provided with 4 strands of barbed wire hot dip galvanised wire of 12G comprising of 2 ply of wires with barbs of 16G spaced at 100mm. Cost to include for GI hook bolts, rings & washers, hot dip galvanised tension wires, 25X6 mm GI flat stretcher bar at end posts, accessories etc. all complete. (Structural post shall be paid separately)	35	RM	2519.905	88196.67
86	Supply and fixing of GI barbed wire weighing 9.38 kg per 100 m (minimum), between the two fence posts fitted and fixed with G.I. staples, turn buckles etc. complete. Payment to be made per metre cost of total length of barbed wire used.	280	RM	11.450	3206.00
87	Demolishing cement mortar brick work/ Stone Masonary work manually/ by mechanical means including stacking of serviceable material and disposal of unserviceable material within 50 metres lead as per direction of Engineer-in-charge.	10	Cum	1976.667	19766.67
88	Supplying & fixing at site GI Angle iron post & strut of required size including bottom to be split and bent at right angle in opposite direction for min. 10 cm length and drilling holes upto 10 mm dia. etc. complete. Rate of Zinc coating shall not be less than 710g/m2 on steel posts.	1000	Kg	122.492	122492.38
89	Antiweed treatment in switchyard area including surface dressing of earth to an extent of ±200mm, rolling/compacted to the lines & grades using half ton roller/surface vibrator with suitable water sprinkling arrangement & micro levelling etc all complete as per Technical Specification.	800	Sqm	17.260	13808.00
90	Supplying and spreading approved quality stone aggregate of 40mm in size in switchyard as per drawing and specification all complete over PCC excluding the cost of PCC. This item also include Antiweed treatment in switchyard area including surface dressing of earth to an extent of ±200mm, rolling/compacted to the lines & grades using half ton roller/surface vibrator with suitable water sprinkling arrangement & micro levelling as per Technical Specification before gravelling	5	cum	3840.286	19201.43
		TOTAL AMOUNT			**9524655.02**

RENOVATION, MODERNISATION & UPRATING OF KODAYAR POWER HOUSE-I FROM lx60MW TO lx70MW

VOLUME – II B
SWITCHYARD CIVIL WORKS

SPECIFICATION NO. PE-TS-470-600-C00l-TBG

SECTION - D
GENERAL TECHNICAL SPECIFICATION

Customer

TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD

BHARAT HEAVY ELECTRICALS LIMITED

NEW DELHI

SECTION – D comprises of sub-sections as mentioned below:

Sub-section 01: Earthwork in excavation and backfilling

Sub-section 02: Cement concrete (Plain and reinforced) and formwork

Sub-section 08: Miscellaneous Metal

Sub-section 09: Masonry and allied works

Sub-section 010: Finish to masonry and concrete

Sub-section 011: Painting, Whitewashing, polishing

Sub-section 016: Road & drainage

Sub-section 020: General Miscellaneous other

VOLUME: II B

SECTION - D

SUB-SECTION – Dl

EARTHWORK IN EXCAVATION AND BACKFILLING

SPECIFICATION NO. PE-TS-999-600-C00l-TBG

Bharat Heavy Electricals Limited

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

Noida (U.P.)·201301

	TITLE: TECHNICAL SPECIFICATION FOR EARTHWORK IN EXCAVATION AND BACKFILLING	SPECIFICATION NO. PE-TS-999-600-C001-TBG VOLUME - II B SECTION - D | SUB-SECTION – D1 REV.NO. 00 DATE 18/10/2022 SHEET 2 OF 22

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.0	SCOPE	3
2.00.00	GENERAL	3
3.00.00	EXECUTION	6
4.00.00	TESTING AND ACCEPTANCE CRITERIA	19
5.00.00	RATES AND MEASUREMENTS	19
6.00.00	INFORMATION TO BE SUBMITTED BY THE BIDDER	20

STANDARD TECHNICAL SPECIFICATION FOR EARTHWORK IN EXCAVATION AND BACKFILLING

1.0.0 SCOPE

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

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

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

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

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

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

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

2.2.0 Work to be provided by others

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

2.3.0 Codes and Standards

All works shall be carried out as per this specification and shall conform to the latest revision and/or replacements of 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 vegetation, roots, salts, rubbish, lumps, organic matter and any other harmful chemicals etc and shall be got approved by the engineer. Normally excavated earth shall be used for back filling. In case such earth contains deleterious salts, the same shall not be used. All clods of earth shall be broken or removed. Where the excavated material is mostly rock and if filling with the same is permitted by the engineer in writing, then the filling with rock shall be done in the following

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

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

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

2.6.0 Quality Control

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

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

2.7.0 Information regarding site conditions

Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the Contractor shall be taken as a guidance only and variation therefrom shall not affect the terms of the contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and / or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the contract so that he may evolve a realistic program me 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 authorized 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 engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed to the approved disposal

area(s) as specified by the engineer. Useful materials, saleable timber, fire woods etc shall be the property of the owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

3.4.0 Classification

All earthwork shall be classified under the following categories:

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

a) **Ordinary Soil**

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

b) **Hard Soil**

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

c) **Soft and Decomposed Rock**

This shall include :
i) limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars ;
ii) unreinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level ;
iii) boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin ; and
iv) any rock which in dry state may be hard, requiring blasting, but which

when wet becomes soft and manageable by means other than blasting.

d) **Hard Rock (requiring blasting)**

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

e) Hard Rock (blasting prohibited)

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

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

3.5.0 Excavation for Foundations and Trenches

3.5.1 General

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

Method of excavation shall in every case be subject to the approval of the engineer. The contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works etc including the safety of the workmen. If any slip occurs, the contractor shall remove all the slipped materials from the excavated pit without any extra cost to the engineer/owner. All loose boulders and 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 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 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 chiseling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. 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 license 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.

3.5.4.1 Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of

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

3.5.4.2 Storage of Explosives

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

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

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

Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

* not to put their feet on the clean floor unless the magazine shoes on.

* not to touch the magazine shoes on ground outside the clean floor.

* not to allow any dirt or grit to fall on the clean floor.

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

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor 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 responsibilities.

Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the

cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

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

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

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

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures

and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.

3.5.4.5 Restrictions in Blasting

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

3.5.5 Disposal

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

a) By using it straightway for backfilling.

b) By stacking it temporarily to use for backfilling at a later date during execution of the contract.

c) i) By either spreading
or
ii) By spreading and compacting at designated disposal areas.

a) By selecting the useful material and stacking it neatly in designated areas as indicated by the engineer for use in backfilling by some other agency.

3.5.6 Disposal of Surplus Materials

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

3.5.7 Protection

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

3.5.8 Dealing with Surface Water

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

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

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

3.5.9 Dewatering

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

Sumps made for dewatering must be kept clear of the foundations. The engineer's prior approval on the method of pumping to be adopted shall be taken; but in any case, the pumping arrangement shall be such that there shall be no movement or blowing in of subsoil due to the differential head of water during pumping.

3.5.10 Timber Shoring

Close or open type timber shoring as approved by the engineer depending on

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

3.5.10.1 Close Timbering

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

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

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

3.5.10.2 Open Timbering

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

3.6.0 Treatment of Slips

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

3.7.0 Backfilling

3.7.1 General

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

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

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

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

3.7.3 Plinth Filling

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

3.7.4 Filling in Trenches for Water Pipes and Drains

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150mm, watered, rammed and compacted taking

care that no damage is caused to the pipe below.

In case of trenches excavated in rock, the filling 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.

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.

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

5.2.0 Measurements

Method of measurements are specified as below:

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

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

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

e) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation, then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

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

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

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

6.0.0 INFORMATION TO BE SUBMITTED BY THE BIDDER

6.1.0 With Tender

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

6.2.0 After Award

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

a) Within 30 days of the award of contract, the contractor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation for the various foundations and the time required for backfilling and compaction after completion of foundation for the structures. The earthwork programme shall be planned in accordance with the foundation programme. The programme should also show how the excavation and backfilling quantities will be balanced minimizing the temporary stacking of spoils. It is to be noted that the engineer even after initial approval of the programme may instruct the contractor to enhance or to retard the progress of work during the actual execution in order to match with the progress of foundations. The initial programme being submitted by the contractor should have sufficient flexibility to take care of such reasonable variations.

b) Within 15 days of the award of contract, the contractor shall submit the drawings for earth work in excavation and backfilling showing detail of slopes,

shoring, approaches, sump pits, dewatering lines, fencing etc for the approval of the engineer.

VOLUME – II B

SPECIFICATION NO. PE-TS-999-600-C002-TBG

SECTION — D

SUB SECTION –D2

GENERAL TECHNICAL SPECIFICATION

CEMENT CONCRETE (PLAIN & REINFORCED)

Bharat Heavy Electricals Limited

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

Noida (U.P.)

C O N T E N T

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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

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

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

f) Submit for approval detailed schemes of all operations required for executing the work, e.g. material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.

g) Design and submit for approval concrete mix designs required to be adopted on the job.

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

i) The various ingredients of concrete

ii) Concrete

iii) Embedments

iv) Joint seals

i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.

j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved Performa for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

2.02.00 Work by others

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

2.03.00 Information to be submitted by the Tenderer

2.03.01 With Tender

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

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

b) Type of plant and equipment proposed to be used.

c) Names of firms with which association is sought for to execute the special items of work in the contract.

d) Types of formwork proposed to be used.

2.03.02 After Award

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

a) Programme of Execution

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

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

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

b) Samples

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

i) Coarse and fine aggregates.

ii) Admixtures.

iii) Plywood for Formwork.

iv) Embedded and anchorage materials as may be desired by the Engineer.

v) Joint sealing strips and other*waterproofing materials.

vi) Joint filling compounds.

vii) Foundation quality Rubber Pads.

c) Design Mix

Design mix as per specification giving proportions of the ingredients, sources of aggregates and cement, along with test results of trial mixes as per relevant 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 Sending Schedules in accordance with Clause 2.01.00 (b) and 3.16.01 of this specification.

e) Detailed Drawings and Designs of Formworks to be used

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

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

g) Mill Test Reports for Cement & Reinforcing Steel.

h) Inspection Reports

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

i) Test Reports

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

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

2.04.00 Conformity with Design

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

Cards allowing the contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the Contractor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the Contractor as per the 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 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 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 ASTMC-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 realized 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 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. 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 troweling 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 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 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 site. Based on various tests results and as per Engineer, the environment condition shall be adopted for which minimum cement content shall be considered. No extra payment shall be made on account of any variation in environment condition.

a) Sufficient number of trial mixes (to be decided by the Engineer) will be

Taken at the laboratory for the various designs and graphs of w/c ratio Vs crushing strengths at various ages will be plotted.

b) All tests will be done in presence of the Engineer who shall be the final authority to decide upon the adoption of any revised minimum cement content. The Contractor will always be responsible to produce quality concrete of the required grade as per the acceptance criteria of IS: 456.

c) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

3.07.00 Water-Cement Ratio

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

a) The requirement of strength.

b) The requirement of durability.

3.07.01 Strength Requirement

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

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

3.07.02 Durability Requirement

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

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

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

3.08.00 Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments and to give the required surface finish shall depend*on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below:

TABLE-V

LIMITS OF CONSISTENCY

Degree of 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
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 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.

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 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.

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

3.13.00 Construction Joints and Cold Joints

3.13.01 Construction Joints

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

Vertical construction joints will be made with rigid stop-board forms having

slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12.

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

a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.

b) Concrete in a beam shall preferably be placed without a joint, but if Provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.

c) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.

d) Feather-edges in concrete shall be avoided while forming a joint.

e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.

f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.02 Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

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

a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.

b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the

Concrete in depth. A rich mortar layer 12 *mm* in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.

c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not raise inspite of extensive vibration, the joint, will be left to harden for at least 12 - 24 hrs. It Will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

3.14.00 Repairs, Finishes, and Treatment of Concrete surfaces

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

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

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

b) Cutting away the defective concrete to the required depth shape.

c) Cleaning of reinforcement & embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.

d) Roughening by sand blasting or chipping.

e) Installing additional reinforcement/welded mesh fabric.

f) Dry packing with stiff mortar.

g) Plastering, guniting, shotcreting etc.

h) Placing and compacting concrete in the void left by cutting out defective concrete.

i) Grouting with cement sand slurry of 1:1 mix.

j) Repairing with a suitable mortar either cement or resin modified mortars.

k) Polymer modified patching and adhesive repair& mortar for beams & columns.

3.14.02 Finishing unformed Surface

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

a) Floor

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

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

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

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

b) Beans, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped

off so that proper bond can develop. Pattern, adequacy, and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.

3.15.00 Protection and Curing of concrete

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

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

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

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

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

3.16.02 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.03 Bending

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS: 2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding with the 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 I Coupler for Splicing

Lapping shall normally do splicing of reinforcement. For M.S. reinforcement bars, butt-welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS: 2751 and IS: 456. For High yield strength deformed bars, lap welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards as per IS: 9417. Welding of High yield strength deformed bar shall not be allowed.

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

3.16.06 Control

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

3.17.00 Cold Weather Concreting

When conditions are such that the ambient temperature may be expected to be 5°C or below during the placing and curing period, the work shall conform to the requirement of IS: 456 and IS: 7861.

3.18.00 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS: 7861 and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 38°C while placing. Positive temperature control by precooling, post cooling or any other method, if required, will have to be done by the contractor at no extra cost.

3.19.00 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of IS: 456.

3.20.00 Form Work

3.20.01 General

If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for formwork and centring and get them approved by the Engineer. The formwork shall

conform to the shape, grade, lines, levels and dimensions as shown on the drawings.

Materials used for the formwork inclusive of the supports and centring shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centring shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rakers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight and horizontal pressure of the concrete as a liquid as well as the working load. In case the contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel and concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are in true plumb and thoroughly cross-braced to keep them so. All floor and beam centring shall be crowned not less than 8 mm in all directions for every 5 metres span. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during

pouring operations without leaving any mark on the concrete.

3.20.02 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, sawdust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.03 Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns, and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork.

Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

3.20.04 Inspection of Forms

Casting of' Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.05 Removal of Forms

Formwork shall be kept in position after casting of concrete for a minimum period as mentioned in IS: 456, however the period of retaining form in position can be extended as per drawing, instruction of Engineer or as required for satisfactory completion of work without any extra cost. Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if the Engineer so desires.

The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly. The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost to the Owner, The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

If any other type of cement other than ordinary Portland cement and Rapid hardening cement is used, the time of removal of forms shall be revised such that the strength of this cement at the time of removal of forms match with strength of Portland cement at the time of removal of form.

3.20.06 Tolerance

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this specification or drawings or directed by the Engineer:-

For -	a) Sectional dimension	-	± 5 mm
	b) Plumb	-	1 in 1000 of height
	c) Levels	-	± 3 mm before any deflection has taken place

The tolerance given above are specified for local aberrations in .the finished concrete surface & should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.07 Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.08 Classification

Generally, the "ordinary" class formwork shall be used unless otherwise

specified.

a) **Ordinary:** These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.

b) **Plywood:** These shall be used in exposed surfaces, where specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class, if it is still in good condition.

c) **Ornamental:** These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned timbers or of plywood, which can be shaped correctly.

3.21.00 Opening, Chases, Grooves, Rebates, Blockouts etc.

The Contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer.

3.22.00 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and other misc. Embedded Fixtures

The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as shown on drawings and secure the same as may be required. The materials shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to paint with one coat of approved anti- corrosive paint and/or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material, the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, Jigs, fixtures, supports etc. shall be used as may be 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 structural to be left embedded for future extension, special connection etc.

d) Dowel bars, etc. for concrete work falling under the scope of other contractors.

e) Lugs or plugs for door and window frames occurring in concrete work.

f) Flashing and Jointing in concrete work.

g) Any misc. embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor.

3.23.00 Expansion and Isolation Joints

3.23.01 General

Expansion and isolation Joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of Joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension, and quality as per drawings and specifications. Prior approval of the method of forming the Joints should be obtained from the Engineer before starting the work.

3.23.02 Bitumen Board/ Expanded Polystyrene Board

a) Bitumen Board

Bitumen impregnated fibre board of approved manufacturer as per IS: 1838 may be used as fillers for expansion Joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the Joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the Joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the Joint shall be sealed with approved sealing compound to a depth of at least 25 mm after

application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

b) Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion Joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.03 Joint sealing strips

Joint sealing strips may be provided at the construction, expansion, and isolation Joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I., Aluminums, or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal Joint and will be procured and installed in largest practicable lengths having a minimum number of transverse Joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of Joint strips of similar make and shape for other Jobs. The Jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation -including the material and tools required for Jointing, testing, protection, etc. If desired by the Engineer, Joints in rubber seals may have to be vulcanized.

a) Metal Sealing Strips

Metal sealing strips shall be either G.I., Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing. The transverse Joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak proof. If required, longer lap lengths and different method of brazing which will render it leak proof, will be adopted by the Contractor. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

i) G.I. Strips

G.I. strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The standard of Galvanizing shall be as per

relevant Indian Standards for heavy-duty work. At the Joints, the overlapping should be for a minimum length of 50 mm.

ii) Aluminium Strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS: 737 of 19000 grades or 31000 grade (Designation as per IS: 6051). A minimum lap of 50 mm length is required at the Joints.

iii) Copper Strips

The Copper strips shall be minimum 18 SWC in thickness and 300 mm width unless specified otherwise and shall conform to the relevant Indian Standards. It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the Joints.

b) Non-metallic Sealing Strips

These will be normally in Rubber or P.V.C. Rubber or P.V.C. Joint seals can be of shape having any combination of the following features:

i) Plain

ii) Central bulb

iii) Dumb-bell or flattened ends

iv) Ribbed and Corrugated Wings

v) V shaped

As these types of seals can be easily handled in very large lengths unlike metal strips, transverse Joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these Joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs & the edges accurately.

c) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion, and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service.

The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25 - 30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75°C
Ultimate Elongation	:	Not less than 350%

b) P.V.C., Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion, and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly

Specific Gravity	:	1.3 to 1.35
Shore Hardness	:	60A to SOA
Tensile Strength	:	10 - 15 N/Sq.mm
Maximum Safe Continuous Temperature	:	70 Deg.C
Ultimate Elongation	:	Not less than 275%

3.23.04 Bitumen Compound

When shown in drawing or directed, the gap in expansion Joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834.

3.23.05 Isolation Joints

Strong and tough alkathene sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in isolation Joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set

concrete to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.06 Pad

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24.00 Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and Just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air Jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If specified on drawings, admixtures like Aluminium powder, "Ironite" etc. may have to be added with the grout in required proportions. Premixed non-shrink grout of approved manufacture having proper strength shall be used with Engineer's approval for important machineries.

3.25.00 Precast Concrete

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose. This yard shall be dry, properly levelled and having a hard and even surface. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven) days of curing and can be removed for erection after 28 (twenty-eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished

after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling, and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials, and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the Joints shall be filled with grout or concrete as per drawings. If centrings have to be used for supporting the precast units, they shall not be removed until the Joints have attained sufficient strength and in no case before 14 (fourteen) days. The Joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

3.26.00 Waterproofing of Concrete Structure

3.26.01 General

Where required, waterproofing of concrete structures shall be ensured internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the Joints. In addition to the above measures, the structures shall be made watertight by adopting "structural waterproofing" as per specification. The design, material, and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the Engineer, test certificates for the materials and samples shall be submitted by the Contractor free of charge. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.02 Water Bar/Seal/Special Treatment of Construction Joint

Water bearing structures and underground structures may have water bar/seals installed at the Joints. They may be metallic, rubber, or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction Joint shall be provided as per clause 3.13.1 with or without water bar/seal as shown on the drawing. In case of water bars being used at the construction Joint, fixing of the same has to be done carefully, so that the water bar is not disturbed during concreting. The construction Joint shall also be treated by any one of the following methods.

Method 1: A surface retarder in the form of a thixotropic gel shall be applied on the Joint surface of the previous pour in case of Joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form

depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water Jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm Just before pouring the next stage of concreting. In case of walls, the above bonding agent will be mixed with water, which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor Joint, however, after washing of retarder a solvent free two-component epoxy resin-bonding agent will be used at the Joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days

Compressive strength	-	55 to 60 N/Sq.mm
Flexural strength	-	5 to 30 N/sq.mm
Tensile strength	-	15 N/Sq.mm (approx.)
Bonding strength to concrete	-	3 N/Sq.mm (approx.)
Bonding strength to steel	-	20 N/Sq.m (approx.)

The whole operation shall be done as per manufacturers specification. The contractor shall provide manufacturer's supervision at no extra cost to the owner.

Method 2: One row of threaded nozzles at regular intervals not exceeding l.5 m centre to centre shall be placed in concrete along the construction Joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the concrete has set to seal the voids in concrete near the construction Joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 kg/sq.cm. The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision. The cost of such manufacturer's supervision shall be borne by the contractor.

3.26.03 Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar/plaster shall conform to 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 plasiticizer will be preferable.

a) In concrete: The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor at no extra cost to supervise the work, if desired by the Engineer.

b) In Plaster: The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor at no extra cost. On completion, the Plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.04 Structural waterproofing

a) Nozzles spaced as required after the concrete is completed shall be drilled into surfaces to be rendered watertight. Non-shrink cement grout with waterproofing compound as per 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

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.

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 teat 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 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 strength.
If the member shows evident failure, the Contractor shall make the structure adequately strong free of cost to BHEL.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor.

If, in the course of dismantling, any damage is done to the embedded items and or other adJacent structures, the same will be made good, free of charge by the Contractor to the satisfaction of the Engineer.

6.00.00 RATES AND MEASUREMENTS

6.01.00 Cast-in-situ Concrete

6.01.01 Rates

a) The unit rates shall include the cost of labour, materials, equipment, handling, transporting, botching, mixing, placing in position, vibrating, compacting, finishing, curing, testing, etc. at all elevations. This shall include the cost of curing by regular wetting or by using curing compound.

b) The unit rates shall include for all working conditions including at locations under water, liquid, mud, in or under foul positions and extreme weather conditions.

c) The unit rates for exposed concrete works (including machine foundations) shall include all incidentals, rendering, smoothening with carborandum stone, finishing with a paste of cement sand mortar, curing, etc.

d) The unit rates shall include all arrangement for maintaining stability of structure during execution.

e) Nothing extra shall be payable for the handling/mixing of extra cement on account of any reason or pouring of second stage concrete.

f) Nothing shall be payable to the Contractor on account of facilities and arrangement provided by him for conducting ultrasonic pulse velocity (UPV) tests or other relevant tests to ascertain grade and quality, etc. of the concrete in case the concrete quality is in doubt and contractor has to establish the quality by further tests. In case of any defects, the Contractor shall rectify the same by cement/epoxy grout at his own cost.

However, mandatory UPV test as specified in the drawings shall be carried out including arrangement of all its facilities, staging, etc. and shall be payable to the contractor as per BOQ item.

g) The unit rates for controlling of the temperature of concrete shall include storing and mixing of ice, water, cooling of aggregate etc.

h) The quoted rate shall include the cost of MIX design, making of all trial mixes using admixtures and mixing in concrete etc. complete.

6.01.02 Measurements

a) Actual volume of concrete work as executed or as per drawings issued, whichever is less shall be measured in cubic 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 23^0C.

6.02.00 Reinforcement

6.02.01 Rates

a. Supply portion: Payment will be made to contractor for the actual quantity consumed in works and (Excluding wastages) entered in Measurement book. This shall be duly certified by Engineer-In-Charge. The contractor will have to submit the invoice, Manufacturer Test Certificate for the dia and quantity claimed for the payment. The contractor will have to submit the 3rd party test lab result also if applicable as per customer approved Field quality plan/ technical specification. The unit rate of supply shall be inclusive of the cost of wastage, supply at site, testing charges etc. No payment on account of wastage (cut piece, difference in weight against theoretical/ actual etc)/theft will be admissible. After reconciliation certified by EIC wastage steel pertaining to Contractor portion can be taken out by contractor subjected to meeting all contractual requirement of projectThe unit rates shall include for cover block, providing binding wire, welding, separator pieces between two or more layers of reinforcement required for keeping the steel in position, etc. at all elevations.

b. **Erection portion**: Reinforcement shall be measured in meter including the length of hooks, overlap, chair, spacer bars, stays, hangers, couplings if any, separately for different diameters as actually used in work. From the length so measured, the weight of reinforcement shall be calculated in Kg on the basis of sectional unit weights as adopted by Indian Standards. Wastage, welded joints and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement. Cost of unloading, storage, watch & ward etc too are deemed to be include in the unit rates.

c) 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.

6.02.02 Measurements

a) N . A

6.03.00 Formwork and Staging

6.03.01 Rates

a) The unit rates shall be inclusive of all staging, scaffolding, making the formwork watertight, etc. for all elevations and in all types of works.

b) No separate payment shall be made for providing fillets, for rounding or chamfering at Junctions, comers, etc.

c) The unit rates shall include the cost of labour, materials etc. and the extra time, which shall be required for the removal of shuttering/ support for satisfactory completion of work.

d) No extra payment shall be made on account of difficulty, wastage etc. for placement/removal of formwork between the network of closely placed steel beams or for the lacing/bracing portions and ribbed slab constructions.

e) Payment for curved shuttering shall be made for curved members/wall whose centerline radius in plan is less than 6m.

f) If the contact surface area in pockets is less than or equal to 0.1 sq.m. in each case, payment shall be done under item for providing formwork in pockets.

6.03.02 Measurements

a) Formwork for different classes (types) shall be measured separately as the actual surface in contact with the concrete and paid on area basis unless included in the rate for concrete. The unit of measurement shall be in sq.m.

b) Openings upto 0.1 sq.m or boxing left for inserts etc. for facility of Contractor's work, shall be neglected as if nonexistent for the purpose of formwork measurement of surface in which the openings occur.

For suspended floor, no deduction shall be made for flange area of secondary steel beams.

d) No measurement shall be taken for the formwork in pockets, openings, chases, blockouts, etc. in concrete, the contact surface area is less than or equal to 0.1 sq.m. in each case.

e) For pockets, if the contact surface area is less than or equal to 0.1 sq.m. in each case, measurement shall be done under item for providing formwork in pockets.

e) Formwork, if required, for Joints shown on drawing or instructed by the Engineer, shall be paid for the 'leading side' only.

6.04.00 Embedded Parts

6.04.01 Rates

a) The unit rate for erection of embedded steel parts, supplied by Engineer shall include transportation from Owner's store to the place of work, erection & installation including setting material in concrete, etc. complete.

b) The unit rate for MS pipe embedments and PVC pipe embedments shall include cutting, welding, fabrication, erection, embedding, and transportation to site. Unit rate shall also include the cost of the pipes.

c) Rate for expansion fasteners shall include cost of fasteners, installation, and fixing including cost of washers and nuts and site testing if required.

6.04.02 Measurements

a) The measurement of the embedded steel parts fabricated and installed by the Contractor shall be based on the calculated weight of steel sections in tonne corrected to second place of decimal.

b) Embedded steel parts supplied by Owner and installed by Contractor Measurement shall be done for the net weight of the embedments installed in tonnes correct to second place of decimal.

c) For PVC pipes/conduits, measurements shall be in quintals correct to second place of decimal for the net weight.

d) For mild steel pipes, measurement shall be in quintals, correct to second place of decimal, for the net weight of the steel pipe supplied, fabricated, and installed.

e) The lugs shall be measured in Kg. correct to second place decimal for the net weight.

f) The expansion fasteners shall be measured in number according to tension capacity.

g) The rails shall not be treated as embedded steel part and the track shall be measured in running metres along the centre line and paid for under separate item of work as specified in schedule of items. Other related civil items associated with the laying of track shall be measured separately and paid under respective items of works.

6.05.00 Groutings

6.05.01 Rates

Rate shall include the cost of surface preparation, admixtures, and curing.

6.05.02 Measurements:

a) Measurement shall be in cubic decimeters.

b) Measurement for grouting shall be by volume of the block out, pockets or bolt hole upto the top surface of foundation concrete and shall be calculated from the dimensions shown on the drawings.

c) Measurement for underpinning shall be by volume between the top surface of the foundation concrete and the underside of the base plate, the plan dimensions being as indicated on the drawings.

d) No deduction shall be made for shims, bolts, shear keys and such other embedments.

f) Pressure inJection grouting with cement based grout if required as per drawing shall be applied at appropriate spacing to cover the desired

surface area and measurement shall be made for the surface area grouted in sqm as per BOQ item. However in water retaining structures, the structural grouting if required to ensure water tightens shall not be payable separately as deemed to be covered in water retaining concrete item of BOQ.

6.06.00 Joints

6.06.01 Rates

The unit rate shall include all the activities described in the schedule of items.

6.06.02 Measurements

a) Bitumen Board/Expanded polystyrene.

The measurement for bitumen board shall be based on actual finished surface area in square meters nearest to second decimal, for the specified thickness.

b) Water Stops

The measurement for water stops shall be in running metres of actual length of the Joint covered, for specified thickness, width, and shapes. No separate measurement shall be made for laps/splices for cross-Joints and mitered Joints.

c) Metal Cover Strips

The measurement for Metal Cover Strips shall be based on actual finished surface area in square metres for the specified thickness.

d) Vibration Damping Resilient Pads

The measurement for this item shall be in square metres for the specified thickness, measured correct to the second place of decimal, of the actual finished surface area.

6.07.00 Dismantling/Demolishing Work – RCC and PCC and Chipping of Concrete

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.

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) For items not covered above, unless otherwise described in method of measurement as described in in 'Method of Measurement of Building and Civil Engineering Works'-IS 1200 (Part I to XXV) latest edition of BIS shall be followed..

6.08.00 Precast Concrete

This clause shall be read in conjunction with relevant provisions specified elsewhere for cast in-situ Concrete.

6.08.01 Rates

a) The unit rate shall include cost of preparation of casting yard, formwork, concrete and its casting, finishing as specified, setting filling of gaps between adJacent pre-cast concrete units with concrete, or cement mortar, curing, handling, erection, grouting, welding, preparation of supporting surface, etc.

6.08.02 Measurements

The measurement of pre-cast concrete members shall be on the basis of volume of concrete in cubic metres nearest to second place of decimal. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings up to 0.1 sq.m. The setting of element with cement mortar shall not be measured separately The filling of concrete cement mortar between the gaps of adjacent precast units shall be considered while computing the volume of pre-cast concrete work and shall be paid for under

this item itself.

7.00.00 LIST OF IS CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed:-

IS: 73 - Indian Standard Specification for Paving Bitumen

IS: 216 - Indian Standard Specification for Coal Tar Pitch

IS: 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete

IS: 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement

IS: 455 - Indian Standard Specification for Slag Cement

IS: 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete

IS: 457 - Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures

IS: 516 - Indian Standard Specification for Methods of Test for Strength of Concrete

IS: 702 - Indian Standard specification for industrial bitumen.

IS: 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete

IS: 1322 - Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing

IS: 1489 - Indian Standard Specification for Portland Pozzolona Cement

IS: 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.

IS: 1609 - Code of Practice for Laying Damp-proof Treatment using Bitumen Felts

IS: 1786 - Indian Standard Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement.

IS: 1791 - Indian Standard Specification for Batch Type Concrete Mixers.

IS: 1838 - Indian Standard Specification for preformed fillers for expansion Joints in concrete pavements and structures (non-extruding and resilient type.

IS: 2185 - Indian Standard Specification for Hollow Cement Concrete Blocks

IS: 2210 - Indian Standard Specification for Design of Reinforced Concrete shell Structures and Folded Plates

IS: 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII

IS: 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement

IS: 2505 - Indian Standard Specification for Concrete Vibrators, Immersion Type

IS: 2506 - Indian Standard Specification for Screed Board Concrete Vibrators

IS: 2514 - Indian Standard Specification for Concrete Vibrating Tables

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 Batchers for Concrete (Single and Double Bucket type)

IS: 2750 - Indian Standard Specification for steel scaffoldings.

IS: 2751 - Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction

IS: 2770 - Indian Standard Specification for Method of Testing Bond in Reinforced Concrete

IS: 3025 - Indian Standard specification for Methods of Sampling and Test (Physical and Chemical) for Water used in Industry

IS: 3067 - Code of practice for general design details and preparatory work for damp proofing and water proofing of building.

IS: 3201 - Indian Standard Specification for Design and Construction of Precast Concrete Trusses

IS: 3370 - Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids

IS: 3414 - Code of practice for design and installation of Joints in buildings.

IS: 3550 - Indian Standard Specification for Method of Test for Routine Control for Water used in Industry

IS: 3558 - Code of Practice for use of Immersion vibrators for Consolidating Concrete

IS: 3696 - Safety Code for Scaffolding and Ladders

IS: 3812 - Indian Standard Specification for Fly Ash for Use as Admixture for Concrete

IS: 4014 - Code of practice for steel tubular scaffolding.

IS: 4031 - Indian Standard Specification for Method of Tests for Hydraulic Cement

IS: 4082 - Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site

IS: 4090 - Indian Standard Specification for Design of Reinforced Concrete Arches

IS: 4634 - Indian Standard Specification for Method of Testing

Performance of Batch-type Concrete Mixes

IS: 4656 - Indian Standard Specification for Form Vibrators for Concrete

IS: 4925 - Indian Standard Specification for Concrete Batching and Mixing Plant

IS: 4926 - Indian Standard Specification for Ready Mixed Concrete

IS: 4990 - Indian Standard Specification for Plywood for Concrete Shuttering work

IS: 4991 - Indian Standard Specification for Blast Resistant Design of structure for Explosion above ground

IS: 4995 - Indian Standard Specification for Design of Reinforced Part-I & II Reinforced Concrete Bins for the Storage of Granular and Powdery Materials

IS: 4998 - Indian Standard Specification for Design of Reinforced Concrete Chimneys.

IS: 5256 - Code of practice for sealing Joints in concrete lining on canals.

IS: 5512 - Indian Standard Specification for Flow Table for use in Tests of Cement and Pozzolanic materials

IS: 5513 - Indian Standard Specification for vacate Apparatus.

IS: 5515 - Indian Standard Specification for Compaction Factor Apparatus.

IS: 5525 - Recommendation for detailing of reinforcement in reinforced concrete works.

IS: 5624 - Indian Standard Specification for foundation bolts.

IS: 5751 - Indian Standard Specification for Precast Concrete Coping Blocks.

IS: 5816 - Indian Standard Specification for Method of Test for Splitting Tensile strength of Concrete Cylinders.

IS: 5891 - Indian Standard Specification for Hand operated Concrete Mixers.

IS: 5892 - Indian Standard Specification for transit mixer and agitators.

IS: 6452 - Indian Standard Specification for High Alumina Cement for Structural Use

IS: 6909 - Indian Standard Specification for Super sulphated Cement

IS: 6923 - Indian Standard Specification for Method of Test for Performance of Screed Board Concrete Vibrators.

IS: 6925 - Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures.

IS: 7242 - Indian Standard Specification for Concrete Spreaders.

IS: 7246 - Indian Standard Specification for Table Vibrators for Consolidating Concrete.

IS: 7251 - Indian Standard Specification for Concrete Finishers.

IS: 7293 - Safety code for working with construction machinery.

IS: 7320 - Indian Standard Specification for Concrete Slump Test Apparatus.

IS: 7861 - Indian Standard Specification for Recommended Practice Part-I&II for Extreme Weather Concreting.

IS: 7969 - Safety Code for Storage and Handling of Building Materials.

IS: 8041 - Indian Standard Specification for Rapid Hardening Portland cement.

IS: 8112 - Indian Standard Specification for high strength Ordinary Portland Cement.

IS: 8142 - Indian Standard Specification for Determining Setting time of concrete by Penetration Resistance.

IS: 8989 - Safety Code for Erection of Concrete Framed Structures.

IS: 9012 - Recommended method for shortcreting.

IS: 9013 - Indian Standard Specification for Method of Making, Curing, and determining compressive Strength of Accelerated-cured Concrete Test Specimens.

IS: 9077 - Code of Practice for Corrosion Protection of Steel

Reinforcement in RB and RCC Construction.

IS: 9103 - Indian Standard Specification for Admixtures for Concrete.

IS: 10262 - Recommended Guidelines for Concrete Mix Design.

IS: 13311 - Non-destructive testing of concrete.

SP: 34 - Handbook of concrete, reinforcement and detailing.

VOLUME: II B

SECTION - D

SUB-SECTION – DS

MISCELLANEOUS METAL

SPECIFICATION NO. PE-TS-999-600-C008-TBG

Bharat Heavy Electricals Limited

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

Noida (U.P.)·201301

C O N T E N T

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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 foundary 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 be brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. When specified steel work shall be galvanised or painted with a coat of zinc chromate primer. Aluminium surfaces, which shall come in contact with masonry, shall be given one coat of bituminous paint.

2.02.00 Erection

2.02.01 Bracing

The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected, including erection of equipment and operation of the same.

2.02.02 Temporary Bolting-Up

As erection proceeds the Contractor shall plum up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever erection equipment or other loads are carried by members during erection, proper provision shall be made to take care of the stresses resulting from the same.

2.02.03 Turned Bolt

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

2.02.04 Welding

Where specified on drawings, welding shall be done in accordance with 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

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.

2.02.0S 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

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 $\pm$0.05mm. 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

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 barded 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 then 13mm and not more than 18mm. The distance between two barbs shall be 75$\pm$12mm.

Straining posts shall be provided at all ends and corners of fences or at changes in direction or acute variation in level and at intervals not exceeding 66 M on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3.0m. Struts shall be fitted to all straining posts behind the chain link fabric in the direction of line of fence. There shall be four evenly spaced row of line wire in all. The top line wire shall be doubled, making five line wire in all. The bottom wire shall be closed to the ground. Each line wire shall be strained tightly by means of eyebolts strainers or winders at each straining points. Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hold in the post and secured to the line wire by three complete turns on each sides of the post. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wire so that they could not be bunched together. Droppers for barbed

wire shall be of mild steel of not less then 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 MEASURMENTS

5.01.0 Rates

Rates shall include supply, fabrication and installation for misc. metals works as required for completion of works like gates, fencing, handrails, ladders, hangers, anchors etc., unless otherwise specified in Schedule of Items.
Rate for fencing shall also include excavation, concreting and supply, erection & fabrication of post (post made of either structural steel or reinforced cement concrete), unless any specific item is excluded.

5.02.0 Measurements

Measurement for MS gates shall be in MT.

Measurement for galvanised MS wire fencing shall be in Sqm.

Measurement for Anchors shall be in nos. for the type as specified in schedule of items.

Measurement of other misc. metals shall be done in MT unless otherwise specified in schedule of items.

TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

VOLUME: II B

SECTION - D SUB-

SECTION – D9

MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009-TBG

Bharat Heavy Electricals Limited

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

Noida (U.P.)·201301

C 0 N T E N T

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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 loose grains and free from any dull, chalky, or earthly appearance. Stone

showing mottled colours shall not be used for face work. A stone shall not absorb more than 5 per cent of its weight of water after 24 hours immersion. The type of stone shall be as specified on drawings and/or instructed by the Engineer. Samples shall be submitted by the Contractor and approved samples shall be retained by the Engineer for comparison of bulk supply.

c) Cement

Cement used shall be Ordinarily Portland Cement or Portland Slag Cement or Portland Pozzolana Cement conforming to IS Codes and shall be fresh when delivered. In special cases, Rapid Hardening Portland Cement, Low Heat Cement etc. may be permitted or directed to be used by the Engineer. The Contractor shall submit the manufacturer's certificate for each consignment of cement procured to the Engineer. If at any time, the Engineer feels that the cement being used by the Contractor is not up to specification, he may stop the work and send the samples of the cement to a testing laboratory for standard tests and all expenses incurred thus shall be borne by the Contractor. The Contractor shall also have no claim for this type of suspension of work.

The cement shall be stored above the ground level in perfectly dry and watertight sheds. The bags shall be stacked in a manner so as to facilitate removal or first in first out basis. Any material considered defective by the Engineer shall not be used by the Contractor and shall be removed from the site immediately.

d) Coarse Aggregate

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

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

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

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

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

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.

3.03.03 Brick Masonry

Bricks shall be soaked by submergence in clean water for at least two hours in

approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing.

Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

3.03.04 Exposed Brickwork

Brickwork in superstructures, which is not covered by plaster, shall be as shown on drawing and executed by specially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule, and string. All brickwork shall be cleaned at the end of days work. If face bricks are specified, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean, and pointed as specified. Where face bricks are used carborandum stone shall be used for rubbing down.

3.03.05 Reinforced Brickworks

Reinforcements shall be as specified. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. columns or welded to steel stanchions.

3.03.06 Stone Masonry

Stones shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall be not less than 8 mm and not greater than 25 mm. At least two stones shall run the

full width of the wall for every square meter of surface area.

3.03.07 Exposed Stone work

Stonework, which is to be kept exposed, shall be as shown on approved drawing. It shall be executed by specially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or instructions. A sample wall, 10 Sq.M. area shall be built and approved by the Engineer and all works shall match with this sample.

3.03.08 Composite Masonry

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.

3.03.09 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings and specified. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

3.03.10 Mouldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with Carborundum stone.

3.03.11 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days work top surface of masonry shall be

kept wet by ponding.

3.03.12 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

3.03.13 Encasing of Structural Steel

This shall be done by building masonry work round flanges, webs etc., and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm.

3.04.00 Damp Proof Course (DPC)

Unless otherwise specified Damp-proof course shall be 40 mm thick 'artificial stone' in proportion 1:1½:3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double chequered and cured by ponding for seven days.

3.05.00 Damp Proof Membrane

Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in 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 consist of laying bricks in cement mortar 1:6 (1 cement: 6 sand) over a 75mm thick bed of dry graded brick aggregate, 40mm nominal size, grouted with sand. The top shall be finished with 1:2 cement mortar pointing (1 cement: 2 sand). Plinth protection shall be laid with a minimum outward slope of 1 in 50.

The brick aggregate shall be well graded, broken from well burnt or slightly overbumt and dense brickbats. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt or any other foreign matter.

The ground shall first be prepared to the required slope around the building. The high portions of the ground should be cut down; hollows and depressions filled up to the required level from the excavated earth and rammed so as to give uniform outward slope. The bed shall be watered and rammed with heavy iron square rammers. Surplus earth, if any, shall be disposed off beyond a lead of 50m or as directed by the Engineer.

Over this, 75mm thick bed of aggregate of 40mm nominal size, shall be laid with a minimum outward slope of 1 in 50. Aggregates shall be carefully laid and packed, bigger sized being placed at the bottom. The brick aggregates shall be consolidated dry with heavy iron rammers.

The aggregates shall then be grouted evenly with sand at the rate of 0.6 cubic metre per square metre area, adequately watered to ensure filling of voids by sand and again rammed with heavy iron rammers. The finished surface shall give uniform appearance. After the subgrade has been compacted thoroughly, brick flooring with bricks of specified strength in cement mortar 1:6 (1 cement: 6 sand) shall be laid.

The bricks shall be laid on edge in Diagonal/Herring Bone Bond or other paftem as specified or as directed by the Engineer. Bricks shall be laid on
12mm thick mortar bed and each brick shall be properly bedded and set home by gentle tapping with handle of trowel or wooden mallet. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. On completion of the portion of flooring, the vertical joints shall be fully filled from the top with mortar. The surface shall present a true plain surface with the required slope.

The pointing shall be done in cement mortar 1:2 (1 cement: 2 sand). The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks so as give a smooth appearance. The edges shall be neatly trimmed with a trowel and a straight edge. The mortar shall not spread over surface of the masonry.

Brick flooring & pointing shall be kept wet for a minimum period of seven days. These shall be protected from rain by suitable covering when the mortar is green.

4.00.00 I.S. CODES

Some of the important relevant codes for this section are:

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:

a) Raking out joints for plastering or pointing or finishing the joint flush as the work proceeds.

b) Preparing top sand sides of existing wall for joining old with new work.

c) Providing, dismantling and removing the scaffolding.

Unit rate for DPC shall be inclusive of formwork and bitumen painting.

5.02.00 Measurement

Brickwork in wall of half brick thickness shall be measured separately in Sqm stating the wall thickness and more than half brick thickness shall be measured by volume. Plaster thickness shall not be considered for computation of volume.

Masonry work in sub structure and super structure shall be measured separately, unless otherwise specified in the Schedule of items.

No deductions shall be made and no extra payment shall be made for following:

a) Opening upto 0.1 Sqm each in area. In calculating the area of the opening lintels or sills shall be included along with the size of the opening.

b) Drainage holes and recesses for cement blocks to embed holdfasts for doors, windows etc.

c) Pipe and fixtures upto 300mm dia. and nothing extra shall be paid for the mortar used for fixing.

d) Ends of dissimilar materials (i.e. joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc); up to 0.1 sqm in section;

e) Chases of section not exceeding 50 cm in girth;

f) Iron fixtures, such as wall ties and hold fasts for doors and windows;

g) Cement concrete blocks as fcr hold fasts and holding down bolts;

h) Wall plates, bed plaros, and bearing of slabs, CHAJJAS and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;

Reinforcement in masonry work shall be paid separately under respective items.

Damp proof course shall be measured in Sqm. No deduction shall be made and no extra shall be paid for opening upto 0.1 Sqm in area.

Plinth protection shall be measured under respective item of works executed required for completion of the work as specified.

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FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-999-600-C010-TBG

Bharat Heavy Electricals Limited

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

Noida (U.P.)·201301

C O N T E N T

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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

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.

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

Engineer.

g) Textured Finish

Mortar consisting of 1 part cement and 3 parts sand by volume shall be
applied in a manner as specified under "Plastering" Clause 2.2.2 Ornamental treatments in the form of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

h) Sand Faced Plaster

The plaster shall be applied in 2 coats. The first coat or the scratch coat should be approximately 14mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows, etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The mortar proportion for this scratch coat shall be as specified in the respective item or work. The scratch coat shall be cured for at least 7 days
& then allowed to dry. The second coat shall be 6mm thick and it shall not be applied until at least 10 days have elapsed after the application of scratch coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation & without joints; finish shall be straight, true, & even. The mortar of this coat shall be as specified under the respective item of work. White sand for finish shall be used for the second coat & for finishing work. Sand for finish shall be of even coarse size & shall be dashed on the surface & sponged.

2.02.04 Curing

All plastered surfaces after laying shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

2.03.00 Pointing to masonry

All Joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand

the drawings. Any surplus mortar shall be scalped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.04.00 Plaster with Metal Lath

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two-layers. The mortar for plastering shall consist of 1 part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.02.01. The application, finish etc. shall be as specified under relevant clause above. Where called for a 2 mm Plaster of Paris punting shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

2.05.00 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The punting shall be applied by skilled workman and given a smooth and ever finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.06.00 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. areas and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.07.00 Stone Facing

Stone facing where specified shall be done as shown on design drawings and

approved shop drawings. The stone shall be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawings for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodible anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanized (weight of zinc coating shall. not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer.

The completed surface shall be neat, or uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings.

3.00.00 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

4.00.00 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.

TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall also include providing, dismantling and removing of scaffolding, surface preparation, curing and all type of surface, shapes/ profiles and at all elevations.

5.02.00 Measurement

All plastering shall be measured net (on surface area on which it is applied) in Sqm. Plaster work shall be classified according to the type used and shall be measured separately. Plaster on ceiling and walls shall be measured separately. Soffits of stairs shall measured as plastering on ceiling.

No deduction shall be made for opening not exceeding 0.5 Sqm and for ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sills of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.

VOLUME: II B

SECTION - D

SUB-SECTION — D11

PAINTING, WHITEWASHING, POLISHING

SPECIFICATION NO. PE-TS-999-600-C011-TBG

Bharat Heavy Electricals Limited

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

Noida (U.P.)·201301

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA AND TESTING	10
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5.00.00	RATES AND MEASUREMENTS	12

PAINTING, WHITE WASHING, POLISHING, ETC.

1.00.00 SCOPE

This section covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster of paris, false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items.

Copper, bronze, chromium plate, Nickel, stainless steel and aluminium shall generally not be painted or finished except if otherwise specified.

Before commencing painting, the Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage; disfiguration or staining to work of other trades or other installations.

2.00.00 INSTALLATION

2.00.01 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade is obtained from the same manufacturing batch. Each and every supply of primer, finish paint etc. shall be accompanied by manufacturer's test certificate. All paint shall be subject to analysis from random samples taken at site from painters bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finished coats to be applied.

All unspecified materials such as snellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

a) White Wash/Colour Wash

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the engineer, and shall conform to IS: 712 latest editions. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 liters of white wash water and a little of indigo or synthetic ultramarine blue shall be added to the lime. Mineral colour not affected by lime shall be added to white wash to get the required tint/shade approved by the Engineer.

b) Dry distemper

Shall be made from suitable pigments, extenders, lime proof tinters, water-soluble binders etc. and share conform to IS: 427. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacture. Only sufficient quantity of distemper required for a day's work shall be prepared.

c) Oil Bound Washable Distemper

Shall be of oil emulsion type containing suitable preservatives and shall conform to IS: 428. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

d) Waterproof Cement Paint

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS: 5410.

e) Acrylic Emulsion Paint

Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide conforming to IS: 5411 (Part-1). It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild soap and water without any deterioration in colour, or without showing flaking, blistering, or peeling.

f) Synthetic Enamel Paint

Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and resist interior surfaces. White and pastel shades shall not yellowing and darkening with aging. The paint shall conform to IS: 2932 and IS: 2933.

g) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

h) Varnishing

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

i) French Polish

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well known approved manufacturer. The material shall conform to IS: 348.

French polish shall not be used on bare wood it shall only be used as finishing coat on wood after the woods pretreated with a liquid wood filler conforming to IS: 345 is applied and rubbed out.

j) Bitumen paint (black bituminous anti-corrosive paint)

Bitumen based anti-corrosive paint conforming to IS: 158 shall be used.

2.00.02 Storage

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement, & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

2.01.00 Preparation of surface

Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.

2.01.02 Wood

All surfaces shall be free from, dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellace coating applied thinly & extended 25 mm beyond the area. All large, loose, or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS: 2338.

2.01.02 Masonry, Concrete, and Plastered Surface

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint, or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from, the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with **Mildew or Efflorescence** shall be treated as below:

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80ml liquor ammonia and diluted to water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.01.03 Metal

The surface preparation shall be done in accordance with IS:1477(Part-1) 'Code of practice for painting of ferrous metals in building' and as directed by Engineer. All metal surfaces shall be absolutely clean, dry, and free from rust, scales, weld slag, flux deposit, wax, grease, dried soap films, foreign matters like cement mortar etc and free from existing loose red oxide zinc chromate primer and should be removed by means of wire brushes, hand scrappers, sand paper, emery cloth, emery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanized iron surfaces shall be pretreated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. The actual painting work should be commenced only after obtaining clearance from the Engineer regarding proper cleaning of the surface.

2.02.00 Application

2.02.01 General

The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints.

Proper tools and implements shall be used. Scaffoldings used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor notes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to free of sags, runs, crawls, or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoat for painting shall be applied by brush only, and rollers spray equipments etc. shall not be used.

No work shall be done under conditions that are unsuitable production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint, which seals the surfaces to moisture shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered property by applying the specified number of coats, further coats shall be applied by the Contractor when so desired by the Engineer.

All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

Painting on ferrous metal surface shall, be done as per IS: 1477 (Part I & 2). The total dry thickness of film should not be less than 120 Micron.

2.02.02 White Washing

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before white washing.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required the Contractor shall do so without any extra cost to the Owner. No brush marks shall show on the finished surface.

2.02.03 Dry Distemper

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1 part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement-plastered surface, the surface shall be washed with solution of 100 gms. of zinc sulphate to 1 litre of water and allowed to dry.

Dry distempering shall be done as per manufacturers instruction. In applying the distempers the brush, should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long, otherwise brush marks may result.

2.02.04 Oil bound washable distemper

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.

2.02.05 Waterproof Cement Paint

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

2.02.06 Acrylic Emulsion Paint

Paint shall be applied after providing one coat of cement primer solvent of approved quality and primer shall be conform to IS: 109. Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be done strictly as per manufacturer's specification.

2.02.07 Synthetic Enamel Paint

Shall be applied on properly primered surface. Subsequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.02.08 Aluminium Paint

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.02.09 Clear Synthetic Varnish

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on white the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has begun to set shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flatting varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

2.02.10 French polish

All unevenness of the surface shall be rubbed down to smoothness with sand paper and the surface shall well dusted .The pores in the shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt siemme or umber.

After application of the filler paste, the French polish shall be applied with a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for case of application. The surface shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit, and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

2.02.11 Chemical Resistant Paint

For chemical resistant paints, epoxy, chlorinated rubber, or vinyl butryl paint system shall be used. Manufacturer's recommendation shall be followed regarding the paint system, exposed to moderately to severe corrosive condition and subject to acid/alkali spillage & fumes, shall be followed.

2.03.00 Protection

Furniture and other movable objects, equipment, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipment shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.04.00 Cleaning up

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

3.00.00 ACCEPTANCE CRITERIA AND TESTING

a) All painted surfaces shall be uniform and pleasing in appearance.

b) All varnished surfaces shall be of uniform texture and high glossy finish.

c) The colour, texture etc. shall match exactly with those of approved samples.

d) All stains, splashes, and splatters of paints and varnishes shall be removed from surrounding surfaces.

Testing

a) As, each part of the work is under progress, i.e. preparation of surface, providing primer, providing different coats of finishing paints, it shall be passed by the Engineer. Variation from the drawings or specification or standard etc. shall not be accepted. The Contractor shall ascertain from the Engineer as to which parts will be inspected and passed from time to time. The Contractor shall provide all necessary arrangement for inspection of the painting work during its different working phase. The Contractor shall provide necessary scaffolding, approach for inspection of the above as per direction and satisfaction of the Engineer. All the necessary cost for scaffolding, approach, platform, lighting arrangement testing and inspection shall be borne by the Contractor. Such inspection and testing will not, however, exonerate the Contractor from his responsibilities for proper workmanship, material etc.

b) The Contractor shall carry out all sampling and necessary testing in accordance with the relevant Indian Standards and shall conduct such tests as called for by the Engineer. Where no specific testing procedure is mentioned in the relevant codes, the tests shall be carried out as per the prevalent accepted Engineering practice as per the direction of the Engineer. Tests shall be done in a laboratory, approved by the Engineer, and cost of testing shall be borne by the contractor.

c) Material/workmanship unsuitable for acceptance shall he removed and replaced by the Contractor. The work shall be redone as per Specification of the contract and direction of the Engineer without extra cost to owner.

4.00.00 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 348	Specification for French polish
IS: 427	Specification for Distemper, dry colour as required.
IS: 428	Specification for Distemper oil emulsion, colour as required.
IS: 1477 (I & II)	Code of Practice for painting of ferrous metal in buildings.

IS: 2338 (I & II)	Code of Practice for finishing of wood and wood based materials.
IS: 2339	Specification for Aluminium, Paints for general purposes in dual containers.
IS: 2395	Code of Practice for painting concrete, masonry, and Plaster surface.
IS: 2932	Specification for enamel, exterior type-1.
IS: 5410	Specification for cement paint, colour as required.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rates for complete items described in the "Schedule of Items".

Rate shall include cleaning, preparation of surface, supply and application of primer, painting and providing all protection and scaffolding required at site.

5.02.00 Measurements

Painting over the concrete/masonry/wooden surface shall be measured net (on the surface area on which it is applied) in Sqm.

No deduction shall be made for opening not exceeding 0.5 Sqm and ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sill of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.

Corrugated surfaces shall be measured flat and measured area shall be increased by 15%.

Painting of structural steel works shall be measured in M.T. of fabricated steel (as per section D-17 clause 6.02.00 i.e Mode of measurement of technical specification for fabrication of structural steel works) unless specified otherwise.

VOLUME: II B

SECTION - D

SUB-SECTION – D16

SPECIFICATION NO. PE-TS-999-600-C016

ROAD AND DRAINAGE

Bharat Heavy Electricals Limited

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

Noida (U.P.)·201301

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.0	CODES AND STANDARDS	4
3.00.0	EXECUTION	7
4.00.00	TESTING AND ACCEPTANCE CRITERIA	36
5.00.00	MEASUREMENT	36

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.

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

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 ± 25mm therefrom. The corresponding tolerance for edges of the roadway and lower layers of the pavement shall be ± 40mm.

b) Longitudinal Profile

The finished levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the engineer and shall not exceed the tolerances as mentioned below.

Sub-grade	± 25 mm
Sub-base	± 20 mm
Base course	± 15 mm
Wearing course	± 10 mm

Tolerance in wearing course shall not be permitted in conjunction with the positive tolerance on base course if the thickness of the wearing course is thereby

reduced by more than 6 mm.

c) Surface Regularity of Sub-grade and Pavement Courses

The surface regularity of the completed sub-base, base course and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table - I. The longitudinal profile shall be checked with a 3m long straight edge at the middle of each traffic lane along a line parallel to the centre of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10m.

TABLE –I

PERMITTED TOLERANCE OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sl. No.	Type of Construction	Longitudinal profile with 3m straight edge					Cross Profile
		Maximum permissible Undulation (mm)	Maximum number of undulations permitted in any 300m length with undulation exceeding (mm)				Maximum permissible variation from specified profile under camber template (mm)
			18	12	10	6	
1	2	3	4	5	6	7	8
1.	Earthen sub-grade	25	30	-	-	-	15
2.	Granular sub-base	15	-	30	-	-	12
3.	Water Bound Macadam with oversize metal (40-90 mm size)	15	-	30	-	-	12
4.	Water Bound Macadam with normal size metal (20-50 mm and 40-63 mm size), Bituminous Penetration Macadam	12	-	-	30	-	8
5.	Surface dressing** (two coat) over WBM (20-50 mm or 40-63 mm size metal), Bituminous penetration macadam	12	-	-	20	-	8
6.	Open graded premix carpet, mix seal Surfacing	10	-	-	-	30	6
7.	Bituminous macadam	10	-	-	-	20***	6
8.	Semi-dense carpet	10	-	-	-	20***	6

9.	Asphaltic Concrete	8	-	-	-	10***	4

Notes:

1. ** For surface dressing in all other cases, the standards of surface evenness will be the same as those for the surface receiving the surface dressing.

2. *** These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance 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 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.

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.

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 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.

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

free from weeds and other undesirable matters. At the time the sod is cut, the grass shall have a length of approximately 50mm and the sod shall be free from any debris.

Thickness of the sod shall be as uniform as possible with about 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that practically all the dense root system of the grass are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than 250mm x 300mm in size but not so large so that it is convenient to handle and transport without damage. During wet weather the sod shall be allowed to dry sufficiently to prevent rearing during handling and during dry weather it shall be watered before lifting to ensure its vitality and to prevent dropping of soil during handling.

3.04.03 Placing The Sods

The area to be sodded shall be previously constructed to the required slope and cross section. Soil in the area shall be loosened, freed from all stones larger than 50mm size, sticks, stumps and any other undesirable foreign matters etc and brought to a reasonably granular texture to a depth not less than 25mm for receiving the sod.

Where required, top soil shall be spread over the slopes. Prior to placing the top soil, the slopes shall be roughened and wetted in order to have a satisfactory bond. The depth of top soil (to be spread) shall be 75mm.

Following soil preparation and top soiling (if required), fertilizer and ground limestone when specified shall be spread uniformly. After spreading, the materials shall be incorporated in the soil by discing or other means. The prepared sod bed shall be moistened if not already sufficiently moist and the sod shall be placed thereon within 24 hours after the same has been cut. Each sod strip shall be laid in close contact with each other and shall be lightly tamped with suitable wooden or metal tampers so as to eliminate air pockets and to press it into the underlying soil. At points where water may flow over the sod, the upper edges of the sod strips shall be turned into the soil below the adjacent area and a layer of earth shall be placed over it followed by thorough compaction.

3.04.04 Staking the Sods

Where the side slope is 2 to 1 or steeper and the distance along the slope is more than 2m, the sods shall be staked with pegs or nails spaced approximately 500 to 1000mm along the longitudinal axis of the sod strips. Stakes shall be driven approximately plumb through the sods and to be almost flushed with them.

3.04.05 Top Dressing

After the sods have been laid in position, the surface shall be cleaned of any loose sod, excess soil and other foreign materials. Thereafter a thin layer of top soil shall be scattered over the top dressed surface and the area shall be thoroughly moistened by sprinkling water.

3.04.06 Watering and Maintenance

The turfing so laid shall be well watered and protected until final acceptance. Watering shall be done in such a way that no erosion or damage to the sodded areas/embankment occur. The Contractor shall erect necessary warning signs and barriers, repair or replace the sods which are failing to show uniform growth of grass or damaged by his operation and shall maintain the sod at his own cost until final acceptance.

3.05.00 Shoulder Construction

3.05.01 Description

This work shall consist of constructing shoulder on either side of the pavement in accordance with the requirements of this specification and in conformity with the lines, grades and cross sections shown on the approved drawings and as directed by the Engineer.

3.05.02 Materials

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

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.

Table - IV
Grading for Granular Sub-base Material

Sieve designation	Percent by weight passing the sieve		
	Grading 1	Grading 2	Grading 3
80 mm 63mm 4.75mm 75 micron	100 90-100 35-70 0-20	100 90-100 40-90 0-25	100 90-100 50-100 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.

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 recompacted.

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.

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 *	IS : 2386 (Part IV)	50 percent maximum
		or		
		Aggregate Impact Value	IS : 2386 (Part IV) or IS : 5640**	40 percent maximum
2.	Base	a) Loss Angeles Abrasion value*	IS : 2386 (Part IV)	50 percent maximum
		or		
		Aggregate Impact Value	IS : 2386 (Part IV) or IS : 5640 **	40 percent maximum
		b) Flakiness Index ***	IS : 2386 (Part I)	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.

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	100
		80 mm	65 - 85
		63 mm	25 - 60
		40 mm	0 - 15
		20 mm	0 - 5
2.	63 mm to 40 mm	80 mm	100
		63 mm	90 - 100
		50 mm	35 - 70
		40 mm	0 - 15
		20 mm	0 - 5
3.	50 mm to 20 mm	63 mm	100
		50 mm	95 - 100
		40 mm	35 - 70
		20 mm	0 - 10
		10 mm	0 - 5

d) Screenings

Screenings to fill the voids in the coarse aggregate shall generally consist of the same material as the coarse aggregates. However where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material is below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 percent.

As far as possible, screenings shall conform to the grading set forth in Table-VII. Screenings of Type-A in Table-VII shall be used with coarse aggregates of Grading-1 in Table-VI. Screenings of Type-A or B shall be used with coarse aggregates of Grading-2. Screenings of Type-B shall be used with coarse aggregates of Grading-3.

Table - VII Grading
For Screenings

Grading classification	Size of screenings	Sieve designation	Percent by weight passing the sieve
A	12.5 mm	12.5 mm	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 done from stockpiles along the side of the roadway or directly from the vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregates nor shall hauling over permitted. The surface of the aggregates spread shall be carefully checked with templates

and all high or low spots remedied by removing or adding aggregates as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregates as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operation.

d) Rolling

Immediately following the spreading of the coarse aggregates, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity or with tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and be indicated by the Engineer.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road. Each pass of the roller shall uniformly overlap not less than one half the width of the track made in the preceding pass.

Rolling shall continue until the aggregates are thoroughly keyed and the creeping of aggregates ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wavelike motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities found shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and rerolled until the entire surface conform to the desired camber and grade. In no case shall the use of screenings be permitted to make up the depressions.

e) Application of Screenings

After the coarse aggregate has been rolled, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreader or directly from trucks. Trucks operating for spreading the screenings shall be so driven as not to disturb the coarse aggregates.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms or hand brooms or with

both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregates.

The spreading, rolling and brooming of screenings shall be carried out in only such lengths of road which could be completed within one day's operation.

f) Sprinkling and Grouting

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to seep the wet screenings into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional screenings applied as necessary until the coarse aggregates are thoroughly keyed, well bonded and firmly set to its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or sub-grade does not get damaged due to the addition of excess quantity of water during construction.

g) Application of Binding Material

After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water and the resulting slurry shall be swept in with hand brooms or mechanical brooms to fill the voids properly and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling the voids form a wave ahead of the wheels of the moving roller.

h) Setting and Drying

After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam is set. The Engineer shall have the discretion to stop hauling traffic from using the complete water bound macadam course if in his opinion it would cause excessive damage to the surface.

3.09.00 Tack Coat

3.09.01 Description

The work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction.

3.09.02 Materials

The binder used for tack coat shall be bitumen of a suitable grade as approved by the Engineer and conforming to 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 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.

Table-IX

Aggregates Grading For 75mm Compacted Thickness of Bituminous Macadam

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
63 mm	100	
50 mm	90 - 100	
40 mm	35 - 65	100
25 mm	20 - 40	70 - 100
20 mm	-	50 - 80
12.5 mm	5 - 20	-
4.75 mm	-	10 - 30
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

Table-X
Aggregates Grading For 50mm Compacted Thickness of Bituminous Macadam

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
50 mm	100	
40 mm	90 - 100	
25 mm	50 - 80	100
20 mm	-	70 -100
12.5 mm	10 - 30	-
10 mm	-	35 - 60
4.75 mm	-	15 - 35
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

c) Proportioning of Materials

The binder content for premixing shall be 3.5 and 4.0 percent by weight of the total mix for aggregate Grading-A and B respectively unless directed otherwise by the Engineer. The quantity of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

d) Variation in Proportioning of Materials

The Contractor shall have the responsibility for ensuring proper proportio ning of materials and producing a uniform mix. A variation in binder content 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.

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.

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.

Table - XI

Quantity of Materials Required For 10 Sq. M of Road Surface For 20mm Thick Open Graded Premix Carpet

Aggregates for Carpet

i) Stone Chippings - 12mm size ; passing 20 mm sieve and retained on 10 mm sieve — 0.18 Cu.m

ii) Stone Chippings - 10 mm size; passing 12.5 mm sieve and retained on 6.3 mm sieve — 0.09 Cu.m

Total — 0. 27 Cu.m

Binder for premixing (quantities in terms of straight run bitumen)

i) For 0. 18 Cu.m of 12 mm size stone Chippings at 52 Kg per Cu.m — 9.5 Kg

ii) For 0.09 Cu. M of 10mm size stone Chippings at 56 Kg per Cu.m — 5.1 Kg

Total — 14.6 Kg

3.11.03 Construction Operation

a) Weather and Seasonal Limitations

Open graded premix carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 Deg. C or below.

b) Preparation of Base

The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with the drawing, specification and as directed by the Engineer. The surface shall be well cleaned by removing caked earth and other foreign matters with wire brushes, sweeping with brooms and finally dusting with sacks as necessary.

c) Tack Coat

A tack coat complying with clause 3.09.00 shall be applied over the base preparatory to laying of the carpet. However application of tack coat shall not be necessary when the laying of carpet follows soon after laying the bituminous course.

d) Preparation of Premix

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer in boilers of suitable design avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. The mixing of binder with chipping shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit if so directed.

e) Spreading and Rolling

The premixed material shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material are laid, rolling shall be commenced with 6 to 8 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 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.

c) Fine Aggregate for Type B Seal Coat

The fine aggregate shall be sand or fine grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky material, organic matter or other deleterious substances. The aggregate shall pass 1.7 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cubic metre per 10 square metre area.

3.12.03 Construction Operations

a) Preparation of Base

The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat, the surface shall be cleaned free of any dust or other extraneous matters.

b) Construction of Type-A Seal Coat

The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer and sprayed on the dry surface in a uniform manner preferably with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the sprayer or through leakage or due to any other reason shall be suitably corrected before the stone chippings are spread.

Immediately after the application of binder, stone chippings in a dry and clean state shall be spread uniformly on the surface preferably by means of a mechanical grittier or otherwise manually so as to cover the surface completely. If necessary the surface shall be broomed to ensure uniform spread of chippings. Immediately after the application of the cover material, the entire surface shall be rolled with a 8 - 10 tonne smooth wheeled roller. Rolling shall commence from the edges and progress towards the centre except in superelevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up the irregularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present an uniform closed surface.

c) Construction of Type-B Seal Coat

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer. Also the aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before the same are placed in the mixer. Mixing of binder with aggregates to the specified proportions shall be continued till the latter is thoroughly coated with the former. The mix shall be immediately

transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed. As soon as sufficient length has been covered with the premixed material, the surface shall be rolled with 6 - 8 tonne smooth wheeled power rollers. Rolling shall be continued till the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

3.12.04 Opening to Traffic

In case of Type-B Seal coat, traffic may be allowed soon after the final rolling when the premixed materials are cooled down to the surrounding temperature. However in case of Type- A seal coat, the traffic shall not be permitted until the following day.

3.13.00 Repair of Existing Water Bound Macadam Surfaces

Pot holes or patches and ruts in the water bound macadam base or surface course which is to be surface treated shall be repaired by removing all loose materials by cutting in rectangular patches and replacing with suitable materials. The repair shall be done as under.

Pot holes, patches and ruts shall be drained of any water and cut to regular shape with vertical sides and then be filled either with i) coarse aggregates and screenings conforming to the specification for water bound macadam and compacted with rollers or other approved rammer etc or with ii) premixed material conforming to the specification for open graded premix carpet and compacted with rollers or other approved means after painting the sides and bottom of the holes with a thin application of bitumen or a combination of both as directed by the Engineer.

3.14.00 Road Side Drains

3.14.01 Drains

The road side drains shall be made in sizes and slopes as shown on the approved drawings. The sides and bottom shall be neatly dressed after excavation. Proper connections shall be made to the culverts outside the plant area as per the drawings and instructions of the Engineer.

The excavated spoils other than that required for backfilling shall be transported and filled in low areas within the plant area or in embankments as instructed by the Engineer. The lining for drains shall be as per the drawings. Lining of drains may be of bricks or cement concrete blocks of specified grade as shown on the approved drawing or as directed by the Engineer. If shown on approved drawing, drains shall be of R.C.C. construction with necessary slopes.

3.15.00 Culverts

Excavation in trenches for foundation of culverts and wing walls shall be done with side slopes as per the drawings and instructions of the Engineer after clearing the site etc. As described in the "Specification for Earthwork in Excavation and Backfilling", backfilling in layers with watering and compaction shall be done after the construction of foundations. The construction of culverts shall be done true to the lines and levels as shown on the drawings. The specification for Masonry and/or Plain and Reinforced Cement concrete shall be followed as applicable.

3.16.00 Pipe Culverts and Drainage Pipes

3.16.01 Materials

The drainage pipes shall be made of R.C.C and shall be either class NP-2 or NP-3 as shown on the approved drawings. Pipe culverts shall be made of reinforced concrete pipe and shall be of class NP4 or RDSO class for railways as shown in the drawing. All pipes shall meet the requirements of 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 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.

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.

VOLUME: II B

SECTION - D

SUB-SECTION — D20

GENERAL MISCELLANEOUS OTHER SPECIFICATION

SPECIFICATION NO. TBG-999-600-C020

Bharat Heavy Electricals Limited

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
Noida (U.P.)·201301

1. STONE SPREADING AND ANTI-WEED TREATMENT

The layout of the area, where anti-weed treatment and stone spreading is to be done, will be provided by the BHEL during detailed engineering. The Contractor shall arrange all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification and direction of the Engineer-In-Charge.

Stone spreading over cement concrete layer shall be done in the areas of the switchyard as per Layout. The material required for site surfacing/stone filling shall be free from all types of organic materials and shall be of standard quality, and as approved by the Engineer-In-Charge.

After all the structures/equipments are erected, antiweed treatment shall be applied in the switchyard where ever cement concrete is to be done and the area shall be thoroughly de-weeded including removal of roots. The recommendation of local agriculture or horticulture department may be sought where ever feasible while choosing the type of chemical to be used.

The antiweed chemical shall be procured from reputed manufacturers. The doses and application of chemical shall be strictly done as per manufacturer's recommendation. Nevertheless the effectiveness of the chemical shall be demonstrated by the Contractor in a test area of 10MX10M (appx) and shall be sprinkled with water at least once in the afternoon every day after forty eight hours of application of chemical. The treated area shall be monitored over a period of two to three weeks for any growth of weeds by the Engineer – in- charge. The final approval shall be given by Engineer – in –charge based on the results.

Engineer-in-charge shall decide final formation level so as to ensure that the site appears uniform devoid of undulations. The final formation level shall however be very close to the formation level indicated in the approved drawing.

After antiweed treatment is complete, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Engineer-in-charge. The sub grade shall be consolidated by using half ton roller/surface vibrator with suitable water sprinkling arrangement to form a smooth and compact surface. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves as an elastic mass.

In areas that are considered by the Engineer-in-Charge to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipments, the material shall be compacted by hand rammer, if necessary. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling / compaction.

The sub grade shall be in moist condition at the time the cement concrete is placed. If necessary, it should be saturated with water for not less than 6 hours but not exceeding 20 hours before placing of cement concrete. If it becomes dry prior to the actual placing of cement concrete, it shall be sprinkled with water and it shall be ensured that no pools of water or soft patches are formed on the surface.

Over the prepared sub grade, 75mm thick base layer of cement concrete in 1:4:8 (1 cement: 4 coarse aggregate: 8 graded stone aggregate 40mm nominal size) shall be provided in the area excluding roads, drains, cable trenches as per detailed engineering drawing. For easy drainage of water, the slope of 1:1000 is to be provided from the ridge to the nearest drain.

A final layer of 100mm thickness of stone aggregate of 40mm nominal size shall be spread uniformly over cement concrete layer after curing is complete.

2. OTHER MISCELLNEOUS CIVIL WORK

Any other work not covered above, technical requirements shall be carried out as per Customer Technical Specification/CPWD specification/IS Codes.



RENOVATION, MODERNISATION AND UPRATING OF

KODAYAR POWER HOUSE - I

FROM 1 X 60MW TO 1 X 70 MW

IN TIRUNELVELI GENERATION CIRCLE

KANYAKUMARI DISTRICT, TAMILNADU, INDIA

INTERNATIONAL COMPETITIVE BIDDING

TENDER SPECIFICATION NO. HE – 2367

VOLUME II OF IV

TECHNICAL SPECIFICATION-
MECHANICAL & CIVIL

OFFICE OF THE
SUPERINTENDING ENGINEER
HYDRO (ELECTRICAL)
5th FLOOR, EASTERN WING
NPKRR MAALIGAI,
144, ANNA SALAI, CHENNAI - 600 002.



TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD
RENOVATION, MODERNISATION & UPRATING OF
KODAYAR POWER HOUSE-I FROM 1x60MW TO 1x70MW
TECHNICAL SPECIFICATION - VOL-II - MECHANICAL & CIVIL

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TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD
RENOVATION, MODERNISATION & UPRATING OF KODAYAR POWER HOUSE-I FROM 1x60MW TO 1x70MW
TECHNICAL SPECIFICATION - VOL-II - MECHANICAL & CIVIL

01. PREAMBLE

i. This specification shall be read in conjunction with the general conditions, other technical details as provided in Vol. I, II, III and the drawings in Vol-IV. This volume deals with the specification for Mechanical & Civil works including Dismantling of TG and all equipment, Renovation of embedded parts, Supply of Turbine, Governing system, Generator, Excitation System, Mechanical Auxiliaries and Civil works on Turnkey Installation for Renovation, Modernisation & Uprating with new Turbine-Generator from 1x60MW to 1x70MW of Kodayar Power House-I, Kodayar in Kanyakumari District of Tamilnadu.

ii. Electrics and Control & Instrumentation (C&I) including Generator CT, PT, LA, NGTR, Generator Transformer, Auxiliary transformers, switchyard equipment and C&I, etc., are covered under Vol. III of the Tender Specification.

02. INTENT OF SPECIFICATION

a) This specification is intended to familiarise the tenderer with the scope of work & services and technical requirements of the subject work. The Tenderer shall study the specification and satisfy himself regarding the workability of the proposed system and shall take full responsibility for the design and engineering of the system & equipment, quality of material, workmanship, guaranteed operation and smooth performance of the system & equipment.

b) If the tenderer wishes to deviate from this specification, the same shall be clearly brought out with justification in the format provided. However, reduction / change in scope will not be entertained.

03. SPECIAL INSTRUCTIONS TO TENDERERS

a) This technical specification (TS) is intended to provide general guidance to the tenderer. All such items, even though not specifically mentioned in this TS, but considered necessary for safe & satisfactory operation and guaranteed performance of the offered system & equipment, shall be considered included in the offer.

b) The tenderer shall visit and carefully examine the site and surroundings to satisfy himself about the nature and condition of all existing facilities, general site condition etc. and all other matters affecting the works. Claim and objection due to ignorance of site condition shall not be considered after submission of offer.

c) All equipment, system and works covered under this specification shall comply with all latest statutes, regulations and safety codes as applicable at Kodayar, Kanyakumari District, Tamilnadu, India. All systems and equipment shall comply in all respects with the requirements of the latest editions of the related IS, IEC, IEEE, VDE, DIN, JIS or any other approved international codes and standards. The electrical equipment shall also conform to the latest Indian Electricity rules, Electricity Act as well as Tamilnadu State Government rules.

d) Other standards are acceptable if they are established to be approved equal or superior to the listed standards subject to approval by the TANGEDCO/Purchaser. The tenderers shall provide English version of the codes and standards applicable.

e) Proposals not meeting the above stipulations of the codes and standards may not be acceptable.

f) The successful tenderer shall study the quality of water at site for suitable design of submerged components of the turbine and material shall be so selected that cavitation and corrosion are minimised.

g) Special instructions indicated in Vol III are complimentary to the above mentioned instructions and tenderer to consider all instructions as a whole.

04. GENERAL TECHNICAL RULES

04.01 INTRODUCTION

a) This part of the specification describes the general technical rules to be followed while carrying out the work of Renovation, Modernisation & Uprating with new Turbine-Generator from 1x60MW to 1x70 MW of Kodayar Power House-I, Kodayar in Kanyakumari District of Tamilnadu. The technical requirements for electrical and Control & instrumentation work are described in volume III of the Tender Specification.

b) The purpose of this `General Technical Rules' is to provide the Tenderer with certain general information on the location and conditions existing at site and to lay down common guidelines and specifications which the Tenderer shall follow in designing the plant and execution of work. Adherence to the `General Technical Rules' shall, however, not relieve the Tenderer of his responsibility regarding type, quality of materials, workmanship and requirement as specified by the TANGEDCO/Purchaser under `Technical Specifications' `Invitation to Tender' and `Draft Contract'.

c) The Tenderer shall satisfy himself regarding the site conditions and other relevant matters by visiting site. It is desirable, for compelling reasons, to deviate from these instructions; he is required to obtain prior approval from the TANGEDCO/Purchaser.

d) All equipment to be supplied and/or engineering services and technical services to be rendered shall be manufactured/executed in accordance with the best trade/ engineering practices judged by the established standards and as given in the Technical Specification. Wherever the codes are not mentioned the best international standards to be approved by the TANGEDCO/Purchaser shall be followed.

e) Any supplies and services which might have not been specifically mentioned in the Technical Specification, but are necessary for efficient and smooth operation and maintenance of the work under Indian conditions, unless expressly excluded from the scope of supplies and services shall be supplied/ provided by the successful Tenderer without any extra cost to the TANGEDCO/Purchaser.

04.02 PLANT AND EQUIPMENT

04.02.01 GENERAL

a) The selection, design and manufacture/fabrication of plant and equipment shall be suitable for the intended service and duty conditions and ensure maximum interchangeability of components and least maintenance. The unit shall be complete in all respect.

b) All the equipment, technological structures, pipes, valves, fittings, etc shall be subjected to inspection and testing as per accepted national or international standards and practices. All the components shall be subjected to inspection and testing as per standard practices of the manufacturer prior to offering them for inspection by the Purchaser /his authorised representative.

c) All equipment shall be complete with approved safety devices, wherever a potential hazard to personnel and or equipment exists. There shall be adequate provision for safe access of personnel to and around the equipment for operational and maintenance functions.

d) All equipment shall be complete in all respect including all accessories essential for proper installation, operation and maintenance irrespective of whether such items are specifically mentioned in the specifications or not.

e) All working parts shall be arranged for convenience of operation, inspection, lubrication and ease of repair and replacement of parts and sub- assemblies with minimum downtime.

f) Suitable working platforms, walkways, ladders lifting tackles and tools required for the above shall be provided.

g) The fabrication and assembly areas shall be kept clean and free from contamination. During assembly of major components, a polythene covering shall be maintained in position to prevent ingress of dirt, grease, etc from overhead cranes or other equipment.

h) During fabrication, equipment, pipes, etc shall be kept sealed to the extent possible to avoid entry of foreign matter and contamination by dirt.

i) Piping shall be degreased after fabrication and maintained sealed until the end is presented for welding or jointing.

j) All equipment shall be visually inspected in the presence of an inspector immediately before closure. A system of physical identification and accountability shall be used to account for all tools, test equipment, shipping blanks and other items used during assembly to obviate the possibility of their being left inside vessels or equipment.

k) On completion of manufacture, each pressure vessel shall be pressure tested at room

temperature in accordance with the appropriate code. The test fluid used for pneumatic test shall be dry and oil free compressed air. Leaks shall be detected by use of water solution of inhibited detergent.

l) On completion of construction, the entire assembly shall be leak tested as above. The detergent shall be washed off with clean water on completion of test before insulation work.

04.02.02 DESIGN CONSIDERATIONS

a) Life of the Electro-mechanical generating equipment i.e., turbine, generator, transformers, auxiliaries etc. shall not be less than thirty five (35) years.

b) The Unit shall be designed for unconstrained operation over maximum net head and minimum net head and full range of ambient and other environmental conditions. The turbine centre line level shall be as available and indicated in Ch-6. Speed rise, pressure rise, run away speed shall be governed by the limits specified in relevant IS.

c) Chemical analysis of water and data including the petro graphic analysis shall be taken into consideration while designing the turbine and other auxiliary equipment susceptible to abrasive effects of silt. Suitable materials, protective coatings and painting shall be provided to resist silt abrasion as per site conditions.

d) The operation of the each Unit shall be smooth and quiet. The noise level shall not be more than 90 dBA at a distance of 1metre from any equipment.

04.02.03 LAYOUT CONSIDERATIONS

a) Layout of equipment shall be developed considering the proper utilisation of space, functional requirements, and future extensions. The equipment layout shall be compact so as to economise use of materials.

b) Maintenance facilities shall be provided as required for assembly, disassembly and handling during maintenance of all equipment and auxiliaries.

04.02.04 OPERATING CAPABILITY OF THE GENERATING UNIT

a. The Unit shall be capable of giving the rated output continuously as specified by the manufacturer at the rated design head and rated discharge and shall be capable of operating between the minimum and maximum head specified in this specification (Vol-II) and ambient temperature at site specified.

b. The maximum continuous over load capacity of the units at the generator terminals during the high head conditions or high discharge conditions or both as guaranteed by the manufacturer shall be based on the hydraulic parameter of the station.

c. The Units and associated auxiliaries shall be suitable for continuous operation without any restriction within a frequency range of -5% to +3% (47.5Hz to 51.5 Hz). All the equipment driven by the electric motors shall give their rated performance even at a power supply frequency of 47.5 Hz.

d. Provision shall be made for starting the Unit in auto mode up to synchronisation by a single command and loading of the unit to full load quickly. The design of the equipment and control system shall permit participation of the units in auto frequency control mode.

e. The Unit and all its associated auxiliaries shall be designed for trouble free operation up to maximum rating of the units for complete range of operation for active power and reactive power output.

f. The redundancy in the Units auxiliaries and station equipment shall be provided so that the generating unit continues to operate even in the event of outage of a part of the auxiliary system.

04.03 MANUFACTURING AND FABRICATION

04.03.01 GENERAL

a) All forgings, castings and structural materials shall conform to the relevant BIS/ International standards.

b) Special non-ferrous materials required for manufacturing parts subject to heavy pressure, severe working conditions, and/or requiring high tensile strength, toughness and resistance to corrosion shall be used.

c) Bronze used for manufacturing parts such as bearings, shall preferably be forged or centrifugally cast.

04.03.02 WORKING STRESSES

a. For rotating parts the units stresses due to run away speed of turbine shall not exceed two third of the yield strength of the material of construction.

b. For other material used in the manufacture of the generator and exciter, etc, the maximum stresses due to the most severe operating condition shall not exceed one third of the yield point nor one fifth of the ultimate strength of the materials. For temporary over loads, units stress not exceeding one half of the yield point stress will be permitted.

04.03.03 BEARINGS

All parts subject to reciprocal motion and rubbing against other parts, shall be provided with bronze or other suitable liners to minimise wear. The liners shall conform to IS:318 or as detailed against the particular equipment capable of being adjusted to compensate for wear. All rotating parts supported on frames shall have proper bearings depending upon speed, torque, load condition, etc.

04.03.04 MACHINE FRAMES AND BASES

a) All machines bases shall be designed for maximum strength and rigidity consistent with good design.

b) Base plates shall be of welded steel construction. Those shall be designed with sufficient depth and stiffness to ensure rigidity of assembly.

c) If bases are made of two or more parts to make up height, locating pins shall be provided. Machined bolts shall be used in drilled and reamed holes for connecting the parts.

d) The machine frames shall have suitable eye bolts or hooks in requisite numbers for lifting purposes during erection and maintenance.

04.03.05 NUTS, BOLTS, STUDS AND WASHERS

a. Machining and manufacturing of all the nuts, bolts, studs and washers shall conform to International Standards.

b. Nuts and bolts for pressure parts shall be of the best quality steel.

c. Nuts, bolts and studs shall be of materials most suitable for the service operating conditions and designed to ensure the stresses arising in normal operation. For bolts used in critical areas the contractor shall provide the following details :

   i) Allowable elongation
   ii) Recommended torque

d. Fitted bolts shall be a close fit in the reamed holes they occupy, and shall be marked in a conspicuous position to ensure correct assembly.

e. The threaded portion of any bolt or stud shall not project more than 1.5 threads above the surface of its mating nut.

f. Where practicable the use of slotted head screws shall be avoided in machinery component assemblies, hexagon socketed screws being preferred.

04.03.06 STEEL FORGING

a) The successful Tenderer shall supply a list of all important forgings and draw up material specification for each one. Copies of this list and specifications shall be supplied to the Purchaser for his use. In each case the quality and inspection requirements shall be clearly stated.

b) Whenever possible steel forgings shall be in accordance with the requirements of International Standards. Forgings shall be free from cracks externally or internally, extensive non-metallic inclusions and surface defects. The successful Tenderer shall carry out non- destructive testing of forgings during machining to verify that no unacceptable defects are present.

c) Repairs by welding or other means shall not be undertaken on forgings at any stage of the production cycle.

d) Each forging shall be suitably branded with an identification number which shall be transferred throughout all final machining stages. The identification number shall be marked on all documents and test certificates relative to the forging.

04.03.07 CASTINGS

04.03.07.01 GENERAL

All castings shall be homogeneous, free of shrinkage, under sizing, porosity or voids. Welding, filling, interlocking or plugging of defective parts shall be done with the approval of Purchaser in writing. All repairs shall be subjected to non- destructive examination after heat treatment.

04.03.07.02 STEEL CASTINGS

a. The successful Tenderer shall prepare material purchasing specifications for all important castings. Each document shall indicate fully the quality and inspection requirements for the component casting covered. Copies of the Specification shall be issued to Purchaser for his use.

b. Castings may be repaired by welding provided written approval of the Purchaser is obtained in advance. The successful Tenderer shall submit drawings, sketches or photographs showing the location and principal dimensions of the defects together with the proposed weld repair procedure.

c. Only welders who have passed an appropriate qualification test shall be employed on the repair of castings. All repairs shall be carried out by the metal arc process.

d. Ultrasonic inspection shall be applied to all important castings to locate the extent of sub-surface defects and to check the wall thickness.

e. All castings shall be identified by stamped, or cast-on reference marks which shall be entered on all relevant documents and test certificates.

f. The Purchaser may require that certain castings shall be examined using radiographic inspection.

04.03.07.03 CAST IRON CASTINGS

Cast iron shall not be used for any part of equipment which is in tension or which is subjected to impact.

04.03.07.04 ALUMINIUM BRONZE CASTINGS

The successful Tenderer shall prepare material purchasing specifications for all important aluminium bronze castings. Each document shall indicate fully the quality and inspection requirements for the component casting covered. Copies of the Specification shall be issued to the Purchaser for his use. The inspection and quality requirements shall include an analysis of each cast, mechanical testing of test bars from each cast, pressure testing, penetrant flaw detection and radiographic examination of selected critical areas.

04.03.08 HYDRAULIC SYSTEM

a) Hydraulic systems required for various units referred herein generally cover the following:
b) Hydraulic fluid reservoir, pumps of various kinds, valves, accumulators, Hydraulic cylinders, oil coolers, Hydraulic motors, various accessories such as filter, strainers, hydraulic pipe work, fittings, flexible hose supporter for equipment, sealing devices, instruments for indicating, recording and integration of various parameters such as pressure, temperature, velocity etc., control devices for manual and automatic operation of the system, safety devices and alarms for abnormal operating condition, interlocks for sequencing and safe operation.

c) Hydraulic fluids shall be used on the basis of proven performance, operating condition, operating costs and easy availability.

d) The Hydraulic power system shall be suitable in every way for the service intended and shall be oriented forwards maximum interchangeability of component and minimising maintenance.

e) Hydraulic systems shall have filters at various points with adequate capacity and necessary filtration rating so as to keep the hydraulic fluid within permissible limits of contamination to achieve maximum life of the components.

f) Each hydraulic circuit shall be designed to minimise surge pressures, etc.

g) The hydraulic system shall be designed taking into account the maximum pressure encountered. Also one must ensure while designing the system that the components of

hydraulic systems are compatible with the hydraulic fluid selected at operating condition in the plant and under atmospheric conditions prevalent at Kodayar Power House-I. The hydraulic units shall be of standard make.

04.03.09 LUBRICATION

a) The successful Tenderer shall provide for proper lubrication systems for all moving parts of the equipment supplied.

b) All oil lubrication systems shall preferably be of circulating type complete with oil reservoir, pumps with motors, filter pressure vessels, pressure regulators, heat exchangers, oil heater, temperature controllers etc., flow switches, level switches, pressure gauges, pressure switches, temperature gauges, oil flow indicators, etc. The oil tanks shall have adequate capacity so as the return oil de aerates, gives away heat picked up from lubricating points before again being pumped.

c) Wherever there is chance of water ingress into the oil lubrication system, the provision for water detection/removal shall be provided.

d) The selection/design and construction shall be suitable in every way for the service intended and shall be oriented towards maximising interchange- ability of components and minimising maintenance.

04.03.10 OPTIMISATION OF INDIAN SUPPLIES & SERVICES

The successful Tenderer shall make all efforts to optimise the supplies and services from Indian sources and shall, however, ensure that the performance of the plant and equipment are achieved as envisaged in the Technical Specification.

04.03.11 PUMPS

Centrifugal pumps shall be provided unless technical or strong economic reasons dictate that a positive displacement, either rotary or reciprocating is more appropriate.

04.03.12 VALVES

04.03.12.01 GENERAL

a) All valves shall be suitable for the service conditions under which they are required to operate. The design, construction and choice of material shall take into account all operational requirements.

b) A complete valve schedule for each pipe work system shall be provided during the contract engineering, in accordance with the specified format.

c) Parallel slide, butterfly or gate valves may be used for air, water services, and sluice valves for low head applications.

d) Any valve which is designed for uni- directional flow shall have an arrow embossed or cast on the valve body clearly indicating the required flow direction.

e) All valves, unless otherwise approved or specified, shall be of the external rising spindle type. Where desirable to protect the spindle against ingress of dirt, or where the position of the valve may create a hazard to operators when the spindle is extended, suitable spindle covers shall be provided. The spindles and operating gear of all valves for use outdoors shall have weather and dust proof protection.

f) Special attention shall be given to the operating mechanism and correct lubrication of all valves to ensure a minimum of maintenance and ease of operation.

g) All valves shall be positioned so as to be readily accessible for operation and maintenance from permanent floors, galleries or access platforms.

h) Eye bolts or similar facilities shall be provided, where necessary, to facilitate the handling of heavy valves or components.

i) When valves are required to be locked in position for operation they shall be provided with a chain, padlock with three keys or other secure locking device.

j) All valves shall be provided with labels or nameplates.

k) Within 2 months of award of Contract, a valve numbering scheme to cover the complete Contract Works shall be agreed. After approval of the numbering scheme, the successful Tenderer shall draw up a valve schedule to cover the Contract Works. The scheduled details of each valve shall include the valve number, its title as it appears on the valve label, the nominal size of the valve, its design pressure and temperature, the Manufacturer's name and model number and a brief description of the valve material. The valve schedule shall be subject to the Purchaser's approval.

04.03.12.02 BUTTERFLY VALVES FOR AUXILIARIES.

a. The valve must be capable of positive shut-off in both directions against full system pressure. Unless an alternative type is proposed by the successful Tenderer and approved by the Purchaser as being fully suitable for the particular duty, the seating of the disc shall be positive (that is, the disc must not be capable of passing through the shut position); a stop fitted on the actuator/ operating lever is not adequate for this purpose.

b. Internal shaft bearings must be capable of opening dry, that is, not dependent on the presence fluid.

c. Each valves body shall be of best quality cast iron conforming to approved standards with a

closure seating of bronze or stainless steel, or resilient seal material. The valve disc shall be of high quality cast iron with seat facing or bronze or stainless steel which may also include the resilient seal material. Shaft bearings shall preferably be of self-lubricating type, with "O" ring seals.

d. The actual position of the valve disc shall be clearly shown by an external indicator. Beside mechanical operation tests, each valve shall be subjected to a body pressure/leakage test and disc strength test.

04.03.12.03 GLOBE VALVES

a) Globe valves shall generally be used for regulating purposes. An arrow indicating the direction of flow through the valve shall be clearly cast or embossed on the body of each valve.

b) Globe valves shall comply with IS:778-1984, R'90 or IS 2906 or equivalent as might be applicable to the particular installation requirement.

04.03.12.04 GATE AND SLUICE VALVES:

Gate and sluice valve shall conform to IS : 780 - 1984, R'90 or IS: 2906. Gate valves shall be used generally for isolating purposes. The valves shall be of the full way open type unless approved to the contrary and when in the full open position the bore of the valve shall not be obstructed.

04.03.12.05 SAFETY RELIEF VALVES:

Safety relief valves shall be of the spring-loaded type unless otherwise specified, or unless the Purchaser has given written permission for the use of a different type of valve actuation.

04.03.12.06 FLOAT VALVES

a. Float valves should be of the equilibrium ball float type. Floats for cold water duty shall be plastic, of a grade that does not deteriorate in sunlight, and for hot water duty be copper. All operating rods, guides, brackets and covers shall be of non-ferrous material.

b. Float valves operating in liquids other than fresh water shall be of materials to the Purchaser's approval. The float valves shall comply with international standards. Float valves shall be complete with float rods and guides together with covers and brackets where required.

04.03.12.07 NON RETURN VALVES

a) Non-Return Valves shall conform to IS : 5312

b) All non-return valves shall be provided with means of draining the space between the valve and its adjacent isolating valve. The design shall preclude the possibility of the valve jamming in the open position; the effect of solid particles settling- out in dead spaces within the valve should be recognized in this respect. Where screw-down non- return valves are supplied, they shall provide a demonstrable leak-tight joint.

c) Where applicable, check and non-return valves shall have an arrow cast or embossed on the side of the valve body to indicate the direction of flow.

04.02.12.08 MOTORISED VALVES

a. Valves, dampers and similar devices requiring abnormal physical effort to operate or high speed operation, shall be provided with powered actuation. Hand operating equipment shall also be fitted for closing and opening, which is effectively decoupled during power operation.

b. The following criteria are preferred in the selection of the power source for the servo mechanism

- isolation and other duties not subject to operation more than once in 10 minutes - electrical, compressed air.
- continuous or intermittent modulation - compressed air, or hydraulic fluid. Modulating Electrical Actuators shall be to the Purchaser's approval.
- continuous or intermittent modulation involving heavy control forces likely to produce fluttering or hunting-hydraulic fluid, electrical.
- emergency control or isolating duties - compressed air, spring loaded, or hydraulic fluid with sufficient reservoir capacity to complete the operation without an external source.

c. Electric actuators for on/off duties shall be fitted with travel limiting devices capable of accurate and positive adjustment. Torque limiting or other devices shall be provided to prevent damage to the mechanism in the event of jamming of the driven device.

d. All powered valve or damper mechanisms shall be provided with accurate indication of the position of the driven device.

04.03.12.09 HAND OPERATION REQUIREMENTS

a. Where required, valve spindle shall be lengthened so that the hand wheel shall be at a height approximately one meter above the level of the floor or platform from which the valve is to be operated and where necessary they shall be provided with pedestals of rigid construction. All thrusts when opening or closing the valve shall be taken directly on the valve body. Pedestal hand wheels or valve tables shall be provided at a convenient operating floor or intermediate floor level. Such pedestals and valve tables shall be

mounted direct on floors or steel members and not on floor grills or plating.

b. All valve hand operating mechanisms shall be easily operable by one person. Special attention shall be given to the operating mechanism for large size valves with a view to ensuring that a minimum of maintenance is required and to obtaining quick and easy operation.

c. All gate, globe and screw down non-return valves shall be of the non-rising hand wheel pattern unless specifically approved by the Purchaser.

d. All valves shall be closed by rotating the hand wheels in a clockwise direction when looking at the face of the hand wheel. In cases where the hand wheel is not directly attached to the valve spindle suitable gearing shall be introduced to ensure clockwise closing. The face of each hand wheel shall be clearly marked "open" or "closed" with arrows indicating the direction of rotation to which they refer.

e. Plastic valve hand wheels will not be acceptable, except where such hand wheels are in the Purchaser's best interests. All valve spindles shall be fitted with indicators so that the valve opening can be readily determined. In the case of valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.

04.03.13 PIPE WORK

a. Before the award of the contract, the successful Tenderer shall supply to the Purchaser schedules of the pipe work to be provided under this Contract. These schedules shall state, for each pipe work system or parts of a pipe work system, the design and operating pressures and temperatures, the fluid transmitted, the piping and valve materials, the types of valves, any corrosion allowances, the pipe work design code, insulation proposals, pipe supports and any other data relevant to the mechanical design of the pipe work system or part of a pipe work system.

b. All piping shall be routed to provide a neat and economical layout and requiring the minimum number of fittings. Piping shall be arranged so that full access is provided for the operation and maintenance of equipment and that removal or replacement of equipment can be achieved with the minimum dismantling of piping.

c. In specification the term "high pressure" refers to where the design pressure exceeds 20 bar.

d. The tenderer has to follow relevant standard for material of all pipes suitable for working pressure if not specified in the specification. However, approval for the same will be required from Purchaser.

e. The steels shall be suitable to withstand the temperature and pressure conditions involved in the operation of the plant under all circumstances. No piping less than 20 mm nominal bore shall be used except for instrument services or services specifically approved by the

Purchaser.

f. In any one system or pipe service all pipe work and fittings shall be of the same material or similar analysis unless specified or agreed to by the Purchaser.

g. The number of joints shall be kept to a minimum necessary for efficient maintenance of the plant. Tees and bends shall be to standard dimensions. Bends shall be of the pulled type or forged. Hot bending with packing may be used for larger sizes according to facilities available, but hot bends in alloy or stainless steels may only be made after permission has been given by the Purchaser. Where pipelines are to be mechanically cleaned (pigged) the bend radius shall not be less than five pipe diameters unless approved by the Purchaser.

h. Adequate provision for expansion of the pipe work shall be made. Expansion joints or bellows shall be used only where they can be justified technically and economically. All drain and vent valves shall be located in easily accessible positions. All drains and vents shall discharge to safe locations. Drains and vent pipe work shall be neatly run and shall not interfere with maintenance or operating access requirements.

04.03.13.01 PIPE SUPPORTS AND ANCHORS

a) Pipe work shall be supported and anchored in an appropriate manner.
b) The successful Tenderer shall take all necessary precautions to ensure that the piping shall be free from vibration by the installation of vibration dampers or other acceptable means.
c) The successful Tenderer shall prepare and include in the plant operating and maintenance manuals, pipe work layout and other similar drawings marked to show the position of every pipe support.

04.03.13.02 PIPE TERMINATIONS AND CONNECTIONS

a) All pipe connections shall be fusion welded except where flange connections are required or specified to facilitate erection or maintenance or where pipe materials used preclude welding.

b) Screw pipe work will only be permitted for pipes of less than 50 mm bore in non-critical air or water services.

c) Below 25 mm bore connections may be compression type couplings in positions where leakage will not introduce any hazard and the type of coupling and particular application has been approved by the Purchaser.
d) Pipe work flanges shall comply with the requirements of the code to which the pipe work is designed.

e) Jointing material, bolts, nuts and washers shall be provided where necessary for flanged pipes, valves and fittings supplied under this Contract.

04.03.13.03 INTERNAL CLEANING OF PIPES

I. The successful Tenderer is responsible for ensuring that the internal surface of all pipelines is thoroughly clean before the pipelines are placed in commission.

II. The procedure adopted is to include the following:

a) Thorough cleaning of all internal surfaces prior to erection to remove accumulations of dirt, rust, scale, and welding slag due to site welding before erection.

b) Prior to, and during erection, all parts shall be inspected to make sure that they are clean and adequate steps shall be taken to prevent entry of foreign matter both during and after erection. Each section erected shall be cleaned out before being connected into the previous section. All headers shall be cleaned before closing up.

c) Thorough cleaning of all pipe work after erection by flushing with water.

d) Already embedded pipes shall be cleaned with wire brush/ pickling to bring back original / required ID.

III. The successful Tenderer shall provide all necessary facilities in the pipe system for carrying out the requirements of item (b) including and temporary pipe work, valves and supports.

04.03.14 TRAPS, DRAINS AND VENTS

The successful Tenderer shall provide all traps, drains and vents which are called for in this Specification or which are necessary for plant operation, line or plant filling.

Drains and vents from different systems, or parts of systems operating at widely differing pressures, shall not be interconnected. At highest point vent and lowest point drain should be provided to avoid the water hammering.

04.03.15 WELDING GENERAL REQUIREMENTS

04.03.15.01 GENERAL

All welding shall conform to the relevant National or International Standard Specification as agreed by the Purchaser.

04.03.15.02 WELDING EQUIPMENT

Any welding equipment which in the opinion of the Purchaser, unsuitable or unsatisfactory for the service for which it is being used, shall be replaced by the Contractor.

The absence of comment by the Purchaser shall not be taken as approval for any equipment.

04.03.15.03 WELD PROCEDURE DOCUMENTS

Complete and full detailed weld procedure documents shall be kept and these shall be made available to the Purchaser on request.

Prior to the commencement of the welding the Contractor shall submit to the Purchaser for approval the welding procedures to be used in the fabrication of the relevant sections of work.

04.03.15.04 WELDERS QUALIFICATION TESTS

All welders shall be qualified for the work and shall hold current welder's qualification certificates in accordance with National Standards.

Records showing the date and result of the qualification tests performed by each welder and weld operator together with the identification number assigned to him shall at all times be available for scrutiny by the Purchaser.

04.03.16 WELDING INSPECTION

04.03.16.01 QUALITY REQUIREMENTS FOR WELDS

All welds subjected to non-destructive tests shall be entirely free from cracks or crack like defects, lack of root fusion, lack of sidewall fusion, root burn through or tailed pores. The standard for porosity and slag inclusions will be as indicated in the agreed standards for design and welding.

04.03.16.02 VISUAL WELD INSPECTION

Each weld shall be subjected to a stringent visual inspection and shall be free from undercut, cracks, porosity and other surface imperfections.

Fillet welds shall be checked for dimensional tolerance and from using a fillet weld gauge. Fillet welds should be slightly concave in form and each leg of the weld shall have equal length.

04.03.16.03 NON-DESTRUCTIVE EXAMINATION

All non-destructive examinations shall be supervised by a fully qualified and experienced specialist appointed by the successful Tenderer . Individual operators in each of the respective techniques shall be qualified and trained in the respective subject.
Dye Penetrant test, Ultra sonic examination, Radiography, Magnetic crack detection shall be carried out in accordance with National Standards.

04.03.16.04 WELD REPAIRS

The Purchaser's approval shall be obtained prior to commencement of any repair or rectification work.

Weld repairs shall be made to the same procedure as for the original weld. All tests shall be repeated after the repair has been completed.

04.03.16.05 MANDATORY INSPECTIONS

All transmission welds between dissimilar materials, such as high alloy steel to carbon steel, or non-ferrous materials to steels, shall be subjected to 100% ultrasonic examination or crack detection wherever practicable. In addition, all butt welds between dissimilar materials shall be subjected to 100% radiographic examination.

All welds in ferritic alloy steels, e.g., having a carbon equivalent value in excess of 0.40%, and high yield-strength steels, e.g. having yield strength greater than 300 MPa, shall be subjected to 100% ultrasonic examination and crack detection wherever possible. In addition, all butt welds in these materials shall be subjected to 100% radiographic examination.

04.04 NOISE AND VIBRATION

04.04.01 NOISE

Maximum noise level tolerable in work areas shall be within the applicable limit. The equipment and the services shall be designed such that limits are not exceeded. The Tenderer shall indicate the maximum noise level guaranteed for each equipment/system with detailed description of noise control measures adopted, if any.

04.04.02 VIBRATION AND BALANCE

The Plant shall be designed and constructed to operate without vibration in so far as the nature of the works will permit. Where vibration must be expected this shall be reduced to the minimum which can be achieved by good design and careful balancing in the case of rotating plant.

The amplitude of vibration of rotating plant when measured on the bearing housings under steady state conditions at the designed operating speeds shall conform to IEC 34-14(1982) or equivalent International Codes.

04.04.03 SCAFFOLDING, STAIRWAY AND LADDERS

Where safe and easy plant operation and maintenance cannot be arranged from provided floor levels, the Contractor shall supply and erect all platform galleries, stairways, access

ways and ladders necessary for providing the required safe and easy access to the plant items. The Contractor shall ensure that the whole of the access ways are of uniform design and pattern throughout the Works. Where access is required for operation then standard design stairways must be provided, but if infrequent access for maintenance only is required then vertical ladders will be considered.

04.04.04 SAFETY GUARDS

All moving parts, shafts, couplings, flywheels, bare conductors and hot or cold surfaces shall be adequately and securely guarded in accordance with the prescribed legislation and to the Engineer's approval so as to afford complete safety to all personnel.

04.05 SPECIAL TOOLS AND TACKLES

Special tools and tackles shall be supplied under this Contract for use by the Purchaser. List of tools and tackles shall be provided by tenderer.
Each tool or appliance is to be clearly marked with its size and/or purpose.
The tools and appliances supplied shall not be used for erection purposes by the successful Tenderer and shall be handed over in new condition.

04.06 PAINTING

04.06.01 GENERAL

a) The primers & finishing paints will conform to latest Indian Standard or equivalent international standards. There shall be of approved quality and shade.

b) General precautions for painting such as preparation of surfaces, application of paints, inspection and testing etc. will be as per relevant clause of IS:1477 (Part I & II) and shall be followed, wherever possible.

c) General compatibility between primer and finishing paints recommended by the paint manufacturer, supplying these paints shall be followed.

d) General compatibility between successive coats must be ensured.

e) Unless otherwise specified, the general colour scheme for finishing coats for different types of equipment and pipelines as per requirement of the Purchaser are to be followed. The colour schemes, however, may be changed, if necessary, by the Purchaser at any stage before the start of the painting of the equipment.

f) In case of Penstock painting, the painting guide lines given in the chapter “PENSTOCK PAINTING”.

04.06.02 PAINTING INSTRUCTIONS

a) In general, unless otherwise specified, all plant and equipment & pipelines will be given one

coat of antirust primer, lacquers, etc. at the supplier's works after completing surface preparation to remove grease, rust, scales and other foreign materials. The second coat of antirust primer will be applied immediately after erection after completing requisite surface preparation) followed by two coats of finishing paint of approved quality & shade.

b) Technological structures, crane girders & other structures shall be given one coat of primer during manufacturer & one coat of primer after erection followed by two coats of finishing paint.

c) For equipment where original colour as per supplier's practice is desired, both primer & finishing coats will be applied at supplier's works before dispatch of equipment.

d) Structures embedded in concrete shall have no shop painting applied. The portion of the column that is to be embedded in concrete shall be given a coat of portland cement slurry after thoroughly cleaning the surfaces from mill scale, grease & oil immediately after fabrication.

e) The portion of the structures embedded underground shall be given two coats of red lead graphite primer at shop and finished with two coats of bituminous black paint of approved quality.

f) Machined/plained surfaces shall be coated with while lead and tallow before dispatch or before being put into open air & covered with gunny cloth.

g) Surfaces to be site welded shall have no shop paint applied within 100mm of welding zone. After site welding normal painting application will be followed.

h) Areas which become in-accessible after assembly shall be painted before assembly.

i) Cables & other electrical accessories shall have adequate antirust protection.

j) Chequered plates shall be given primer coats only.

k) The phosphate coated surface shall have one coat of baking based and two coats of finished paint of amino alkyd resin stone enamel.

l) External surface of pipe fittings shall be thoroughly cleaned by wire brushing and given two coats of red oxide zinc chromate primer at supplier's works & two coats of final synthetic enamel paint after erection.

m) The equipment which are to be dispatched in knocked down condition and require assembling at site, shall be given two coats of rust and corrosion preventive primer and one coat of synthetic enamel paint of approved quality and shade. After assembly at site, such equipment shall be given one final coat of synthetic enamel paint.

n) The equipment which can be sent as a single block unit duly shop assembled, shall be given full application of paint i.e. two primer coats of rust and corrosion preventive primer and two finish coats of paint of approved quality and shade as per relevant Indian Standards/equivalent international standards.

o) All painting shall be carried out by brushing or roller application with prior permission of the Purchaser.

p) All metal parts not accessible for painting shall be made of rust and corrosion resisting materials. Interiors of equipment will be suitably quoted with anti-rust compounds.

q) The fasteners shall not be painted. These will be dispatched with application of anti-rust compound.

r) Any special painting requirement indicated on the Contractor's drawings by the Purchaser during approval stage shall be binding.

04.06.03 SURFACE PREPARATION AND ENVIRONMENTAL CONDITIONS

a) All surfaces to be painted shall be thoroughly cleaned of dirt, grease, rust & mill scale. Removal of rust & scale shall be by hand brushing, power driven wire brushes or by sand blasting, as the surface condition/service condition warrants.

b) The paint shall be applied on the metallic cleaned surface after it is perfectly dry but not later than 3 hours after cleaning of the surfaces. Reasonable time gap should be allowed between any two consecutive coats of primer or finishing coats.

c) Surfaces coming in contact with acid & acidic fumes alkalis, soda, detergents etc shall be cleaned thoroughly to get complete metallic surface as per IS;1477 Part I & II or BS 4232-1967. After sand blasting the surface shall be cleaned with cotton rags, soaked in benzene, to remove fine rust, grease, etc. No sand blasted surface shall be exposed to weather for more than 3 hours.

d) The choice of primer & finishing paint will depend on the environmental condition to which the plant & equipment & pipelines are exposed to.

e) Paints are to be applied on dry surface only under agreeable weather conditions. Painting in damp & foggy weather conditions will not be permitted.

f) For a selected primer the method of surface treatment best suited for that primer & suggestion of paint manufacturer shall be obtained and followed.

g) Zinc rich primer paints which have been exposed for a long time before the finishing coat is applied shall be washed down thoroughly to remove soluble zinc salt deposit.

h) The recommendation of paint manufacturer shall be forwarded to the Purchaser for

approval.

04.06.04 PRIMER PAINT

a) In general, two coats of primer paints conforming to relevant Indian Standard or equivalent international standards shall be applied on all unmachined surfaces, except noted otherwise.

b) Where equipment is to be finish painted for dispatch, both coats will be applied before finishing coats at supplier's works.

c) Where equipment warrants finishing coat after erection, one coat will be applied just after manufacture at supplier's works and the second coat just after erection at site after surface cleaning.

d) Equipment on which primer coat has been damaged due to prolonged exposition at site, final erection or transport, shall be given two coats of primer at site before applying finishing coats. Before applying paint the surface will be thoroughly cleaned by sand paper.

e) The primer applied should be compatible in quality and colour schemes with the subsequent finishing coats.

f) Unless stated otherwise, the following primer paints shall be used depending upon the exposition and environmental condition to which the plant & equipment, structures & pipelines are exposed to :

- Aluminium zinc oxide - conforming to IS;2931
- Red oxide zinc chromate - conforming to IS;2074
- Heat resistant aluminium primer paint - conforming to IS:161
- Air drying chemical resistant paint
- Epoxy resin paint (cold cured) -
- Poly urethene paint
- Chlorinated rubber based conforming to DEF-1402, Ministry of Defence

04.06.05 FINISHING PAINT

a) Two coats of finishing paint compatible with the primer and conforming to relevant Indian Standard or equivalent international standards shall be applied on all un-machined surfaces unless mentioned otherwise.

b) Unless noted otherwise, the following finishing paints will be applied on plant & equipment, structure & pipelines depending upon the exposition and environmental conditions to which

the plant & equipment, structures & pipelines are on subjected to:

- Synthetic enamel conforming to IS; 2932 exterior type
- Epoxy based finishing paint -
- Heat resistant silicon based Aluminium paint IS:161

c) The finishing paint shall be of approved colour. The undercoat shall have different tinge to distinguish from the finishing paint.

d) The surfaces of the equipment on which finishing coats of paint has been damaged due to prolonged exposition at Contractor's work, erection site, during transport, storage or final erection shall be thoroughly cleaned & touched up with the same paint as applied previously.

04.06.06 THICKNESS OF COAT OF PAINT

a) A single coat of paint when dry should have a thickness of 25 to 30 microns (0.025 to 0.030 mm) or 1 mil to 1.25 mils.

b) Total thickness of 4 coats (2 primer coats + 2 finishing coats) should have thickness of 100 to 125 microns (0.100 to 0.125 mm) or 4 to 5 mils.

c) In case of bituminous aluminum gilsonite based paint 3 coats are to be applied. The total thickness of 3 coats will be not less than 100 microns (0.100 mm) or 4 mils.

d) Immediately following the award of the Contract, the Contractor shall submit the names of the proposed paint supplier and applicator together with a quality assurance program for approval. All paints for one section shall be provided by one manufacturer and preferably shall be manufactured in one country to ensure compatibility

04.07 CODING SCHEME

A coding scheme for identifying the drawings, plant and equipment, structures, spares and shipping documents shall be adopted by the Contractor.

04.07.01 CODING SCHEME FOR DRAWINGS

A 10 digit drawing numbering scheme is proposed for all the plant and equipment/spares to be supplied. The scheme will be cleared by the Purchaser.

04.07.02 CODING SCHEME FOR PLANT AND EQUIPMENT/ SPARES (EQUIPMENT IDENTIFICATION NUMBER)

A 8 digit coding scheme is proposed for all such items of supply. The first 3 digits conform

to the shop complex, next 3 represent the equipment number. Suffixes of 2 digits may be used at the end of six digit, wherever necessary. (Identification number presently used by plant people shall also be given for easy identification number).

04.07.03 SHIPPING CODE FOR PLANT AND EQUIPMENT/SPARES

The various items of plant units which arrive at site in packages have to be stored at proper areas/stores so that they can be retrieved easily and also to ensure the completeness of supply proper storing of the packages have to be done without opening the packages. As such, the boxes/packages have to be marked so that the contents may be easily identified for proper storage and easy retrieval.

Shipping code will comprise :

- Code number assigned to the Contractor
- Code number of equipment
- Package SN/total number of packages

04.07.04 COLOUR SCHEME FOR PLANT & EQUIPMENT

The Purchaser will indicate the colour scheme to be followed during painting of the plant and equipment. This as well as the equipment identification number will be indicated by the Purchaser soon after the Contractor submits the list of plant and equipment along with GA drawings.

04.08 ERECTION, TESTING & COMMISSIONING OF PLANT AND EQUIPMENT AND PIPELINES

04.08.01 GENERAL

a. The successful Tenderer, amongst other things, shall be responsible for renovation of the plant equipment to be reused and erection of plant and equipment, fluid system, electrics, auxiliaries, etc. as per the scope of supply within the design limit as given in the Technical Specification.

b. The successful Tenderer shall take delivery of the equipment and transport the same to his store/erection site, maintain his own stores for the storage of equipment and all related documents and records and finally transport the equipment to site for erection. He will take an erection-cum-storage insurance policy covering all the risks including third party liabilities for equipment as well as human life. All security arrangements also shall be made by the Contractor.

04.08.01

c. The successful Tenderer shall unpack the cases and do visual checking against physical

damages of equipment and do cleaning of the equipment before start of erection.

d. The successful Tenderer shall be responsible for proper and neat storage and also undertake conservation of all consignments including damaged boxes. During storage of equipment, the successful Tenderer shall take into account deterioration and carry out the re-conservation of the complete equipment/parts/supplies as may be necessary as per the Storage Instructions of the Manufacturer of equipment/components. The successful Tenderer shall also supply the consumables required for such re-conservation work and repair/replace parts required thereof for the proper functioning of the equipment after erection and commissioning.

04.08.01

e. Damage/shortage of the equipment/component during transit/transfer/storage, shall be made good by the successful Tenderer without loss of time so as not to upset the agreed erection and commissioning schedule and at no extra cost to the Purchaser. Delay on account of settlement of insurance claims by the Contractor shall not be taken into cognizance by the Purchaser.

f. The successful Tenderer shall be liable to make good any damage to existing equipment and/or facilities caused by the successful Tenderer's personnel. In case any existing equipment or facility is required to be dismantled for erection of the new equipment, the same shall be restored at no extra cost to the Purchaser.

g. The equipment will be installed on the civil foundation provided by the Purchaser/ successful Tenderer r (if specified). However, if any deficiency is noticed in the quality of concreting, dimensions, center-lines, levels, locations, etc of the foundation or anchors bolts or other embedment, the same will be rectified by the successful Tenderer at no extra cost. Minor chipping/minor rectification of the equipment for proper erection, alignment, etc. shall be done by the successful Tenderer. Chipping/dressing of the foundation with air or air and water jet prior to placing the equipment will also be carried out by the successful Tenderer.

04.08.01

h. The successful Tenderer shall lay and maintain properly all the temporary supply lines at the erection site for temporary power, water, air connections required for erection purposes, from the points earmarked by the Purchaser for this purpose.

i. The successful Tenderer shall provide all necessary construction tools, compressors, small hand tools, instruments, all commissioning instruments, welding equipment, service bolts, nuts, jigs and fixtures, winches, alignment tools, precision levels etc. and other equipment which may be required for carrying out the erection work efficiently within the time schedule. Unless otherwise specified, the above construction materials shall be the property of the Contractor after the erection work is over. Special tools & tackles obtained by the Purchaser with the equipment will, however, be the property of the Purchaser.

04.08.01

j. The successful Tenderer shall provide all temporary ladders, scaffolding materials, platforms, supports and other necessary facilities required for handling, erection and visual inspection of supplies at the point of installation and shall also provide necessary packing plates, wedges, shims, leveling screws, etc. required for erection of plant and equipment.

k. The successful Tenderer shall provide erection consumables like oxygen and acetylene gas, welding rods, solder lugs, oil, grease, kerosene, cotton waste, etc. required for erection of plant and equipment.

l. The successful Tenderer shall erect and maintain his own site offices, main stores and site temporary stores as required for the work and arrange for maintaining in neat manner the area placed at his disposal.

m. The successful Tenderer shall provide sufficient fencing, notice boards and lights to protect and warn others as may be considered necessary by the Purchaser.

n. On placement of order, the successful Tenderer shall provide his scheme for mobilisation with bar chart indicating clearly the resources, of erection machinery man-power and machinery proposed to be deployed to ensure timely completion of work and quality of workmanship.

04.08.01

o. The plant and equipment will be erected as per the instructions of the manufacturers/suppliers and under the supervision of the supervisory personnel, to be deputed by the successful Tenderer at site. The successful Tenderer shall also undertake rectification work on account of manufacturing defects, required for proper erection and assembly which can be done at site only according to site condition.

p. The successful Tenderer shall align, level, couple and securely fix all equipment, steel structures, appurtenances and accessories in accordance with drawings and/or instructions.

04.08.01

q. All precision survey instruments including leveling instruments shall be arranged by the successful Tenderer

r. The successful Tenderer shall supply materials and carry out flushing and first filling of oil and lubricants, grease, chemicals and as required till successful commissioning.

s. Laying and termination of cables, bus bars, bus ducts and earthing shall be done by the Contractor.

t. Installation and connection of all piping and fittings from the headers termination points to the equipment and inter-connection of all service lines within the design limit after the main headers/termination points shall be successful Tenderer 's responsibility.

u. The successful Tenderer shall check electrical connections to individual items.

v. The successful Tenderer shall be responsible for calibration of all the instruments at site.

w. The successful Tenderer shall be responsible for checking the correctness of erection of mechanical equipment, auxiliary systems, electrical equipment, other equipment, etc. as per the specification and relevant drawings.

04.08.01

x. The successful Tenderer shall arrange all facilities at site to undertake radiographic testing and stress relieving of butt welded pipe joints, as required.

y. The successful Tenderer shall be responsible for the management of erection work with proper and adequate supervision for ensuring progress of erection work and quality of workmanship.

z. The successful Tenderer shall deploy required number of supervisory, skilled, unskilled and auxiliary labor as required, for the erection work and comply with such reasonable instructions of the Purchaser in the interest of satisfactory progress and completion of the work according to the schedule.

aa. The successful Tenderer shall be responsible for total commissioning of the Plant including mechanical run, commissioning and demonstration of Performance Guarantee Tests.

04.08.01

bb. The successful Tenderer shall organise the work in a manner that other work at site is not impeded and the workmen therein not endangered. He shall arrange temporary access at site, if required, for the erection work.

cc. The successful Tenderer shall intimate the Purchaser/ concerned Plant authorities in writing well in advance about the requirement of shut down of any of the existing units/facilities for inter-connection/ incorporation of additional facilities. The shut down period shall be mutually discussed and finalised. The work to be undertaken during the shut down period shall be planned meticulously by the successful Tenderer to reduce the shut down period to the minimum.

dd. The successful Tenderer shall make temporary arrangement for maintaining the continuity of the services/ facilities before commencement of the diversion of existing service lines wherever shut down is not possible, without any extra cost to the Purchaser.

ee. The successful Tenderer shall return to the Purchaser all crates, packing cases and packing materials and all returnable supplies belonging to the Purchaser at a place designated by the Purchaser at the erection site in the conditions these exist during and after erection work is completed.

04.08.01

ff. The tests/checks to be conducted during erection by the Contractor shall be as per the manufacturer's instructions. The Contractor shall attend to the rectification of erection defects, if any, expeditiously. The Contractor shall arrange all testing instruments for such testing at site.

gg. The successful Tenderer shall carry out final painting including supply of paint of the plant & equipment and pipelines, etc. erected as per the instructions of the Purchaser.

hh. Grouting of the equipment on the foundations with shrinkkomp/ferro grout shall be the responsibility of the Contractor.

ii. The successful Tenderer shall indicate to the Purchaser well in advance the requirement of services such as electric power, water, EOT crane, etc. required during construction/erection period.

jj. The Contractor will arrange for the staying facilities of his working personnel.

04.08.01

kk. All safety, health and pollution control measures, as required to be adopted as per the Statutory Regulations and the Safety Codes for projects issued along with the tender documents otherwise required or implied by statutory regulations or practices, shall be strictly followed by the Contractor during the execution of the Contract. The Contractor shall set up a suitable safety organisation of his own at site in this regard.

ll. The successful Tenderer shall comply with all Statutory Rules & Regulations with respect to the employment of labour at site including payment of minimum wages as per Govt. rules, deduction of employees's contribution to Provident Funds, depositing the same along with Contractor's contribution to the Provident Fund Commissioner, Employees State Insurance and other statutory deductions/obligations.

mm. At the end of the work the Contractor shall remove all such temporary structures put up by him and hand over the site to the Purchaser in neat and tidy manner.

04.08.02 SUPERVISION OF ERECTION, TESTING, COMMISSIONING AND PERFORMANCE GUARANTEE TESTS

a) The successful Tenderer shall depute at site engineer/ specialists from various disciplines for the supervision of renovation erection, testing trial run, commissioning and performance guarantee tests of the plant and equipment under his scope of supply including the foreign

engineers/specialists from various disciplines. The above mentioned Indian and foreign engineers/specialists shall supervise the erection, testing, commissioning and conducting of performance guarantee tests of the plant and equipment with their auxiliaries so as to establish to the Purchaser that the guarantees as stipulated by the Purchaser and agreed by the successful Tenderer are fully met.

b) The Purchaser may place his engineers of respective disciplines to witness successive steps adopted in successful erection, testing, commissioning and performance guarantee tests.

04.08.03 CONTRACT TERMINAL POINTS

(i) The successful Tenderer's responsibility for making connections shall be as follows unless otherwise stated in the Specification:

a) Where pipe work and ducting supplied under this Contract connects the equipment already existing or supplied by the Purchaser, the connection shall be made under this contract.

b) This contract includes the terminating and connecting up all cables, which are supplied under this Contract except where noted.

c) All associated existing cabling not included in the Contract will be checked and tested under the supervision of the Purchaser but it will be the responsibility of the successful Tenderer under this Contract to assist the Purchaser in re-checking all final connections and to ensure the subsequent satisfactory operation of the equipment.

(ii) The successful Tenderer shall be deemed not to have fulfilled his obligation insofar as the commissioning of the plant in concerned until complete end-to-end tests have been carried out to the satisfaction of the Purchaser.

04.08.04 MECHANICAL COMPLETION AND COMMISSIONING

For Mechanical Completion and Commissioning refer Volume -I /tender specification.

05. DESCRIPTION OF THE EXISTING PLANT

05.01 EXISTING FACILITIES OF POWER PLANT TO BE USED FOR RM&U

Following facilities already installed are to be used for RM&U with new TG of 1x60MW Kodayar Power House-I.

05.01.01 RESERVOIR

Name of reservoir	Kodayar Dam – I (Upper)
Reservoir area	3.29sq.mile (8.3sq.km)

Max. water level & FRL	+4350 ft
Min. draw down level	+4250 ft
Maximum storage	2589.8 Mcft
Dead storage	3 Mcft
Effective storage	2586.8 Mcft
Average annual inflow	2211.15 cft

05.01.02 WATER CONDUCTOR SYSTEM

TUNNEL:	
Type	Horse Shoe
Diameter	7 ft
Length	10400ft (RCC 2040ft + PCC lined 8360ft)
SURGE SHAFT:	
Type	Open plain
Surge shaft depth	434 ft
Surge shaft Dia	20 ft
PENSTOCK:	
Length	7000 ft
Diameter	6' ~ 4'6" (1.83 ~ 1.37 m)
Thickness	$^{7}/_{8}$" ~ $1^{1}/_{2}$" (22.225 ~ 38.10 mm)

05.01.03 POWER HOUSE

1.	Length	32.91 m
2.	Width	21.41 m
3.	Height	19.18 m
4.	Machine hall Floor Level	358.750 m (1177ft)
5.	Governor Floor Level	355.40 (1166ft)

05.01.04 STATION CRANE

1.	Capacity	135/20 Ton
2.	Type	E.O.T
3.	Manufacture	M/s. Hindustan Motor Ltd., Calcutta
4.	Commissioned on	1968
5.	Motor Details	
a)	Long travel Motor	
	Make	Associated Ele. Industries

	HP	35
	Rating	½ Hour
	RPM	965
	Voltage	400/440
	Amp	49
b)	Cross Travel Motor	
	Make	AEI
	HP	7
	RPM	910
	Voltage	400/440
	Amp	22
c)	Main Hoist Motor	
	Make	Associated Ele. Industries
	HP	40
	Voltage	400/440
	Amp	56
d)	Auxiliary Hoist Motor	
	Make	Associated Ele. Industries
	Power	24.5 (Hp
	RPM (1/p)	965
	Voltage	400/440
	Amp	35

05.01.05 GANTRY CRANE

1	Make	M/s. Manning Maxwell and Moore Michg
2	RPM	1500
3	HP	20
4	Voltage	400

05.02 EXISTING FACILITIES TO BE DISMANTLED FOR MAKING WAY FOR NEW UNIT

The complete TG set of the unit is to be dismantled. Following are some of the details of major components.

05.02.01 WATER CONDUCTOR SYSTEM

BUTTERFLY VALVE:	
Dia	1700 mm

Max. Working Pressure	224ft of Water Column
MAIN INLET VALVE:	
Dia	1000 mm
Max. Working Pressure	90 kg

05.02.02 TURBINE

Make	Hydro Vevey, Switzerland
Type	Pelton wheel, Vertical shaft
Net head	3109 ft
Discharge	275 cusec
Output of turbine	87130 HP
Rated speed	500 rpm
No of jet	2
Included angle	81^0
Dia of jet	7.6" (193 mm)
Nozzle centre level	+1158 ft
No. of buckets	22
Dia of runner	97" (3100 mm)
Weight of runner	9.6 ton
Material of runner	13:4 (Cromium:Nickle)
Dia of shaft	579.5 mm
Water consumption	16.5 cft / unit energy
Centerline of runner	1158

05.02.03 GOVERNOR

Make	Vevey, Switzerland
Type	Accelero – Tachymetric
Rating	1700 ft Lbs
Oil pressure	415 lbs / sq inch (30 kg/cm^2)

05.02.04 GENERATOR

Type	Synchronous
Make	Alsthom, France
Normal Apparent Rating	66667 KVA
Power factor	0.9

KW	60,000
Volts (Nominal / maximum)	11000/12000 Volts
Nominal Stator current	3500 Amps
No. of Rotor Poles	12
No. of Generator Air Cooler	6
Insulation Class	B
Speed	500 RPM
Minimum. Fly wheel effect of Generator required for regulation	2,50,000Lb ft^2
Zero Sequence reactance	0.06
Direct axis transient open circuit time constant	8.4
Negative sequence reactance X2	0.19
Short circuit ratio	1.2

05.02.05 EXCITATION SYSTEM WITH AVR

Excitation voltage	120V
Excitation current (under nominal load and voltage condition)	1250A

05.02.06 POWER TRANSFORMER

Make	ANSALDO SAN GIORGIO COMPAGNIA GENERALE GENOVA, Italy
Year of Installation	1970
Capacity	3x22500 kVA
DETAILS OF ONE SINGLE PHASE TRANSFORMER OF CAPACITY 22500KVA	
VOLTAGE	
HV	110kV
LV	11kV
CURRENT	
HV	354.5 Amp
LV	3542/√3 Amp
Phase	1
Frequency	50 Hz
Impedance Volts	9.66%
Type of Cooling	OFW
Weight of Core & Winding	16.785Tons

Weight of Oil	6.32 Tons
Total Weight	29.62 Tons
Volume of Oil	1560 gallon
Oil Cooler	
Oil Flow	1560 imp gallons / minute
Water Flow	430tre / minute

05.02.07 UNIT AUXILIARY TRANSFORMER (UAT)

Make	Current Electricals, Madras
Capacity	300 kVA, 3 Phase, 50 Hz
Voltage ratio	11000V / 415V
Vector Group	Dy11
Cooling	ANAN
% impedance	4.8
Current : HV LV	 15.175 A 417.4 A

05.02.08 STATION SERVICE TRANSFORMER

Make		Radio & electricals Limited, Madras
Capacity		250 kVA, 3 Phase, 50 Hz
Voltage ratio		11000V / 416V
Vector Group		Dy11
Cooling		ONAN
% Impedance		4.87
Current	HV LV	13.1A 347A

05.02.09 11kV GENERATOR CABLES:

Material / Core	Aluminium / Single Core
Cross Section	625 Sq mm
No. of Cables / phase	10

05.02.10 110kV SWITCHYARD :

POTENTIAL TRANSFORMERS FOR LINE	
Make	BALTEAU, Belgium
Ratio	110kV/√3/110V/√3
VA	250
Phase	1
CURRENT TRANSFORMER	
Make	ASEA
Ratio Available	125/150/250/300/500/600
Ratio Adopted	500/1
Burden /Class	30VA/BM
Burden/Class	60 VA/S

05.02.11. 110kV SWITCHYARD:

	SF_6 Circuit Breaker	
1	Make	AREVA
2	Rated Voltage	145kV
3	Frequency	50 Hz
4	Normal Current	2000 A
5	Lightning Impulse Withstand Voltage	650 kVp
7	Short Circuit Withstand Current	40kA
8	Duration of Short Circuit	3 Sec
9	Total Mass	1534 kg
10	Year of Manufacture	2009

06. SCOPE OF WORK, EXISTING FACILITIES& BATTERY LIMIT

06.01 SCOPE OF WORK

The broad scope of work for the Unit is as follows.

a) Dismantling of existing TG Set including associated auxiliaries, like cooling water system, governing system, lube oil system, firefighting system etc. and place these at a suitable storage space / yard nearby.

b) Renovate and reuse the Fixed/embedded components: turbine casing, turbine housing/discharge chamber and foundation plates and anchorages.

c) Assess the condition of various existing civil foundations, modification of housing to accommodate the new configured manifold, strengthen and reuse the foundations

d) Collect all the information/dimension, take all measurement, if any, require carrying out for Computerized Simulation Study.

e) Design, Computerized Simulation Study, manufacturing, inspection and testing, supply, packing for dispatch/shipment, freight and insurance, port handling including custom clearance, loading, transportation to site, storing at site, complete erection of all the components testing, commissioning, start up and performance testing and handing over of Unit 70 MW Hydro turbine-generator set(TG set). The TG sets includes Pelton turbine, Synchronous Generator along with associated Auxiliaries; Electrics including Step-up transformer, Unit Auxiliary transformer, Station Service Transformer, Complete new switchyard equipments with unit bay and 2 nos feeder bay and associated equipment; Control& Instrumentation; associated civil work. Tenderer shall ensure that the TG set shall be completed with all materials and equipment whether specifically mentioned herein or not but required for satisfactory operation of the Unit. The design criteria and detailed scope are given in 06.04.

06.02 EXISTING FACILITIES OF THE UNIT TO BE DISMANTLED

The following existing facilities of the unit shall be dismantled

a) Turbine and associated auxiliaries, Generator set including the associated equipment up to Generator Transformer in the switchyard and station auxiliary transformer in the back side of power house. The broad details of the existing major equipment have been given in **Chapter-5.**

b) All facilities associated with the above including cables, cable structures, maintenance platforms etc.

c) Transport/shift and place all the dismantled equipment (which are to be newly supplied as per detail scope) to the storage space ear marked for the purpose.

d) (Not all tools required for dismantling are available with purchaser, however tools as available can be used by Contractor, but responsibility of assessment of healthiness of tools will lie with the Contractor)

The broad facilities/equipment to be dismantled are given in **Table** below

SL. NO.	NAME OF THE EQUIPMENT / FACILITY TO BE DISMANTLED	REMARKS
1.	Butterfly Valve including complete control system etc.	
2.	Main Inlet Valve including complete control system etc.	
3.	**TURBINE AND ASSOCIATED AUXILIARIES**	
a	Runner with Buckets, nozzles including spears, deflectors and its lever and linkages	
b	Turbine Shaft	
c	Turbine Guide Bearing	
d	Complete governor along with piping	except embedded piping if any
e	Brake system	except embedded piping if any
f	Lube oil System including pipe, valves, pump, motor, strainer, cooler etc.	Except embedded pipe if any
4.	**GENERATOR & ASSOCIATED EQUIPMENT AND ELECTRICS**	
a.	Stator	
b.	Rotor	
c.	Generator shaft	
d.	Thrust Bearing	
e.	Generator guide bearing	
f.	Generator air coolers	
5.	Excitation System including Pilot Exciter, Main Exciter, Slip rings, Excitation panels, Amplidyne etc.	
6.	Generator Transformer and associated facilities	
7.	Station Service transformer and other associated facilities	
8	Unit Auxiliary Transformer	
9	11kV/0.110 kV Potential Transformers, 11kV Current Transformers, Lightning Arrestors and Generator Neutral Grounding Transformer	
10	TG Control Desk and Metering & Protection Panels	
11	ACDB and DCDB	
12	HT Cables, LT Power Cables, Control Cables and Instrumentation cables	
13	Switchyard Equipment	
COMMON FACILITIES		
1.	Cooling water system including pipe lines, filters, valves etc.	Except embedded pipe if any
2.	Fire protection system	Except embedded piping

SL. NO.	NAME OF THE EQUIPMENT / FACILITY TO BE DISMANTLED	REMARKS
		if any
3.	110 V DC system Battery and Battery chargers	

06.03 EXISTING FACILITIES TO BE RENOVATED AND UTILISED:

Fixed/embedded components of Unit e.g.turbine casing, turbine housing/discharge chamber and foundation plates and anchorages, Penstock, Drainage and dewatering system, compressed air system, EOT crane of power house are to be renovated and reused.

The required renovation details are enumerated in table below:

SL.NO.	NAME OF THE EQUIPMENT	DETAILS OF RENOVATION
1	Penstock	As detailed in this chapter
2	Turbine housing/ discharge chamber	As detailed in this chapter & Sec-B of this Volume
3	Foundation plates and anchorages	As detailed in Sec-B of this Volume
4	Drainage and Dewatering System	As detailed in this chapter
5	Compressed air system	As detailed in this chapter
6	EOT crane of power house	As detailed in this chapter
7	Complete Unit area	As detailed in this chapter

06.03.01 PENSTOCK

A. The penstock need to be cleaned and painted with water resistant paint as per the specification detailed below: Anchor blocks are to be repaired; Guide pads are to be refurbished and properly lubricated; All Expansion joints to be replaced with new one. Maintenance platforms are to be painted with weather proof paint if any strengthening is required same shall be carried out by contractor.

i) Internal surface of the penstock shall be cleaned by using brush, water jet and shot blasting. After cleaning the internal surface shall be painted with water resistant paint. For selection of the paint necessary water analysis shall be carried out by contractor. Contractor shall submit a detailed procedure for cleaning and painting for approval from Purchaser.

ii) Outer surface of the penstock shall be cleaned by using brush and water jet. After cleaning the outer surface shall be painted with weather proof paint. Contractor shall submit a detailed procedure for cleaning and painting for approval from Purchaser.

iii) All Expansion joints shall be designed to take care of the expansions between the two consecutive anchor blocks. The material of the convolute of the expansion joints shall be of stainless steel.

iv) Guide pads shall be lubricated as per relevant standard.

v) Radar type - Latest new technology version level transmitter to be provided at Kodayar Dam-I reservoir and Chinna Kuttiyar reservoir as detailed in control and instrumentation specification

vi) New penstock drain valve with electric motor operation will be provided

vii) Ultrasonic Flow meter with monitoring at control room will be provided as detailed in control and instrumentation specification

06.03.01.01 PENSTROCK PAINTING:

PIPE TUNNEL AND PENSTOCK PAINTING (INNER AND OUTER)

GENERAL

a) The scope shall include cleaning and painting for both outer and inner portion of penstock.

b) The pipe tunnels and penstocks shall be painted after sand blasting and thorough surface preparation.

c) The painting shall be done as per recommendation of CECRI (Central Electro Chemical Research Institute) as follows:

Paint scheme for sand blasted surface condition:	
One coat of zinc ethyl silicate primer to a dry film thickness of	70-75 microns
followed by	
One coat of epoxy– MIO undercoat to a dry film Thickness of	100-110 microns
followed by	
One coat of chlorinated rubber top coat	100-110 microns
Total dry film thickness	270-295 microns

Paint schemes for surface cleaned by wire brush:	
One coat of epoxy polyamide red oxide zinc Phosphate primer to a thickness of	70-75 microns
followed by One coat of chlorinated rubber–MIO undercoat to a thickness of	100-110 microns
followed by	
One coat of chlorinated rubber top coat to a Thickness of	100-110 microns
	----------
Total thickness	270-295 microns

06.03.01.02 SPECIFICATION FOR ZINC ETHYL SILICATE PRIMER

Zinc ethyl silicate primer is of two pack system. One pack contains ethyl silicate binder with suitable solvents. The other pack contains zinc dust with additives. The contents of the two pack are to be mixed in suitable proportions before application over the metallic substrate.

Binder		Ethyl silicate
Figment Zinc content	:	Zinc dust with additives 80-85% by wt.
Dry Film thickness/coat	:	70-75 µm
Application	:	By brush or Spray.
Spreading rate.	:	6-7 sq.m/litre.
Drying time	:	Surface dry in 4 hours.
Over coating.	:	24 Hours.

06.03.01.03 SPECIFICATION FOR TWO PACK EPOXY POLYAMIDE MIO (MICACEOUS IRON OXIDE) UNDER COAT

This under coat is based on two pack iron oxide system. One pack contains epoxy resin pigmented with micaceous iron oxide and other additives.
The other pack contains polyamide resin dissolved in suitable solvent which is the curing agent. The contents of the two pack are to be mixed in suitable proportions before application over the substrate.

Resin	:	Epoxy resin which is the condensation Product of bisphenon-A and Epi-chlorophydrin with terminal epoxide groups.
Epoxide equivalent	:	450-500
Curing agent	:	Polyamide
Pigment	:	The main pigment shall be micaceous iron oxide constituting about 50% by weight of total pigments.
Application	:	By brush or Spray
Dry film thickness /coat	:	100-110 µm
Volume Solids.	:	55-60%
Spreading rate.	:	4-5 sq.m/litre
Drying time	:	Surface dry in 4 hours
Over coating.	:	After 24 Hours
Pigment volume concentration (PVC)	:	40%

Note : Subsequent coatings (Top coat) has to be applied within 20-24hours.

06.03.01.04 SPECIFICATION FOR CHLORINATED RUBBER TOP COAT

This is single pack system. In this system, chlorinated rubber resin containing chlorinated paraffin plasticiser is pigmented with yellow iron oxide and silica extenders.

Resin	:	Chlorinated rubber resin (chlorine content 63% w/m) containing chlorinated paraffin plasticiser.
Pigment	:	The main pigment shall be Yellow iron oxide containing silica as extender material.
Volume Solids	:	50-60%
Dry Film Thickness	:	100-110µm
Application	:	Spray
Spreading rate	:	4-5 sq.m/litre.
Drying time	:	Surface dry in 4 hours
Pigment volume concentration (PVC)	:	20%

06.03.01.05 SPECIFICATION FOR TWO PACK EPOXY-POLYAMIDE ZINC PHOSPHATE PRIMER

This primer is based on two pack system. One pack will contain epoxy resin pigmented with iron oxide, zinc phosphate and other additives.
The other pack will contain polyamide resin dissolved in suitable solvents. The contents of the two pack are to be mixed in suitable proportions before application over the metallic substrate.

Resin	:	Epoxy resin which is the condensation Product of bisphenon A and Epichlorohydrin with terminal epoxide groups.
Epoxide equivalent	:	450-500
Curing agent	:	Polyamide
Pigment	:	The main pigment shall be red iron oxide and zinc phosphate. Zinc phosphate should be 40% by weight of total pigments
Application	:	Spray
Dry film thickness /coat	:	70-75 µm
Volume Solids.	:	55-60%
Spreading rate	:	5-6 sq.m/litre.
Drying time	:	Surface dry in 4 hours
Over coating.	:	24 Hours.
Pigment volume concentration (PVC)	:	30%

Note : Subsequent coatings (Under coat) has to be applied within 20-24 hours.

06.03.01.06 SPECIFICATION FOR CHLORINATED RUBBER MIO UNDERCOAT

A. This is a single pack system. In this system, chlorinated rubber resin containing chlorinated paraffin plasticiser is pigmented with micaceious iron-oxide (MIO) pigments.

Resin	:	Chlorinated rubber resin (Chlorine Content 63% w/w) containing chlorinated paraffin palsticiser).
Pigment	:	The main pigment shall be Micaceous iron oxide (MI0) constituting about 50% by wt of total pigments.
Volume Solids	:	50-60%
Dry film thickness /coat	:	100-110 µm
Application	:	Spray.
Spreading rate	:	4-5q.m.sq. /litre

Drying time.	:	Surface dry in 4 hours
Over coating	:	After 24 Hours.
Pigment volume concentration (PVC)	:	40%

Note : Subsequent coatings (Top coat) has to be applied within 24-36 hours.

B. SPRAY - TABLE

DESCRIPTION	CONVENTIONAL AIR SPRAY	AIRLESS SPRAY
Coverage sq.m/day	400-800	600-1000
Overspray %	20-40	10-15
Portability	Fair	Excellent
Direct Drive units.	No	Yes
Pin holding	possible	Unusual
Hoses	2	Usually one.
Masking	Considerable	Moderate
Penetration of corners &volds	Fair	Good
Thinning before spray	Usual	Sometimes
Film Build/Coat	Lower	Higher
Moisture (Compressor)	Possible	None
Versatility	More	Less
Paint clogging problems	Slight	Possible

06.03.01.07 EXTERNAL PENSTOCK PAINTING :

As done normally. Normal anti-corrosive painting. Cleaning and painting are for both the outer and inner portion of penstock.

PENSTOCK PAINTING (OUTER) - Coal Tar Paint Specification
Product Name: Tarstil Tar Gr.B.
ISI Code: IS: 290/1961 Type B

DESCRIPTION:
TarStil Tar Gr.B is Coal Tar based economical anti-corrosive coating.
TarStil Tar™ Gr. B conforms to IS: 290/1961 Type B.

CHARACTERISTICS

		TarStil Tar Gr.B
Colour	:	Black
Drying Time, hrs.	:	24
Consistency	:	Brushable
Dry film thickness per coat	:	60 Micron
Specific Gravity	:	1.15
Theoretical Coverage, m^2/L • On metal Surface	:	10

• On concrete Surface	:	8
• On wooden surface	:	8
Flash Point, ^{0}C	:	75

06.03.01.08 APPLICATION METHODOLOGY

a The surface to be treated should be thoroughly cleaned and dried. All dirt scales and dust must be removed.
b Apply by brush to form a protective film on evaporation.
c Two coats are normally recommended. The period of protection is, however, considerably increased by the application of a third coat.
d Each subsequent coat should be applied when preceding coat has become dry and hard.
e Three coats of Tarstil Tar Special are generally recommended.

06.03.02 TURBINE HOUSING/DISCHARGE CHAMBER

Housing/Discharge Chamber shall be modified for accommodating the new symmetrical manifold. Internal surfaces of housing shall be weld filled by grinding and providing protection coating. The detail modification work is described under Civil Work.

06.03.03 DRAINAGE AND DEWATERING SYSTEM :

This has been detailed in Cooling Water System

06.03.04 COMPRESSED AIR SYSTEM

a. The existing compressors shall be refurbished with replacement of all pipe, valves, instruments etc. The details of the existing compressors are as detailed below:

Compressor -1:

Make	:	K.G. Khosla and Co.
Type	:	B.D.12
Capacity	:	340 lit/min
Opening Pressure	:	30 Kg/cm2 (to be confirmed)

Compressor -2:

Make	:	K.G. Khosla and Co.
Type	:	B.D.7.2
Capacity	:	505 lpm
Opening Pressure	:	30 Kg/cm2 (to be confirmed)

Air receiver tank:

Capacity	:	400 liter
Maximum pressure	:	35 Kg/cm2

Working pressure of air brake: 7 Kg/cm2
Working pressure for general purpose: 4 Kg/cm2

b. Two additional compressors (1W+1S) of adequate capacity along with air receiver, pipe, valve,

necessary instruments etc. shall be provided for operation of governor OPU.

c. Each compressor shall comprise of intercoolers, after coolers, intake air filter cum silencer, discharge valve with NRV, relief valve, and all necessary instruments, Air receiver tank etc.

d. There should be interconnection in between the existing and new compressors through pressure reducing valves so that air can be availed for braking purpose in case of failure of both the existing compressors. These compressors shall be installed at coupling chamber floor. A tentative space is proposed in the equipment layout drawing.

06.03.05 EOT CRANE OF POWER HOUSE

The power house consists of an EOT crane with a main hoist of 135 tonnes and auxiliary hoist of 20 tonnes for the erection and maintenance of the unit. For renovation of EOT crane following works to be carried out:

i) Replacement of wire ropes and refurbishing of hoist machinery (gears, gear boxes, sheaves, wheels etc.)
ii) Replacement of power conductors (down shop and/or trolley and bridge)
iii) Replace/provide power disconnecting devices to meet current standards
iv) Replacement of mechanical load brakes with electrical load brakes
v) Replacement of motors
vi) Replacement of control systems
vii) Replacement of control and power wiring or conductor and collector systems.
viii) Replacement of lighting system
ix) Refurbishment of lifting beam
x) Re-painting
xi) Load test by certified agency

06.03.06 COMPLETE UNIT AREA INCLUDING GENERATOR TRANSFORMER

Cleaning of the area including minor repairs. All surface drains to be discharged in tail pool/discharge chamber whichever is applicable. All existing pipe valves are to be replaced with new except embedded if any.

06.04 SUPPLY OF PLANT & EQUIPMENT

The broad scope of supply of new equipment/facility is as follows.

SL .NO	NAME OF EQUIPMENT/FACILITY	UNIT	QTY
A	**MECHANICAL EQUIPMENT**		
1	Butterfly Valve including complete control system etc.	Sets	1
2	Main Inlet Valve including complete control system etc.	Sets	1
3	Turbine (suitable for producing 70MW at Generator terminals at rated head and discharge) and accessories	Sets	1
4	Governor and its accessories	Sets	1
5	Generator and its associated equipment	Sets	1

SL .NO	NAME OF EQUIPMENT/FACILITY	UNIT	QTY
6	Excitation system & Voltage regulator	Sets	1
7	Cooling water system	Sets	2
8	Lube oil System	Sets	1
9	Compressed air system	Sets	2
10	Fire protection system	Set	1
11	Air conditioning system	Lot	1
B	**ELECTRICAL EQUIPMENT- REFER VOLUME-III OF T.S.** Complete switchyard equipments for unit bay and 2 nos feeder bay with 110 KV BUS		
C	**CONTROL & INSTRUMENTATION- REFER VOLUME-III OF T.S.**		
D	**CIVIL WORKS**		
	Civil works as per scope	LS	As per Section B of this Volume
E	**SPARES AND TOOLS & TACKLES**		
1	Mandatory spares as per list	Sets.	1
2	Commissioning spares	Sets.	1
3	Recommended spares	Sets.	1
4	Special Tool & tackles	Sets.	1
5	Maintenance tool & tackles	Sets.	1

06.05 BATTERY LIMITS :

The "Battery Limits and Termination Points' shall be as under

(i) shall start from Pipe tunnel (downstream of surge shaft) upto tail race on the water conducting system &

(ii) shall include complete electric and C&I upto the drives and upto switchyard i.e. CTs and feeder breakers, upto the take off towers of Transmission.

06.06 FACILITIES ALREADY INSTALLED FOR THE PROPOSED UNITS

Tunnel, Surge tank, Penstock, Turbine casing, Turbine housing/discharge chamber, Power House, EOT Crane etc. are constructed/installed and to be utilized for the proposed Unit. The details may be seen from the enclosed Drawings. The approximate dimensions and capacities are given in Chapter-05 of this volume.

For Space available inside power house, refer Drgs. enclosed in Vol-IV.

06.07 DESIGN CRITERIA AND DETAILED SCOPE OF WORK

06.07.01 REFERENCE DOCUMENTS

- IEC 60041: latest edition, Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines

- IEC 60193: latest edition, International code for model acceptance tests of hydraulic turbines
- IEC 60308: latest edition, International code for testing of speed governing systems for hydraulic turbines
- IEC 60545: latest edition, Guide for commissioning, operation and maintenance of hydraulic turbines
- IEC 60609: latest edition, Cavitations pitting evaluation in hydraulic turbines, storage pumps and pump turbines
- IEC 60994: latest edition, Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump-turbines)
- ISO 7919 Pt-5: Mechanical vibrations of non-reciprocating machines- measurements on rotating shafts and evaluation criteria of machines set in hydraulic power generating and pumping plants.
- IEC 60995: latest edition, Determination of the prototype performance from model acceptance tests of hydraulic machines with the consideration of scale effects
- IEC 61362, ¾ Guide to specification of hydro-turbine control systems

- ISO 3740: latest edition, Acoustics – Determination of sound power levels of noise sources – Guidelines for the use of basic standards and for the preparation of noise test codes

06.07.02 DESIGN CRITERIA

a) 06.07.02.01 Tenderer shall assess and confirm the possibilities of accommodation of new runner and manifold in the existing turbine pit and fitting with the existing turbine shaft before putting up the bids. Necessary modification if required shall also be included in the scope of tenderer.

b) Tenderer may carry out necessary overall inspection of the unit as may be considered necessary over and above the data/information provided herein, so as to achieve the desired outputs. The data/drawings made available in this tender document are as collected from TANGEDCO and correctness of the data drawings are to be confirmed by tenderers during site visit before pre-bid or later Tenderer shall be solely responsible for arriving at the desired performance and should not make any plea of non-availability/incorrectness of data etc. as the criteria for not achieving the output.

c) Tenderer shall visit the site, study the existing machines in detail satisfy himself with plant details before putting up the offer. The details of existing plant are already described in the **Chapter 05**. The technical requirements for installation of new runner with buckets are given below and to achieve output all suggested and required modification shall be carried out by the Tenderer.

d) The scope of work shall include but not limited to the following:
e) The manufacturers / suppliers shall make in-depth study on various aspects before offering

the equipment guaranteeing to meet requirements of cavitations free performance for entire range of head and discharges at the available turbine setting and with the available water.

f) If the Tenderer wishes to deviate from this specification, the same shall be clearly brought out to the Purchaser with justifications in the format provided in Schedule –A of Techno-commercial Schedule.

g) The Tenderer shall specify the minimum head and maximum head at which the unit can be safely operated without any cavitation and vibration.

h) The new turbine shall be designed as per site condition and meet the requirement as specified in the Technical Specification.

i) The weight of the turbine rotating parts and any unbalanced vertical hydraulic thrust shall be supported by the generator thrust bearing.

j) The new turbine shall be manufactured after carrying out computer simulation studies and/ or model test by the successful bidder.

06.07.02.02 COMPUTATIONAL FLUID DYNAMIC STUDIES (CFD MODEL TESTING)

a) To ensure the output and efficiency of the machine, the new turbine shall be designed and manufactured based on computerized simulation studies. Cavitation performance of the turbine shall also be carried out. The successful tenderer shall furnish the results of the study tests to Purchaser for review/approval.

b) In case the successful tenderer proposes model test, then the Tenderer shall furnish details as to where they will carry out the model test. Report of **Model Testing** shall be made available to the purchaser by the successful tenderer before going ahead with the manufacturing of the turbine.

c) In case the contractor has already performed model tests on homologous models, the purchaser, at his discretion, permit the contractor to proceed with the manufacturer after approval by the Purchaser of the model test report.

d) The performance of the model tests either a fresh or that had been done earlier shall be as per IEC 193 and 193A in all respects. Hydraulic performance tests shall be made at various nozzle openings to determine the machine characteristics including regimes of safe operation, zones of vibration etc. These tests shall include determination of capacity, hydraulic thrust, runaway speed, nozzle opening output relationship, etc., and such other details as covered in IEC 193 and 193A. Model tests shall simulate all possible normal operating conditions of the prototype for entire range of the heads and loads.

e) The tenderer shall clearly mention the time within which the model tests including manufacturer of a new model, if required, will be completed. The delivery schedule given by the tenderer shall be recokened from the date of approval of model tests or model test report or from the time of permission to proceed with the prototype manufacturer. If the model test is already available, this shall be submitted within one month after the award of the contract if required by the purchaser.

f) Basic data for **design of turbine** are as follows :

i. The turbine is to be accommodated in the space available in the turbine pit.
ii. The trash rack, intake, penstock, surge tank, turbine casing, turbine pit etc. are already there and the same are to be utilized for the installation of the proposed unit.
iii. The turbine shall be designed for a rated/design head of 940.30m. Necessary modification of the foundation if required shall be done by the Contractor.
iv. The new turbine will be designed based on the following parameters.

Rated /Design Head	:	940.30m
Maximum Head	:	972.92m
Minimum Head	:	914.32m
Elevation of nozzle center line	:	EL506.36m
Temperature of water		
Minimum	:	8 ºC
Maximum	:	31.5 ºC

g) Detail raw water analysis shall be done by the contractor for design of turbine for design of equipment which are directly come in contact of water.

06.08 DETAILED SCOPE OF WORK

06.08.01 BUTTERFLY VALVE

A new butterfly valve of adequate capacity along with the complete control system shall be provided. The size of the valve shall be matching with the existing penstock. The valve and the control system shall be designed in accordance with latest IS 7326 or equivalent standards.

06.08.01.01 DESIGN CRITERIA

MATERIAL: Material shall be as per latest IS 7326. If required necessary water analysis shall be carried out by Contractor.

PERMISSIBLE STRESS LEVELS:

The maximum permissible stress levels at the design head shall be as follows:

For steel:
Tensile strength= 0.25 of ultimate tensile stress or 0.5 of yield strength whichever is less

Shear Stress =0.35 yield point

For Bronze:
Bearing Stress= 0.035 ultimate tensile strength

06.08.01.02 DESIGN OF MECHANICAL PARTS

06.08.01.02.01 VALVE BODY

The valve body should be cast, cast fabricated materials as per latest IS 7326 or equivalent standards. The body should have two hubs for trunnion bearing housings. Flanges for connecting to penstock should be at right angles to the axis of the bore and concentric with the bore and the faces should be parallel. Where design does not permit the use of through bolts, the valve flange may have tapped holes. The body may be made in single piece or in parts for convenience of manufacture and transportation to site. The body should be stress relieved before any machining is done. The shell of the body shall be designed to sustain maximum static head including pressure rise.

06.08.01.02.02 VALVE DISC

Disc shall be designed to offer minimum head loss in open position and to sustain the full differential pressure across the closed valve. The Disc should be cast, cast fabricated materials as per latest IS 7326 or equivalent standards. The Disc should be stress relieved before taking up for machining operation. The angular travel of the Disc shall be nearly 90^0 from open to shut-off position. Thrust collar shall be provided to hold the Disc in the centre of valve body.

06.08.01.02.03 VALVE TRUNIONS

Valve trunnions shall be of either one piece unit extending completely through the disc or of the stub type comprising two separate trunnions in the valve disc hub. The design of trunnions shall be such that it will safely sustain maximum differential pressures across the closed valve. The trunnion and any keys or dowels, etc, used for transmitting the torque between trunnion and disc, should be capable of withstanding the maximum torque required to operate the valve. The trunnion should also be designed for the stress developed during valve closing under emergency condition and over velocity or penstock rupture condition.

06.08.01.02.04 BEARINGS

Bearings shall be self lubricated sleeve type or self centring type. It shall be able to sustain the maximum load imposed by trunion. The materials of the bearings shall be as per latest IS 7326 or equivalent standards.

06.08.01.02.05 SEAL

The seal shall be fibre reinforced solid rubber type. Seal shall be designed to provide tight shut-off. The seal shall be securely attached either to the body or to the disc. The seal material shall be compatible with the temperature and characteristics of the water. Materials of the seal shall be as per latest IS 7326 or equivalent standards.

06.08.01.02.06 SEAL SEAT

Rust resisting seal seat against which sealing ring seats shall be securely attached to either the body or the disc. This can be of bolted or welded construction. Material shall be as per latest IS 7326 or equivalent standards.

06.08.01.02.07 TRUNION SEAL

Trunnion seal shall be provided on both driving and non-driving trunnions. Its design shall be such as to prevent any leakage and to ensure further adjustments and replacement. Material shall be as per latest IS 7326 or equivalent standards.

06.08.01.02.08 FOUNDATION

The existing foundation shall be used. Strengthening of existing foundation shall be checked by Contractor for the proposed butterfly valve and necessary strengthening and any modification if required the same shall be carried out by the Contractor.

06.08.01.02.09 LIFTING DEVICE

There is no EOT provision for handling /dismantling the existing BFV and erection of new BFV. So the tender shall make his own material handling arrangement (mobile crane) to carry out the dismantling / erection of BFV.

06.08.01.02.10 OPERATION AND CONTROL

a) Operation and control of the valve shall be in accordance with latest IS 7326 or equivalent standards.

b) An oil operated hydraulic servo motor shall be used. One or more servomotors may be used for the operation of the valve. The servomotors shall be fixed type and shall be sized to transmit the required operating torque through levers to the valve trunion & closing shall be achieved with dead weight

c) For operation of the valve, a separate oil pressure unit including compressed air system shall be installed in the valve house. All the bearings and pivots shall have bushes and of self- lubricated type. The valve seal shall also be operated from the same control unit. All the control equipment such as control panel, indicators, limit switches, alarms, trip switches etc. and necessary valves, pipes shall be provided. Provision of operation from the control room as well as from local shall be provided.

06.08.02 **SPHERICAL VALVE (MAIN INLET VALVE):**

A new spherical valve of adequate capacity along with the complete control system shall be provided. The size of the valve shall be matching with the existing penstock dia. The valve shall have service seal as well as repair seal. The valve and the control system shall be designed in accordance with latest IS 7332 or equivalent standards.

06.08.02.01 DESIGN CRITERIA

MATERIAL: Material shall be as per latest IS 7332. If required necessary water analysis shall be carried out by Contractor.

PERMISSIBLE STRESS LEVELS:

The maximum permissible stress levels at the design head shall be as follows:

For steel:

Tensile strength= 0.25 of ultimate tensile stress or 0.5 of yield strength whichever is less

Shear Stress = 60% of the tensile stress

For Bronze Bushings:

Bearing Stress ≤ 35 N/mm^2

For self lubricated Bushes:

Bearing Stress ≤ 35 N/mm^2

06.08.02.02 DESIGN OF MECHANICAL PARTS

06.08.02.02.01 VALVE BODY

a) The body shall have two holes for trunnion bearing housings and suitable bosses for by-pass connection, drainage, air release and for mechanical locks if necessary. Flanges for connecting to penstock shall be at right angle to the axis of the bore and concentric with the bore and the faces shall be parallel. The flanges shall have tapped or through holes. Repair seal shall have a boss on upstream side for connection of a pipe for equalizing pressure and on inlet side a cylindrical surface lined with stainless steel shall be provided where movable ring of repair seal slides. On the outlet side it shall have a cylindrical surface for fitting the service seal.

b) The body shall be made in two parts from assembly point of view. The joint may be vertical, horizontal or diagonal according to the suitability of assembly and transport.

c) The body shall be designed, such as to sustain maximum pressure including water hammer.

06.08.02.02.02 ROTOR

Rotor and trunnions shall be joined together by means of welding or shall be integrally cast, cast-fabricated or fabricated from materials as per latest IS 7332 or equivalent standards. Rotor shall have necessary provision to accommodate service seal and repair seal. The angular travel of the rotor shall be $90^0$from open to close position. Cylinder of the rotor shall be horizontal when valve is open and vertical when valve is closed. There shall be provision for movement to open and close the service seal.

06.08.02.02.03 VALVE TRUNIONS

Trunnions shall be made of material as per latest IS 7332 or equivalent standards and of forged steel or cast steel when integral with rotor. Levers shall be fixed by means of wedge pins, parallel pins or keys.

The design of rotor and trunnions shall be such that they will safely sustain maximum differential pressure including any surge pressure across the closed valve, and the maximum forces due to the servomotor

06.08.02.02.04 BEARINGS

Bearings shall be self lubricated bush type. It shall be able to sustain the maximum load imposed by trunion. The materials of the bearings shall be as per latest IS 7332 or equivalent standards.

06.08.02.02.05 SEAL AND VALVE

The seal and valve , Operation , lifting device are detailed below:

06.08.02.02.06 SERVICE SEAL

The service seal shall be manufactured using the material as per latest IS 7332 or equivalent standards. The design shall have the provision for movement of the seal. Seal shall be designed to provide tight shut-off.

06.08.02.02.07 REPAIR SEAL

It shall consist of movable and fixed rings and mechanism for movement of movable ring. Fixed ring shall be fixed on the rotor and movable ring shall slide on the valve body. Mechanism for movement of movable ring shall be designed such that ring shall movein axial direction very smoothly and give a good tightness when repair seal is closed. Clearance between movable ring and valve body shall be sealed by suitable design rubber seal or cord. A by-pass connection shall be provided to equalize the pressure to enable smooth opening of the repair seal.

06.08.02.02.08 BYPASS VALVE

A new bypass valve of adequate capacity shall be supplied. The size of the by-pass valve should be sufficient to balance the downstream pressure at least by 60 percent of the upstream pressure, considering the maximum leakages through the guide vanes.

06.08.02.02.09 SEAL VALVE

A new seal valve of adequate capacity to drain pressurised water behind the disc to withdraw the disc instantaneously.

06.08.02.02.10 FOUNDATION

The existing foundation shall be used. Strengthening of existing foundation shall be checked by Contractor for the proposed main inlet valve and necessary strengthening and any modification if required the same shall be carried out by the Contractor.

06.08.02.02.11 LIFTING DEVICE

Existing lifting device shall be used.

06.08.02.02.12 OPERATION AND CONTROL

a. Operation and control of the valve shall be in accordance with latest IS 7332 or equivalent standards.

b. An oil operated hydraulic servo motor shall be used. One or more servomotors may be used for the operation of the valve. The servomotors shall be fixed type and shall be sized to transmit the required operating torque through levers to the valve trunion.
For operation of the valve, a separate oil pressure unit including compressed air system shall be installed. All the bearings and pivots shall have bushes and of self lubricated type. The valve seal shall also be operated from the same control unit. All the control equipment such as control panel, indicators, limit switches, alarms, trip switches etc. and necessary valves, pipes shall be provided. Provision of operation from the control room as well as from local shall be provided.

06.08.03 TURBINE

06.08.03.01 TYPE,RATING AND DESIGN REQUIREMENTS

a. The turbine shall be of the vertical shaft, Pelton type having adequate no. of buckets and suitable for coupling through vertical shaft synchronous generator.
b. The turbine shall be complete and consist of Runner assembly, spear, deflector etc. All other existing equipment shall be renovated and the same shall be utilized for the new turbine set.
c. The turbine shall be designed to give rated output (at generator terminals) at rated head of 940.30m with maximum efficiency of the turbine. The turbine would have output higher (minimum 10%) than the rated output when operating at heads higher than the rated head. The maximum output both at minimum and maximum heads shall also be stated in the offer.
d. The details of the hydraulic system and basic data for design of turbine are given above. There is no transport limitation.
e. The already constructed power house plan and section (enclosed with this specification) shows space availability, turbine setting (Centre line of turbine and Minimum tail water level), penstock details, tentative layout of equipment.
f. The Tenderer shall critically study the silt data and chemical analysis of water and take the same into account in designing the turbine and auxiliary equipment susceptible to abrasive effect of silt, making all such specific provisions and measure including selection of materials, coatings and paintings which will help to resist silt abrasion and enable easy and quick maintenance / replacement of worn out components.
g. The hydraulic turbine shall comply with latest versions of relevant IEC/IS standards.
h. The turbine shall have smooth and quiet operation. The vibrations, pressure pulsations and power fluctuations shall be within the limits specified in relevant standards. The amplitude of vibrations at the shaft shall not exceed the limits specified in relevant ISO standards.

i. The peak efficiency of turbine shall be higher than 91.5% and weighted average efficiency shall not be less than 91%.

06.08.03.02 WEIGHTED AVERAGE EFFICIENCY :

Weighted average efficiency (η_W) will be calculated as follows:
Weighted average efficiency (ηw) = 0.5 x $\eta 100$ + 0.3x $\eta 80$ + 0.2x $\eta 60$
($\eta 100$, $\eta 80$, $\eta 60$ mean the efficiency of the turbine at rated head and when it delivers 100%, 80% & 60% of rated MW (Electrical) Output respectively).

a) The values of critical sigma as per IEC 193A shall be furnished in form of curves for different nozzle openings and different heads of operation. Plant sigma curves as recommended by the manufacturer shall also be plotted on it clearly to show the safety margin available.
b) The moment of inertia of the unit and normal nozzle and deflector closing shall be so adjusted that maximum momentary speed rise of the unit and the maximum pressure rise in the penstock shall not exceed existing limits. The maximum runaway speed of the unit, under any combination of head and load conditions shall be stated in the tender.
c) Maximum noise level resulting from any of the operating conditions shall not exceed 90 db (A) at any place 1.0 m away from any operating equipment.
d) The turbine shall be capable of running safely at maximum runaway speed without any damage to its parts for a period of not less than 15 minutes for every such occurrence, with cooling water supply on.
e) However critical speed of the machine shall be about 25% higher than maximum runaway speed.
f) The turbine shall be capable of delivering a guaranteed output of not less than 70.96MW at shaft coupling when operated at a rated net head of 940.30 m and at rated speed of 500 rpm. This output shall be generated within 90% nozzle opening and shall be called rated output of the turbine.
g) The capacity curve at net heads of to 914.32 m at different nozzle opening up to full nozzle opening shall be stated.
h) The turbine shall be designed for continuous operation over the range of net heads of 972.92m to 914.32 m.

i) The turbine shall have the required parameters as per standards.

06.08.03.03 COOLING WATER FAILURE DURATION WITHSTAND CAPACITY

The turbine guide bearing shall be designed and guaranteed to withstand operation at maximum continuous rating without any damage or deterioration for a period of at least 15 (Fifteen) minutes without cooling water supply.

06.08.03.04 GENERAL ARRANGEMENT AND CONSTRUCTION

a) The General arrangement shall be same as of existing Unit except the modification of housing to accommodate the new manifold for making the symmetrical nozzle.The turbine

shall be so constructed as to allow all the removable parts to be dismantled conveniently. The design shall also permit vertical movement of runner shaft by an amount sufficient for adjustment of bearings and for clearing the joint at the coupling of the turbine and the generator.

b) All equipment shall be neatly arranged and shall be readily and easily accessible for operation and maintenance. The necessary walkways, handrails, ladders, chequered plates, platforms, etc., required shall be provided by the Tenderer.

06.08.03.05 THE DETAIL PROPOSAL OF TURBINE COMPONENTS

06.08.03.05.01 RUNNER

a) The runner shall be forged fabricated of 13/4 chromium-Nickel stainless steel conforming to relevant standard. The buckets shall be machined and ground smooth. The runner shall be designed to withstand the loads imposed by any combination of fully open nozzles in operation at rated speed including maximum runaway speed and maximum head without exceeding the permissible stress. The forged fabricated construction, runners should be manufactured out of a forged disk on the periphery of which the bucket roots should be milled. The nozzle opening versus output and output versus efficiency curves shall be submitted along with the tender.

b) The machine shall be designed for condenser operation also.

c) The complete runner assembly shall be statically balanced in the shop. During manufacturing of buckets, shape and surface finish shall be maintained to limit the cavitation erosion damages. Proper quality control shall be provided during all phases of fabrication and manufacture to ensure that the final product is a good representation of the model runner or hydraulic design.

06.08.03.05.02 NOZZLE

New set of 02 nos. or 04 nos. symmetrical nozzles shall be provided. The nozzles for supplying the water to turbine runner will be designed for producing a solid uniform jet. The nozzle body should be of welded stress relieved steel tube and the nozzle tip will be provided with a removable stainless steel seat ring at the point of final water discharge. Removal and replacement of the seat ring should be possible without disturbing/dismantling the runner. Adequate distance between the nozzle and runner should be maintained to minimize the jet dispersion.

06.08.03.05.03 SPEAR / NEEDLE

New set of spear shall be provided. The jet will be controlled by spear of 13 Cr 4 Ni Stainless Steel. The needle stem should also be made of Stainless steel. The spears shall be designed in such a way to fit in the proposed nozzle. Spear shall be regulated by spear servomotor through spear rod.

06.08.03.05.04 DEFLECTOR

a) A suitably designed jet deflector, one for each nozzle shall be provided.

b) Deflector should be coordinated to ensure simultaneous action with needle as required by operation. Under normal speed control the needle should do the governing. On larger part load rejections, the deflector should deflect the complete jet until the needle approaches the position required for normal turbine speed. Each deflector shall be actuated by common servomotor through levers & link and will be coordinated with needle so that upon a rise in speed each jet shall be quickly deflected first, followed by slow closure of the needles. The cutting edge deflector will be designed of 13 Cr/4 Ni Stainless Steel. The deflector will be capable of deflecting the jet completely within the time required to keep the speed rise within the specified limits during load rejection.

c) The deflector will be designed to withstand the maximum discharge from the nozzle without damage. A position indicator will be provided to indicate at all times the setting of the deflector cutting edge with respect to the centerline of the nozzle

06.08.03.05.05 TURBINE GUIDE BEARING

a) New turbine guide bearing of self lubricated and segmental type with external lube oil coolers shall be provided. The bearing shall be designed as per latest IS/IEC standard. Guide pads shall be babbit lined with white metal and will be located above the runner and will consist of removable bearing segments. The guide bearing should be designed to support the maximum loading in the horizontal direction imposed by the turbine shaft for any loading of operation.

b) The babbitt lining on the guide bearing segments/pads shall be according to a grade suitable for the bearing and anchored tightly to the shell. The babbitt lining shall be accurately bored and shall be suitable for oil circulation. Suitable lifting eye bolts and backing-out studs shall be provided for use in removing and installing the bearing segments.

c) The bearing should be capable of being operated continuously without failure at normal temperature at rated speed and should be capable of being operated for 15 minutes at maximum runaway speed without failure with cooling water. Also, the bearings should be capable of being safely operated at rated speed without cooling water flow, when starting from normal-level oil temperature, for at least 15 minutes.

d) The lubricating oil system shall be designed so that the temperature of the bearing metal and bearing oil shall not exceed 70^0C and 65^0C respectively under continuous operation in any operating conditions.

e) The bearing housing shall be made of cast steel, or welded plate steel of heavy construction. The bearing shall be rigidly supported on the turbine head cover. Irrespective of the material used, the bearing shall be stress relieved before final machining operation. For ease in maintenance guide bearing housing shall be designed in two halves.

f) The successful Tenderer shall supply and install the following indicating and protection devices for the guide bearing. All electrical contacts shall be wired to terminal blocks in the turbine terminal box. The operating/contact voltage rating of these instruments shall be 220V DC.

i) Adequate numbers of temperature sensing devices, liquid expansion type thermometer, one in each segment/ pad for bearing metal and one in bearing oil for bearing oil

temperature. The devices shall have two sets of separately adjustable contacts suitable for operating alarm and tripping circuits. The device shall have a third contact to indicate loss of thermometer bulb pressure or loss of power supply.

ii) DTT and RTDs in alternate pad shall be provided; however, provision for installation of DTT and RTDs in all pads shall be provided. Two more RTDs shall also be provided for detection of lube oil temperature.

iii) One direct reading flow-meter with electrically separate low-flow alarm contacts for the bearing cooling water supply, if cooling water is required.

iv) One direct visual indicator of the bearing oil level marked in liters and high and low level adjustable alarm contacts.

v) One oil-water contamination detector, if water cooled bearing arrangement is used.

vi) A flow meter with two electrically separated alarm contacts to indicate low water flow to the bearing cooling system. (The piping shall be provided with a sufficient number of unions to permit ease of removal)

06.08.03.05.06 MANIFOLDS

New symmetrical manifolds of adequate size shall be provided. Manifolds shall be designed to fit in the modified existing housing. Material of the manifold shall be high strength structural steel as per the relevant latest IS/IEC standard and shall have suitable sections for ease of shipment and to be within transport limitation. Modification/strengthening of the manifold housing as required to make symmetrical shall be included in the scope of work. It shall be designed to withstand maximum water pressure including water hammer and shall be complete with anchors, supports, turn buckles, hold down rods etc. The manifold shall have suitable flanges for connection to the main inlet valve and openings for provision of nozzle-needle assemblies.

06.08.03.05.07 TURBINE SHAFT

a) A new turbine shaft shall be supplied by the contractor to couple the runner with generator shaft. The shaft shall be made of forged/fabricated carbon or alloy steel properly heat treated. It shall be provided with coupling flanges at top and bottom for connecting to the generator shaft and to the runner respectively. The turbine and generator manufacturer shall coordinate for proper design and construction. The shaft typically shall have a bearing journal for oil lubricated hydrodynamic guide bearings on the turbine runner end or wearing sleeve for oil lubricated water cooled.

b) The magnitude of shaft run out shall not exceed the approved tolerances in Indian/international standards. Two bands shall be machined and marked on the shaft for use for verticality and alignment purposes. The length of the shaft and elevation of coupling flange shall be as finalized during detailed engineering, by the contractor after co-ordination with generator manufacturer.

c) Immediately above the turbine guide bearing housing, a circumferential line shall be machined on the shaft and an adjustable pointer shall be mounted on the bearing housing opposite this line to indicate any axial movement of the shaft and to permit realignment after thrust bearing dismantling.

d) The shaft shall be designed for eccentric loading caused by unbalanced operation in addition to torsional loading.

e) The shaft coupling shall be designed as per provision of ANSI/IEEE Std 810 or applicable standard for fabricated shaft. The coupling bolts shall be designed for tightening using hydraulic tensioner/tightening device.

f) The turbine shaft diameter shall be coordinated with the generator shaft diameter. The critical speed of the combined turbine and generator and generator rotating part shall be calculated by the contractor and first critical speed shall be at least 25% above the maximum runaway speed. Calculations satisfying the compliance with these requirements shall be submitted to Purchaser prior to manufacturing.

g) The shaft shall be painted all over except mating surfaces of coupling bearing journal, vibration pickup band and shaft sleeve, which shall be adequately protected during shipment.

06.08.03.05.08 SERVOMOTORS

a) Each nozzle and deflector of the turbine shall be provided with common hydraulic servomotors having sufficient capacity to supply the maximum force necessary to open/close the nozzle/deflector under maximum operating head, at the minimum oil pressure.

b) The servomotor cylinders may be made of cast steel or welded steel plate. The servomotor piston rod shall be of forged steel and provided with bronze bushings. Lubrication shall be arranged to ensure that lubricant is admitted to high pressure areas regardless of nozzle/deflector position. The piston rod shall be arranged for adjustment of stroke. The connecting rod pins shall be hardened and ground.

c) The inner surface of the cylinder shall be bored to uniform diameter, and shall have a surface finish to allow the piston to traverse freely and smoothly with minimum oil leakage past through the piston and seals . Suitable packing shall be used toprevent oil leakage from the cylinder past the piston rod. The piston connecting rod shall be of forged steel of uniform diameter. Each piston shall be fitted with not less than three piston rings, suitably shaped to give close contact and uniform pressure on the cylinder walls.

d) The servomotor cylinders shall be provided with flanges for connecting oil piping. Connections for pressure gauges shall be provided at each end of each cylinder. An air vent and a drain cock shall be provided on each servomotor for bleeding/draining purposes.

e) Provision shall be made for field alignment of the servomotors, using levelling plates supplied by the Contractor. The servomotor flange shall be dowelled in field to its mounting flange.

f) A manual locking device of simple construction shall be provided on the servomotors to permit locking of nozzles in fully open and fully closed positions and capable of withstanding safely the full operating force of the servomotors. The device shall be such that it can be easily engaged and disengaged by one man. Electrical contact switches suitable for indication for 220 V D.C. systems shall be provided to indicate nozzle locked in fully open and fully closed positions. An additional contact for unit start interlock shall be provided. All contacts shall be wired to terminal blocks in the turbine terminal box.

g) Bypass connections equipped with orifices and/or at the adjustable needle valves shall be provided on the servomotors to retard the rate of closure of the nozzles from slightly below speed-no load position to the fully closed position. Bypass connections shall be fitted with check valves to prevent sluggish movement on opening the nozzle from the fully closed position to provide damping effect. A suitable pointer and scale, graduated in tenths with subdivisions, shall be provided to indicate the percent stroke of the servomotor and nozzle opening from the closed position. The scale shall be calibrated in the field and marked “closed” at one end of the scale and “opened” at the other end.

h) The servomotor stroke must be capable of manual adjustment. Means for positively locking the adjustment must be provided. Servomotors shall be shop tested under a hydrostatic pressure equal to 150% of the maximum design pressure of the governor oil system.

06.08.03.05.09 TURBINE GOVERNOR

06.08.03.05.09.01 GENERAL

A. Governor monitors speed deviations in the turbine; converts that speed variation into a change of nozzle and deflector servomotor position which changes the nozzle and deflector opening; to maintain optimal efficiency of the turbine for a given load. It is also used to start the unit, synchronize the unit to the grid, load, and shut down the unit.

B. A new governing system of digital PID type with provision of RGMO. The Digital governor shall be a dedicated redundant microprocessor based PID type. The performance of the governing system shall be governed by relevant IS/IEC standards. The speed sensing system shall have redundancy.

C. Among other things, the restricted governor mode of operation shall essentially have the following features:

a) There should not be any reduction in generation in case of improvement in grid frequency below 50.2Hz. Whereas for any fall in grid frequency, generation from the unit should increase by 5% limited to 105% of the maximum continuous rating of the unit subject to machine capability.

b) Ripple filter of +/- 0.03 Hz. shall be provided so that small changes in frequency are ignored for load correction, in order to prevent governor hunting

06.08.03.05.09.02 OTHER FEATURES OF THE GOVERNOR

The governor offered should have the following salient features.

a) The governor should take into account load fluctuations, speed droop, gate limit control etc. and combine them to achieve the desired operation under various possible modes of operation. The governor should be reliable for safety of turbine and ability to develop power under various head conditions. Easy replacement of components should be possible with modular design, without affecting power generation.

b) The governor shall be capable of operating the following modes – speed control, load control, gate limiter control and water level control.

c) The system program shall be in a language that is easy to understand, learn and implement. The program shall be stored in a non-volatile memory. All programs and listing including changes made during commissioning shall be handed over to Purchaser.

d) The governor shall be independent for each unit. The components of the governor shall be selected on the criteria of high performance, reliability and ease of maintenance. The governor shall be suitable for operation of the unit in complex grid system.

e) Digital governors with either proprietary controllers or controllers based on industrial PLCs shall be supplied. Magneto strictive Linear Displacement Transducer (MLDT) non-contact linear displacement feedback sensor shall be used.

f) Governor pump cycle time shall be monitored during regulating and shutdown to establish a baseline and trend to indicate any increases indicating internal leakage of the valves or problems with the turbine servomotors.

g) Pump noise and vibration shall be monitored for indicating bearing failures, excessive oil foaming, loose pipe connections, and possible blockage of oil flow.

h) Speed Sensor shall be a Speed Signal Generator (SSG) driven directly by the unit. Creep detector shall be part of speed sensor capable of measuring very slow shaft revolutions that might occur from leakage of the nozzles while the unit is shut down. The system shall detect movement and turns on auxiliary equipment to prevent damage.

06.08.03.05.09.02

A. PERMANENT SPEED DROOP CONTROL

There should be a provision for altering frequency vs. gate servomotor relationship by changing the permanent speed droop setting to achieve desired regulation. Speed setting device shall be provided to allow synchronising, manual load control and frequency control.

B. TEMPORARY SPEED DROOP CONTROL

The temporary speed droop control shall be provided for controlling the movement of the servomotor without any hunting. The governing parameters, temporary droop percentage and decay time constant shall be set so as to allow stable operation. This control shall derive its input from the guide vane servomotors.

C. GATE LIMIT CONTROL

A gate control shall be provided to enable the max. Opening of the guide vanes. This shall lock the whole governing system to avoid further opening of the guide vanes irrespective of the load required.

D. PERFORMANCE REQUIREMENTS

The governor shall conform to IEEE / ASME standard no. 125/IEC-308. The governor shall meet the following minimum performance requirements:

06.08.03.05.09.02

E. STABILITY

a. The governor shall be deemed to be stable if the control system (water passages, turbine, generator and voltage regulator) is inherently stable when:

b) Speed oscillations greater than +/-0.15% of rated speed do not occur with the governor controlling the turbine driving a generator at rated speed at no load or with an isolated load.

c) Power oscillations greater than +/-0.15% rated capacity of the turbine do not occur with the governor controlling the turbine driving a generator under sustained load demand in parallel with other generators which are themselves capable of operating in parallel with the governors speed droop not less than 2%

F. DEAD TIME

The elapsed time from the initial speed change of the turbine to the first movement of the nozzle servomotor for a sudden load change of more than 10% of the full load rating of the turbine shall not be more than 0.2 second.

G. DEAD BAND

The total magnitude of the sustained speed change within which there is no resulting measurable change in the position of the nozzle servomotors at rated speed of the turbine shall not exceed 0.02% of the rated speed of the turbine at any opening.

H. ELECTRIC POWER SUPPLY TO THE GOVERNOR

Station Battery 220 V DC Power supply shall be provided for Governor Operations.

I. DIGITAL ELECTRONIC CONTROLLER

Digital electronic controller unit shall consist of

- Digital Processor
- Visual Display Video
- A PLC unit for control, logic and signal I/O.
- Power Supply

- Terminal Cards
- Relays for digital outputs
- Signal Converters
- Humanmachine interface
- Other communication units
- Other Accessories for governor electronics
- All hardware and software required to make program changesincluding a mobile work station.

06.08.03.05.09.02

J. HYDRAULIC ACTUATOR

Hydraulic actuator unit shall consist of following mainomponents:

- Main oil distributing valve
- Proportional (Pilot) Valve
- Restoring (Servo motor Position Feedback) Mechanism/Connections with 100% redundancy
- Control Valves
- Flow Control Valves
- Check Valves
- Pressure Switches
- Manifold blocks associated piping and fittings
- Other required accessories

K. OIL SYSTEM

K-1. OIL PUMPING UNIT: Oil pumping unit comprising of following main components:

- Sump tank
- Motor Driven main and stand by vertical screw oil pumps mounted onthe sump tanks
- Oil pressure tank with associated accessories
- Oil piping and valves
- Instrumentation
- Oil leakage unit.
- Dust preventor.

K-2. HIGH PRESSURE OIL SYSTEM

High pressure oil system shall be provided for operation of nozzle and deflector servomotors through governor. 02 nos. (1W+1S) high pressure compressed air system of adequate capacity as per relevant IS/IEC standard including air receiver/ Accumulator, air dryer, piping, valves instruments etc. shall be considered for operation of oil pressure unit. The sizes of various components of oil sump tank and pressure receiver shall be calculated as per relevant IS/IEEE standards. The oil volume below machine shutdown level shall be sufficient to perform three (3) full operations of servomotor (i.e., close-open-close) with oil pumps being out of operation.

Piston type accumulator with nitrogen bottles shall be used for pressures higher than 60 Kg/cm2

K. INSTRUMENTS

All the instruments of turbine and governing system shall be replaced with new set. The specification for Control and Instrumentation is given in vol. IV Sec.B of Tender document.

06.08.03.05.09.02

L. GOVERNOR OIL

Oil of appropriate quality free from impurities or acidity shall be provided for first filling of the oil sump tank, Pressure receiver, governing circuit and servo motor.

Tenderer shall supply indigenous oil from any reputed oil company of India as approved by the Purchaser.

M. CABLING

All internal and external cabling required for turbine and governor shall be supplied and laid as per the technical specification given in Vol. IV, Sec. A of this document.

06.08.04 GENERATOR AND ASSOCIATED EQUIPMENT

06.08.04.01 GENERAL:

The generator shall comply with the latest versions of IS/IEC standards. The efficiency of generator shall be 98 % or more at rated load.

Insulation shall be thermal class F for the stator and the rotor windings with temperature rise limited to that of thermal class B as per relevant IEC standards.

RTDs or thermocouples shall be provided at suitable locations for monitoring temperature of stator core, stator winding and bearings. The temperature of rotor winding will be displayed in excitation panel by resistance measurement method.

06.08.04.02 GENERAL ARRANGEMENT AND CONSTRUCTION

The General arrangement shall be same as of existing Unit. The Generator shall be so constructed as to allow all the removable parts to be dismantled conveniently.

All equipment shall be neatly arranged and shall be readily and easily accessible for operation and maintenance. The necessary walkways, handrails, ladders, chequered plates, platforms, etc., required shall be provided by the contractor.

06.08.04.03 GENERATOR

The generator shall comprise the following:

One no. synchronous generator, direct driven, vertical shaft with 10% continuous overload each to match the turbines as given in Clause 06.04.03.01 of this Volume, complete with air cooled stator, rotor, shaft, Thrust cum upper Guide Bearing, Lower Guide Bearing (if applicable), safety devices etc., Instruments for measuring flow, vibrations, temperatures, etc with provision of extra contacts / ports for integration with plant SCADA.

One (1) set of fire protection systems for generator complete in all respects.

One (1) set of brake / jack systems complete with high pressure oil jacking pumps, piping, valves etc. for braking, jacking, etc. of the generator rotor.
One (1) set of brake dust collection systems.
One (1) set of carbon dust collection system.
One (1) set of high-pressure, automatic, lubricating systems for lubrication of thrust bearing at the time of starting / stopping of the unit.
One (1) set of anti-condensation heaters.
One (1) set of stator air coolers.
One (1) set of oil coolers for thrust cum upper andlower guide bearings.
One (1) set of all required oil, air and water pipes, fittings, valves, pressure gauges and flow relays.
One (1) set of interconnecting cables, termination, etc. between various parts.
One (1) set of moisture detector system.
One (1) set of sole plates, foundation bolts, sleeves and anchor plates etc. required for proper erection, leveling and alignment of the generators and their components.
One (1) sets of access doors, stairs, railings, and platforms.
All special tools and devices for handling, assembly, installation, erection, dismantling and testing of the generators and auxiliaries.
Oil for the first filling of bearings and jacking system, etc. including 10% extra.
Erection, testing and commissioning of generator.
Field acceptance and performance tests, including submission of report on generator.
Any other item not specified above but necessary to complete the assembly or mentioned hereunder, erection, testing, commissioning including field acceptance testing of generator and associated auxiliaries.

06.08.04.04 SPECIAL DESIGN AND LAYOUT CONDITIONS

The Generator shall be vertical shaft suspension type synchronous Generator with thrust –cum upper guide bearing located above the rotor and lower Guide bearing below the rotor. The design and construction of turbine and generator shafts shall be adequately coordinated between the generator and turbine manufacturers.

06.08.04.05 BASIC DIMENSIONS AND RATING

The dimensions of generator shall be such that ,it is accommodated in the existing slot and generator barrel

A. **RATING**

No. of phases	3
Construction type	Conventional
Rated continuous output, (MVA)	77.78
Continuous overload output (110% of rated output) (MVA)	85.55
Rated generator voltage, (kV)	11 ± 10%
Rated frequency (Hz)	50 +3% -5%
Combined voltage and frequency variation	±10%

Power factor (cos Φ)	0.9 lagging
Rated speed (rpm)	Matching turbine speed
Direction of rotation (when viewed from top)	Matching the direction of rotation of turbine
Insulation class of stator and rotor windings	Epoxy based F
SCR	1.1

Temperature rise of stator and rotor windings shall be limited to that of thermal Class B as per relevant IS/IEC Standards.

06.08.04.06 CAPACITY AND TEMPERATURE RISE

The generator shall be capable of delivering a guaranteed rated continuous output of 77.78MVA and maximum continuous overload output of 85.55 MVA at rated pf., rated voltage and rated frequency at the terminals without exceeding the limit of temperature rise as follows:

FOR RATED CONDITION

- Stator winding :85^0 C(ETD)
- Rotor winding :90^0 C(Resistance)

For overload condition the temperature limits will be 10^0 C more than above temperature rise limits.

SHORT CIRCUIT WITHSTAND CAPABILITY

The generator shall be capable of withstanding a three phase short circuit at the generator terminals when operating at rated continuous power output i.e. 77.78 MVA and at rated power factor for a period not less than 3 sec.

OCCASIONAL EXCESS CURRENT

The generator shall be capable of withstanding occasional excess current equal to 1.5 times the rated current for not less than 30 seconds each time.

06.08.04.07 WAVE FORM AND POLY-PHASE SYMMETRY

The waveform of the e.m.f. between terminals of the generator on open circuit shall be practically sinusoidal. The waveform shall be accepted as practically sinusoidal if none of its instantaneous values varies from instantaneous value of the same phase of the fundamental wave (50Hz) by more than 5 percent of the peak value of the fundamental. The poly-phase voltage system of each generator shall be practically symmetrical. Poly-phase voltage system is considered as practically symmetrical if neither the negative sequence nor the zero sequence components exceeds 5 percent of the positive sequence component. Special steps shall be taken to eliminate harmonic voltage wave, which may cause inductive interference with communication circuits or resonance in the transmission system. Total harmonic distribution factor (THD) shall not exceed 1.5 percent. The calculated no-load harmonics in the voltage waveform shall be furnished.

06.08.04.08 STABILITY AND PERFORMANCE

The generator shall operate satisfactorily in parallel with other machines connected to the grid. The generator shall be able to operate on sudden application / or loss of maximum load and during momentary short circuits and sustained ground faults without causing any abnormal vibration or resonant conditions. The generator shall be capable of operating continuously on an unbalanced system such that with none of the phase currents exceeding the rated current, the ratio of negative sequence component of current (I_2) to the rated current (In) does not exceed 0.08, and under fault conditions shall be capable of operation with the product of $(I_2/ I_n)^2$ and time in seconds (t) not exceeding 20.

06.08.04.09 RUNAWAY SPEED WITHSTAND CAPABILITY

The generator shall be designed and constructed to be capable of safely withstanding maximum runaway speed for a period of 15 minutes (with cooling water flow intact) without incurring damage from stresses under such conditions.

06.08.04.10 SPEED, RUNAWAY SPEED

The unit shall be designed for a nominal speed of 500 rpm. The runaway speed has to be determined by the turbine manufacturer and to be coordinated by the contractor.

06.08.04.11 DIRECTION OF ROTATION

The direction of rotation shall match the direction of rotation of the turbine.

06.08.04.12 EFFICIENCY

The guaranteed full load efficiency at rated voltage and frequency shall be 98 percent or more

- Bearing friction losses (total bearing losses of generator + thrust bearing losses apportioned to generator rotor weight).
- Windage / ventilation losses.
- Iron losses.
- Stator copper losses.
- Stray load losses.
- Field winding copper losses
- Excitation system losses.

06.08.04.13 Performance Criteria & Guarantee

The equipment covered under this contract shall be capable of performing all intended duties and it is the responsibility of the Contractor to supply the equipment as per guaranteed technical particulars.

06.08.4.14 DESIGN AND CONSTRUCTION

06.08.04.14.01 GENERAL

a). The generators shall be of suspension type with combined thrust and guide bearing located above the rotor and another guide bearing below the rotor. The generators shall be capable of safely withstanding maximum stresses during normal operation, runaway-speed conditions, two phase and three phase short-circuit conditions or single phase earth fault at the maximum output for which generators are capable of, 180 deg and 120 deg out-of-phase synchronization, magnetic unbalance at runaway speed with 50% of the poles short circuited and brake application etc. Seismic forces shall also be taken into consideration for design of the generators.

b). The construction of the generator shall be such that the rotor poles, stator bar and generator air coolers can be easily maintained/repaired without disturbing the upper bracket.

c). The thrust bearing housing shall be so designed as to provide easy access to the bearing pads. Openings with removable covers shall be provided for this purpose. The thrust bearing pads and the thrust faces shall be capable of being reached and inspected through the oil cooler windows (after emptying the bearing oil, removal of coolers and with rotor jacked up).

d. The guide bearings also shall be of such construction that these can be removed/ dismantled without disturbing the thrust bearings , rotor, stator, etc.

e. The core stacking to the extent shall be carried out at manufacturer's work. In case for sufficient reasons such as transport limits, the work of core stacking for stator shall be carried out at site, it shall be so mentioned by the contractors in their tenders, giving reasons. The stator frame design shall be suitable for lifting the built stator from service bay for installation in pit.

f. Similarly, the rotor construction shall be such that rotor poles are easily removable and replaceable. The poles shall be interchangeable.

g. The rotor shall also be supplied in the maximum possible assembled condition within the transport limits given. If to meet the transport limits rotor rim of lamination sheets is required to be built up at site the rotor construction shall be designed accordingly to suit the assembly at site (stacking, pressing, curing of lamination insulation, installation and mounting of rotor poles).

h. All parts of the generating unit shall be designed mechanically to withstand all electrical, mechanical, and other stresses which may be experienced during the operation of the unit, including short circuit, faulty synchronization, over speed and runaway conditions.

i. All equipment shall be designed and manufactured under due consideration of the prevailing transport limitations.

j. The design of the unit, including the relative locations of the rotor, generator thrust and guide bearings shall be such as to cause no abnormal vibration or resonant conditions. The unit shall be physically stable under worst short circuit conditions.

k. The supporting brackets will be steel fabricated and shall be rigid enough to support and transmit the load to the concrete structure /foundation under worst conditions . The bearing bracket supporting the brake assemblies shall, however, be designed to withstand the braking of the rotor even at 50% speed (though normal braking speed shall be lower).

l. Upper guide bearing bracket shall house the upper guide bearings in their hub.

m. Rotor field poles shall be arranged in a manner to permit easy removal with the unit rotor left in place. Field pole electrical connections shall be located in a position to facilitate ease of inspection, separation and reconnection. The field poles shall be provided with adequate damper windings to reduce voltage distortion etc.

06.08.04.14.02 MAIN SHAFT AND COUPLING

a) The generator shaft shall be made of the best quality forged carbon or alloy steel, properly heat-treated.
b) The design and construction of turbine and generator shafts shall be adequately coordinated by the generator and turbine manufacturers.
c) The critical speed and vibration strength of all rotating parts shall be checked with the turbine manufacturer and shall be verified by calculations.
d) The first critical speed of the combined rotating parts of the turbine and the generator shall be at least 25% above the maximum runaway speed.

e) The main shaft shall have an integrally forged flange for connection to turbine shaft flange. All coupling dimensions shall be agreed upon by the turbine and generator manufacturers and shall essentially conform to IEEE 810 “IEEE standard for hydraulic turbine and generator integrally forged shaft coupling and shaft run out tolerances” or an equivalent approved standard.

f) The generator manufacturer shall be responsible for the alignment and balancing of the rotor with the turbine shaft and runner after installation inaccordance with the stipulations

06.08.04.14.03 BEARINGS

a) The generator shall be provided with thrust cum upper guide bearing arranged in upper bracket. A new set of self-lubricated thrust bearing consisting of thrust pads, thrust collar, oil reservoir with external cooler etc. shall be provided.

b) The thrust bearings shall be with babbit lined pads of ample sized to be capable of safely coping with all operational conditions including runaway speed and start-up/shut-down without lift-pumps, hydrostatic lubrication or applying the brakes. All guide bearing pads shall be white metal lined.

c) The arrangement, design and construction of the bearings shall be duly coordinated with the turbine manufacturer and should take into account weights of the rotating parts of turbine, with unbalanced hydraulic thrust under all conditions of operation. Type and quality of the oil shall be the same for turbine and generator bearings.

d) The bearings shall be capable of operating at the following, guaranteed conditions:

- Continuously at 50 to 110%rated speed.
- 30 minutes at any speed between 110% rated and runaway speed with cooling water supply.
- 15 minutes at rated speed and full load without cooling water supply.
- 2 minutes at runaway speed without cooling water supply.

e) The thrust bearing shall be of the manufacturers standard design, with flexible self-adjusting pad, support (spring mattress type, tilting pad type or of other proven and reliable design), providing sufficient reference for long-term satisfactory operation.

f) Thrust bearing shall possibly so designed so as to remove the Thurst pad without dismantling thrust collars.

g) While designing the withstand capacity of the thrust bearing, weight of all rotating parts including shaft and runner, hydraulic tonnage at over load or more for which turbine is capable of under worst hydraulic conditions and severest faults or run away speed shall be taken in to account.

h) The size of the thrust bearing may further be designed by restricting the specific pressure on thrust bearing segments as per IEC.

i) A high pressure lubrication system shall be provided for lubrication of thrust bearing during start-up and shut-down. The system shall operate automatically at set speeds between 0 and 100%. Nevertheless, safe start-up and shut-down shall also be possible in case of failure of this system.

j) New self-lubricated guide bearings with internal/external coolers shall be provided. The guide bearings shall be of the multi-segment type. Guide bearing pads shall be babbit lined.

k) The thrust, lower guide bearing and the upper guide bearing shall be of the self-pumping lubricated type with oil-to-water coolers.

l) Material of coolers shall be as follows :

Tubes	: 90/10 Cu-Ni
Tube plates	: Mild Steel

m) Supply and return line flanges with shut-off valves shall be provided at generator floor level to allow connecting the oil circuits to the oil transfer and treatment system. An overflow with connection to the return line shall be included.

n) Special care shall be taken in the design of the bearing seals. No oil vapour shall enter the generator compartments. The system shall preferably be based on quenching air and vent-

pipes with filters.

o) The bearings shall be adequately insulated to prevent harmful flow of shaft currents induced by the generator field. Test points shall be arranged at an easily accessible location to allow regular checks on the existence of shaft voltage. Above arrangement can be combined with the auxiliary brush-holder provided for the rotor earth fault protection.

p) All provisions shall be included to permit loss measurement using the calorimetric method.

q) The **thrust bearing** shall be equipped with all the necessary indicating and control devices. Some of them are indicated as under:

- One oil level indicator in the bearing oil reservoir with high and low level alarm contacts and tripping contacts for very low oil level.
- Provision for DTTand RTDs shall be kept in all pads
- Resistance temperature detectors located in all the pads.
- Dial type thermometers(DTTs)shall be provided in diametrically opposite pads and one for the oil.
- One direct-reading water flow gauge along with low-flow alarm contacts.
- One oil-water contamination detector.

r) Each guide bearing (upper and lower) shall be equipped with the following:

- One oil level indicator in the bearing reservoir with high and low level alarm contacts and tripping contacts for very low oil level.
- Provision for DTT and RTDs shall be kept in all pads
- Resistance temperature detectors located in all the pads.
- Dial type thermometers (DTTs) shall be provided in diametrically opposite pads and one for the oil.
- One direct-reading water flow gauge, low-flow alarm.
- One oil-water contamination detector.

06.08.04.14.04 BRAKES AND JACKS

06.08.04.14.04.01 BRAKES

a) The generator brakes shall consist of asbestos free brake liners mounted on a vertical piston moving in a cylinder and shall operate against a polished circular steel brake track. The brakes shall be pneumatically operated type; compressed air at suitable pressure shall be supplied from the compressed air system. Existing compressed air system shall be utilized for brake application. Limit switches shall be provided for each brake to prevent the unit from starting if the brake is applied. The brakes shall be mounted on the bottom bracket of the generator.

b) A combined hand – operated and solenoid – operated air valve to control the operation of the generator brakes shall be supplied and mounted in the actuator cabinet – brake control panel. The operation of the solenoid of the air valve shall be selected by means of a control switch with “manual”, “off” and “automatic” positions. The control switch shall be provided with spring return to “off” from the “manual” position and shall maintain the “automatic” position when so placed. A manual locking device shall be provided to permit locking of the brake valve in the “on” position. When in the “on” position, the control switch shall operate

the solenoid of the air brake valve directly. With the switch in "automatic" position, the solenoid of the air brake valve shall be controlled by means of a suitable electric circuit, the requirements of which are given below.

c) Needle Valve position switches and speed switches as specified herein shall prevent the application of the brakes until the Needle valves are fully closed and the unit speed has decreased to the required level. It shall be possible to apply the brakes continuously after an adjustable period of time by means of the automatic control. The brakes shall be automatically released after the adjustable period of time sufficient to ensure that the unit has been brought to a complete stop.

d) When the control switch is in the "automatic" position a separate contact shall be closed for interlock in the auto-start circuit. A pressure switch shall be provided in the air line to the brake cylinders with contacts to open as an, interlock to prevent start – up whenever the brakes are on. A second pressure switch shall be provided in air supply line to brake valve to energize an alarm circuit of low air pressure.

06.08.04.14.04.02 JACKS

The brake cylinders shall also be designed to serve as hydraulic jack to lift the generator rotor to a sufficient height to facilitate removal & adjustment of bearing pads. A limit switch for operation of an indicating lamp shall be provided to indicate when maximum permissible raised position of the rotor is reached.

06.08.04.14.04.03 BRAKES AND JACK CONTROL PANEL

a. Brake and jack control panel shall be supplied. The panel shall house items such as solenoid valves, manual isolation valves, associated piping. The unit shall also house air filters to filter air entering the braking system to prevent rusting etc.

b) Jacking of the generator rotor shall be done when the rotor is standstill. A separate inlet and outlet connections shall be provided in the panel for connecting the pressure and drain line of the pressure oil system. Independent piping of braking and jacking shall be provided which shall become common at the outlet of this panel and shall connect to brake / jack assembly. Necessary provision shall be provided for draining of oil after jacking operation. All required instrumentation and interlocks shall be provided for safe and reliable operation of the system.

06.08.04.14.05 GENERATOR AIR COOLERS

a) The generator shall be provided with a close re-circulating cooling system complete with air ducts, surface air coolers, water header, metal housing, alarm devices, reducing valves and all other accessories.

b) Each air cooler shall be of the straight tube type made of solid drawn cupro nickel alloy, so as to provide adequate thermal conductivity and maintain the efficiency of such conductivity during the life of the surface coolers. The cooler shall have adequate cross section to give sufficient mechanical strength and to reduce vibration. Provision for expansion and contraction over the entire expected range of temperature variation shall be made. Each cooler shall be liberally designed ensuring satisfactory performance of the cooler, even

when 10% of total tubes of all surface air coolers are blocked/chocked.

c) All coolers shall be pressure tested at site before erection.

d) RTDs shall be provided at the inlet and outlet of the air cooler cooling water header. Contractor shall confirm that the opening of the generator barrel is sufficient to draw the quantity of air. Any modification on the barrel required shall be done by the Contractor.

e) Water for cooling will be available at a temperature not exceeding 31.5^0 C. The surface cooler shall have sufficient cooling capacity to limit the temperature cooled air to a maximum of 40^0C, even with one cooler out and balance 20% tubes blocked.

06.08.04.14.06 STATOR AND STATOR WINDING

a) The stator shall consist of a frame, a core and a winding.

b) The stator frame shall be of welded steel of liberal design utilizing only tested quality MS plates and structural only. The stator frame shall be in two or more sections as per transport limits. The stator frame section joining shall be as per manufacturers design practice. The stator frame shall be of robust design to withstand maximum forces acting on it under the worst condition of operation. The stator frame shall be designed for lifting the completely built stator and provided with suitable lifting lugs and devices for handling.

c) The core laminations shall be punched from high grade non-ageing cold rolled silicon steel coated with suitable insulating enamel to minimize eddy current losses and piled on dovetail key ribs which are accurately and securely fastened to the stator frame. The core shall be ventilated by means of radial air ducts throughout the stack length. The ducts, formed by non-magnetic space blocks will direct the air uniformly with minimum obstruction.

d) The stator core shall be clamped by means of flange and finger assemblies at both ends of the core. The assemblies are constructed by welding the non-magnetic fingers to the flanges and together they bridge the core and stator frame. The required pressure is provided and maintained with through studs.

e) All the necessary tests shall be conducted after piling and before winding at manufacturer's work for detection of hot spots. In the event stator winding is carried out at site, all the necessary tests shall be conducted at site by the Contractor and all the required items for test shall be arranged by the Contractor only. The stator winding shall be bar type, Y-connected with line and neutral leads brought out to the stator terminals. Each phase winding shall be distributed around the stator such as to minimize unbalanced magnetic pull. The stator winding and connections as well as connecting leads, main and neutral leads shall be of epoxy cast resin type, corresponding to class 'F' insulation. The maximum accepted temperature rise at maximum output will be limited to the temperature rise corresponding to class 'B' insulation.

f) The insulation shall be made of the best quality material and suitably impregnated insulation method employed shall give a homogeneous insulation without any voids, high thermal stability and insensibility against humidity, oil and other pollutions. All the strands

shall be insulated suitably so that no short circuit between adjacent strands may occur. The stator winding shall be adequately supported and braced to withstand the full stresses due to electrical short-circuiting. End connections of stator bar shall be made at the top of the winding.

g) The winding to the extent possible shall be manufactured and assemled at manufacturer's work before shipping to site. In the event that part of the stator winding is required to be done at site, supply of all insulation materials and other items and performance of all work for completing the winding at site shall be done by the Contractor. Adequate number of temperature detectors per parallel circuit per phase, shall be embedded in various parts of the stator winding. Resistance temperature detectors or thermocouples shall be provided for temperature measurement of the core. All the temperature detectors in and around generator shall be wired by shielded cables.

h) Terminal Arrangement

i) The main end of the windings shall be extended upto the bus bars with suitable insulating enclosure where they pass through the generator housing. Provision shall be made on the main side of terminals for mounting one set of CTs for generator differential protection inside the generator housing itself. The leads on the neutral side shall be so arranged as to permit mounting of all the generator CTs for metering, voltage regulation and protection before the formation of the neutral point. Suitable cable sealing ends shall be provided at the neutral point for facilitating the connection of the cable to be run to the neutral grounding cubicle.

06.08.04.14.07 ROTOR

a) The design and construction of rotor shall be in accordance with most modern practices details of which shall be furnished by the Contractor.

b) The rotor shall be designed for assembly on the rotor assembly bay in the erection area of the powerhouse. The Contractor shall provide all suitable rotor erection pedestals and sole plate adapters for the permanent use by the Purchaser.

c) The rim of the rotor shall be laminated and constructed out of 2mm thick or less steel having radial ventilating ducts located along with lengths and shall be bolted together to make a compact structure. The hub of the rotor shall be securely attached to the main shaft taking care of requirements both at normal operating speed and maximum over speed conditions. The rotor spider shall be of fabricated construction with arm radiating from the central hub. The pole pieces shall be built up of thin laminations secured by bolts passing through supporting end plates.

d) Pole assembly drawings, lifting arrangement drawings shall be furnished. Lugs, handling equipment, special slings etc. shall be supplied. The design should be such that Rotor pole disassembly as when required is easy. The design of the rotor shall be such as to permit the removal and replacement of field poles without the removal of the rotor from the stator. If tapered keys are used to secure the field poles to the rotor rim, the drive key shall project above the rotor rim at a sufficient distance to facilitate removal of this key by

means of a key puller and to permit checking for tightness. Suitable keeper's keys shall also be provided to ensure that the keys do not get loose in service.

06.08.04.14.08 FIELD WINDING

a) The field winding shall be insulated with class "F" insulation and shall consist of copper strips. Temperature rise shall be limited to class B. The field winding shall be adequately braced to withstand the stresses due to worst condition of short circuit and also due to centrifugal forces.

b) The field poles shall be provided with adequate amortisseur winding of the low resistance to improve stability under single phase fault conditions.

c) Equipment to monitor residual voltage of the rotor shall be provided. For each assembly new brush gear and slip ring shall be provided. The connections from the field coils to the collector ring shall be braced against mechanical forces. The brake ring on the rotor shall be supplied in segments, which may readily be replaced. "The brake ring of the rotor shall be designed to withstand all loads/vibrations/ stresses etc. for the braking at 50% of the rated speed".

d) Provisions shall also be made for rotor fans and air baffles at the top and bottom.

06.08.04.14.09 COLLECTOR RINGS

The collector rings shall be in an accessible location above the rotor and provision shall be made for reversing the polarity of the collector rings. The brushes and collector rings shall also be so positioned as to avoid contamination by oil vapours or oil leakage from the bearing.

06.08.04.14.10 ROTOR TEMPERATURE MEASUREMENT

One shunt, to be mounted in the generator field leads, shall be furnished complete with calibrated shunt leads for connection to a field temperature recorder for measurement of rotor temperature.

06.08.04.14.11 ROTOR GROUND FAULT DETECTION

A collector ring and brush assembly shall be mounted on the generator shaft for field winding ground detector relays.

06.08.04.14.12 BRAKE DUST COLLECTOR

Suitable exhausting arrangements for sucking and collection of brake dust, shall be provided during braking operation of the machine, consisting of extraction unit, hoppers

around brake assembly for trapping dust and flexible hoses for connecting hoppers to the extraction unit. The extraction unit shall have a motor driven exhaust fan to be fitted with an easily removable sheet steel bin for collecting heavy dust. The lighter particles of the dust shall be collected by suitable fabric based filter.

06.08.04.14.13 CARBON DUST COLLECTOR

Suitable exhausting arrangement for sucking and collection of carbon produced/emitted by the brushes shall be provided so as to avoid the conduction through carbon deposition resulting in earth faults.

06.08.04.14.14 SPEED MEASUREMENT

For measurement of speed of the unit for governor operation etc. atoothed wheel & necessary probes shall be provided and mounted onthe generator shaft.

06.08.04.14.15 ROTOR LIFTING DEVICE

The contractor shall design the device in an optimum manner and submitthe lifting arrangement drawing.

06.08.04.14.16 COOLING SYSTEM

a) The unit shall be self-ventilating by its own circulation action. The generator shall be totally enclosed. Pit seals shall be provided for separation of the generator air-cooling system from the turbine pit.

b) The air-water heat exchangers (stator air coolers) shall be mounted on the stator frame, each provided with shut -off valves at inlet and outlet. Each cooler shall be readily removable without disturbing the others whenthe machine is not in operation.

c) The surface air coolers shall have sufficient capacity to maintain stator winding temperature rise within class B temperature limit when the unit is operating at overload output, under worst system parameters i.e. at the maximum stator current.

d) The cooling system shall be complete with air coolers, oil coolers, cooling water pipes, fittings, flow indicating devices, flow relays and all other accessories. All internal piping shall be terminated in a flange on the generator barrel for connection with the plant cooling water system as specified in “Cooling Water System”.

e) The number of coolers provided, the normal working pressure and pressure drop through the coolers shall be indicated and supported by calculations. Connections shall be provided at the bottom of the air coolers to facilitate complete drainage. The coolers shall be designed for at least 10-kg/cm2 nominal pressure (Though working pressure shall be 2 to 5 kg/cm2). Automatic air vents with drain pipes shall be provided at the top to prevent air locks in the coolers. Lifting lugs shall be provided to facilitate the removal of any cooler through the top of the generator cover. Each cooler shall be provided with a pocket for

inserting thermometer on discharge end. The cooling water pipes inside the barrel shall be suitably coated with fine quality paint to prevent damage due to condensation on pipes. Various sensors and instrumentation shall be provided.

f) The cooling system of generator shall be provided with the following supervisory equipment:

- RTD's in each water supply line, to measure the temperature of incoming water.
- RTD's to measure the temperature of the outgoing water from each cooler.
- One RTD for each cooler to measure the temperature of the heated air leaving the stator core and entering the air coolers.
- One RTD for each cooler to measure the temperature of the cooled air entering the generator rotor.
- Water flow gauges at inlet and outlet with low-flow alarm contacts and indicating dial mounted on the gauge panel.
- Pressure gauges at inlet and outlet of all the heat exchangers.

06.08.04.14.17 FIRE PROTECTION SYSTEM & FIRE ALARM SYSTEM

a) An automatic carbon dioxide fire protection system complete CO_2 cylinders, ring headers, discharge nozzles, temp. detectors etc., shall be provided for generator. The temperature detectors shall be of the rate the rise of temperature type. Automatic controls shall be arranged to discharge CO_2 into the generator in the event of operation of temperature detector of the differential relay of the generator (if provided). The system shall be complete with manual operation arrangement to release CO_2 and with all necessary pipes, fittings, directional valves, etc.

b). Carbon dioxide based, fire protection system shall be provided for Generators as per Tariff Advisory's latest practice. A common CO2 fire fighting system shall be provided. The system shall contain one set of main cylinder bank for initial and extended discharge and 100% standby cylinder bank. The system shall include fire detection panel, heat detectors, smoke detectors and associated auxiliaries. Two CO2 banks, each consisting of an adequate number of CO2 cylinders will be provided for flooding of unit . One acting as main and the other as standby.

b) Fire Protection system has been detailed in the clause Fire fighting and Fire Protection system in tender specification.

06.08.04.14.18 SAFETY / MONITORING DEVICES

06.08.04.14.18.01 VIBRATION MONITORING SYSTEM:

a) the event of online vibration Monitoring System being offered as part of the package, the same shall be installed and in addition to that a portable vibration meter shall be supplied by the tenderer

b) A continuous vibration monitoring system complete with proximity probes, input/output module, control/processor unit, relays, junction boxes, cabling and associated accessories shall be supplied for on-line monitoring of vibration in the generating unit. It shall comprise:

- 2 nos. non-contact type proximity probes each for all the guide bearings i.e. upper, lower and turbine guide bearing to measure radial vibration in both axes.
- 3 nos. contact type proximity probes at each location at upper bracket, lower bracket and turbine bracket area to measure axial vibrations.
- 1 no. contact type proximity probe at thrust bearing to measure axial vibrations.
- Synchronization probe
- Set of input/output model, control /processing /communication unit, relays, junction boxes, cabling and associated accessories. The monitor with its control accessories shall be located at the unit control panel.

c) The system shall have the provision to monitor, record, analyze, diagnose, indicate and trip etc. as provided in chapter “Control and Instrumentation System” and “Protection System”. The system shall be integrated with plant SCADA system.

d) The system shall be of a make of international repute having proven performance and acceptability in the field of Hydropower. The details and scope of the system shall be approved during detailed engineering.

e). IN addition to the above a portable vibration meter of reputed make shall be supplied by the tenderer.

06.08.04.14.18.02 ANTI-CONDENSATION HEATING

In order to avoid water condensation during long non-operative period of the machine, heating elements shall be installed inside the generator barrel. These elements shall be rated for three-phase 415 V A.C., 50 Hz; and their terminals shall be connected to an easily accessible terminal box. The heating shall be controlled automatically by adjustable hygrostat, setting range about 50-100% relative humidity. The anti-condensing heating shall also be provided with manual ON/OFF switch and corresponding indication lamps in the local control panel. Provision shall also be made for adjustable thermostat for automatic control of the heaters.

06.08.04.14.19 MISCELLANEOUS PROVISIONS

INSTRUMENTATION FOR FIELD ASSEMBLY AND TESTS

The Contractor shall make arrangements for bringing all types of electrical and mechanical instruments required for field assembly of the rotor, stator and all testing equipment for testing and commissioning including field acceptance tests. These shall remain the contractor’s property after fulfillment of all field tests.

06.08.04.14.20 TERMINAL BOXES

The generator manufacturer shall supply terminal boxes to be located inside the generator pit, for connection of control and secondary leads from the generator equipment and auxiliaries located in the generator enclosure. All leads including control and indications shall be wired to this terminal box.

06.08.04.14.21 CONTROL WIRING AND CONDUITS

All internal wiring and conduits for control, relaying, fire protection, internal illumination and other systems shall be brought out to terminal boxes, and shall be suitably labeled.

06.08.04.14.22 INSTRUMENTATION, CONTROL AND SAFETY DEVICES

Necessary sensors/sensing elements, signal generators for sequential control and interlocks, measurement (indication, recording of quantities), monitoring of abnormal conditions of operation (for safety, alarm annunciation and shutdown) and related instrumentation which are embedded in and/or mounted on the generator or its adjacent (local) gauge panel should be included in the scope of supply of the generator as an integral part.

These items shall generally pertain to the following:

Temperatures	Stator, rotor, bearings.
Liquid Level	Oil in bearing oil baths
Pressure	Brake air, High pressure lubrication oil, cooling water
Flow	Cooling water for generator air coolers, bearing oil coolers
Shaft current/ Over speed/ Creep/ Vibration/Fire	Generator
Thrust bearing oil film monitoring	Thrust bearing

The contractor shall cover these items in the generator supply. They shall also include any additional item not indicated but which are necessary for smooth operation and safety of the equipment. A list of these additional items shall be decided during detailed engineering.

06.08.04.14.23 MISCELLANEOUS PIPING, TUBING, VALVES

All internal piping and valves for the following functions shall be included in the scope of the Tenderer:

- Cooling water inlet, outlet and drain for generator air and oil coolers.
- H.S. Lubrication oil supply to thrust bearing meant for lubrication during start-up and shut down of the unit.
- Oil filling and drain connections at the bearings.
- Piping for brakes and jacks.

- Tubing for connections between temperature sensing elements (vapour bulbs) to dial type thermometers, pressure gauge tubing.
- Any other essential piping, tubing, etc.

06.08.04.14.24 CABLING

The following control and auxiliary power cables and wiring shall form part of the generator supply:

- All wiring within the generator housing for the speed signal generator connections, thermometers, flow meters, RTDs /DTTs, all alarms and control and metering circuits associated with the generator.
- Capillary tubes/Cables between the generator and the gauge board.
- All 240 volts A.C. wiring, lighting fixtures and convenience outlets within the generator housing.
- All conduit and/or cable trays required for conductors and cables within the generator housing.
- A cable-marshalling box with approved disconnecting links to terminate all cables leading to the exterior of the generator.

06.08.05 EXCITATION SYSTEM AND DIGITAL VOLTAGEREGULATOR

06.08.05.01 DETAILED SCOPE OF SUPPLY

The excitation system and DVR shall consist of: -

- One (1) set of dry type excitation Transformer
- One (1) set of full wave fully controlled rectifier system with (n+n) layout thyristor bridge arrangement for 100% redundancy, complete with firing circuit, control system etc.
- One (1) sets of digital voltage regulators with all limiters & power system stabilizer.
- One (1) set of power supply units
- One (1) set of field flashing equipment, including transformers.
- One (1) set of DC field circuit breakers
- One (1) set of discharge resistors
- One (1) set of digital control and metering equipment
- One (1) set of excitation cable connecting the rotor to DC field breaker
- Any other items not specified above but are necessary to complete the system for satisfactory operation.
- Set of Spares

(Note: One set is defined as the total number required for one unit.)

06.08.05.02 SPECIAL DESIGN AND LAYOUT CONDITIONS

The excitation system shall be of the static, digital, constant-voltage type with controlled thyristors. It shall feature a very sensitive, quick acting control of the generator voltage and reactive power respectively. The system shall be of reliable design with an adequate

record of satisfactorily working reference plants.

06.08.05.03 BASIC DIMENSIONS AND RATINGS

Unless otherwise stated, rating, characteristics, test and test procedures, etc. of the equipment of excitation system and DVR shall comply with the provisions and requirements of the latest applicable International / Indian Standards.

06.08.05.04 PERFORMANCE CRITERIA & GUARANTEE

The equipment covered under this contract shall be capable of performing all intended duties and it is the responsibility of contractor to supply the equipment as per guaranteed technical particulars.

06.08.05.05 DESIGN AND CONSTRUCTION

The equipment offered shall be capable of withstanding lightning and switching surges and dynamic over voltages to which they may be subjected to and shall meet all the performance requirements and tests as described in the specification. The equipment shall conform to the latest issue of IEEE 421 or equivalent standard.

06.08.05.06 EXCITATION TRANSFORMER

The excitation transformer shall be of the 3-phase, cast-resin dry type, class H insulated. The winding material of transformer shall be copper .The L.V. and H.V. windings shall be impregnated and vacuum cast into moulds of glass fibre reinforced epoxy resin. The windings shall be provided with temperature sensors (PT 100) and static alarm and tripping device. The transformer shall be naturally air cooled, installed in a cage, designed and constructed to match perfectly with the common switchgear assembly. The L.V. connections to the rectifier cubicle shall be of copper buses and/or cables respectively and shall be in the scope of the contractor.

06.08.05.06.01 CHARACTERISTICS OF EXCITATION TRANSFORMER

Ratings of the excitation transformers shall be sufficient to meet the duties specified herein.

Primary rated voltage	11 kV
Secondary rated voltage	To be decided by generator and Excitation equipment manufacturer
Class of insulation	H
Type of cooling	AN
BIL (High tension)	75 kV
Power frequency withstand voltage	28 kV

The manufacturer shall supply a metal box, which will enclose the transformer high voltage bushings and terminate the isolated phase bus feeding the transformer. The flexible connectors from the isolated phase bus to the transformer bushing shall be arranged by

bus-duct manufacturer. The manufacturer shall provide a flange for bolting the phase bus enclosure to the metal box. To maintain the generator isolated phase bus arrangement, metallic barriers of suitable design to prevent short circuit between phases shall be installed between phases inside the transformer.

06.08.05.07 THYRISTOR EQUIPMENT

a) This equipment shall essentially consist of silicon power thyristor bridges installed in adequate cubicles. Each thyristor with relevant fast acting semi-conducting fuses shall be mounted on draw-out modules facilitating inspection and replacement. The fuses shall be monitored individually or in groups providing alarms and trips as required.

b)The design shall provide 100% redundancy in (n+n) layout arrangement of bridges where n is no. of bridges in one circuit. The rectifier shall be rated for the following duty cycles:

- Continuous operation at its maximum rating.
- Three phase fault adjacent to HV terminals of the generator
- Short circuit on the high voltage side of the transformer with duration of 2 sec.

c) The static excitation equipment shall be of modular design in such a way that it can be readily removed for inspection or replacements of parts.

d) Two independent circuits shall be provided for the manual and automatic control respectively.

e) The following monitoring and protection features shall be included:

- Temperature monitoring of thyristors
- thyristor failure
- D.C. short circuits
- Thyristor and field circuit over voltage protection
- Transient over voltage originating from the A.C. system, lightning or switching surges.
- The system shall operate correctly with supply voltages up to 120% rated voltage or unbalanced supply voltages.

f) Calculation for the capacity of rectifier shall be submitted. While determining the capacity, effect of ageing shall also be considered .The rectifier PIV (Peak Inverse Voltage) rating shall not be less than 4 times the maximum RMS voltage of the inputs.

g) The kVA rating and voltage ratio of the field flashing transformer (forming part of supply) and requirement of DC for field flashing shall be indicated in the tender along with other details.

06.08.05.08 DIGITAL VOLTAGE REGULATOR (DVR)

a. The DVR shall be a digital (numerical) type regulator. The digital voltage regulator shall respond continuously and practically instantaneously to correct any change in generator

voltage. It shall maintain the generator voltage for steady- state load conditions, without hunting, with 0.5% accuracy for any excitation within the operating range of the generator. For steady-state conditions with the generator circuit breaker open, the regulator shall maintain the generator terminal voltage at or below105% of its rated for speeds ranging from rated speed up to an over speed of 120% rated speed. An exciter limiting control shall be provided to limit the generator voltage to max. 125% of rated voltage in the event that the digital voltage regulator is tripped coincidentally with 110%load rejection and the generator speed rising to runaway speed. The voltage regulator shall be provided with over- and under- excitation limiters. The intervention of the limiters shall not cause perceptible

b. deviations or oscillations of the generated active and reactive power. The characteristics of the under-excitation-limiting curve shall match the static and dynamic stability curves of the generator. Such devices shall allow the regulator to reduce the exciter voltage to zero or to negative values in order to prevent over- voltages in case of operation under line reactive load conditions and over speeding of the unit.

c. The following features shall be included:
    i. stator current limiter
    ii. field current limiter
    iii. load angle limiter

d. The field current limiter shall act on DVR with a time delay so as not to disturb transient response of the system during voltage dips/faults. A slip stabilizer unit shall be provided to suppress the low frequency power oscillation during the operative conditions. The voltage regulator shall be equipped with a sensitivity-adjusting device and with an adjustable voltage droop compensation(compounding).

e. After the generator voltage attaining initial maximum value neglecting the instantaneous rises following any load rejection up to 110% of the rated load, DVR shall restore the generator terminal voltage to a value not more than 5% above or below the voltage being held before load rejection and shall maintain the voltage within these limits throughout the period of the generator over speed.

f. The voltage regulating system shall include device for improving the damping of active electromechanical oscillations. These devices shall operate to supplement the voltage regulating action by addition of an additional control signal into the excitation system input. This supplemental input signal shall influence the excitation system as to cause a change in field current of the machine for stabilized operation. As an option, adaptive control function feature to the slip stabilizer shall be offered. The function of the control is to optimize the setting of the slip stabilizer to suit the different configuration system. The setting of device shall be determined by the contractor.

g. The excitation system shall be designed for manual and automatic operation. The change-over from automatic to manual control shall be performed automatically following a failure of the regulator when operating on automatic control. The generator voltage shall be controlled within a range of +10% and –15% of rated voltage. A static follower shall be

provided so that, in the case of change-over from automatic to manual control, it prevents the excitation current from deviating more than 5% of no-load excitation current under steady conditions. An alarm and visual indication shall be provided to indicate change from 'AUTO' to 'MANUAL'. The automatic and manual control circuits shall be fully independent. Local and remote control shall be possible.

h. The voltage setting device shall be of the solid-state digital type providing a range of +10% and –15% for local and remote control and indication. For testing purposes, settings of 0 to 115% shall be adjustable at the DVR cubicle.

Initial Excitation System

i. In order to overcome the deficiency of remnant magnetism when starting the machine, initial excitation shall be applied to the field winding. The respective power shall be derived from the A.C. supply system via transformer and rectifier. All equipment for automatic field flashing, i.e. circuit-breakers, blocking diodes, control devices, protection, etc. shall be included. Provision shall also be made for field flashing through station batteries as stand-by arrangement. The field flashing circuits shall get disconnected when 70 % of the rated voltage is achieved at the generator terminals and normal excitation circuit takes over. This system shall also cope with the requirements of the excitation necessary for test runs.

06.08.05.09 DE-EXCITATION SYSTEM

To achieve a quick suppression of the generator field and thus the voltage, the field winding shall be shunted by a discharge resistor (voltage dependent type). After tripping the generator circuit breaker the DC field breaker shall connect the discharge resistor and simultaneously the polarity of the excitation shall be reversed.

06.08.05.10 CONTROL CUBICLE

The control cubicles shall comprise all control and supervisory devices required for the operation of the entire excitation system and DVR. The minimum requirements for instrumentation are the following:

- A.C. supply voltage
- D.C. supply current
- D.C. field current
- Set-point indicator for DVR control

06.08.05.11 INTERFACE WITH UNIT AND STATION CONTROL EQUIPMENT

A bus oriented control system will be provided. The digital voltage regulating and excitation control equipment shall be capable to communicate via serial interface and the field bus with the unit control boards. All signal interchange shall be realized through the bus.

06.08.05.12 CUBICLES

All the equipment of static excitation and DVR shall be suitably housed in sheet metal, dust proof cubicles. All these cubicles shall be located at one place in a row without any gap in

between. The dimensions of the cubicles shall be identical to present a neat and functional line up.

06.08.05.13 PROTECTION OF STATIC EXCITATION EQUIPMENT

The excitation equipment shall be protected against internal faults, failure of thyristor bridges, cooling fans etc. for which contacts shall be provided for alarm and shut down of the unit .The items of protection covered shall be the following but not limited to:

- Excitation equipment internal faults
- Current asymmetry protection more than two stacks faulty
- Over current protection for overload and short circuit protection of the excitation transformer and rectifiers
- Cooling fan failure (main and reserve)
- Loss of regulator DC power
- Failure of thyristor firing circuit
- Failure of DVRs
- Individual cooling fan failure
- Rectifier cubicle exit air high temperature
- Current asymmetry, one thyristor stack faulty
- Operation at minimum excitation limit
- Operation at maximum excitation limit
- Excitation transformer winding temperature
- Failure of field flashing circuit equipment
- Prevent over fluxing of the transformer

06.08.05.14 EXCITATION CONNECTIONS

Excitation power cable connections between the generator slip rings and the DC field breaker cubicles shall be provided. The power cables shall be of adequate copper cross-section to continuously carry the rated current of the excitation system and the maximum current for 10 seconds. They shall be made of highly flexible conductors and the cable insulation shall be of the heat-resistant type, taking into account the maximum temperature rise of 65°C at 40ºC ambient temperature in the slip-ring compartment. The cables shall be adequately spaced and supported with consideration to the electro-mechanical forces involved and designed to prevent undue heating during continuous operation.

06.08.05.15 OTHER ITEMS

Bus duct - Generator CT, PT, LA & surge panel shall be provided as described in respective chapters (refer vol. IV)

06.08.06 COOLING WATER SYSTEM

06.08.06.01 SCOPE OF WORK

Two numbers (1W+1S) cooling water pump-motor sets of adequate capacity shall be envisaged for meeting the cooling water requirement of bearing oil coolers of generator and turbine, stator air coolers and transformer oil coolers.

All necessary piping, valves, strainer, duplex filters, instruments, flow indicators with contacts are in tenderer's scope. Scope shall also include level monitoring system for emergency overhead tank and cleaning of the overhead tank. Replacement or rerouting of embedded piping shall also be included in the scope.

06.08.06.02 DESIGN CRITERIA

Source of the cooling water pump shall be taken from a sump pit located downstream of the power house situated outside the pump house which is fed by tail race water of running units. Return hot water from each cooler (excluding transformer oil cooler) is discharged in to the turbine pit. Hot water from transformer oil cooler is discharged into tail pool.

In case of failure of cooling water pumps, cooling water can be drawn from an emergency over head tank installed at the top of the power house.

All pipe, valve and fittings shall be designed as per IS 1239 & 3589 of latest edition.

06.08.07 DRAINAGE AND DEWATERING SYSTEM :

Following works to be carried out for drainage and dewatering system

a) Exposed pipe is to be replaced by new one. Pipe and fittings shall be designed in accordance with IS 1239 or equivalent standards.
b) Replacement or rerouting of embedded piping
c) Strengthening of pipe supports if any to be done.

06.08.08 LUBE OIL SYSTEM

A suitable grade of oil (as per IS or IEC standard) for lubrication of bearings of the TG unit shall be considered. All the bearings of the proposed TG unit shall be self-oil lubricating type with internal/external oil coolers as described above in respective clauses. A new portable type oil centrifuge of adequate capacity and of latest design shall be provided. This oil centrifuge shall be used for purification of the lube oil during maintenance of the unit. A suitable mechanism shall be provided for top up the oil to the bearings as required. Standard oil drums shall be supplied for used oil as well as for pure oil. All these arrangements shall be placed on coupling chamber floor.

06.08.09 COMPRESSED AIR SYSTEM

New compressors for governor operation shall be provided. For detail refer Clause 06.01.02 (4) of this volume.

06.08.10 FIRE PROTECTION SYSTEM (FPS)

In addition to details in chapter 06.04.03.04 (p), Technical Specification for complete fire protection system to be provided for the Kodayar Power House-I complex is given below.

06.08.10.01 GENERATOR FIRE FIGHTING SYSTEM (FFS)

Refer the Fire Protection and Fire alarm System clause of tender specification.

06.08.10.02 INTRODUCTION-FIRE PRODUCTION SYSTEM (FPS)

In order to combat any occurrence of fire in various areas/unit of the proposed Kodayar Power house-I complex, an elaborate system of fire protection shall be provided. The system shall be planned in conformity with Tariff Advisory Committee's (TAC) guidelines, BIS and other relevant standard/codes.

Major facilities envisaged are as following:

i. Fire Hydrant System

ii.) Microprocessor based intelligent Fire detection and alarm system

iii). Water spray system comprising of MVWS and HVWS.

iv). Portable fire extinguishers

06.08.10.03 SCOPE OF WORK AND SERVICES IN FIRE PROTECTION SYSTEM

A. The scope of work covers on turnkey basis design & engineering, supply, erection, painting, testing, commissioning and handing over of complete Fire Protection System envisaged for the Kodayar Power house-I complex.

B. The source of water is same that of the CW pump & availed by farming a suction header or using the existing CW suction pipes. The existing CW pump room shall be utilized with necessary modification for installation of fire hydrant pump and associated suction/ delivery piping, valves and fittings

C.Major work comprises of following :-

a. Fire Hydrant system consisting of internal as well as external hydrants for the entire area.

b. High velocity water spray system(HVWS) for transformer and Medium velocity water spray system (MVWS) for cable galleries in power house complex.

c. Provision for Dewatering of water from cable galleries.

d. Portable Extinguishers shall be provided in all control rooms and other services rooms.

e. Microprocessor based intelligent Fire detection and Alarm system for various plant premises.

f. Piping, valves, sluice gates etc.

g. All civil & structural works

h. All electrics.

i. Controls and instrumentation.

j. Shop and site painting for all equipment, pipes etc.

k. Erection, testing, commissioning, PG test and Warranty for the complete fire protection system

l. All the requirements of TAC for complete Fire Protection System shall be incorporated by the tenderer in their scope irrespective of whether the details are described in specification and/or shown in the drawings or not.

06.08.10.03.01 The scope of work and services to be rendered by the tenderer for installation of fire protection systems shall include but shall not be limited to the following activities.

i. Design & engineering, handling at site, preparation of erection drawings, fabrication and erection as per approved drawings, site testing, painting, commissioning and fulfillment of guarantee of all fire protection systems, sub-systems and integrated systems as described above.

ii. Miscellaneous materials and services shall include but not limited to the following

a. All piping integral to and/or between any equipment furnished under this specification, except as otherwise specified.

b. All necessary instruments, power and control wiring integral to any equipment furnished under this specification. This shall include terminal blocks and integral wiring to these terminal blocks for equipment requiring external connection.

c. Earthing strips of all panels, & other firefighting equipment supplied by the

tenderer shall be connected to the nearest earthing ring available at site.

d. Digging of underground trenches, laying of cables, laying of protection slab/bricks over the cable routes, back filling of trench and levelling of earth if required.

e. GI pipes/ conduits and other accessories wherever required for laying of cables.

f. Other erection materials like cable supporting structures, channels, brackets, clamps and other hardware materials, as required, for laying of cables.

g. All erection accessories, consumables and miscellaneous materials, though not specifically indicated in this specification, but actually required for completing the job in all respects.

h. All necessary connections for hook-up with other system, if required and as per instruction of the purchaser.

i. Erection, testing and commissioning materials.

j. Initial fill of gas and other fire extinguishing media (including quantity required for PG test) and demonstration.

k. Valve chambers for all isolation valves.

l. Housing for deluge valves.

06.08.10.03.02 All Civil works as elaborated in Civil specification.

06.08.10.03.03 Civil works pertaining to underground buried pipelines such as excavation, laying, backfilling, compacting, construction of valve chambers, manholes, laying of encasing pipes below roads shall also be in the scope of the tenderer as a part of pipe laying. In case group of pipes are crossing road, RCC culverts to be provided below the roads and the same are included in the scope of the tenderer.

06.08.10.03.04 All civil works for completeness of fire protection systems which may not have been described but required technically.

06.08.10.04 TECHNICAL SPECIFICATION

06.08.10.04.01 FIRE HYDRANT SYSTEM:

06.08.10.04.01.01 GENERAL

Sump pit located downstream of the power house shall be the source of water for the complete fire fighting system. 02 nos. (1W+1S) fire water pump and motor sets including pipe, strainer, valves, instruments etc. shall be supplied. These pumps shall be installed in the existing fire water pump house after modification of the same. The pumps shall supply the water for fire hydrant system, HVWS, MVWS etc.

The scope of the tenderer shall include fire hydrant system, consisting of pipe network, pressure controllers, internal & external hydrants, hoses, valves, hose boxes, nozzles, couplings, related instrumentation, supports for pipes & valves.

Details regarding painting, erection, hydrostatic testing, testing & commissioning, etc. refer chapter- IV of this volume

06.08.10.04.01.02. SCOPE OF WORK OF THE TENDERER ALSO INCLUDES THE FOLLOWING

- Taking taping from firefighting pump discharge header for complete hydrant system.
- Pressure controller- 1 No.
- Piping from tapping point up to each hydrant with necessary pipe supports
- Valves with supports
- Fire hydrant with hoses, nozzles, couplings, etc.
- Taking branch, from the above mentioned tapping, for high velocity water spray (HVWS) system as well as for MVWS system
- Pressure controller on the branch going to HVWS system
- Erection, testing & commissioning of the total system
- Pressure available at the farthest hydrant shall be 3.5 Kg/cm2 minimum.

06.08.10.04.01.03. FIRE HYDRANTS (EXTERNAL & INTERNAL)

i. All fire hydrants shall be designed generally as per IS: 5290 – 1993 Type A, i.e, single outlet type.

ii. Each hydrant shall consist of valve, matching flange, CAF gasket, nuts, bolts and instantaneous spring lock type female outlets with blank cap & chain. \

iii. Each Hydrant shall have a permanent stainless steel name plate and Stainless steel tag fixed on the hydrant indicating the Tag No.

iv. Hydrants shall be designed for 100% tight shut off.

v. Material of construction for the various components shall be as follow:-

Body, Bonnet, stop valve, check nut : SS 04Cr17NiMO2 as per IS:6529-1972.
Female coupling and blank cap : SS 04 Cr 17NiMO2 as per IS:6529-1972.
Hand wheel : CI as per IS:2010 -1978

Other Components : As per IS: 5290-1993.

vi. Companion flanges shall be made of Carbon steel plates conforming to IS:2002 Gr 2A'92 and drilled to IS: 6392-1971 (Reaffirmed 1994) Table 17.

vii. Each internal hydrant shall be complete with two hoses of 15 m for TG area and 7.5 m length for other area and shall include hose couplings, nozzle, spanner & other accessories. The hoses and other accessories shall be kept in a hose box, which shall be installed near each internal hydrant.

viii. Each outdoor hydrant shall be provided with stand pipe with bend, two hoses of 15m length with couplings, spanner, nozzle etc. The hoses & accessories shall be kept at certain hose stations located suitably to facilitate fire fighting.

06.08.10.04.01.04. LOCATIONS OF HYDRANTS

Sl. No.	Unit	Internal Hydrants (single headed) Nos.	External Hydrants (single headed) Nos.
1.	Machine Hall	3	---
2.	Coupling chamber floor	2	---
3.	Cooling water pump house floor	1	
4.	Switch Yard	---	2
5.	Transformer Yard	---	2

06.08.10.04.01.05. HOSE BOX

Each hose box shall be fabricated out of 18 SWG MS sheet. The two sides and back of the hose cabinet shall be made from sheet by pressing. The top shall have pressed edges slightly projecting outside to prevent water (While cleaning etc) from entering the cabinet.

The cabinet shall be fitted with double door having glass panes. The thickness of glass shall not be less than 3.0 mm. The door shall be provided with a lock with duplicated key and knob on the body of door. Suitable hooks etc. shall be provided in the cabinet to hold the hose reel etc. mentioned above. Suitable wall mounting brackets shall be provided with the cabinet.

06.08.10.04.01.06. HOSE STATION

There shall be seven no. of strategically located hose stations for storage of hoses for yard hydrants. The dimension of hose stations will be (2.0x1.5x2.0)m each. These will be constructed of brick masonry and RCC roof and will have glass panelled double doors. Each hose station shall have provision for storing a minimum of 12 houses.

06.08.10.04.01.07. HOSES AND ACCESSORIES

i. Each hose shall be as per IS: 636-1988 Type A& of reinforced, rubber lined flax canvas material and shall be supplied complete with instantaneous spring lock type couplings as per IS:903 – 1993.

ii. Each hose shall have a diameter of 63mm. Each nozzle shall be of 25 mm size.

iii. 2.0 mm GI wire shall be wound around the coupling so as to cover 120 mm length of hose.

iv. Nozzle, Coupler (male/female), lifting key, branch pipe shall be of stainless steel construction. Branch pipe shall include solid stream nozzle.

v. The hoses shall be suitable for a working pressure of 8.5 Kg/cm2 and shall be capable for withstanding water pressure of 32 Kg/cm2 without any leakage, sweating or bursting.

06.08.10.04.01.08. ISI MARKING

All the equipment supplied except (Hose box) shall have ISI stamp/marking on them.

06.08.10.04.02.00 FIRE DETECTION & ALARM SYSTEM: (FDA) (microprocessor based):

a. Fire Detection and Alarm System (FDA) shall be intelligent addressable microprocessor based automatic system. The System shall be designed, manufactured, assembled and tested in accordance with the relevant Standards of National Fire Protection Association (NFPA) latest. All components shall have UL / FM / LPCB / VDS / IS 2189 approval and shall also have approval from Tariff Advisory Committee (TAC). In case of conflict among any Standard / Norm, the stringent one shall govern.

b. All equipment, in general, shall be designed for smooth, efficient and trouble-free operation in tropical humid climate for 45 deg C ambient as 24 hour average with short time maximum of 50 deg C and a humidity of 100%. The derating of equipment shall be done for an ambient temperature of 45 deg C. For specific applications involving arduous conditions, the equipment shall be based on actual ambient temperature of the area of classification.

06.08.10.04.02.01 SCOPE OF WORK

The scope of work includes design, engineering, supply, erection, testing, commissioning, performance tests and handing over of intelligent addressable type Fire Detection and Alarm system for various premises of the project as mentioned in Table-1.

TABLE-1

SL. NO	DESCRIPTION	FALSE CEILING	TYPE OF SYSTEM
1.	Control Room including Battery Charger Room	Yes	FDA system and Fire extinguisher
2.	Battery Bank room	No	FDA system including Fire Extinguisher
3.	office room	No	FDA system with Fire Extinguisher
4.	All other areas including above areas	No	Fire Extinguishers

The system shall mainly consist of the following:

SL.	ITEM DESCRIPTION	TENTATIVE BOQ
A)	Intelligent Addressable-type microprocessor based optical / Photoelectric – cum- Thermal Detectors	LOT
B)	Intelligent Addressable-type microprocessor based fixed cum Rate of Rise Heat Detector	LOT
C)	Intelligent Addressable-type microprocessor based photo-electric Smoke Detector	LOT
D)	Intelligent Addressable-type Manual Pull Station	LOT
E)	Intelligent Addressable-type Control Modules.	LOT
F)	Electronic hooter with Strobe	LOT
G)	Response Indicator	LOT
H)	Intelligent Addressable-type Fire Alarm Panel (Total Loop and one (1) additional spare loop has to be considered)	LOT
I)	Relay/Contactors	LOT
J)	Networking / special Cable	LOT
K)	Control Cable 2X 1.5 / 2.5 Sq. Mm	LOT
L)	Fire Extinguishers	LOT
M)	PC & Printer with Furniture	LOT
N)	Intelligent Addressable Isolator Module	LOT
O)	Intelligent Addressable Monitor Module	LOT
P)	Intelligent Addressable Repeater Panel	LOT
Q)	Auto Dialing Facilities	LOT

a) The Intelligent Addressable Microprocessor based Automatic Fire Detection and Alarm system shall be software controlled automatic system and shall provide necessary programmed activities and various controls. The system shall consist of central processing units, man machine interface, communication system, microprocessor based fire alarm control panels, TFT monitor, printer Addressable Intelligent Automatic sensors and Interface unit as applicable.

b) Fire alarm control panel shall function as communication interface between Central Processing Unit and sensors and controlled devices. Addressable Intelligent type microprocessor based Detectors / Manual Pull Stations and required field devices in the various areas shall be connected to fire alarm control panels by class A wiring to the loop module.

06.08.10.04.02.02 EARTHING:

At least 2 Nos.
One lot of earthing conductors, accessories and electronic earth pit shall be provided, as required, for proper earthing as per statutory norms and to meet the stipulations of IEC. The equipment shall be earthed by connecting it to the nearest earth grid by two separate contractors. Copper strip and wire shall be used for all earth conductors.

06.08.10.04.02.03 ELECTRONIC EARTH PITS

a. At least 2 Nos. Electronic earth pits shall be proved near the control room as per the Indian standard.

b. Test Magnet along with Detector removal telescope handle shall be provided.

c. Automatic Clean Agent such as IG – 55 (Argonite) or IG – 541 (Inergen) based automatic Fire Protection system for control room shall be provided as per NFPA – 2001. While designing of the system 100% stand-by shall be considered.

d. Any of the following system and equipment may be selected for the Fire Protection System:
   i. NOTIFIER SYSTEM
   ii. EDWARDS SYSTEM
   iii. SIEMENS / CERBERUS SYSTEM

e. All items indicated against fire detection cum alarm system shall be supplied by Tenderer as per approved drawings. The system shall be supplied exactly as per specification / as per approved drawing with bill of quantities meeting the NFPA, IS 2189-1988 and TAC norms.

f. Site supervision work shall be carried out by manufacturer's certified persons.

06.08.10.04.02.04 TECHNICAL (FIRE PROTECTION SYSTEM) (FPS)

06.08.10.04.02.05 GENERAL

a) A microprocessor based intelligent addressable type automatic fire detection cum alarm system shall be provided for complete power plant including all electrical and common facility premises mentioned in Table-1.

b) In all the electrical premises multisensor addressable intelligent detectors in double configuration shall be provided except battery room where rate of rise cum fixed temperature type heat detectors shall be provided.

c) The system shall have self-monitored microprocessor panel incorporating the latest technological developments. The automatic fire detection cum alarm system shall operate taking into consideration the air change/air velocity of the ventilation system. Response indicators shall also be provided for all the detectors above false ceiling in control room.

d) Tenderer shall assess the quantity of interconnecting cables and wires, supporting arrangement and include the same on lump sum basis.

a. Following parts of fire detection and alarm system shall be provided:

- Main Fire Alarm Panel
- Personal computer with TFT monitor, key board, mouse and printer
- Manual pull stations (indoor type)
- Manual pull stations (outdoor type) with canopies
- Hooters (indoor type)
- Hooters (outdoor type) with canopies
- Multi sensor detectors (photo electric cum rate of rise and heat detector type)
- Rate of rise cum fixed temp type heat detectors
- Isolators
- Relay modules
- Response indicators
- Area panels
- Photoelectric Detectors
- Maintenance free Ni-Cd battery and battery chargers
- FRLS cables, conduits, junction boxes, earthing materials etc.
- Siren and hooter

06.08.10.04.02.06 SYSTEM DESCRIPTION (Fire protection system) (FPS)

a. Intelligent addressable Microprocessor based control panel shall be provided to detect, differentiate and monitor the following conditions of the detectors.

- Fire
- Fault condition
- Open circuit
- Short circuit
- Low voltage condition of batteries

b. Panels shall have provision to accommodate 20% extra locations or one loop for future use (whichever is more).

c. The system shall have display as well as print options. Fire alarm panel shall have mimic and text display.

d. The system shall also be suitable to work on UPS system. Purchaser will provide one feeder from their board. Requirement of UPS power shall be furnished by the bidder.
e. There will be one number Main Fire Alarm Panel to be installed in Power Plant Control Room.

f. For tripping of A/C, ventilation drives, signals shall be initiated from Main Fire Alarm Panel only if two adjacent detectors give fire signal.
g. Number of loops in fire alarm system shall be finalised based on requirements / future use during detailed engineering stage. The Tenderer to note that all loops shall be closed type. Panel shall have provision to adjust the sensitivity of the detectors from the panel itself. Mimics shall be developed in monitor to know at a glance operation of detectors in a particular area.

06.08.10.04.02.07 MAIN FIRE ALARM PANEL (MFAP)

MFAP shall be located in main control room. Fire signal from all the area panels shall be repeated in MFAP. MFAP shall have text display.

Fire Alarm Panels shall also have the following features:

1. Logging an alarm, time and action text on printers.
2. 'NO & NC' contact for common fire/fault signal of individual loop for sending the information to the 'Power Plant DCS'/ Automation system or other area.
3. Auto dialing facilities with security office, central fire brigade station etc.
4. Networking system with other panels.
5. The possibility of expanding to a bigger system with several control panels and control and information units.
6. Programmable activation of control output relays for tripping Air Conditioning & Ventilation system.
7. System shall be interfaced with existing telecommunication system for alerting central fire brigade station personnel.
8. Main Fire Alarm panel shall have provision of transmitting the signal to the remote station; necessary software for the interfacing with the other panel/DCS system shall have to be included in the scope.
9. Fire alarm panel shall have enclosure protection feature of IP 55 and the sheet steel enclosures shall be minimum 2 mm thick.
10. Ni-Cd batteries shall be provided for the standby back-up of the fire alarm panels.

06.08.10.04.02.08 PERSONAL COMPUTER AND PRINTER:

a. Personal computer with TFT monitor along with key board and printer shall be provided to monitor all the data loggings of events, system diagnostics and to print out the required events / data logged with date, time, etc. Status of all the detectors shall be displayed on demand on TFT monitor. It shall display alarm, pre-warning faults and location of the fire or faults like open circuits and short circuits.

b. TFT screen shall be of minimum 21 inch size. Processor type shall be latest version of Pentium. Printer shall be color Inkjet type. Suitable furniture for PC and printer with revolving and rolling chair shall be included in the scope of the Tenderer. In PC it shall be possible to have geographical mimic and graphic display for the complete area. PC and printer shall be located in main control room and connected to MFAP.

06.08.10.04.02.09 NETWORKING

The MFAP shall have provision for serial interface with Plant DCS. A provision shall be kept to add / remove panels from the network. Necessary cabling, interface cards, hardware and software are included in the scope of the Tenderer. In network connection, Tenderer shall provide two spare cores to be used in case of fault in working cores.

06.08.10.04.02.10 POWER SUPPLY

a. Tenderer shall include all power supply cabling for the fire alarm panel from the existing power supply boards.

b. The fire alarm panel shall be provided with 24 V DC batteries along with battery charger of adequate capacity so that if AC power fails, DC source will be available automatically without interruption. Batteries for above shall be Ni-Cd maintenance free type. Battery shall be capable to withstand the total normal requirement for duration of 48 hours and for duration of 30 minutes to meet alarm load requirement. Alarm load shall consist of normal detection equipment plus all sounders/siren etc. Boost/trickle charging facility shall be provided in the panel. Battery shall be kept separately in the control room at suitable place.

06.08.10.04.02.11 DETECTORS

a) Detectors shall be of latest series intelligent addressable type and microprocessor based. Close loop shall be formed with connections of detectors. Each close area shall have isolator at entry points and exit points which will automatically open the part of loop on short circuit. Alert signal (first) and final fire signal (second) shall have differentiable sound.

b) It shall be possible to adjust sensitivity of detectors through area panel or MFAP. Detectors and Panels shall be from the same make.

c) In Ni-Cd battery rooms rate of rise-cum- fixed type heat detectors shall be provided.

d) Remote response indicators shall be provided for all detectors located above false ceilings in control room. Required work for fixing of the indicator above ceiling shall have to be carried out by the Tenderer. For detectors to be mounted in existing control room over the false ceiling, Tenderer to take necessary precautions so that existing facilities shall not be disturbed.

e) Detectors shall not foul with ventilation duct and shall not be located near diffuser. Detectors and fire panels shall have UL listing FM approval. Fire alarm panel shall be UL/FM/LPC/TAC approved.

f) Multi sensor detectors shall be installed as per latest practices indicated in IS: 2189-1988, TAC and NFPA codes. Minimum two numbers of detectors for the smallest premise shall be provided. Coverage area shall conform to IS 2189-1988.Tenderer shall select the spacing of detectors considering the air change factor of the ventilation/air conditioning system ,height of room ,beam depth etc. as per IS 2189-1988.

g) In cable shafts smoke detectors at top of the shaft shall be provided with required fixing arrangement.

06.08.10.04.02.12 MANUAL PULL STATIONS (MPS)

a) MPS shall be provided at each entry /exit point of electrical room, emergency exit, yard area, transformer bay etc. MPS shall be intelligent addressable, break glass type connected to its location card. Both indoor/outdoor MPS shall have glass cover and removal of glass shall initiate communication to area panel and main fire alarm panel.

b) Total numbers of Manual pull stations and their locations shall be finalized during detailed engineering. Travel distance between two consecutive MPS shall not be more than 50 meters. Signal of the MPS shall appear at the Area Panel and Main Fire Alarm panel. At main entry points of buildings and electrical rooms minimum one number Manual pull stations shall be provided. In outdoor areas, MPS shall be suitable for outdoor location with rain canopy and shall be mounted on structure or wall at prominent places. Whenever existing supports are not available, Tenderer shall consider steel structure support arrangement so that MPS shall be located at 1 meter from ground level.

06.08.10.04.02.13 SIREN / HOOTER

a) Siren shall be mounted on suitable support near chimney (capacity 1 Km range to operate in case of confirmed fire is registered in the main fire alarm panel). Siren shall also be suitable for manual operation. Siren shall have three types of sound; first alarm (or alert), second fire (or emergency) and third clear. Tenderer shall furnish details for above. Siren shall be connected to UPS power supply and all necessary arrangement shall be provided by the Tenderer for this. Purchaser will provide only one UPS feeder from the DB located in main control room.

b) Hooter shall be connected in each zone internally as well as externally. External hooters may be clubbed together i.e. common entry/exit point of view for cable areas.

06.08.10.04.02.14 CABLES & CABLE LAYING

Cables used for interconnecting hooters shall be limited to one premise only. All incoming-outgoing power supply cables & inter connecting cables used for the system shall be fire resistance low smoke (FRLS) type 1100 V grade PVC insulated, PVC inner and outer sheathed having 2.5 mm2 copper conductor, armoured type conforming to IS:1554 (Pt.-1). Three core cables (keeping one core as spare) shall be used for the detector/ device connection.

06.08.10.04.02.15 DETECTOR CIRCUIT CABLES SHALL BE CLASS "A" WIRING.

a) Fire cable routing shall be separated from other cables to the extent possible. All switches, cable ending junction boxes, multi-way junction boxes, FRLS connecting cables, panels etc. shall be included to make the system complete in all respect. This shall include wiring/cabling up to Area Annunciation panels. Cables for detection system shall be laid keeping sufficient space from illumination cables. Cable shall be laid as per approved cable routing and cable layout drawings and as per normal plant practice and manufacturer's guideline. Route markers for fire cables shall be separate and distinct from other markers.

b) Separate cables shall be provided for telephone and public address system. Cables for telephone system shall be twisted pair.

c) All cables for networking, telephone, public address shall be armoured type. The cables shall be laid in pipes while crossing road, drain etc.

06.08.10.04.02.16 QUANTITIES OF ITEMS

No. of detectors, response indicators, manual pull stations, isolators, interconnected cables, incoming cables, conduit for laying of cables shall be provided by the Tenderer as per the requirement to cover all the areas based on approved drawings. Quantities are to be calculated by the Tenderer and shall be provided to meet all requirements. List of electrical premises has been enclosed, however Tenderer to ensure coverage of detection network for all electrical rooms of the plant and cable galleries. Tenderer to cover all electrical rooms by Fire Detection System whether same is indicated specifically or not.

06.08.10.04.02.17 INTERFACE DEVICES

Tenderer shall include all interfaces/ hooking up devices for connecting output of alarm points, interlock points etc.

06.08.10.04.02.18 INTERLOCKING WITH A/C & VENTILATION SYSTEM

a) There will be interlocks to shut off the exhaust fans and simultaneous tripping of A/C and ventilation system. The fire signal from first detector will operate the audio-visual alarm whereas on confirmation of fire signal from the other detector the ventilation/air conditioning system shall be switched off automatically. Appropriate tripping relays and their contacts shall be provided by the Tenderer for this purpose considering zone wise operation, partitions in cable gallery and number of fans/ system operating in the electrical rooms.

b) Potential free contacts shall be made available for each zone for tripping of respective ventilation/air conditioning system. Location of above relay module shall be as finalized during detailed engineering stage. Tenderer to consider all accessories such as cabling/

wiring, contact multiplication etc required to achieve the system requirement.

c) Contact of auxiliary relays shall be made available in relay auxiliary panel of the above mentioned places and shall be suitable to wire directly in MCC control circuit.

06.08.10.04.02.19 ERECTION MATERIALS

a) All fixing accessories for cabling, detectors and panels shall be included by the Tenderer including cable tray.

b) GI conduit shall be provided in outdoor area, wall/floor crossing and inside building, metal or rigid PVC conduit shall be provided.

c) Civil works like chipping of floor, grouting, providing inserts, providing base frame for panels, conduits are included in the scope of the Tenderer.

06.08.10.04.02.20 TESTING, COMMISSIONING & PERFORMANCE GUARANTEE

All tests and inspection of the installation shall be done in conformity with the functional requirement of the system as per IS: 2189, TAC and NFPA norms. The Tenderer shall furnish a detailed testing, commissioning and performance testing procedure for all the systems for approval by the purchaser. Performance testing shall include acceptance criteria for each equipment and complete system. As soon as a given facility or a portion thereof is completed and ready to energize and start-up, the purchaser may test run and operate it without relieving the Tenderer of his responsibility or guarantee.

06.08.10.04.03 WATER SPRAY SYSTEM COMPRISING OF HVWS AND MVWS –

For protection of Cable galleries etc. from fire Medium Velocity Water Spray (MVWS) system shall be provided. For protection of Generator Transformer (GT) High Velocity Water Spray (HVWS) system shall be provided. The system shall be designed as per TAC, BIS and NFPA guidelines.

06.08.10.04.03.01 DESCRIPTION OF THE SYSTEM

HVWS & MVWS envisaged is a special fixed pipe system connected to a reliable supply of water from existing hydrant main pipe line and equipped with spray nozzles (projectors) for specific water discharge and impingement over the surface or area to be protected. The piping system is to be connected to the water supply through an automatically actuated valve (deluge valve) which can initiate flow of water. Deluge valves for the spray system are to be actuated by an automatic detection system which in the case of transformers consists of quartzoid bulb detectors mounted around the protected area and for cable galleries these are part of fire detection & alarm system.

06.08.10.04.03.02 OPERATION OF THE SYSTEM

a) Initially, delivery line should be pressurized upto deluge valve with the water line pressure upto deluge valve should be maintained at around 7 kg/cm2. The Q.B. detector line should

be pressurized to a pressure of 4 kg/cm2 with the help of water which should be tapped from the header itself. Deluge valve clack is kept in horizontal position in normal condition due to balanced hydraulic pressure on two sides of the clack.

b) In case of transformer fire, temperature will rise all around the transformer. On reaching a predetermined temperature (generally 30^{o}C above ambient temperature) quartozoid bulb detectors, which are installed on pressurised water line (water for which is tapped from the main header itself), will shatter. As the bulb shatters, water in the detector line gets released through the detector openings and water pressure in detection line drops rapidly. This results in creation of pressure differential in the deluge valve and leads to latter's actuation. During this operation pressure in the water delivery line falls rapidly resulting in start up of main electrical driven pump. In case of power failure, pressure in the header shall go on decreasing causing start up of diesel engine driven pump.

c) In case of cable galleries the actuation of deluge valves are effected by signal from fire detection and alarm system provided in the premises. Cable galleries shall be provided with smoke detectors, photoelectric and ionization type alternately. These have been described in detail in FDA specification. In the event of fire in the premises, the detection system shall give signal to Main Fire Alarm Panel (MFAP) which in turn shall actuate the solenoid of the deluge valve concerned. There shall be provision for manual operation of the system also by operating quick opening valves of each deluge valve.

06.08.10.04.03.03 MAIN COMPONENTS OF THE SYSTEM

The HVWS/MVWS System shall be provided with the following major components:

a. Water Supply at high Pressure
b. Arrangement of Spray Nozzles
c. Arrangement of Quartzoid Bulb Detectors (for HVWS)
d. Deluge Valve
e. Y-type Strainers just before deluge valve
f. Pipes, fittings and fixtures
g. Basket strainers in HVWS system header
i. Pressure gauges, pressure switches and solenoid valves
j. Fire detectors

06.08.10.04.03.04 DESIGN CRITERIA

Following salient parameters shall be followed for the design of the system.

i. Water application rate for HVWS - 10.2 lpm/m2 of the surface area of the entire transformer including bottom surface, radiators etc. For MVWS in cable galleries ,6.1lpm/m2 on each tray. The working pump capacity shall be decided based on the water requirement (whichever is higher) and selection of pump shall be from TAC approved pump capacities. The capacity of water reservoir shall be equal to at least one hour pumping.

ii. The system shall be so hydraulically designed that the pressure at the hydraulically

most remote projector in the network shall not be less than 3.5 bars for outdoor transformer and 2.8 bar for indoor installations. For cable galleries also Pressure at remotest sprayer - not less than 2.8 bars.

iii. Velocity in the feed pipe shall not be more than 10 m/s.

iv. The header shall be laid under ground and tappings for the individual deluge valve shall be taken there from.

v. Q.B. detectors shall be installed in two rings one at top and another at bottom around the protected area. Maximum spacing between detectors shall be 2.5 m.

vi. Projectors (for transformers) shall be installed in rings encircling the protected area. One ring shall be provided at the top and subsequently rings for every 3 m from top to bottom shall be provided.

vii. There shall be common header for HVWS and MVWS systems which shall be fed water from the pump dedicated for the spray system. The hydrant header and spray system (HVWS & MVWS) headers shall be inter-connected with a non-return valve in between so that hydrant system can be a back-up for the spray system.

viii. In cable galleries, the protected area shall be divided into several zones, each of which shall be fed by individual deluge valve. In event of fire water shall be sprayed on the zone concerned (i.e. zone under fire) along with preceding and succeeding zones. Zone lengths for cable galleries shall be 30 m .

ix. Distribution of sprayers in cable galleries : The sprayers shall be installed in rows at the central aisle between the cable trays and spaced at not more than 3 m from each other.

06.08.10.04.03.05 EQUIPMENT SPECIFICATION

06.08.10.04.03.05.01 DELUGE VALVE ASSEMBLY

i. Deluge valve assembly functions on differential pressure operation allowing quick opening of the valve and thereby rush of water to the protection system. The valve consists of inlet, outlet and priming chamber. The inlet and outlet chambers are separated from the priming chamber by the valve chamber and a diaphragm. In the `Set' position, pressure is applied to the priming chamber through a restricted prime line. The pressure is trapped in the priming chamber and holds the clapper on the seat due to the differential design. In the `Set' position the clapper separates the inlet from the outlet keeping the system piping dry. When the pressure is released from priming chamber, the clapper moves and allows the inlet water supply to flow through the outlet and to the fire extinguishing system.

ii. The deluge valve assembly will consist mainly of the following :

- Isolation valves on both upstream and downstream sides.
- Inline strainer

- Deluge valve proper
- Actuator/pilot assembly
- Drain valve
- Pressure gauges
- Solenoid valve

iii. The deluge valve shall be of resetting type, taking minimum time for resetting. The deluge valve shall be UL/FM/TAC/IS approved make.

iv The deluge valve shall be installed in the existing DV building. Necessary civil jobs required for the purpose is under the scope of the tenderer.

06.08.10.04.03.05.02 SPRAY NOZZLES (PROJECTORS AND SPRAYERS)

Water spray nozzles for the system shall be of suitable orifice size and varying discharge angles to cover fully all the area supposed to be protected. The nozzles shall be of Gunmetal with Nichrome finish or Stainless steel. The nozzles shall be normally open type, Spray nozzles(projectors) shall bear UL/FM/TAC/IS approvals.

06.08.10.04.03.05.03 STRAINER

Y type strainer shall be provided on the inlet side of each deluge valve assembly. The strainer shall prevent deposition of foreign particles in the valves and thereby malfunctioning of control valves. The material of construction of the strainer shall be gun metal and it will bear TAC/IS approval.

06.08.10.04.03.05.04 QUARTZOID BULB DETECTORS

The Q.B. detectors shall bear TAC/UL/FM approval and shall have a temperature rating of minimum 79 degree centigrade. However the tenderer shall take into account the temperature at which they shall operate.

06.08.10.04.03.05.05 FIRE DETECTORS (PART OF FIRE DETECTION & ALARM SYSTEM)

Detectors have been described in detail elsewhere in the package specification. Following types of detectors shall be used for automatic actuation of MVWS system:- Cable galleries: Analogue addressable type smoke detectors

06.08.10.04.03.05.06 PIPES, VALVES & FITTINGS

i. Pipes and pipe fittings in general shall comply with the requirements of BIS codes. Piping layout must follow good engineering practice. Proper attention shall be given to obtain full functional requirement of piping system with a layout which provides sufficient clearance for other equipment and other personnel and easy access for operation and maintenance.

ii. All piping shall be complete in all respects and shall consist of necessary valves, fittings, suports, air release and drain valves and other accessories. The air release and drain valves shall

be provided at high and low points respectively. Each of the branch connection taken from the network shall be provided with an isolation valve.

iii. Wherever over-ground pipelines are crossing roads and railway tracks, they shall be laid on pipe bridges to provide the necessary clearance for the traffic movement. A minimum clear height of 6.0 m above road top level shall be maintained.

iv. All pipework shall be designed to provide complete flexibility to prevent development of undesirable forces or moments at points of connection to equipment, at anchorages or at guide points, due to thermal expansion. Flexibility shall be provided by changes of direction or by use of bends, loops, offsets etc.

v. The specification of pipes are as below.

T.S. for Pipes between deluge valve and main header

i) Upto 150 mm nominal size - M.S ERW Black pipes conforming to IS-1239- 1984 Part-I (heavy grade) With Plain ends.

ii) 200 mm to 400 mm size - M.S. ERW Pipes conforming to IS-3589 -1973 but thickness as specified below

Nominal Dia : O.D x Thickness in mm
DN 200 mm : 219.1 x 6.35
DN 250 mm : 273.0 x 7.14
DN 300 mm : 323.9 x 7.14
DN 350 mm : 355.6 x 7.14
DN 400 mm : 406.4 x 7.14

T.S. for Pipes and valves after deluge valve

The material of construction and manufacturing standard of pipes, fittings, valves, fasteners, gaskets, etc. shall be as described in table below:-

Table
Nominal pressure (PN) - 10 Kg/Cm2
Test Pressure (PT) - 15 Kg/Cm2

Sl. No.	Items	Nominal dia.(mm)	Specification
1.	Pipe	65 and below	IS-1239 (Part-1) - '90 heavy, G.I.
		80	IS-1239 (Part-1) - '90 Medium, G.I.
		100 to 150	IS-1239 (Part-1) - '90 Medium, G.I.
		200 to 450	IS-3589 Gr.410 ERW pipe commercial quality or equivalent. Thickness same as in clause 11.02 (ii) above.

Sl. No.	Items	Nominal dia.(mm)	Specification
2.	Pipe fittings		A 234 Gr. IS-1239/3589/2062
2.1	Screwed fittings	65 & below	IS-1239 (Part-1) - 90 Galvanised
2.2	Fabricated fittings		
	Bends	150 and above	Mitred bends with radius 1.5 DN from black pipe.
	Tees/Crosses	150 and above	Fabricated from black pipes by smithing.
	Reducers	150 and above	Fabricated from black pipes by taper cutting and welding.
3.	Bolting	All sizes	IS - 1367
4.	Gaskets	All sizes	Sheets rubber to IS-635-`79 type-A, 3 mm thick compressed Asbestos to IS-2712-`79
5.	Flanges	All sizes	Slip on flanges to IS-6392 - `71 machined from Carbon Steel plates to IS-2002-`92 Gd. 2 with bore to suit pipe O.D.
6.	Valves		
	Isolation	50 & below	CI gate valves, screwed, as per IS-780 - `84 class - PN - 1.6
		65 to 300	CI gate valves, flanged as per IS- 780-84 class - PN - 1.6
		350 and above	CI gate valve, flanged as per IS-2906-`84, Class - PN - 1.6
	Throttling		
		50 and below	Gunmetal globe valve, Screwed, as per IS-778-`84 Class-2.
		65 to 300	CI globe valve with brass/bronze renewable seat rays flanged.

06.08.10.04.03.05.07 VALVES

Valves shall be provided on pipe work for stopping and starting of flow, controlling flow rate, diverting flow, preventing back flow, controlling pressure, relieving pressure and for venting and draining of pipelines etc.

Valve selection shall be made based on the following considerations :

- Suitability of valve materials in regard of properties of fluids, temperature, pressure, erosion and shock.
- Valve size.
- Main function of the valve (viz. throttling, stop, permitting flow in one direction, diverting flow, relieving pressure etc.)
- Friction head losses.
- Ease of operation, i.e. method of actuation-closing time.

- Maintenance considerations.

The valves to be provided shall include but not be limited to the following :

- Isolation valves on the main header at various locations.
- Gate valves in the branch pipes from header to DV and from DV to the served area.
- NRV on all pipe lines requiring unidirection flow only.
- Quick opening safety shut off valves.
- Manual drain valves.

06.08.10.04.03.05.08 PIPE SUPPORTS AND FIXTURES

Necessary pipe supports & fixture, pipe thrust block or pipe bridge to run the pipes overhead/underground or in the pipe trench as the case may be, shall be included in the scope of the tenderer. The tenderer shall study the location of protected premises and their auxiliary equipment and accordingly plan the pipe routing and the location of spray nozzles, deluge valves and manually operated valves. The fire protection equipment and the fixtures located in the vicinity of the transformers should not pose any operational problem. At places, where no supports/trenches are available the tenderer shall consider dedicated supports required for the pipe lines/spray nozzles etc. for the system.

06.08.10.04.03.05.09 CIVIL WORKS

a. The tenderer's scope shall include complete engineering and construction on a turnkey basis inclusive of design, detailed engineering, supply of all construction materials, including cement, reinforcement steel, and structural steel, construction and testing in respect of all facilities required for completion and handing over of the work as per technical specification and tender drawing within the battery limit. Specification for civil works has been given elsewhere in the package specification. All civil works described below shall be under tenderer's scope .

b. Cable and pipe trenches within the battery limit.
c. Earthwork for building and equipments, sumps trenches etc.
d. All masonry in sub structure and superstructure.
e. All finishing work to flooring, walls, ceiling etc. as required.
f. All finishing work and painting works to masonry, concrete structures, steel works as required.
g. All plumbing and water supply fittings, rain water drainage including rain water downcomers and connecting the same to the nearby storm water drain.
h. All necessary civil works required for road lighting.

06.08.10.04.04 PORTABLE FIRE EXTINGUISHERS –

a. Different types of portable fire extinguishers will be deployed in various area of the complex as a measure of first-aid fire fighting.

b. Major units of power house complex where extinguishers are to be deployed are enumerated below:

- Machine hall
- Transformer yard

- Switchyard area
- Main control room
- All other services rooms /units as per site condition if not listed above

c. Portable extinguishers will be conforming to IS 15683-2006 code.

06.08.10.05 ERECTION, TESTING, COMMISSIONING & PERFORMANCE GUARANTEE

a. The erection of all plant and equipment shall be carried out according to the latest engineering practices and according to the working drawings, erection specification, instructions etc. duly approved by the Purchaser. The tenderer shall carry out the work in the presence and/or as per the instructions of site engineer/supervisory personnel deputed by the Purchaser. The erection shall be carried out by highly skilled workmen.

b. The tenderer shall be responsible for paying strict attention to statutory regulations for prevention of accidents and to other safety rules. The regulations for prevention of accidents shall be deployed at appropriate places and should be distinctly visible to all personnel working in the area.

c. The tenderer shall supply all required consumables, construction and erection materials, petrol, diesel oil, kerosene, solvents, sealing compound, tapes, brazing and soldering materials, welding and brazing gases, erection bolts, nuts and packing sheets/compounds, temporary supports, wooden blocks, spacers, templates, jute and cotton wastes, sand and emery paper etc. as required for the satisfactory completion of work.

d. The tenderer shall make his own arrangement for handling the equipment and pipelines at the stores and transporting it to the site of installation. In addition to the above, the tenderer shall follow all the relevant erection clauses/conditions stated under various chapters in the tendering specification.

e. The tenderer shall provide all tools, labour including necessary subsistence, erection supervision, equipment, materials, accessories, to erect/install and make ready for operation, functionally complete total fire protection system for as described and specified in this specification.

06.08.10.06 TESTING, COMMISSIONING & PERFORMANCE GUARANTEE OF THE COMPLETE SYSTEM.

TESTING

All tests and inspection of the installation shall be done in conformity with the functional and statutory requirement of the system. The tenderer shall furnish a detailed testing and commissioning procedure for all the systems for approval by the purchaser. As soon as a given facility or a portion thereof is completed and ready to energize and start-up, the purchaser may test run and operate it without relieving the tenderer of his responsibility or guarantee.

06.08.10.07 START-UP AND COMMISSIONING

a. Tenderer shall provide the services of all technicians, erection and start-up engineers necessary to bring the complete installation of fire protection system into operation.

b. The tenderer shall be responsible for the integrated commissioning of the plant & equipment supplied by him including trials, commissioning and demonstration of performance guarantee test.

c. The Tenderer shall render the following services:

a) Prepare equipment for trial runs and start-up.
b) Start-up and commissioning of equipment.
c) Preliminary operation, initial operation, trial operation and Final acceptance test.

d) The tenderer shall be required to clean up the equipment and surrounding area and prepare it for trial runs and operation.

e) Priming connections, cooling water supply to bearings, lubrication piping to bearings, stuffing box jackets and sealing glands of all rotating equipment shall be checked by the tenderer.

f) Sequence checking of all control systems, pneumatic and cable connections, checking operation of all interlocks and protective devices shall be done by the tenderer.

g) Blow down of all piping systems, installations and removing strainers in piping and equipment, as required shall be done by the tenderer.

h) Calibration and adjustment of relay settings, instruments etc., disconnecting and reconnecting the driven and driving parts of any equipment and drives, as required, during the trial runs and rectification, if any shall be done by the tenderer.

i) The Tenderer shall provide personnel as required for assisting starting up and commissioning of equipment as well as adjustments, repairs and rectifications of defects in erection of the equipment during commissioning of the equipment and upto final acceptance.

06.08.10.08 COMMISSIONING

On completion of the trial operation, all the systems shall be under observation in operative condition. The Tenderer shall provide skilled personnel including necessary tools and consumables wherever necessary to rectify the deficiencies observed.

06.08.10.09 PERFORMANCE GUARANTEE

a) The performance guarantee tests shall be completed within a time schedule to be mutually agreed upon between the Purchaser and the tenderer. Details of the performance tests, test

procedures and test schedules for the demonstration of the performance guarantee as per IS/TAC regulations, shall be submitted to the Purchaser and shall be mutually agreed upon and approval may be obtained from TANGEDCO.

b) The tenderer shall conduct the operation during the performance tests and shall take full responsibility of the operations.

c) If the tenderer is unable to achieve the performance values as a whole or in part during the performance tests, the tenderer shall repeat the tests for demonstrating the performance values. Before repeating the tests the tenderer shall take any and all measures as may be needed, at his own cost in order that the performance values can be achieved.

d) The observations of each performance test shall be recorded and signed by the Purchaser and the tenderer. If such data conform to the performance test values, the tenderer shall be entitled for the "Final Acceptance Certificate" from the Purchaser.

e) If even with two repetitive tests and if necessary, by using additional operating personnel from the tenderer's crew and at his own expenses, the performance values are not reached the tenderer shall undertake at his own cost such modification or replacement as are considered necessary to obtain the performance guarantee values and the responsibility to demonstrate performance guarantee shall continue to remain with the tenderer till so established.

06.08.11 AIR CONDITIONING SYSTEM

06.08.11.01 SCOPE OF WORK

06.08.11.01.01 Air-conditioning systems shall be of energy efficient and low operating cost.

The scope of work for air-conditioning systems for the control room of Kodayar Power House-I shall include the design, engineering, manufacture / procurement, inspection, shop painting, supply F.O.R. site stores, transportation of materials from above site stores to erection site, storage, erection, painting, testing, commissioning and performance guarantee of air-conditioning systems.

06.08.11.01.02 AIR-CONDITIONING SYSTEM

The air conditioning system to maintain 23±2 ...C & RH<70% shall include Split type air conditioners for control room. The control room shall house control and relay panels.

Sl. No.	Area/premises	Type of equipment	Capacity of air conditioning equipment
1.	Control room	Split AC	Adequate capacity.

The details of experience and credentials shall be furnished in their offer. Further, the Tenderer shall take care of the following specific points with respect to air conditioning and ventilation systems.

a) Electrics for Air-conditioning System are included in scope of the Successful Tenderer.

b) Makes: VOLTAS, BLUE STAR, CARRIER AIRCON, LG, SAMSUNG, HITACHI

c) All commissioning spares as required for the air conditioning and ventilation systems shall be supplied by the Successful Tenderer.

06.08.11.02 DESIGN CRITERIA FOR AIR-CONDITIONING SYSTEMS

The outside /inside design conditions for air-conditioning and ventilation systems will be as specified below:

		Summer	Monsoon	Winter
Air-conditioning				
Dry bulb temperature (0C)	:	38.2	30	--
Relative humidity, %	:	70	80	--

Heat load calculations of AC system shall be submitted and get approved by the successful Tenderer for approval of the Purchaser / TANGEDCO before submitting any detail engineering drawing.

06.08.11.03 EQUIPMENT AND SYSTEM DESCRIPTION

06.08.11.03.01 AIR-CONDITIONING FACILITIES

a) Three phase industrial heavy duty type Scroll/rotary compressor shall be used for Split air conditioner and shall be selected with minimum 3 star rating as per BEE (Bureau of Energy Efficiency) standards and labeling programme.

b) Suitable rain protection canopy shall be provided over the condensing unit of split air conditioner. Condensate drain piping shall be made of GI Class B pipe.

c) Power consumption ratings for split air conditioners – Under Test Conditions

Rated Cooling Capacity		Maximum Power consumption (kW)
Kcal/h	kW	
3000	3.5	1.7
4500	5.2	2.6
6000	7.0	3.4
7500	8.7	4.5
9000	10.5	5.4

Source- Code no. IS1319 (part-2):1992

d). Insulation material for air conditioning application shall be with zero ODP such as HCFC free rigid insulation foam insulation, mineral fibre board, cork wool, expanded (bead) polystyrene, etc. Materials that do not inherently have a zero-ODP shall be avoided and shall not be used.

06.08.11.03.02 SPECIFICATION OF SPLIT AIR CONDITIONERS

The split type air conditioner shall be as per IS 1391 : Part 2 : 1992 (RA 1999) shall essentially be housed in two parts indoor unit& Outdoor Unit. Outdoor unit shall comprise of air-cooled condenser, condenser fan, hermetically sealed compressor and controls housed in a weather proof steel cabinet suitable for outdoor installation. Indoor Unit shall comprise of cooling coil, air circulating low noise fan, supply air grill with motorized flow deflector, evaporator drain connection and controls enclosed in a insulated steel cabinet.

06.08.11.03.02.01 OUTDOOR UNIT

(a) Air-cooled Condenser having condenser coil internally grooved copper tube with split aluminum fins. The condenser shall be fitted with a fan of propeller type. The condenser shall be built on an air-cooled design using outside ambient air to condense the refrigerant. The condenser coils shall be constructed of integrally enhanced Seam less copper tubes arranged in staggered rows. This shall have a minimum of 2 rows to provide proper heat rejection. It should be able to take an additional load of up to 10% more than the required heat surface area for countering high ambient conditions. The copper tubes shall be mechanically expanded into lanced and rippled Aluminum fins of minimum 0.1mm thick with approx. 10 - 13 fins per inch.

b) The refrigerant circuit shall consist of rotary / Scroll type compressor with R-22 refrigerant cooled motor, air-cooled condenser, thermostatic/capillary expansion valve, cooling coil, piping etc. The fan shall circulate ambient air and cool the condenser that in turn will cool & condense the refrigerant vapour flowing through the condenser. The cool refrigerant will reach the cooling coil section via Expansion device as cold liquid vapour mixture at low pressure and will cool the warmer air received in the return air grill from the premises. Then the refrigerant after gaining heat of the circulating air, will return to the compressor via Refrigerant pipe as vapour where it will be compressed and sent to the condenser. Thus the refrigerant will gain heat from the room air in cooling section as well as from compressor drive in the compression process of compressor and will release the total heat to the condenser cooling air at the condenser.

c) Steel structure with heavy gauge G.I. sheet metal casing and duly powder coated in which the above are mounted. The above enclosure shall be mounted on MS Channel frame structure with ribbed rubber pads for isolation of noise & vibration transmission to the building structure.

d) Installation

The wall brackets shall be supplied, grouted in to the walls / laid over chajja of the building and finished. Protective GI sheet (16G) cover shall be supplied along with all outdoor units, exposed to rain/sun/dust.

06.08.11.03.02.02 INDOOR UNIT

a) Cooling coils shall have large diameter copper tubes with aluminum fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg / Sq. cm. air pressure while submerged in water. Tubes shall be hydraulically expanded for minimum thermal contact resistance with the fins. Fin spacing shall be approx. 13 /15 fins per inch. The units shall be fitted with minimum 2/3 -row coil for giving the desired cooling effect.

b) The air circulation is achieved by the operation of the blower. The blower shall be low noise, high static – high flow type. This will supply cold air from cooling section of the indoor unit to the premises through the supply air grills provided at the front panel. The cold air supplied will gain the heat of the premises thereby cooling the room and will be sucked into the cooling coil section of the air-conditioner by the same blower through the return air grill provided at the front panel of the unit. Thus the re-circulating room air will remove the excess heat of the premises. There shall be air filter of large area for filtration of the return air into the unit.

c) This LCD remote/panel controller shall be a part of the factory assembled unit which shall be installed in a separate weather proof panel and remotely located. The panel shall have a soft touch keypad which can be used for setting/altering the unit set points/control commands. There shall be alpha numeric display in English with features illustrating the machine operating status.

d) **Installation**

The indoor unit shall be suitable for high ceiling mounting. Necessary refrigerant, condensate drain line and power & control wiring interconnection between outdoor & indoor unit shall be made at site after installation of the indoor unit.

e.) Safety Devices

The units offered shall be provided with all necessary safety devices, which are essential for proper operation of the equipment. These shall not be limited to the scope of this specification and shall have all safety devices required for optimum operation of the unit.

The following minimum safety devices are suggested :

(a) Low voltage cutout

(b) Low evaporating cutout

(c) In-built internal overload
(d) High condensing pressure cutout
(e) Motor overload trip/protection

06.08.11.04 EQUIPMENT SCHEDULE

SL. NO.	System envisaged / Equipment specification	Description of equipment	Quantity
1	Split Air Conditioners	Split AC Unit of adequate capacity consisting of outdoor unit and connected high ceiling indoor unit along with wall mounted control cubicle, GI sheet canopy on outdoor unit and other standard accessories all assembled in polyester powder coated steel cabinet	----------
		Refrigerant copper piping interconnection between outdoor and indoor units (total Piping length to be included as per site condition)	1 Lot
		MS support bracket (Prefabricated & painted) including operating platform for outdoor unit	1 Lot
		Power & control cabling between outdoor & indoor units	1 Lot
		Condensate drain piping (GI class B) from indoor unit to outside the air-conditioned premises	1 Lot

07. PERFORMANCE REQUIREMENT AND GUARANTEE

07.01 The Tenderer shall study the specification and satisfy himself thoroughly regarding the work ability of the plant, equipment and systems offered and also take full responsibility for the guaranteed operation and performance of the same as well as for their smooth, safe and reliable functioning.

The tenderer shall state and guarantee the following Turbine, Generator and Generator Transformer parameters. The tenderer shall demonstrate the same during P.G. test, failing which L.D. and reduction clause will be applicable as per penalty clause no. 6.34.5 of Vol-I.

Sl. No.	Description	Guaranteed value
1	Turbine output in MW	
a	At rated/ design net head of 940.30 m	
b	At maximum net head of 972.92 m	
c	At minimum net head of 914.32 m	
2	Rated generator output, MW at 0.90 pf	
3	Turbine weighted average efficiency	
4	Generator weighted average efficiency	
5	Transformer weighted average efficiency	

07.02 Values of critical plant sigma as determined as per IEC code 193A should be given in the form of curves of different guide vane positions for different heads. Plant sigma curves as recommended by the manufacturer shall also be plotted on it clearly to show the safety margin available.

07.03 The Tenderer shall study the temperature & quality of water for the components of the turbine in direct contact of water to be designed and material to be selected so that considerable erosion or corrosion due to cavitation will not occur.

07.04 The Tenderer shall incorporate necessary provisions at the time of executing civil work and manufacturing of electro-mechanical equipment, so that the performance testing of the unit can be done.

07.05 The tenderer shall clearly indicate the method he proposes to carry out the Performance guarantee test, with facilities he proposes to provide during construction of civil works, manufacturing and erection of equipment.

07.06 The Tenderer shall carry out the performance test to prove the guaranteed efficiency and performance of turbine in accordance with the IS / IEC publication no.60041 latest edition, (field acceptance tests to determine the hydraulic performance of hydraulic turbines). The total system performance shall also be guaranteed and demonstrated.

07.07 The Tenderer shall state and guarantee the rated output of the unit at generator terminal at rated head and discharge, which will be duly verified and established at site. The tenderer shall also furnish output at max. head & discharge within vibration limits & class B temp limits. Similarly, the max. & min. output at rated head shall be furnished along with corresponding discharges with smooth operation within permissible vibration & class B temp. rise limits.

07.08 The minimum guaranteed weighted average efficiency for turbine cannot be **below 91%** and the peak efficiency shall be **higher than 91.5%.** The Tenderer shall state and guarantee the weighted average efficiency of the unit (combining turbine and generator) at rated head output. The tenderer has to conduct the performance guarantee test immediately after successful commissioning & trial operation. Price for these performance tests shall be quoted separately in the price format.

07.09 The Tenderer shall guarantee the vibration of the machine components in accordance with as per the latest relevant IS/IEC standard.

07.10 The Tenderer shall guarantee the noise limits in accordance with IEC 60034 - 9 (noise limits) and as per the General Technical Rules.

07.11 All equipment shall be guaranteed for workmanship, materials design and satisfactory performance to the parameters in accordance with the tender specification document and relevant clauses of the general conditions of contract. The guarantee for performance shall cover individual items and systems for their ratings/outputs. All machines / equipment shall be guaranteed for 24 (Twenty four) months from the date of initial take over.

07.12 The Tenderer shall also guarantee the integrated operation of all the systems and equipment covered in his scope as a whole including interfaces required to be established with other related systems and equipment. The Tenderer shall study the specification and satisfy himself thoroughly regarding the workability of the plant, equipment and systems offered and also take full responsibility for the guaranteed operation and performance of the same as well as for their smooth, safe and reliable functioning.

07.13 The Tenderer shall conduct performance acceptance tests on each of the major items of equipment supplied to demonstrate that the equipment and system supplied are capable of achieving the performance parameters specified and contracted for, in accordance with the general conditions of contract. The total system performance shall also be guaranteed and demonstrated.

07.14 The tenderer shall guarantee the runner against excessive pitting caused by cavitation for 18 months from the date of commissioning or 8000 hours of operation whichever is earlier.

07.15 Excessive pitting shall be defined as the removal of metal from runner and other hydraulic passages of a weight $W=15\ Dj^2z$ per 1000 hrs of operation, where Dj is the maximum jet diameter in meters, z is the number of jets and W is the weight in kg. If the 18 months of guarantee period expire before completion of 8000 hours of operation, the guarantee shall apply to the actual hours of operation proportionately.

In case of cavitation pitting exceeding the guarantee, the turbine supplier shall at his cost, take corrective measures, such as modification of design, finish, replacement, repair, etc. and the turbine after modification, etc., shall be subject to cavitation guarantee as for the original equipment. In determining whether or not excessive pitting has occurred, metal removal by erosion, corrosion or by the presence of injurious elements in water, etc., shall be exclude. Cavitation and pitting evaluation shall be in accordance with IEC 609 (Cavitation, pitting evaluation in hydraulic turbines, storage pumps and pump turbines).

08. GUARANTEED TECHNICAL PARAMETERS

08.01 GENERAL

Tenderer shall furnish the complete technical guaranteed parameters of all the plant & equipment offered for the project as per the format given in this section.

Tenderer shall provide detailed information of the offered equipment. In case data sheet of any component is not included in this chapter, same shall be furnished by the tenderer.

08.02 TURBINE, GOVERNING SYSTEM AND AUXILIARY

08.02.01 GUARANTEED AND OTHER TECHNICAL PARTICULARS

SL. NO.	ITEM DESCRIPTION	VALUE	REMARKS
A	**TURBINE**		
1.	Name & address of manufacturer		
2.	Type of turbine and shaft orientation		
3.	Critical sigma		
4.	Plant sigma		
5.	Guaranteed rated output at rated head	kW	
6.	Guaranteed max. output max. head	kW	
7.	Guaranteed max. output at minimum head	kW	
8.	Min. output at min. head and min. discharge	kW	
9.	Min. output at max. head	kW	
10.	Guaranteed efficiencies at rated net head and following outputs		
A	100% of full load	%	
B	80% of full load	%	
C	60% of full load	%	
D	Best efficiency at an output	%	
E	Performance curves including model hill curves (Mention No. of drawings enclosed)		
11	**Cavitation guarantee in Kg/1000 hours of operation**		
	Parts subjected to max. erosion	Kg/1000 hours of operation	
	Operational restriction for turbine if any for above guarantee		
12.	Efficiency at max. head and max. discharge	%	
13.	Efficiency at minimum head and minimum discharge	%	
14.	Efficiency at minimum output and max. head	%	
15.	Efficiency at max. output and minimum head	%	
16.	**SPEED**	RPM	
A	Specific speed in M.K. units		
I	per jet		

SL. NO.	ITEM DESCRIPTION	VALUE	REMARKS
Ii	per turbine		
B	Rated speed	RPM	
C	Max. runaway speed	RPM	
D	Direction of rotation when viewed from drive end/top		
17.	Guaranteed minimum factor of safety under worst conditions based on the yield point of the material		
18	Name and location of the part having the factor of safety as above		
19.	**Momentary rise in speed on suddenly reducing load to zero at rated speed from**		
A	100% of full load not exceeding	%	
B	¾ full load not exceeding	%	
C	½ full load not exceeding	%	
20.	**Time of Needle closing for regulation**		
A	Full load rejection	Seconds	
B	¾ full load rejection	Seconds	
C	½ full load rejection	Seconds	
21.	**Momentary drop in speed on increasing load from zero at rated speed to**		
A	Full load	%	
B	¾ full load	%	
C	½ full load	%	
22.	**Time of Needle opening in item (21) above**		
A	Full load	Seconds	
B	¾ full load	Seconds	
C	½ full load	Seconds	
23.	**Fly wheel effect of :**		
A	The generating unit for regulation stated above	Kg/m2	
B	Turbine runner and shaft		
C	Flywheel (if any)		
24.	Max. water hammer pressure % of rated head		
25.	**RUNNER**		
A	Material and composition		
B	No. of runner buckets		
C	PCD of buckets		
D	Weight of runner		
E	Source of runner casting		
26.	**SHAFT**		
A	Material and composition		
B	Diameter	mm	
C	Length	mm	

SL. NO.	ITEM DESCRIPTION	VALUE	REMARKS
D	Weight	Kg	
27.	Elevation of centre line of nozzle(s)		
28	**NOZZLE AND NEEDLES**		
A	No. of nozzles		
B	Material of nozzle mouth		
C	Material of needle tip		
D	Nozzle diameter		
E	Max. jet diameter		
29	**MANIFOLD/DISTRIBUTOR**		
A	Type		
B	Material		
C	Inlet diameter		
D	No. of sections		
E	Maximum design pressure		
F	Weight		
30	**DEFLECTOR**		
A	Material of deflector		
B	Deflector closing time		
31	**HYDRAULIC THRUST**		
A	Maximum thrust	N	
B	Minimum thrust	N	
32	Noise at a distance of 1m from the turbine	db	
33	**VIBRATION (LOCATION ALSO TO BE MENTIONED)**		
A	Horizontal		
B	Vertical		
C	Axial		
33	**TURBINE GUIDE BEARING**		
A	Location		
B	Type of bearing		
C	Diameter and length	mm	
D	Working temperature of bearing surface	^{0}C	
E	Medium of lubrication		
F	Recommended grade and make of lube oil/water		
G	Quantity of lube oil/water		
H	Material of bearing		
I	Weight		
J	Max. runaway speed the bearing can withstand		
K	Max. duration of above runaway speed		
L	Whether the bearing can withstand the runaway speed with or without cooling water		

SL. NO.	ITEM DESCRIPTION	VALUE	REMARKS
B.	**GOVERNING SYSTEM**		
1	Make		
2	Type of governor		
3	Rating		
4	Guaranteed sensitivity of governor (Minimum speed change to which governor will respond)	RPM	
5	Range of adjustment of permanent speed droop		
6	Range of adjustment in speed setting		
7	Governing opening and closing times		
8	Description and method of operation		
9	Adjustment range in governor opening and closing time		
10	**HYDRAULIC ACTUATOR**		
A	Range of adjustment of guide vane /needle opening time	s	
B	Range of adjustment of guide vane /needle closing time	s	
C	Range of pressure for satisfactory operation	Kg/cm2	
11	**OIL PRESSURE VESSELS**		
A	No. of vessels per unit		
B	Dimensions of pressure vessels		
C	Normal volume of oil in each		
D	Normal working pressure		
E	Grade of oil recommended		
12	**OIL PUMP AND SUMP TANK**		
A	No. of oil pumps per unit		
B	Type of pump		
C	Capacity of each pump		
D	Total volume of sump tank		
E	Effective volume of sump tank		
F	Total volume of oil in the governing system		
13	**COMPRESSED AIR EQUIPMENT**		
A	type		
B	make		
C	details		
C	**COOLING WATER SYSTEM**		
1	Source		
2	No. of pumps		
3	Rating of each pump		
4	Capacity of duplex strainer		
5	Material and size of strainer element		
D	**COMPRESSED AIR SYSTEM**		
1	No. and capacity of compressors		

SL. NO.	ITEM DESCRIPTION	VALUE	REMARKS
2	Make		
3	Type		
4	Working pressure		
5	Design Pressure		
6	Test Pressure		
7	Capacity of air receiver		
E	**BUTTERFLY VALVE**		
1	Make		
2	Diameter		
3	Working pressure		
4	Design Pressure		
5	Test Pressure		
F	**SPHERICAL VALVE**		
1	Make		
2	Diameter		
3	Working pressure		
4	Design Pressure		
5	Test Pressure		
G	**GENERAL**		
1	**HEAVIEST PACKAGE FOR SHIPMENT**		
A	Name		
B	Weight		
C	Dimension (LxWxH)		
2	**LARGEST PACKAGE FOR SHIPMENT**		
A	Name		
B	Weight		
C	Dimension (LxWxH)		
3	**HEAVIEST ASSEMBLY TO BE LIFTED BY POWER HOUSE CRANE**		
A	Name		
B	Weight		
C	Dimension (LxWxH)		

08.03 GENERATOR, EXCITATION SYSTEM AND AVR

08.03.01 GENERATOR

Sl. NO.	DESIGNATION	VALUE	REMARKS
1.	Make of generator		
2.	Type and reference		
3.	Rated synchronous speed for synchronous frequency of 50 Hz		
4.	Direction of rotation		
5.	Name and location of part of party stressed to maximum under runaway condition		
6.	Maximum permissible continuous negative phase sequence current.		
7	Normal voltage and voltage range.		
8	Power factor		
9	Frequency and frequency range		
10	**Guaranteed rated output for temperature rise mentioned in specifications under conditions of**		
a	0.90 power factor at any voltage in the operating range.		
b	Rated voltage, zero leading power factor during line charging with 5% full load positive excitation margin.		
c	0.90 power factor lagging continuous overload capacity at any voltage		
d	95% rated kV, zero leading power factor during line charging with 5% full load excitation margin.		
11	Flywheel effect of the rotating parts of the generator, GD^2		
12	Inertia constant of the generator based on the generator rated KVA.		
13	Short circuit ratio.		
14	Runaway speed at which all parts are guaranteed to withstand safety.		
15	Minimum factor of safety based on yield point of materials		
16	Maximum temperature rise for the output guaranteed under item 10 (a)		
17	**At any voltage and frequency in the operating range**		
a	Stator winding by embedded temperature detector.		
b	Rotor winding by resistance measurement.		
c	Bearing by embedded temperature detector		
d	Other parts by thermometer.		
18	**Guaranteed under item 4 (iii) at any voltage and frequency in the operating range**		
a	Stator winding by embedded temperature detector.		

Sl. NO.	DESIGNATION	VALUE	REMARKS
b	Rotor winding by resistance measurement		
c	Bearing by embedded temperature detector		
d	Other parts by thermometer		
19	**Overall efficiency of generator while operating at rated voltage, 0.90 power factor lagging and 75^{0}C winding temperature at**		
a	110% full load		
b	100% full load		
c	90% full load		
d	80% full load		
e	60% full load		
f	40% fullload		
g	**Weighted average efficiency.**		
20	**Inherent regulation i.e. increase in voltage at constant speed and excitation on taking off.**		
a	110% full load		
b	100% full load		
c	60% full load		
21	**Reactance (referred to rated generator KVA base)**		
a	**Synchronous reactance**		
	i) Direct axis (X_d) sat/unsat.		
	ii) Quadrature axis (X_q)		
b	**Sub transient reactance**		
	i) Direct axis (X'd) sat/unsat.		
	ii) Quadrature axis (X'_q)		
c	**Sub transient reactance**		
	i) Direct axis ($X"_d$) sat/unsat.		
	ii) Quadrature ($X"_q$) sat/unsat.		
22	**Negative phase sequence reactance**		
a	(X_2) sat/unsat.		
b	Zero phase sequence reactance (X_6)		
c	Armature leakage reactance		
d	Ratio of quadrature axis sub-transient reactance to direct axis sub-transient reactance ($X"_q/X"_d$)		
23	**Thrust bearing.**		
a	Temperature rise by RTD's while delivering rated output with cooling water supply at 30^{0}C.		
i	Pads		
ii	Oils		
b	Temperature rise by RTD's while delivering the maximum output with cooling water supply at 30^{0}C.		

Sl. NO.	DESIGNATION	VALUE	REMARKS
i	Pads		
ii	Oils		
24	**Guide Bearing.**		
a	Temperature rise by RTD's rated output with cooling water supply at 30^0C.		
i	Pads		
ii	Oils		
c	Temperature rise by RTD's of the bearing while delivering the maximum output with cooling water supply at 30^0C.		
i	Pads		
ii	Oils		
25	**Operating capability of thrust bearing (in minutes) for the following conditions of operation.**		
a	At rated speed without cooling water supply.		
b	At runaway speed with cooling water supply		
c	At runaway speed without cooling water supply		
d	At low speed of 4% of rated speed with lubrication system 'ON'		
26	**Operating capability of guide bearing (in minutes) for the following conditions of operation.**		
a	At rated speed without cooling water supply.		
b	At runaway speed with cooling water supply		
c	At runaway speed without cooling water supply		
d	At low speed of 4% of rated speed with lubrication system 'ON'		
27.	**Generator resistance at 75^0C.**		
i)	Armature winding per phase.		
ii)	Field winding		
iii)	Damper winding		
28.	**Generator time constants**		
i)	Direct axis transient open circuit time constant		
ii)	Direct axis transient short circuit time constant		
iii)	Quadrature axis transient short-circuit time constant		
iv)	Direct axis sub-transient time constant		
v)	Short-circuit time constant of armature winding.		
vi)	Short-circuit time constant of damper winding with excitation winding shorted.		
29.	Maximum $(I_2/I_n)^2$ t value.		
30.	Synchronizing power at rated voltage 50Hz, 0.90 power factor lagging.		

Sl. NO.	DESIGNATION			VALUE	REMARKS
31.	Allowable continuous single phase loading at rated voltage and power factor				
32.	Calculated generator capacitance per phase to ground of stator winding.				
33.	**Voltage waveform**				
i)	Waveform deviation factor				
ii)	No load harmonies in the voltage wave				
34.	**Telephonic harmonic factor**				
i)	Balance				
ii)	Residual				
35.	**Schedule of losses (At Rated voltage, power factor and frequency)**				
	Losses	**110 % F.L**	**100% F.L**		**60% F.L**
i	Friction windings losses				
ii	Core losses				
iii	Armature I^2 R losses at 75^0C				
iv	Stray load losses				
v	Field I^2 R losses at 75^0C				
vi	Static Excitation system losses				
Total losses.					
36.	**Generator stator**				
a	Material of stator core				
b	Number of sections in which stator is divided for transportation.				
c	Grade thickness and insulation of stator Laminations.				
d	Insulation thickness of winding.				
	i) Slot portion				
	ii) Over-bang portion				
e	Stator core dimensions				
i	Inside diameter.				
ii	Outside diameter.				
iii	Length without/with air ducts.				
iv	Ratio of stator core diameter and length				
v	Total number of slots				
vi	Finished slot size.				
vii	Net weight of active iron				
f	Outside diameter of stator frame.				
g	Diameter of stator foundation				
h	Width of air gap at centre of pole top				

Sl. NO.	DESIGNATION	VALUE	REMARKS
i	Flux density at rated voltage on no load in		
	a) Air gap.		
	b) Stator core.		
	c) Teeth		
	d) Pole body.		
j	Current density in stator winding		
k	Cross sectional area of copper winding stator, cach bar.		
l	Weight of copper in stator winding.		
m	Resistance of stator winding per phase at I^2 R losses at 25^0C		
n	Calculated capacitance of stator winding per phase.		
o	Detail of transposition of stator		
p	Total weight of stator		
37.	GENERATOR ROTOR		
a	Materials		
i	Pole Punching.		
ii	Rim punching.		
iii	Spider arms		
iv	Spider hub.		
v	Pole and plates.		
b	Type of rotor rim construction		
c	Construction of field poles		
d	Method of attaching field poles to the rotor rim		
e	Class of insulation o field winding		
f	Material and thickness of insulation.		
g	Width and height of pole body		
h	Weight of active iron in each field pole		
i	Maximum current density in rotor winding.		
j	Cross-sectional area of copper in field winding.		
k	Weight of copper in filed winding per pole		
l	Damper winding.		
i	Number and diameter of damper bars per pole		
ii	Whether connected between poles.		
m	Resistance of filed winding at 25^0C		
n	Factor of safety at maximum speed based on yield strength of material.		
o	Type of collector rings.		
p	Number of brushes/collector rings		
q	Diameter of assembled rotor		
r	Total weight of rotor		
38.	**SHAFT**		

Sl. NO.	DESIGNATION	VALUE	REMARKS
a	Material and construction		
b	Diameter (nominal)		
c	Length		
d	Diameter of axial bore		
e	Diameter of coupling flanges.		
f	Weight of assembled shaft.		
g	Computed critical speed of		
i	Without considering unbalanced magnetic force (pull)		
ii	Considering unbalanced magnetic force (pull)		
h	Tolerance for shaft alignment		
i	Factor of safety (based on the yield strength of the material)		
39.	**THRUST BEARING.**		
a	Type.		
b	Location.		
c	Diameter of bearing		
i	Inside		
ii	Outside		
d	No. of pads and size		
e	Effective bearing area.		
f	Composition of pad material		
g	Thickness of material		
h	Type, number and location of		
i	Temperature detectors		
ii	Dial type thermometers		
iii	Cooling water requirement		
iv	Quantity		
v	Pressure range		
i	Normal working temperature of bearing (pad)		
j	Maximum permissible temperature of bearing for		
i	Alarm		
ii	Trip		
k	Total load on thrust bearing including hydraulic thrust		
i	Design load.		
ii	Actual during working conditions.		
l	Distance through which rotor is to be raised for removal of thrust bearing pads		
m	Pump motor rating for lubrication system		
40.	**GUIDE BEARINGS**		
a	Type		
b	Location and number		

Sl. NO.	DESIGNATION	VALUE	REMARKS
c	Number pads and size		
d	Effective bearing area		
e	Material of bearing pads		
f	Normal working temperature of bearing		
g	Maximum permissible temperature of bearing for		
i	Alarm		
ii	Trip		
41.	OIL		
a	Type and grade of specification		
b	Standard to which it shall conform		
c	Quantity of oil for first filling of thrust and guide bearing oil.		
42.	**BEARING BRACKETS**		
a	Material and composition		
b	Type and construction		
c	No. of arms		
d	Weight		
43.	**GENERATOR BRAKES**		
a	No. of brake units		
b	Size of brake shoe		
c	Size of piston		
d	Material of brake ring.		
e	Material of brake liner.		
f	Air pressure required for operation.		
g	Speed at which the air brakes are applied.		
h	Time required for bringing the machine to rest by applying mechanical brakes.		
i	In normal shut down.		
ii	In emergency shut down.		
44	**GENERATOR COOLING**		
a	Type and method of cooling		
b	Number and location of fans.		
c	Number of surface air coolers.		
d	Temperature of air entering generator from coolers.		
e	Maximum number of surface air cooler required for maximum output of generator.		
f	Details of other method cooling (if required)		
45	Weight of generator rotating parts		
46	Weight of complete generator		
47	**Heaviest package for transportation**		
a	Name		

SL. NO.	DESIGNATION	VALUE	REMARKS
b	Weight		
c	Dimensions (L x B x H)		
48	**Largest package for transportation.**		
a	Name		
b	Weight		
c	Dimensions (L x B x H)		
49	**Heaviest assembly to be lifted by power house crane.**		
a	Name		
b	Weight		
c	Dimensions (L x B x H)		
50	**Largest assembly to be filled by power house crane.**		
a	Name		
b	Weight		
c	Dimensions (L x B x H)		
51.a	Maximum clearance required for the EOT crane hook above service bay for lifting of assembled generator.		
51.b	Whether the available EOT crane clearance is good enough for the assembled generator		
52	**Largest assembly to be taken out through the stator bore**		
a	Name		
b	Weight		
c	Dimensions (L x B x H)		

08.03.02 EXCITATION AND AVR SYSTEM

ITEM	DESIGNATION	VALUE	REMARKS
	EXCITATION SYSTEM AND AVR		
1.	Manufacture		
2.	Place of manufacture		
3.	Type designation		
4.	Applicable standards		
5.	**Rating of excitation system at rated generator output and rated power factor (hot rotor winding)**		
i)	Field voltage		

ITEM	DESIGNATION	VALUE	REMARKS
ii)	Field current		
iii)	Field power		
iv)	No load excitation voltage		
v)	No load field current		
vi)	Field flashing current and duration		
6.	**Ceiling voltage in per units of rated field voltage**		
i)	Ceiling voltage at no load		
ii)	Ceiling voltage at rated load.		
7.	Field current at rated ceiling voltage.		
8.	Excitation system voltage response ratio		
9.	Response time to reach 95% of the difference between rated ceiling voltage and full load field voltage.		
10.	Time to rach+0.5% of ceiling voltage from rated voltage.		
11.	Maximum time period for operation at ceiling voltage power factor 0.9 and maximum generator power.		
12.	Data of excitation system at 110% rated generator terminal voltage, power factor 0.9 and maximum generator power.		
i)	Field voltage		
ii)	Field current		
13	Maximum continuous output capability of excitation system.		
i)	Maximum field current		
ii)	Maximum field voltage		
14	Maximum duration of over excitation		
15	Time to reach 5% limit of generator terminal voltage in case of load rejection		
16	Maximum overshoot of generator terminal voltage in case of load rejection.		
17	Setting time to reach 0.5% limit of generator terminal voltage after over speed conditions.		
18	Range of voltage level setting		
19	i) Range for manual control of excitation.		
	ii) Frequency range of operation		
	iii) % transformer drop compensation		
20	Excitation transformer		
i)	Type		
ii)	Transformer continuous three Phase power rating.		

ITEM	DESIGNATION	VALUE	REMARKS
iii)	Transformer voltage ratio		
iv)	Transformer no-load losses (three-phase) at rated voltage, and rated frequency.		
v)	Vector group / connection.		
vi)	Transformer total losses (75^0C three-phase) at full load at rated voltage and rated frequency.		
vii)	No-load current at rated voltage frequency.		
viii)	Impedance voltage (75^0C) at rated frequency on 100% rated kVA.		
ix)	Transformer temperature rise after continuous operation with rated kVA, under rated conditions. - Winding (by resistance) - core		
x)	Transformer rated voltage at rated frequency and no-load.		
a)	High-voltage		
b)	Low voltage		
xi)	Standard applicable		
xii)	Material		
a)	Core		
b)	Conductor		
xiii)	Class of insulation		
xiv)	BIL		
xv)	Temperature rise		
21	Voltage Regulation system.		
i)	Make		
ii)	Type		
iii)	Accuracy of voltage regulation		
iv)	Range of voltage setting.		
a)	Auto mode		
b)	Manual mode		
v)	Voltage regulation from no load to full load.		
22	Rectifiers		
	Type of rectifiers		
	Type of thyristors		
	Number of thyristor per Interchangeable module.		
	Number of modules per bridges or stacks		
	Number of bridges or stacks		
	Number of parallel paths.		
	Number of thyristors		
	a) In series		

ITEM	DESIGNATION	VALUE	REMARKS
	b) In parallel per path		
	Rated current of rectifiers		
	Rated voltage of rectifier		
	Average forward current rating per thyristor.		
	Forward voltage drop per thyristor		
	Maximum safe operating temperature.		
	Maximum surge current rating.		
	Max. permissible duration of surge current.		
	Cooling fans for rectifiers (if necessary) number of fans.		
	Fan ratings		
	Electrical fan motor ratings		
a)	Rated voltage		
b)	Rated power consumption		
	Auxiliary transformer(s) for cooling fans and other		
a)	Ratings		
b)	Rated primary voltage		
c)	Rated secondary voltage		
23	Field circuit breaker		
i)	Rated current		
ii)	Rated voltage		
iii)	Rated breaking current		
iv)	Total opening current		
v)	Total opening time		
vi)	Total closing time		
vii)	Operating sequence		
24	AC-field flashing equipment		
i)	Duration of flashing		
ii)	Power rating of field flashing transformer.		
iii)	Rated voltages of transformer		
a)	Primary		
b)	Secondary side		
25	DC-field flashing equipment		
i)	Power requirements		
ii)	Supply voltage		

09. QUALITY CONTROL, INSPECTION & TESTING

09.01 QUALITY CONTROL AND INSPECTION

09.01.01 GENERAL

a) Inspection & testing of plant & equipment shall be carried out by TANGEDCO/Purchaser at the works of successful tenderer (Contractor/Sub-contractor(s)) during manufacturing and on final product to ensure conformity of the same with the acceptable criteria of technical specifications, approved drawings, authenticated manufacturing drawings and reference national/international standards.

b) This specification is in addition to provisions laid-down in TANGEDCO/Purchaser's General Condition of Contract (GCC) and special instructions to tenderers, if any.

09.01.02 QUALITY ASSURANCE PLAN (QAP)

a) Contractor shall furnish Quality Assurance Plan (QAP) for respective equipment after completion of detailed engineering and finalisation of billing schedule / equipment identification number for TANGEDCO/Purchaser's approval prior to start of manufacturing.

b) QAP shall be prepared and furnished by the successful tenderer in FORM No. 11.20(DQM)F-09 and 10 Rev 0 (enclosed) for structural & mechanical and electrical items respectively in four sets.

09.01.03 INDICATIVE SURVEILLANCE BY TANGEDCO

Surveillance level by TANGEDCO shall vary from equipment to equipment as per product below for guidance of contractors in developing QAP.

SN	Categories of Equipment	Extent of Inspection (as applicable from equipment to equipment)
i.	Forged, cast, lined products and piping	Material test certificates to be submitted by the contractor at the time of giving inspection call for the main equipment in the final stage. Following checks/tests will be carried out in final stage. Visual inspection Alignment and fitment checking Dimensional checking Witnessing of NDT as per design requirement.
ii.	Manufactured items (Mechanical, fabricated and welded)	Material and manufacturer's test certificates to be submitted by the contractor at the time of giving inspection call for the main equipment in the final stage. Visual inspection Alignment and fitment checking

SN	Categories of Equipment	Extent of Inspection (as applicable from equipment to equipment)
		Dimensional checking Weld inspection – visual and NDT as per design requirement. Radiographs are to be shown and reports to be submitted to TANGEDCO for review during inspection, if applicable. Witnessing of other tests like pneumatic, hydraulic no-load running, functional, balancing, performance etc. depending upon criticality of the part item / equipment.
iii.	Bought-out items	Following standard bought-out items shall be accepted on the basis of manufacturer's test certificates. ERW Pipes, if supplied by approved manufacturer's Flowmeters Pneumatic & hydraulic cylinders Insulation materials Bolts, nuts & washers (Grade 4.6).
iv.	Electrical equipment	Final inspection & Testing Verification of test certificates Visual & workmanship Dimensional Witnessing of routine tests as per relevant standards. Manufacturer's to be submitted for verification. Witnessing of type/acceptance tests, as applicable
v.	Instrumentation	Final inspection & testing. Verification of test certificates Workmanship and visual Dimensional checking Calibration of the instrument for specified parameters shall be checked.

09.01.04 CALIBRATION OF MEASURING EQUIPMENT

All the measuring equipment used for inspection & testing shall be calibrated and appropriate accuracy class of measuring equipment shall be used. Calibration standards used for calibration of measuring equipment shall be traceable to national standards of National Physical Laboratory (NPL), New Delhi with unbroken chains of comparison.

09.01.05 CALIBRATION CERTIFICATE OF ALL MEASURING EQUIPMENT

a) Valid calibration certificate for all measuring equipment used during inspection and testing with traceability to national standards of NPL/NPL-accredited laboratories shall be furnished along with inspection call prior to undertaking inspection by TANGEDCO/Purchaser.

b) Calibration certificate shall also indicate reference no. of calibration standards calibrated by NPL/NPL- accredited laboratories and copies of such calibration certificates of calibration standards shall also be furnished when asked for.

09.01.06 TEST CERTIFICATES AND DOCUMENTS

a) For each of the items being manufactured, following test certificates and documents, as applicable for each of the equipment, in requisite copies including original shall be submitted to Inspection Agency. All test certificates must be endorsed by the manufacturer and Contractor with linkage to project, purchase order and acceptance criteria.

b) Raw materials identification & physical and chemical test certificates for all materials used in manufacture of the equipment (except IS 2062-1992 Gr. A & IS 210-1993, FG-150).

c) WPS, PQR & WPQ Documents as per applicable code.

d) Details of stage wise inspection & rectification records for fabricated items, castings, forgings and machined articles.

e) Control dimension chart with records of alignment, squareness etc.

f) Manufacturer's material and performance/relevant test certificates for all bought-out items.

- Details of heat treatment and stress relieving charts as per specification.
- Non-destructive Test report as per respective code.
- Static /dynamic balancing certificate for rotating components / machines.
- Hardness test certificate
- Pressure Test Certificates
- Performance Test Certificates for all characteristics.
- Geometric accuracy and repeatability test reports of machine tools
- Routine / type / calibration / acceptance /special test certificates for electrical items.
- Surface preparation and painting certificates.
- Certificates from components authority for the item coming under statutory regulations.

g) Where physical and chemical test certificates of material are not available, the contractor/Sub-contractor shall arrange to have specimens and test samples of the materials. Tested in his own laboratory at his cost and submit the copies of test results in requisite numbers to Inspection Agency for scrutiny and approval. Number of test samples against each heat / cast / lot or batch of materials shall be as per relevant Indian or

International Standards.

h) Where facilities for testing do not exist in the contractor/Sub-contractor's laboratories or in case of any dispute, samples and test pieces shall be drawn by the Contractor/Sub-contractor in presence of Inspection Agency and sealed sample shall be sent to any approved laboratory for necessary tests at Contractor/Sub-contractor's cost.

i) The Inspection Agency shall have the right to be present and witness all tests being carried out by the Contractor-Sub-contractors at their own laboratory or approved laboratories. Also the Inspection Agency shall reserve the right to call for confirmatory test on samples, at his discretion.

09.01.07 MANUFACTURING AND INSPECTION SCHEDULE

a) The Contractor shall submit to the TANGEDCO/Purchaser quarterly programme of inspection and tests one month in advance of the commencement of the quarter. The Contractor shall give the TANGEDCO/Purchaser a minimum of 30 days clear notice of any work being ready for inspection and tests specifying the period likely to be required for such inspection and tests.

b) Thereafter, the TANGEDCO/Purchaser or his inspector shall, unless inspection or test is voluntarily waived, attend at the Contractor's or his Sub-Contractor(s)'s premises, such inspection and tests within 7 days of the date on which the equipment is notified as being ready for inspection and test.

c) Should the TANGEDCO/Purchaser fail to attend such inspection and test, the Contractor may proceed with the inspection and test at his option which shall be deemed to have been made in the TANGEDCO/Purchaser's presence and shall forthwith forward to the TANGEDCO/Purchaser copies of inspection/test certificates for acceptance by the TANGEDCO/Purchaser. The proforma and number of copies for inspection/test certificates shall be mutually agreed. However, if the TANGEDCO/Purchaser request the Contractor for a revised date of inspection but within 15 days of the date of inspection as communicated by the Contractor, the Contractor shall arrange the inspection on the revised date as requested by the TANGEDCO/Purchaser.

d) Contractor/manufacturer shall not dispatch any equipment till receipt of MDCC from TANGEDCO/Purchaser.

09.01.08 INTERNAL INSPECTION BY CONTRACTOR / MANUFACTURER

a) Inspection and tests shall be carried out by Contractor / Manufacturer in accordance with approved drawings, TS P. O., and approved QAP. Contractor / Manufacturer shall maintain record of each inspection and test carried out and signed documents shall be submitted to TANGEDCO for verification.

b) Contractor shall carry out their internal inspection & obtain clearance from statutory bodies e.g. IBR, CCE, TAC, Weights & measures, safety. IE rules etc. prior to offering any

equipment for TANGEDCO inspection in accordance with approved QAP.

c) Contractor / manufacturer shall ensure use of appropriate calibrated measuring equipment during their internal inspection, as well as make available the same during TANGEDCO inspection and tests. Also they shall make necessary arrangement for access and use of TANGEDCO owned measuring equipment during inspection.

d) Contractor / Manufacturers shall identify all the inspected equipment/component/raw materials & shall maintain the record of status of inspection viz. Inspected & found acceptable, require rectification/rework, rejected etc.

e) The contractor shall establish and maintain procedures to ensure that product that does not conform to specified requirements, is prevented from inadvertent use or installation. The description of non-conformity that has been accepted subsequently by TANGEDCO/Purchaser by concession and/or or repairs, shall be recorded.

f) Repaired and reworked product shall be offered for re-inspection to TANGEDCO along with records of corrective action taken.

g) Contractor / Manufacturer shall not dispatch any equipment till receipt of dispatch clearance from TANGEDCO.

09.01.09 METHOD OF ISSUING INSPECTION CALL TO TANGEDCO/PURCHASER

Inspection call shall be floated to respective offices in the enclosed Form No. 11.20 (DQM)F-05/2, REV-0 duly filled in, with ten days clear margin, enclosing all documents like test Certificates, Internal Inspection Reports, P.O., Sub-P.O., T.S., Approved QAP, approved GA drawings/data sheets and manufacturing drawings with a copy of call letter to Inspection Co-ordinating Office, Inspection calls without above documents shall be ignored.

09.01.10 OBLIGATIONS OF CONTRACTOR

a) The Contractor shall provide all facilities and ensure full and free access of the Inspection Engineer of TANGEDCO/Purchaser to the Contractor's or their Sub-contractor's premises at any time during contract period, to facilitate him to carry out inspection & testing of the product during or after manufacture of the same.

b) The Contractor shall delegate a Representative/Co-ordinator to deal with TANGEDCO/Purchaser on all inspection matters. Also, Contractor's Representative shall be present during all inspection at Sub-Contractor's works.

c) The Contractor / Sub-Contractor shall provide all instruments, tools, necessary testing & other inspection facilities to Inspection Engineer free of cost for carrying out inspection.

d) The cost of testing welds by ultrasonic, radiographic and dye penetration tests etc. in the

fabrication workshop shall be borne by the Contractor.

e) The Contractor shall ensure that the equipment/assembly/component of the plant and equipment required to be inspected, are not dismantled or dispatched before inspection.

09.01.11 INSPECTION CERTIFICATE

a) On satisfactory completion of final inspection & testing, all accepted plant & equipment shall be stamped suitably and Inspection Certificate in standard form shall be issued by the Inspection Engineer for the accepted items. If a final certificate can not be issued, a provisional certificate shall be issued.

b) If the tests were not witnessed by the TANGEDCO/Purchaser or his representative the certificate shall be issued on receipt of the inspection and tests report from the Contractor but not later than 30 days after the receipt of the said report by the TANGEDCO/Purchaser.

c) In the event a certificate is not issued by the TANGEDCO/Purchaser during 30 days, the Contractor, if considered necessary, can arrange dispatch along with the certificate with the clear understanding that if the TANGEDCO/Purchaser reject such equipment at a later date, the Contractor shall rectify the same at his own cost to the TANGEDCO/Purchaser's satisfaction. No Plant shall be shipped or left or otherwise dispatched before such certificate has been issued.

d) The satisfactory completion of these inspection and tests or the issue of the certificate shall not bind the TANGEDCO/Purchaser to accept the work, should it on further tests during or after erection be found not to comply with the Contract.

09.01.12 INSPECTION WAIVER CERTIFICATE

For the waiver category of items indentified in the approved QAP, TANGEDCO/Purchaser shall issue Inspection Waiver Certificate after scrutiny of Contractor's internal Inspection Report, Test Certificates and other Documents as identified in QAP.

09.01.13 GENERAL CLAUSES

a) The Contractor shall bear all costs of any and all inspections and tests. Where special tests in addition to agreed tests are required by the TANGEDCO/Purchaser, the Contractor shall bear the cost of the testing provided the Contractor is convinced that within this/these special test(s) the quality of the equipment in accordance with the specification can not be proved. If such special tests are necessary based on the results of the agreed test, then cost of all such special tests shall be to the account of the Contractor in all cases.

b. The TANGEDCO/Purchaser upon giving 7 days notice in writing and stating any grounds of objection, shall have the right to reject any or all equipment or demand rectification or replacement thereof.

b) In the case of commissioning spares, operating & maintenance spares and mandatory spares, the same shall be offered for inspection along with the main equipment or after the main equipment has been satisfactorily inspected and tested.

c) TANGEDCO/Purchaser reserve the right to inspect any product at any stage of manufacturing without prior notice to Contractor/Manufacturer beyond pre-identified stages & hold points of approved QAP.

d) Inspection / tests including mechanical running test, material test, performance test shall be carried out and relevant test certificates shall be furnished.

e) All pressure parts shall be hydraulically tested at not less than 150% of design pressure prior to painting and lining. The pressure parts shall be kept pressurised for at least 15-20 minutes at this pressure.

f) All other parts including interconnecting piping shall be hydraulically tested wherever possible as per relevant standards.

09.02 TESTING

09.02.01 SHOP ASSEMBLY AND TESTS

a) The equipment / components of turbine and generator such as runner, turbine shaft, needle, servomotor, turbine guide bearing, generator shaft etc. shall be shop tested as per relevant National/ International Standards/approved shop assembly drawing .

b) Shop tests of turbine and associated equipment shall be carried out by the manufacturer at their works not limited to the following:

1. Once turbine manufactured first shall be assembled in the shop to the extent possible
2. Static balancing of runners
3. Hydrostatic testing at 1.5 times the maximum working pressure for not less than 15 minutes for manifold, servomotors etc.
4. Non-destructive testing of welds
5. Performance tests for individual auxiliary equipment
6. Complete assembly and simulation of governors
7. Assembly of distribution
8. All motors/pumps/compressors, etc shall be tested as per relevant IS/IEC standards

09.02.02 FIELD ACCEPTANCE TESTS

a) The turbine shall be tested at site for establishing fulfillment of guarantees in respect of turbine output & efficiencies including weighted average efficiency. The test shall be carried out as per **IEC – 60041** for field acceptance tests of hydraulic turbine. The arrangement for this test including the testing devices shall be supplied and erected by the successful tenderer.

b) The TANGEDCO/Purchaser at his discretion may call third party for witnessing the tests before acceptance.

c) The field acceptance test shall include testing during erection, certification of the completion of erection of the equipment by the TANGEDCO/Purchaser and tenderer. Equipment wise field quality plan shall be submitted by the tenderer. After completion of erection pre-commissioning checklist points shall be attended by the tenderer. Equipment wise pre-commissioning checklist schedule shall be submitted by the tenderer.

d) After attending the pre-commissioning checklist points the tenderer shall go for commissioning of the equipment as per commissioning procedure and the same shall be submitted by the tenderer before commissioning. After successful commissioning of the complete system the tenderer shall go for PG test as per the TGP approved by TANGEDCO/Purchaser.

e) The successful tenderer shall submit formats of protocol for each of erection, testing and commissioning for approval by TANGEDCO/Purchaser.
If the performance at field is found not to meet the requirement, then the equipment shall be rectified by the Tenderer without any extra cost within the overall time schedule.

09.02.03 PERFORMANCE GUARANTEE TEST

- The PG tests for the turbine and generator shall be done for satisfactory performance in accordance with the following standard and TGP approved by TANGEDCO/Purchaser:

- IEC 60545 - Guide for commissioning, operation and maintenance of hydraulic turbines
- IEC 60034 - Rotating electrical machinery and
- IEEE Guide Std 115 - Test procedure for synchronous machine.

- Report & Test certificates shall be submitted to TANGEDCO/Purchaser.
- The PG test shall be conducted by the prospective bidder by arranging Accredited / Reputed third party agencies like IIT, Roorkee, STEAG, etc.

- TANGEDCO/Purchaser or his authorised representative shall be given full access to witness all tests. Prior to performance tests, the contractor shall intimate TANGEDCO/Purchaser allowing adequate time so that if TANGEDCO/Purchaser so desires his representative can witness the test.
- All equipment, measuring instruments including tools and tackles necessary for conducting the performance test to be brought by the contractor / third party agency.
- The contractor shall get approval from TANGEDCO before nominating the third party agency for PG test.
- Necessary additional control/instrumentation points to facilitate third party PG Test shall also be provided as per standards.

09.02.04 TESTS ON GENERATOR & ELECTRICS

The tests listed below are to be carried on each set

09.02.04.01 Test Prior to initial run

1. Insulation resistance of bearings
2. Insulation resistance of the slot winding thermometer
3. HV testing of RTD
4. Measurement of the insulation resistance and polarization index of the stator winding
5. Measurement of the insulation resistance of the field winding including slip rings
6. High potential DC test on stator winding
7. High potential DC test on field winding
8. Evaluation of the stator winding capacitance & tan delta measurements
9. Measurement of rotor impedance / interturn test
10. DC resistance measurement of the stator winding
11. DC resistance measurement of the field winding
12. Preliminary test of all systems

09.02.04.02 TESTS AFTER INITIAL RUN, MACHINE NON-EXCITED

1. Bearing temperature test up to rated speed
2. Measurement of air pressure in winding overhang space and specified measuring points in the unit
3. Measurement of the air flow rate and determination of the cooling effect
4. Measurement of air pressure in the bearing housing / vapor exhaust
5. Determination of the braking time
6. Balancing of the rotor
7. Over speed test
8. Measurement of shaft / bearing vibration
9. Check for mechanical vibration on parts of the system

09.02.04.03 ELECTRICAL TEST AFTER INITIAL RUN AND PRIOR TO SYNCHRONIZATION

1. Primary tests of generator protection
2. Short – circuit saturation curve, checking of voltage in all relays & meters
3. Open-circuit saturation curve, checking of voltage in all relays & meters.
4. Determination of the synchronous reactance & short circuit ratio.
5. Phase sequence test

6. Measurement of the voltage balance
7. Wave from analysis
8. Optimization of excitation system
9. Measurement of the shaft voltage
10. Shaft / bearing vibration measurement; generator excited
11. Synchronization tests

09.02.04.04 CHECK OF THE EXCITATION SYSTEM

1. AVR-operation including automatic follow up of manual regulator and auto change over
2. Response tests of excitation system
3. De excitation circuit
4. Insulation test
5. High voltage test
6. Performance test at reduced voltage (to extent possible)

09.02.04.05 AVR-

- Accuracy test
- Sensitivity test
- High voltage test
- Performance test at reduced voltage
- Manual channel followed by auto channel
- Range of voltage adjustment test for both auto & manual channel
- Performance test of all limiters
- IR test

All the tests listed above shall also be repeated at site.

- Check OPN of all devices & function of all units / sub units.
- IR Test

09.02.04.06 SYNCHRONIZATION TEST

To be indicated by the tenderer.

09.02.04.07 OTHER TESTS :

- pressure tests on all water pipe lines of cooling water (For generator circuit)
- operation check of cooling water circuit with measurement of inlet / outlet
- Measurement of water quantity in air cooling ckt during rated operation
- Braking time from half speed to zero speed with torque reduced to 10% of rated and with excitation removed.
- Bearing temperatures (all bearings) during rated operation.
- Functional tests of fire fighting equipment.
- Start / Stop sequence test; integrated operation of the plant
- Checking of each equipment, relay, meter, LT motor etc shall be carried out as per the details given in the respective chapters.

Inspection & Testing

For excitation transformer, field control equipment & items not mentioned in the writer up, routine test as per relevant codes shall be conducted at works and at site tests shall be

conducted as per the manufacturer's erection / commissioning manuals.

09.02.05 COOLING WATER SYSTEM (CWS)

a) The contractor shall conduct hydrostatic test on the complete system. For hydrostatic test, the contractor shall furnish the pumps, barrels, tanks, blanks, connections, calibrated test gauges along with and all other necessary apparatus for the test. The contractor shall furnish, install and dismantle all temporary lines from the TANGEDCO/Purchaser's water supply to the system under test, after obtaining due permission from the TANGEDCO/Purchaser regarding finalization of the tapping point.

b) All testing and commissioning shall conform to IS: 5822-1970 for activities, which have not been specified in this specification but found necessary for proper execution of the work.

c) Before commissioning, all the pipelines shall be blown with compressed air to remove any dirt from inside. The portion of pipe to be blown at a time shall be selected in consultation with the TANGEDCO/Purchaser, for maximum effectiveness of the operation. The contractor shall arrange, all the temporary connection, blanking, compressors, etc. required for the job.

d) After air blowing, the pipelines shall be furnished with clear water until the discharge from the pipe is found clean. Flushing velocity shall not be less than the working velocity. contractor shall provide all the temporary connections required for inlet and outlet of flushing water as well as the facilities for drainage of the flushed out water.

09.02.06 OTHER AUXILIARIES

Testing & commissioning of the other auxiliary systems such as Butterfly valve, Spherical valve, Compressed Air system, Dewatering system etc shall be carried out as per relevant standard.

09.02.07 FIRE PROTECTION AND HVWS & MVWS SYSTEM

Testing & commissioning of Fire Protection System shall be carried out as per TAC, NFPA & BIS norms.

10. DATA, DRAWINGS AND INFORMATION TO BE SUBMITTED

10.01 ALONG WITH OFFER

10.01.01 Scope of work with general description of the system and equipment offered specifying the important features. Tenderer shall indicate clearly the work to be carried out in turbine, generator and all other auxiliaries with regard to modifications, additional accessories if required for completion of the job shall be supplied by the contractor without any extra charge, etc. to achieve the rated design capacity.
The description to be accompanied by single line diagrams, and equipment layout to enable the TANGEDCO/Purchaser to have a proper appreciation of the equipment offered and its operation.

10.01.02 Filled in Technical Particulars as given in Ch. 08

10.01.03 Specific Exclusion, if any

10.01.04 Work schedule with bar chart indicating all activities

10.01.05 Main cross section drawing of proposed turbine and generator showing the various components/ parts/ assemblies of the turbine to the extent possible.

10.01.06 Layout drawings of the power house showing the overall dimensions and layout of turbines, clearly indicating unit spacing, dimensions of turbine distributor, etc., and all important elevations

10.01.07 Description of lubrication system along with drawings

10.01.08 Physical and schematic drawings of excitation system and AVR along with descriptive literature.

10.01.09 The general arrangement and overall dimensions of the generators, exciters and bearings, ducts, cable and piping etc.

10.01.10 Charts, Curves and Hill Curves showing performance and cavitation characteristics of the turbine.

10.01.11 Generator Characteristic Curve showing performance of generator

10.01.12 Schematic Diagram and Block Diagram of bearing oil lubrication system, Cooling water System, Drainage /Dewatering system, Compressed Air System, Brake Air System, Fire Protection System

10.01.13 Detailed write up of Microprocessor based digital governor

10.01.14 Physical & Schematic drawings and descriptive literature on the governor and governing mechanism.

10.01.15 Block diagram of excitation and governor control system with start/stop sequence of the plant with control levels.

10.01.16 Phase-wise requirements of power for construction, erection/testing and commissioning activities.

10.01.17 List of performance tests proposed by the tenderer to demonstrate the guaranteed parameters for turbine, generator, electrical equipment and other auxiliaries in addition to tests/checks given in the specifications.

10.01.18 Technical catalogues of equipment offered.

10.01.19 List of annunciation considered in turbine panel, generator desk and in common aux. panels.

10.02 AFTER PLACEMENT OF ORDER

The list of Data/Drawing/Documents to be submitted by Successful tenderer for approval, information will be intimated to the successful tenderer.

11. LIST OF PREFERED MAKES

The Tenderer shall have to select any of the sub-vendors from the list of preferred makes only and no deviation to this effect will be entertained during the execution of the contract unless a specific approval has been obtained for by the Tenderer from the TANGEDCO/Purchaser.

Sl. No.	EQUIPMENT	Preferred Makes
1.	PUMPS	KI RLOSKAR/KSB/MATHER & PLATT/WPIL
2.	MOTORS	NGEF/BBUGEC/BHEUKEC/ JOYTI/ABB
3.	SOLENOID VALVE	ASCO(INDIA), SEITZ-ROTEX, SCADER DUNCAN
4.	INSTRUMENT CABLES	CABLE CORP., FINLOEX CABLES, TOSHNIWAL CABLES
5.	GATE, GLOBE, BALL VALVE	AUDCO, DEZURIC, TIFLIN, SAKHI INTERNATIONAL, BDK
6.	DUPLEX FILTER	OTOKLIN, SUPERFLO, FILTERATION ENGINEERS
7.	PRESSURE CONTROLLERS	SAIL, TISCO, AJANTA TUBE, MAN INDUSTRIES, MUKAND
8.	PLUG VALVES	AUDCO, DEZURIC, TUFLIN
10.	COMPRESSOR	ATLAS COPCO/ IR/ ELGI/ KPC

12. SALIENT FEATURES

Sl.No.	SALIENT FEATURES		
1.	Name of the Dam/Weir	**Kodayar Dam - I**	**Kodayar Dam - II**
2.	Location	K.K.District	K.K.District
3.	River	Kodayar	Kodayar
4.	Purpose	Fore Bay Dam	Fore Bay Dam
5.	Catchement Area	29.12 Sq.km	29.01 Sq.km
6.	Type of Dam/Weir	Masonry Gravity	Masonry Gravity
7.	Height	87.78 m	61.00 m
8.	Length	166.0 m	152.40 m
9.	Length of Earthern Dam Left Flank		
10.	Right Flank		
11.	Reservoir F.R.L.	1325.90 m	350.52 m
12.	Reservoir M.W.L	1325.90 m	350.52 m
13.	Reservoir M.D.D.L.	1295.40 m	318.82 m
14.	Reservoir Capacity at	3.0 Mcft.	3.23 Mcft.

	MDDL		
15.	Reservoir Capacity at FRL	98.69 x 10^6 m^3	0.883 x 10^6 m^3
16.	Reservoir Capacity at MWL	98.69 x 10^6 m^3	0.888 x 10^6 m^3
17.	**SpillWay**		
	Discharge Capacity	257 Cumec.	787 Cumec.
	Crest Length	9.14 m	12.19. m
	Crest Level	1319.80 m.Msl.	341.13 m.Msl.
18	**Gates**		
	Type of Gates	Lift Type	Lift Type
	No. of Gates	One	One
	Size of Gates	9.14 x 6.10 m	12.19 x 9.14 m
19	**Scourvent**		
	Size	1.52 x 2.13 m	1.52 x 2.13 m
	Gate size	2.40 x 2.31 (R) & 2.40 x 2.99 (E)	3.17 x 2.36 (R) & 2.57 x 2.97 (E)
	Still Level	1274.06 m MSL	300.23 m MSL
20	**Intake**		
	Size	2.135 m Dia.	2.74 m Dia.
	Discharge Capacity	8.21 Cumec.	19.40 Cumec.
	Still Level	1290.56m	313.94m Msl
21	**Tunnel** Shape & Size of Tunnel Lined/Unlined Length of Tunnel	Horse Shoe 1555.80 m 3571	- 2.13 m dia. 2015.20 m
22	Flume/Channel		
	Size		
	Lined/Unlined Length		
23	Surge Shaft		
	Size	20 Ft. Dia.	20 Ft.
	Height	434 Ft.	394 Ft.
	No. of Gates		
	Size of Gates		
24	**Valve House**		
	Type of Valve	Butterfly	Butterfly
	Type of operating		
	Mechanism	Open-Water Servo Motor	Open-Water Servo Motor
		Close-Counter Weight	Close-Counter Weight
	Make	Litostraj	Litostraj
	Operating Pressure (Servo)	14 Kg	14 Kg
25	**Penstock**		
	No. of Penstock	One	One
	Length	7000 Ft. (2150.67m)	259 m

	Dia. of Penstock	1.68/1.52/1.37 m	2.13/1.65 m
	Discharge capacity	275 Cusec.	698 Cusec.
	Under Ground		
	No. of Penstock		
	Dia of Pressure Shaft		
	Discharge capacity		
26	**Main Inlet Valve (MIV)**	Spherical	
	Nos.	One	One
	Dia.	1000 mm	1500 mm
	Make	Hydovevey. Switzerland	Litostraj
	Operating Pressure	96 kg/cm^2	26.5 Kg/Sq.C.m.
27	**Tail Race**		
	Size of Tail Race		
	Length of Tail Race		
	No. of Gates		
	Discharge Capacity		

SECTION –B

CIVIL WORKS

SECTION –B

CIVIL WORKS:

1.0 GENERAL:

1.1 The project comprises of renovation, modernisation and uprating with new Turbine set of Hydro-Electric Power Generating Unit of 1x60MW Kodayar Power House – I at Kodayar, Kanyakumari Distt., Tamilnadu. Work shall be executed in such a way that the new constructions/replacement should match with the existing structure. Utmost care shall be taken while carrying out dismantling work so that no damage is done to the existing structures. Also safety of the existing structure shall be looked into while making new construction.

1.2 The tenderer shall visit and carefully examine the site and surroundings to satisfy himself about the nature of all existing structure, existing underground services, general site condition, extent of dismantling work, the site for disposal of surplus materials, debris etc., and all other matter affecting the works. Claim and objection due to ignorance of site condition shall not be considered after submission of tender.

2.0 SCOPE OF WORK:

The civil engineering work consists of the following works including providing foundations and repair/renovation works in the following areas.

(i) Civil works in discharge chamber and replacement of new manifolds and nozzles with new design.

(ii) Civil work for laying new rail-track/modification of existing rail-track of 3 nos. single phase transformer to 1 no. 3-ph transformer.

(iii) Civil works in the Control Room including Vitrified tiles flooring in control room, wall paneling, painting the wall panels, lighting arrangements, false ceiling, Furniture, Glass partitions for control room, storage units and providing air conditioning system.

(iv) Necessary Repair and Improvement works to the existing Valve House Building.

(v) Improvement works to the existing Kodayar Power House-I building.

(vi) All civil works for the buildings, equipment foundations, facilities and miscellaneous civil works to be provided for the project.

(vii) Construction/ modification of foundation for the structures of switchyard equipment

2.01 IN DISCHARGE CHAMBER AND PLACEMENT OF NEW MANIFOLDS & NOZZLES WITH NEW DESIGN:

(a) Analysis of structural stability of modified discharge chamber to accommodate symmetrical nozzles.

(b) Cutting concrete in the housing to remove existing nozzles and to make the surface smooth matching with adjacent surface.

(c) Cutting concrete as per changed layout and placement of new manifolds & nozzle

(d) Concreting and strengthening of concrete to fix manifolds and nozzle
(e) Steel lining of discharge chamber

2.02 CIVIL WORK FOR LAYING NEW RAIL-TRACK/MODIFICATION OF EXISTING RAIL-TRACK OF 3 NOS. SINGLE PHASE TRANSFORMER

All the civil works required for laying new Rail-Tract /Modification of the existing rail Tract is the scope of the contractor.

2.03 CIVIL WORK FOR MODIFICATION IN CONTROL ROOM:

2.03.01 FLOORING & LIGHTING

Vitrified tiles flooring in control room and necessary lighting to be provided by the contractor.

2.03.02 WALL PANELING

59.5mm Thick Dry Wall Partitions with 9.5mm USG Fiberock boards fixing one side with 50mm floor Channel & 48mm Stud, joint finishing with USG All Purpose jointing Compound & laminate (1.8mm minimum) finish upto 2.1 mtr from floor.

2.03.03 PAINTING ON WALL PANEL

All interior wall panels shall be coated with approved shade of water based low VOC led free Acrylic emulsion paint over plaster of paris / wall putty of 1st quality. A minimum of two finishing coats of paint over a primer will be provided.

02.03.04 FALSE CEILING AND AIR-CONDITIONING

Air conditioning and false ceiling of the control room covering Control and Relay Panels should be provided.

Providing and fixing in position false ceiling with LUXALON 84 R/C ceiling system comprising of 84 mm wide x 16mm deep perforated panels roll of approved colour formed of 0.5mm thick Aluminum alloy stove enameled on both sides fixed on panel carriers 62 mm wide x 29mm deep out of 0.95mm thick enameled Aluminum satin black with cutouts to hold panels in a module of 100mm (16 mm gap between panels) at maximum 1.3 M c/c carriers to be suspended from roof by 4mm dia galvanised steel wire hangers with special height adjustment clips made of spring steel at maximum 1.3 M c/c hangers fixed to roof by "J" hook and Nylon inserts with provision of openings for fixing light fittings, air conditioning grills etc. complete with all bye works as per drawing and manufacturer's specification.

2.03.05 FURNITURE IN CONTROL ROOM INCLUDING TECHNICAL SPECIFICATIONS:

2.03.05.01 WORKSTATION:

L-Shaped workstation 1500x1500 overall worktop size. (Four person module with 1200 high cross partition in between).

2.03.05.02 PARTITIONS (TILE BASED) ATTACHED WITH WORK STATION:

a) Construction of Glass Partition wall with door in control room to separate LT Switchgear, Battery Bank etc from area covering control & Relay Panels.

b) The double skin partition system shall consist of powder coated metallic frames, interchangeable panels of marker/writing white panels/powder coated metallic tiles, plain /frosted glass minimum 5mm thick, powder coated aluminum capping and curvilinear trimmings, heavy duty connectors etc. complete. The entire system shall be modular based, free standing but rigid, without any toxic material, and flexible to accommodate changes. Partition system shall be hollow type with concealed wire way ducts for cable management of power, communication and LAN. Metal Tile Sheets shall be of minimum 0.8mm thickness with stiffener as per IS: 513-1994 or other approved IS.

c) Main frame work of partitions shall be double walled, **1200**, unless otherwise specified, with facility to extend in all direction. These should be firmly secured to work station/ground, with no crippling or chasing of Floors.

d) The frame work and partition system including tiles shall be of sound structural design to support mounted storages, work surfaces and supplementary components. Such hanging slots shall be concealed and provided with safety catches to prevent unintended pull fall out. The partitions shall be designed to support work surfaces on either or both faces of the modules. Partition shall be assembled with proper fittings to form basic skeleton structure on to which panels are slide in /snap tiles finished in 50 micron (minimum) powder coating. Overall thickness of partition system shall be minimum 50 mm.

02.03.05.03 ALL PARTITION MAIN FRAMEWORKS SHALL HAVE FOLLOWING MINIMUM COMPONENTS & DIMENSION:

a) VERTICAL MEMBERS/MAINFRAME:
CRCA mild steel sections with 50 micron powder coated / Extruded anodized / powder coated aluminum sections & thickness varying from 1.2mm to 2.1mm.

b) BOTTOM HORIZONTAL MEMBERS:
CRCA mild steel (Graded) 'C' channel

c) TOP HORIZONTAL MEMBERS:
1.2mm thick M.S. tube / composite section made out of 0.8mm thick CRCA in parts welded together having enough stability.

d) INTERMEDIATE MEMBERS:
Minimum two numbers horizontal members shall be provided at intermediate excepting top and bottom with additional member above/below worktop shall be provided for raceways. All partition shall have continuous raceway at the bottom of all partition.

e) LEVELER BRACKET AND LEVELLER:
Leveler bracket shall be 2mm thick CRCA with M4 nut to be weld for connecting vertical channel with M8 nut to be weld for better stability along with M8 leveler and shall have minimum 20mm adjustment.

f) COVER SECTION ASSEMBLY:

Cover sections (0.8mm thick CRCA) should be fixed with 2mm bracket / sliding arrangement for the panels.

g) END POST:

End post shall be of minimum 1.5mm thick CRCA of minimum 50 micron powder coated with cap provided at the end or in between to provide strength to the free standing partition of height 1200/1500 mm.

g) VERTICAL & HORIZONTAL TRIM WITH CAP:

Vertical & Horizontal Trim shall be of 1.2mm thick (minimum) aluminium curvilinear sections. Staggered height junction shall be of same profile of vertical & horizontal trim and the profile at junction shall match with the top profile of the trim. Universal cap / end cap and junctions shall be of die cast .

h) RACEWAY:

There shall be raceway (and not mounting plates) at 2 different levels (one continuous raceway at skirting level & 2nd part raceway of 750 mm long below worktop), for each modular workstation. Each raceway shall be 750mm long and 100 to 150mm high. Total length of raceway per workstation shall be minimum 4500 mm.(for L- shaped).

J) TILE SIZE:

100mm to 150mm high skirting & There will be 2 module tiles above skirting (externally). No. of internal tiles to match with the technical requirements.

2.03.05.04 STORAGE UNITS:

A. LATERAL FILING CABINET:

(i) Lateral filing cabinet, two drawer unit of approx size { (750 (W) x 450(D)x750(H)} with ball bearing slides full extensions of capacities 40 Kg per pair with recess handle / flush type handle / built in pulling system with central locking system (made out of zinc die-cast/alu. Bar, nickel plated).
It shall be made of CRCA sheet (minimum 0.8mm thick) with powder coating (minimum 40-50 micron) with top covered with approved board matching with worktop with edges sealed with PVC lipping. Shutters made of CRCA (minimum 0.8mm thick)/ both side pre-laminated particle board 25mm thick.

(ii) Lateral filing cabinet three drawer unit approx size 750(W) x 450(D)x1050(H) with ball bearing slides full extension of capacities 40 kg/pair with handle/pull out arrangement with central locking systems (Made out of zinc die – cast / Alu. bar, nickel plated).
It shall be made of CRCA sheet (minimum 0.8mm thick) with powder coating (minimum 40-50 micron) with top covered with approved board matching with worktop with edges sealed with PVC lipping. Shutters made out of CRCA (minimum 0.8mm thick)/both side pre-laminated particle board 25mm thick.

2.03.05.04-B- HINGE DOOR UNIT:

(i) Hinge door unit (Full height) approx size 900(W) x450(D)x1980(H)}with two leaves shutters & 5 (five), shelves inside. Shutters, made of CRCA/ both sides 25mm thick pre-laminated particle board with espagnolette lock (Finish- zinc alloy, nickel plated).

It shall be made of CRCA sheet (minimum 0.8mm thickness) with powder coating (minimum 40-50 micron) with all front facia covered with CRCA (0.8mm minimum thick)/ Pre-Lam particle board matching with worktop and top covered with approved board matching with worktop with edges sealed with PVC lipping it shall have minimum 60 Kg per shelf load bearing capacity.

a) All locks shall be of Hafele/hettich make.
b) Leveling bolt & matching nut shall be welded with the bottom horizontal members for proper gripping (dia of bolt shall be minimum 8mm).

2.04 IMPROVEMENT WORKS TO THE VALVE HOUSE & POWER HOUSE BUILDING:

2.04.01 VALVE HOUSE

Necessary Minor repair works shall be carried out in the existing **Valve House building** by erection of new steel door and ventilators and painting with 2 coats of acrylic emulsion paint over wall surface and enamel painting for steel works is the scope of the contractor.

2.04.02 POWER HOUSE

Minor repairs, Power House painting and improvement works to the **Power House building** such as Replacing the damaged steel door and windows including replacing the glass panes, Repairing and servicing the rolling shutter gates and painting with enamel paint, Damaged downfall pipes shall be replaced, Necessary treatment shall be done in water leaking/damp wall areas, Providing 2 coats of acrylic emulsion over a primary coat inside and outside of power House building after scrapping out the existing surface completely in all floors and providing enamel painting for steel door & windows and Providing floor finishing with industrial type flooring for the area excluding Control room Building and finished with power trovel after dismantling/chipping the existing flooring is sthe scope of the contractor.

2.5 ALL CIVIL WORKS FOR THE BUILDINGS, EQUIPMENT FOUNDATIONS, FACILITIES AND MISCELLANEOUS CIVIL WORKS TO BE PROVIDED FOR THE PROJECT SHALL INCLUDE BUT NOT BE LIMITED TO THE FOLLOWING:

a) Civil foundations for equipment - The repair, refurbishment and modification / strengthening of existing TG & Auxiliary equipment foundations should be done as per the requirement of the equipment base profile and static/dynamic loading. Strengthening should be done by injecting cement slurry with admixture. The existing concrete surface should be given treatment to develop adequate bond between old and new concrete. Anchor bolts should be provided by drilling holes in the existing concrete and fixing it by epoxy based mortar. The grouting under the base plate should be done with non-shrink free flow grout.

b) Refilling redundant recesses in floor

c) Drilling panel cable access holes through floors/RCC wall

d) Modification of turbine foundation and the pit to accommodate new runner.

e) Strengthening of existing concrete structure

f) Rehabilitation of distressed concrete structure and inserted parts/steel linings

g) Stoppage of leakage of water from surface of concrete

h) Cleaning of dewatering pit

i) Removal of debris after completion of construction.

2.6 CONSTRUCTION/ MODIFICATION OF FOUNDATION FOR THE STRUCTURES OF SWITCHYARD EQUIPMENT .

3.0 TECHNICAL SPECIFICATION:

3.1 TURBINE & GENERATOR, AUXILIARY EQUIPMENT FOUNDATIONS AND DISCHARGE CHAMBER:

Modification of existing foundations of turbine & generator and other equipment is to be done as per the base profile of the equipment. The structural stability of modified discharge chamber is to be analysed to accommodate symmetrical nozzles. The successful tenderer shall check the adequacy of the strength/serviceability of the existing foundation/structure considering the static and dynamic loads of the equipment. The preparation of strengthening scheme/plan, if required and implementation of the same shall be under the scope of successful tenderer. The successful tenderer has to furnish the calculations justifying adequacy of the proposed scheme strengthening.

3.2 STRENGTHENING OF EXISTING CONCRETE STRUCTURE

Strengthening of existing concrete structure shall be carried out where it is expected to carry more superimposed loads than the original design due to new/ upgraded technological requirement. All necessary modification in the existing structure shall be simultaneously considered to accommodate the new set up.

The Successful Tenderer shall submit the following with regard to strengthening work.

a) As built drawing of the existing portion.

b) Load data of the new structure.

c) Scheme and design calculation for all new structures. The design calculation shall include static design calculation for all structures and dynamic analysis for all important structures subjected to impact, vibrations etc. induced by equipment.

d) After getting approval of the TANGEDCO/Purchaser for the scheme and design calculations, the Successful Tenderer shall prepare construction drgs. for the same and submit for TANGEDCO/Purchaser's approval.

The successful Tenderer shall stand fully responsible for design/safety of all structures irrespective of approval of the same by the TANGEDCO/Purchaser.

3.3 CONCRETE AND REINFORCED CONCRETE STRUCTURE:

a) All concrete and reinforced concrete structures shall be constructed.

b) The mix design adopted shall be suitable for proper strength, workability and service condition of the structure. Minimum cement content and maximum water cement ratio shall be normally

as per stipulations of BIS codes. However, in case of exposure to aggressive environments, the mix design adopted shall be suitable to ensure durability of the concrete under the condition.

c) Unless specifically approved by the Engineer the maximum nominal size of coarse aggregates for concrete shall be 20mm and down.

d) Steel reinforcement to be used shall be Fe415 grade or equivalent shall be used unless otherwise specified.

e) Wherever there is a joint of old and new concrete, suitable chemical treatment shall be given to the surface of old concrete to develop adequate bond between them.

3.4 DESIGN LOADS:

Loads due to normal operating condition as well as due to extra ordinary conditions shall be taken into account. For normal operating condition, following loads shall be considered.

- Dead loads
- Live loads (not less than $2T/m^2$)
- Load throw loads
- Piping loads
- Thermal loads
- Unbalanced dynamic loads from turbine and generator
- Torque load
- Temperature load (as specified by manufacturer) for extra ordinary conditions, following loads shall be considered.
- Seismic load (as per IS: 1893)
- Wind load (as per IS: 875)
- Short Circuit load
- Any other abnormal load due to machine breakdown, as specified by manufacturer.
- The load combinations shall be as per IS: 2974(part-3).

3.5 MATERIAL OF CONSTRUCTION:

All reinforced concrete work will be of grade M30. Corrosion inhibitors of approved make will be used in Concrete for all RCC work excepting for storm water drains as per manufacturer's specification and details.

The following standards shall be taken as guidelines unless otherwise specified above:

(i) IS: 2974(Part-3)
(ii) IS: 1893-2002
(iii) IS: 456-2000
(iv) IS: 4247-1993

3.6 QUALITY OF CONCRETE:

(i) The quality of concrete of the existing foundations of various equipment in the Power House is not showing any visible damage. The surface does not show any sign of distress excepting spalling at a few places. Repair of damage of any concrete structure, if found during removing of equipment, shall be done with epoxy based concrete/mortar/grout.

(ii) The modification/strengthening of existing foundation should be done as per the requirement in case any defect/crack is found.

1) Strengthening should be done by injecting cement slurry with admixture.
2) The existing concrete surface should be given treatment to develop adequate bond between old and new concrete.
3) Anchor bolts should be provided by drilling holes in the existing concrete and fixing it by epoxy based mortar.
4) The grouting under the base plate should be done with non-shrink free flow grout.
5) Concrete work shall secure a dense, homogeneous, smooth mass including required finishes, possessing required strength and resistance to weathering and abrasion for the structures and foundations.
6) Design of all reinforced concrete structures shall be as per the IS:456 and of pre-stressed concrete structures as per IS:1343. The structural safety of all foundations on soil shall, in general, be based on IS:1904. The design of water retaining structures shall be according to IS:3370.
7) For calculation purpose "Working Stress Design" or "Limit State Design" methods may be adopted, but design shall be consistent throughout.

(h) Unless otherwise specified, minimum grades of concrete to be used shall be as follows:

Blinding concrete	M 7.5
Plain cement concrete	M10 & M15
All reinforced concrete	M30

(i) Grouting below machine/equipment bases and pockets shall be of non-shrinking grout of adequate thickness and strength. Grouting below bases of building structural members shall be with concrete of minimum grade M35.

4.0 STRUCTURE AND FOUNDATION DESIGN:

4.1 STRUCTURE DESIGN :

a) The design calculations for all the structures and foundations shall be furnished. The design calculations shall include static design calculations for all structures and foundations, dynamic analysis for all important structures and foundation subjected to impact, vibrations etc. induced by equipment and other external forces.

b) The data sheet showing specifications of materials, design standards followed, load data assumed including the seismic loading, vibration considerations, deflection, etc. shall be furnished. The loading combinations and other design assumptions made in design are to be furnished.

c) Measures required for the safety of the buildings and foundations.

d) Design and construction/reconditioning of structures, facilities etc. shall take into account requirement for operation and maintenance of all equipment and its users.

e) This being a RM&U project, while designing and preparing new facilities the successful tenderer shall take into account the structures, foundations, drains, sewers etc of the existing units and modify them, if found necessary, to match the new ones.

4.2 FOUNDATION DESIGN

f) Foundations for structures and equipment shall be proportioned to resist the worst condition of loadings and shall be generally designed as per the provisions of IS:1904.

g) Generally foundation for buildings & equipments shall not be structurally connected to ground floor slab. The top level of the stem for building column foundations shall be so provided that no part of the steel column base assembly protrudes over finished floor level. The column base assemblies shall be encased with concrete up to floor level.

h) Foundation of equipment subjected to dynamic loading shall be isolated from adjoining floors/foundations to prevent propagation of vibration to adjoining structures.

i) Supporting structures and foundation for equipment which may cause vibration shall be designed for the dynamic effect of equipment together with the direct loads. The dynamic loads and other relevant data required for analysing the dynamic effect shall be taken as per manufacturers' data and recommendations.

j) Structures and foundations supporting vibrating equipment shall be proportioned to avoid resonant frequencies. The dynamic analysis shall be done as per the stipulations as recommended by respective IS codes as well as the stipulations recommended by equipment manufacturer.

5.0 DESIGN CALCULATIONS, DRAWINGS AND DOCUMENTS:

5.1 The design calculations/scheme drawing shall be submitted by the successful tenderer for approval of the TANGEDCO/Purchaser prior to submission of construction drawings. The following aspects shall be considered with regard to design calculations.

a) The successful Tenderer shall undertake investigation of field problems by critical visual examination and additional field test non-destructive as required to be ascertained:

Defects associated with concrete like erosion, cracks, cavities, pitting, corrosion, spelling and peeling of and deterioration of reinforcement etc.

- Leakage of water through the structures
- Condition of components
- Condition of external surfaces
- Condition of internal surfaces

b) The successful Tenderer shall prepare detailed working drawings considering overall foundation layout for the equipment, buildings services etc., space requirement and clearances as necessary. The successful Tenderer shall submit a comprehensive and complete list of drawings.

c) The successful Tenderer shall submit for approval/information, general arrangement and detailed working drawings for all concrete, reinforced concrete and other civil works.

d) The successful Tenderer shall submit As-built drawings incorporating all site modifications after completion of construction work.

e) If the successful Tenderer intends to carry out any part of the work through subcontractor then prior approval of the subcontracting agencies shall be taken from the TANGEDCO/Purchaser.

f) The successful Tenderer shall submit photographic records of observation of field problems. Along with this the successful Tenderer shall submit report/drawing showing scheme for rehabilitation/reconstruction of distressed concrete structure/inserted parts.

6.0 QUALITY CONTROL:

The successful Tenderer shall carryout all checks and tests as directed by the Purchaser / TANGEDCO and submit the results thereof. Acceptance of works shall be subjected to achieving required quality as laid down in code of Bureau of Indian Standards.

7. TECHNICAL RULE:

a. This Technical Rule is meant for civil engineering works included in the scope of work in the package. It includes loading standards, permissible stresses, functional requirement, quality standard, architectural guidelines, norms etc to be adopted as a basis for preparation of design and drawings by the successful Tenderer.

b. The design prepared by the successful Tenderer shall not only provide for the requirement indicated in this technical rule but also consider the overall process requirement, service conditions and provisions to be made for future expansion. The design shall be compatible with the operating conditions in the plant and the atmospheric conditions prevalent at location of project site.

c. Standardisation and unification shall be carried out to the maximum extent possible.

d. TANGEDCO/Purchaser reserves the right of selecting a particular make of materials and components. The successful Tenderer shall supply materials / components of the particular make, if so required.

8. DESIGN PARAMETER:

8.01 GENERAL

a) In addition to the minimum requirements outlined herein, the successful Tenderer shall design and construct the buildings, structure, foundations and other civil items as required for all equipment and systems considering all aspects of operational requirements and maintenance of these equipment and facilities.

b) General provision, materials, workmanship, dimensional tolerances, safety requirements for construction works etc. shall be in accordance

8.02 LOAD CONDITION

a. All foundations and concrete structures shall be designed to resist full operating dead and live loads, with appropriate combination of wind and seismic forces and with due allowance for impact, vibration etc. as secondary effects of live loads, temperature variation etc. While designing structures and foundations either the effect of seismic forces or wind loads, whichever produces the worst effect, shall be considered along with usual load conditions**.**

b. Apart from the operating loads indicated by the equipment manufacturers, the design of buildings and structures shall be based on dead and imposed loads calculated according to IS: 875, subject to minimum imposed loads indicated below.

c. The live loads listed hereunder are minimum loads for the areas involved. Special use areas shall be investigated and loading revised upward as necessary. Additional loading due to electrical cables, ventilation and air conditioning, piping etc. shall be considered as per technological requirements.

d. All buildings (except as noted separately):

i.	Roofs	150 kg/m^2
ii.	Platform and stair	500 kg/m^2
iii.	On ladders	120 kg at centre of rung
iv.	Removable covers	1500 kg/m^2
v.	Generator lay down area	2000 kg/m^2
vi.	Control Room	1000 kg/m^2

e) Design wind pressure and forces shall be as per the provisions of IS:875. Stresses induced due to dynamic effect of wind shall be considered in design as per relevant IS codes.

f) Seismic forces shall be considered according to the provisions of IS:1893.

g) Members subjected to temperature variations shall be designed to withstand the stresses arising out of such temperature variations.

h) Design of structures shall provide for temporary loads, which may be lifted during erection and maintenance of plant and equipment. Consideration shall be given in the design of structures to the contributing loads from piping and cabling including provisions for piping anchors and dead endings of electrical conductors.

i) In case of moving loads, full load under worst operating condition together with minimum 25% vertical impact factor shall be considered for vehicles and machinery travelling on tracks (rails). Horizontal forces along and transverse to the rails as per equipment manufacturers data and recommendations shall be considered in design of the track supporting structures and foundations.

j) The design of buildings and structures shall take into account the loadings due to future extension of units as well as due to and installation of additional equipment, in future in the units.

8.03 PERMISSIBLE STRESSES :

Allowable stresses for all reinforced concrete structures shall be as per IS: 456 and for prestressed concrete structure as per IS:1343

9.0 <u>STANDARDS:</u>

a) The design criteria for civil engineering work shall be in accordance with this Technical Rule. Detailed instructions on such aspects as are not indicated herein shall be as per the latest standards, codes and recommendations of the Bureau of Indian Standards (BIS) specifications/Indian road Congress and specifications published by Ministry of Surface and Transport (MOST). In the absence of suitable BIS specification and codes of practices, other recognised international standards and codes such as of International Standards Organisation (ISO), British Standards and codes, Deutsche Industries Norm (DIN), American concrete Institute (ACI) may be used, with prior approval of the TANGEDCO/Purchaser.

b) In case of anything mentioned in this Technical Rule is at variance with BIS or other standards mentioned herein, the provisions of this Technical Rule will prevail.

10. SUBMISSION OF DESIGN CALCULATIONS, DRAWINGS AND DOCUMENTS BY SUCCESSFUL TENDERER:

a. The successful Tenderer's scope shall include complete engineering and construction on a turnkey basis inclusive of detail design, basic engineering, detailed engineering, supply of all materials, construction and testing in respect of all facilities required for completion and handing over of the work as per technical specification.

b. The successful tenderer shall undertake within the battery limits any change in the location of unit/item and/or structures/parameters, sizes etc. of civil structures which may be necessary during engineering/execution from those indicated by the successful tenderer in their contract drawings at no additional cost to the TANGEDCO/Purchaser.

c. The checking and correctness of all main centerlines is the responsibility of the successful tenderer irrespective of any checking by TANGEDCO/Purchaser.

d. All other civil works that will be necessary to complete the work in all respects.

e. The design calculations shall be submitted prior to submission of construction drawings.

f. Necessary approval for civil drawings and other documents may be obtained from TANGEDCO.

11. GENERAL:

a) Renovation of the Inspection Bungalow and the approach roads to the Power House and Camp area will be taken up by TANGEDCO prior to taking up the RMU works by the contractor.

b) The available quarters at Kodayar Lower camp will be provided to the contractor as is where is condition with market rent and electricity consumption charges will be levied based on the conditions stipulated by TANGEDCO then and there.

c) All the materials which can obviously be quantumized should be furnished individually in price break up schedule, unless specified by the Purchaser. Materials not specified, but felt necessary by contractor shall also be furnished in the breakup schedule.

d) All the materials/work/modification necessary for satisfactory completion of the scope of work, whether specified in pricing, specification, commercial and technical terms of this order including annexure, etc., or not, shall be supplied/work done by the contractor without any extra cost and shall not cite the details furnished in the price breakup schedule as a base for any extra claim thereof.

e) Split up of quantity and working sheet for data including lead particulars (Rate/per) has to be furnished.

f) Applicable GST in % may be indicated.

12. LIST OF RELEVANT I.S. CODES:

IS: 269-1989: Specification for 33 grade ordinary Portland cement.
IS: 383-1970: Specification for coarse and fine aggregates from natural sources for concrete.
IS: 432 (PART-1)-1982: Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement-hard drawn steel wire.
IS: 432 (PART-2)-1982: Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement-hard drawn steel wire.
IS: 455-1989: Specification for Portland slag cement.
IS: 456-2000: Code of practice for plain and reinforced concrete.
IS: 458-1988: Specification for precast concrete pipes (with or without reinforcement).
IS: 651-1992: Specification for salt glazed stone ware pipes and fittings.
IS: 771-1963: Specification for glazed earth ware sanitary appliance (line water closets, urinals wash basins, sink etc.)
IS: 782-1978: Specification for caulking lead.
IS: 783-1985: Code of practice for laying of concrete pipes.
IS: 814-1991: Covered electrodes for manual metal are welding of carbon and carbon manganese steel.
IS: 816-1969: Code of practice for use of metal arc welding for general construction in mild steel.
IS: 875(PART-1)-1987: Code of practice for design loads (other than earthquake) for buildings and structures - dead loads.
IS: 875(PART-2)-1987: Code of practice for design loads (other than earthquake) for buildings and structures - imposed loads.
IS: 875(PART-3) –1987: Code of practice for design loads (other than earthquake) for buildings and structures - wind loads.
IS: 875(PART-5)-1987 Code of practice for design loads (other than earthquake) for buildings and structures - special loads & load combinations
IS: 1038 -1983: Specification for steel doors, windows and ventilators.
IS: 1080 -1986: Code of practice for design and construction of shallow foundations on soil (other than raft, ring and shell).
IS: 1609 -1991: Code of practice for laying damp proofing treatment using bitumen felts
IS: 1742 -1983: Code of practice for building drainage
IS: 1786 -1985: Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS: 1893 -2002: Criteria for earthquake resistant design of structures.
IS: 1904 -1986: Code of practice for design and construction of foundations in soil: General requirement
IS: 1905 -1987: Code of practice for structural use of unreinforced masonry
IS: 2062 -1992: Structural steel (fusion welding quality)
IS: 2751-1979: Welding of mild steel plain and deformed bars for reinforced concrete construction
IS: 2950(PART-1)1981: Code of practice for design and construction of raft foundations – design
IS: 2974(PART-1) 1982: Code of practice for design and construction of machine foundation - foundation for reciprocating type machines.
IS: 2974(PART-2) 1980: Code of practice for design and construction of machine foundations - foundations for impact type machine (Hammer foundations).
IS: 2974(PART-3) 1982: Code of practice for design and construction of machine foundations - foundations for rotary type machines (medium and high frequency).

IS: 2974(PART-4) 1979: Code of practice for design and construction of machine foundations - foundations for rotary type machine of low frequency.
IS: 2974(PART-5) 1987: Code of practice for design and construction of machine foundations - foundations for impact type machines other than hammers (forging and stamping press, pig breakers, drop crusher and jolter).
IS: 3006-1979: Specification for chemically resistant glazed stone ware pipes and fittings.
IS: 3067-1988: Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
IS: 3114-1985: Code of practice for laying of cast iron pipes.
IS: 33'70(PART-1) 1965: Code of practice for concrete structures for the storage of liquids - general requirements.
IS: 3370(PART-2) 1965: Code of practice for concrete structures for the storage of liquids - reinforced concrete structures.
IS: 3370(PART-4) 1967: Code of practice for concrete structures for the storage of liquids - design tables.
IS: 3614(PART-1) 1966: Specification for fire check doors - plate, metal covered and rolling type.
IS: 3764-1992: Excavation work - code of safety.
IS: 3414-1968: Code of practice for design and installation of joints in buildings.
IS: 4127-1983: Code of practice for laying of glazed stone ware pipes
IS: 4326-1976: Code of practice for earthquake resistant design and construction of buildings.
IS: 6494-1988: Code of practice for water proofing of underground water reservoirs & swimming pools.
IS: 7452-1990: Hot rolled steel sections for doors, window sand ventilators
IS: 1239-1968: Specification for mild steel tubes, tubular and other wrought steel fitting (Part -I Mild Steel Tubes).
IS: 1580-1991: Bituminous compounds for water proofing and caulking purposes.
IS: 13311(Part-I)-1992: Non-destructive testing of concrete

TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD

RENOVATION, MODERNISATION & UPRATING OF
KODAYAR POWER HOUSE-I FROM 1x60MW TO 1x70MW

TECHNICAL SPECIFICATION - VOL-IV - DRAWINGS

RENOVATION, MODERNISATION AND UPRATING OF KODAYAR POWER HOUSE - I

FROM 1 X 60MW TO 1 X 70 MW
IN TIRUNELVELI GENERATION CIRCLE
KANYAKUMARI DISTRICT, TAMILNADU, INDIA

INTERNATIONAL COMPETITIVE BIDDING
TENDER SPECIFICATION NO. HE. 2367

VOLUME IV OF IV

DRAWINGS

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SUPERINTENDING ENGINEER
HYDRO (ELECTRICAL)
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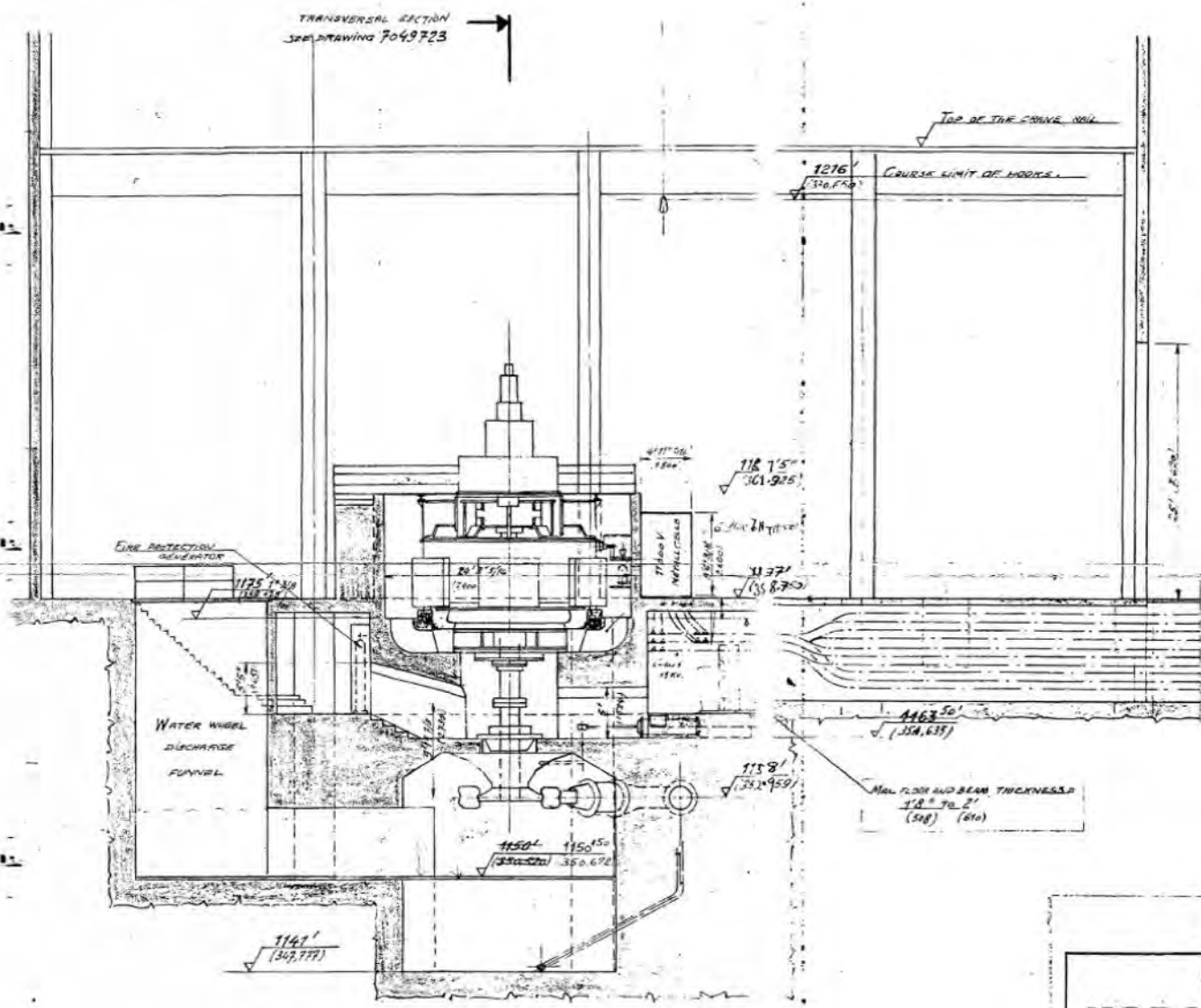
RENOVATION, MODERNISATION & UPRATING OF

KODAYAR POWER HOUSE-I FROM 1x60MW TO 1x70MW

TECHNICAL SPECIFICATION - VOL-IV - DRAWINGS

VOLUME I	:	NOTICE INVITING TENDER (NIT) COMMERICAL SPECIFICATION INCLUDING INVITATION TO TENDER, INSTRUCTIONS TO TENDERER AND GENERAL TERMS AND CONDITIONS OF CONTRACT
VOLUME II		TECHNICAL SPECIFICATION FOR
SECTION - A	:	TURBINE, GENERATOR AND OTHER MECHANICAL EQUIPMENT
SECTION - B	:	CIVIL WORKS
VOLUME III		
	:	ELECTRICS
	:	CONTROL AND INSTRUMENTATION

VOLUME IV : DRAWINGS



DWG. MEC/S/10H0/11/S3/TS/M/01

TITLE: POWER HOUSE CROSS SECTION (EXISTING)

E1 1 5

MADRAS STATE ELECTRICITY BOARD

KODAYAR I POWER STATION

GENERAL DRAWINGS-FINAL SCHEME LONGITUDINAL SECTION VIEW OF POWER STATION	PLANS GÉNÉRAUX DE PRINCIPE COUPE LONGITUDINALE DE LA CENTRALE
	Dessiné : JOUAN — Echelle 1/100 — N°de Class'
	Vérifié : — Service EREAL
	Enregistré 5-12-65 — Cde N° 45/66a2
Rectifications following MS E.B.S letter dt 21/9/66 (EA/A2/KDR. I/8) Drawing KOD 450-A/3R2 and ALSTHOM note dt 17-10-66	ALSTHOM 38, AVENUE KLÉBER PARIS
	N° 7049724 F° — Nbre Ft — Ver Ft

N° 7049724 Fo

KODAYAR DAM 1
FRL 4350 FT
MDDL 4250 FT
EFF. STORAGE 2586.8 MCFT
INTAKE SILL LVL 4235 FT

TUNNEL: HORSE SHOE, DIAMETER: 7 FT, LENGTH: 10400 FT (RCC 2040FT + PCC LINED 8360 FT)

SURGE SHAFT
TYPE: OPEN PLAIN
DEPTH: 434 FT
DIAMETER: 20 FT

VALVE HOUSE A17 EL3786FT
BFV Dia 1700mm
32°30'30"
A16 EL3564FT
DIA 5'6"
34°01'39"
A15 EL3300FT
25°39'29"
A14 EL3139FT
DIA 5'6"
14°29'44"
A13 EL3056FT
17°27'51"
A12 EL2920FT
25°48'10"
A11 EL2720FT
DIA 5'6"
29°01'51"
DIA 5'0"
A10 EL2493FT
13°45'45"
A9 EL2380FT
03°11'12"
A8 EL2355FT
DIA 5'0"
18°18'03"
A7 EL2202FT
20°02'43"
A6 EL2094FT
DIA 5'0"
20°37'45"
A5 EL1985FT
DIA 4'6"
12°28'29"
A4 EL1894FT
32°32'30"
A3 EL1760FT
DIA 4'6"
19°58'59"
A2 EL1640FT
16°10'20"
A1A EL1524FT
DIA 4'6"
34°26'20"
A1 EL1380FT
54°04'17"
AT
EL1158FT
MIV
Dia 1000mm
PH
KODAYAR DAM 2

ELEVATION

KODAYAR DAM-I

SURGE SHAFT

11°50'39" A17
04°53'24" A16
02°36'36" A15
A14
02°35'44" A13
A12
A11
A10
07°22'00" A9
A8
A7
A6
A5
12°45'00" A4
A3
A2
23°46'20" A1A
A1
AT MIV
PH
KODAYAR DAM 2

PLAN

FOR TENDER PURPOSE ONLY

NOTE :-

1. DRAWING IS BASED ON DATA MADE AVAILABLE BY TANGEDCO.
2. DRAWING IS INDICATIVE

REV	SEC	ELECT	GL&T	MH
1				
2				
3				
4				

REV.	DATE	ZONE	DESCRIPTION	BY	VERIFIED

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DRAWING NO. | REFERENCE

TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED
TAMILNADU

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MECON LIMITED

SECTION	PP & EE
LOCATION	RANCHI
DESIGNED	
DRAWN	
CHECKED AND VERIFIED	
APPROVED	

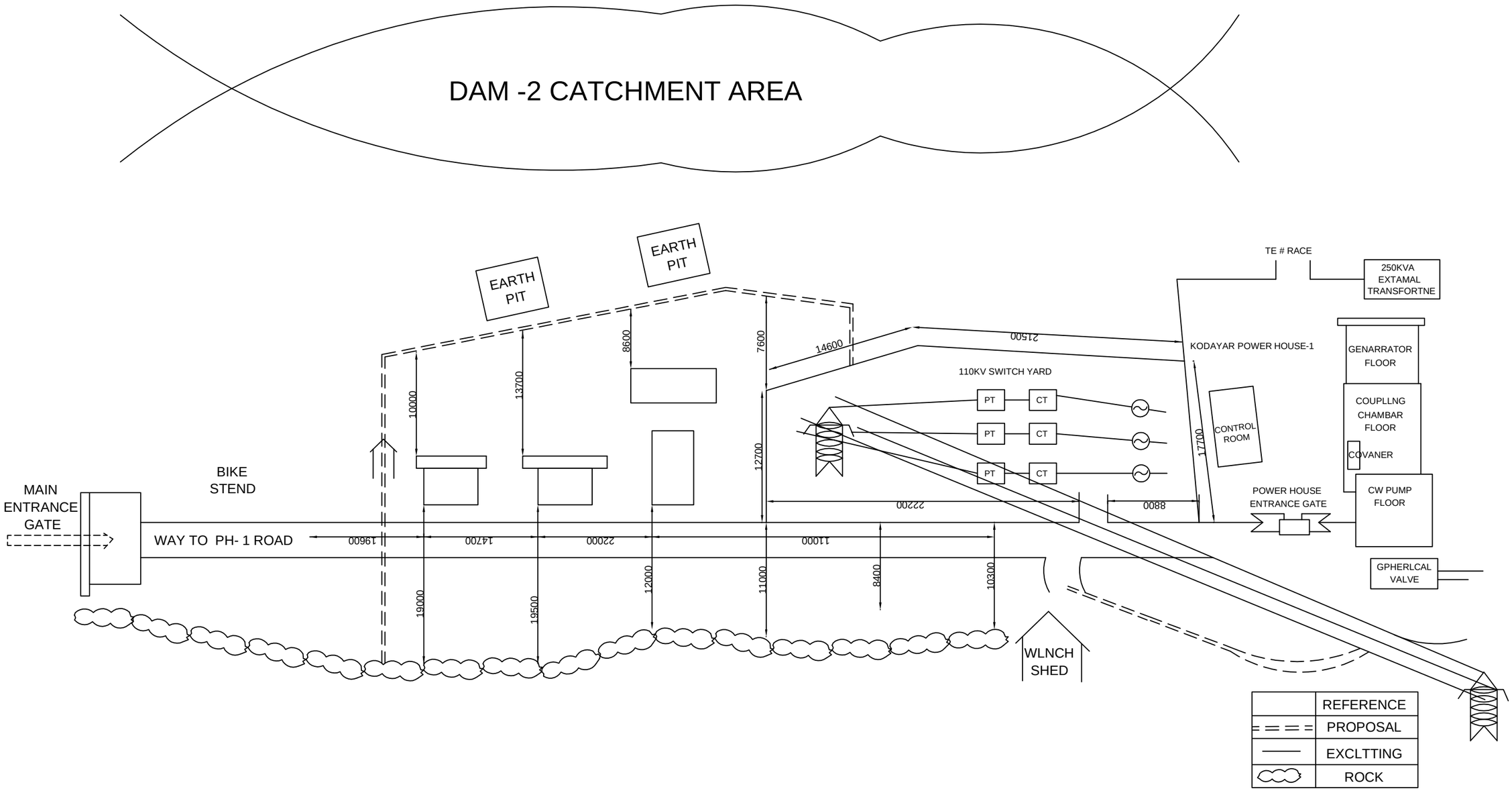
RM&U OF KODAYAR HYDRO ELECTRIC POWER HOUSE–1

WATER CONDUCTOR SYSTEM

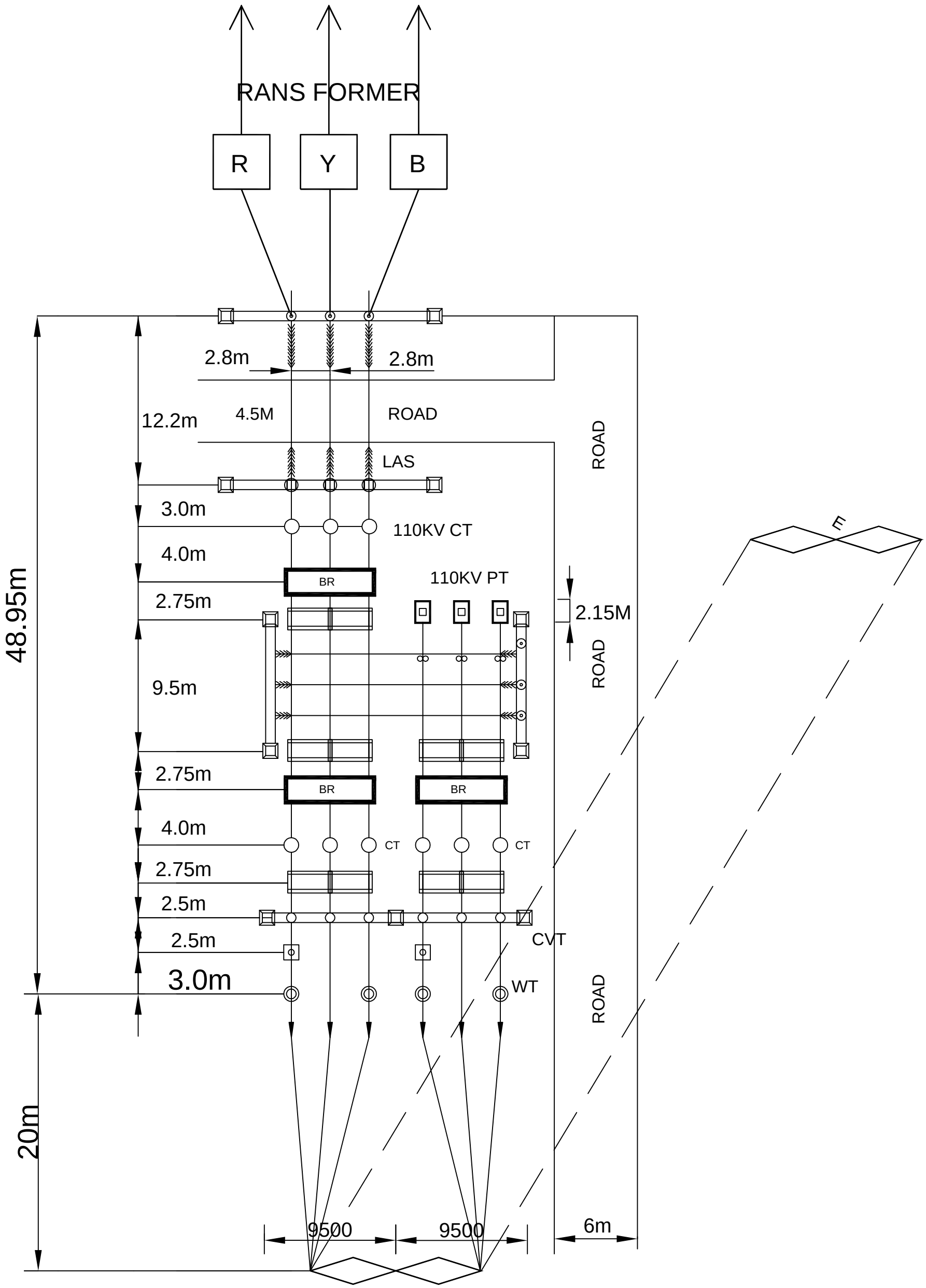
SIG.
DATE :-
SCALE -
SHEET 1 OF 1
REV. 0
DRG.No. MEC/S/10HO/11/S3/TS/M/07

LAYOUT OF 110KV SWITCH YARD AT KODAYAR POWER HOUSE - 1 (AVAILABLE SPACE)

SPECIFICATION NO. HE2367

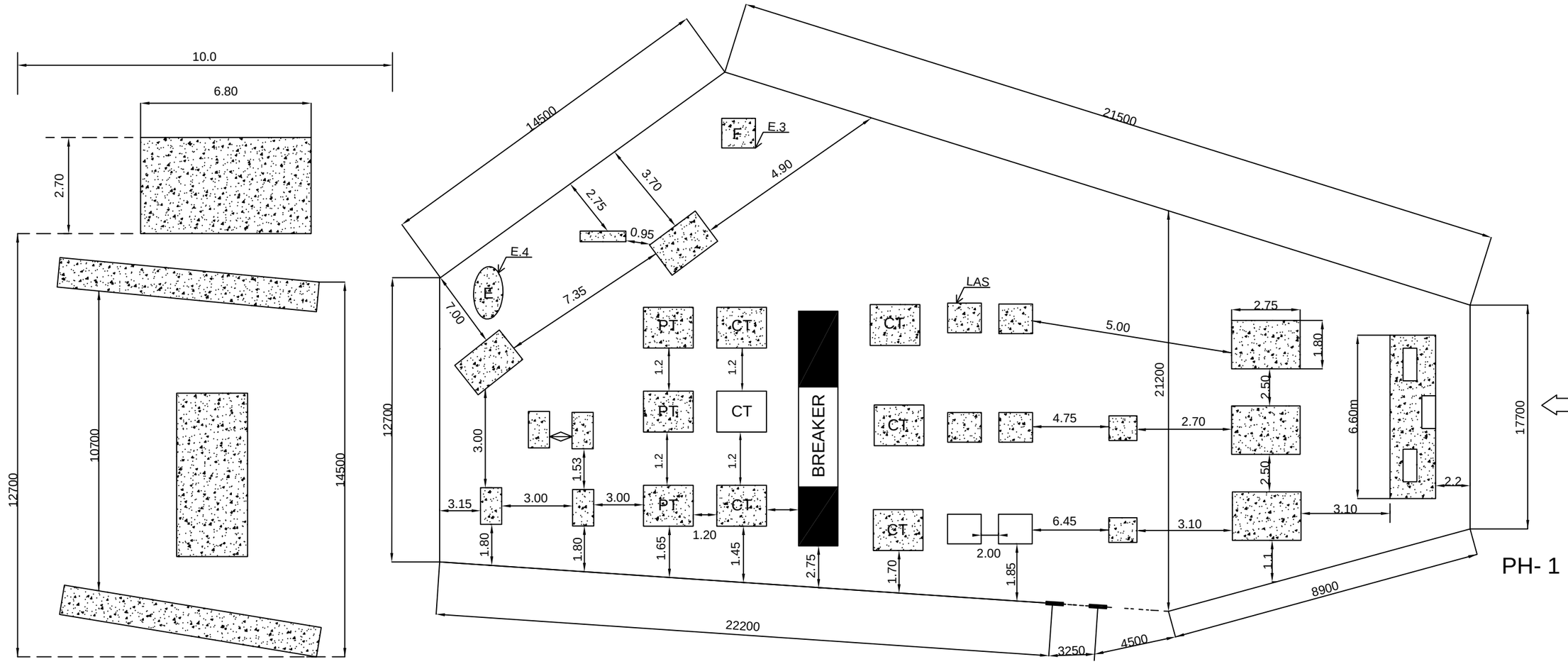


KODAYAR PH.1



PRO. TOWER

SPECIFICATION NO. HE2367



SCALE ALL IN METERS

0.3 x 0.3 - SUPPORTING PILLAR PLLNTH

LAS 0.75 x 0.75 - SUPPORTING PILLAR PLLNTH

0.75 x 0.75 - SUPPORTING PILLAR PLLNTH

CT 1.10 x 1.10 - SUPPORTING PILLAR PLLNTH

PT 1.10 x 1.10 - SUPPORTING PILLAR PLLNTH

SF6 BKR 1.50 x 1.50 - SUPPORTING PILLAR PLLNTH

2.50 x 2.50 - 110KV AB SWITCH SUPPORTING PILLAR PLLNTH

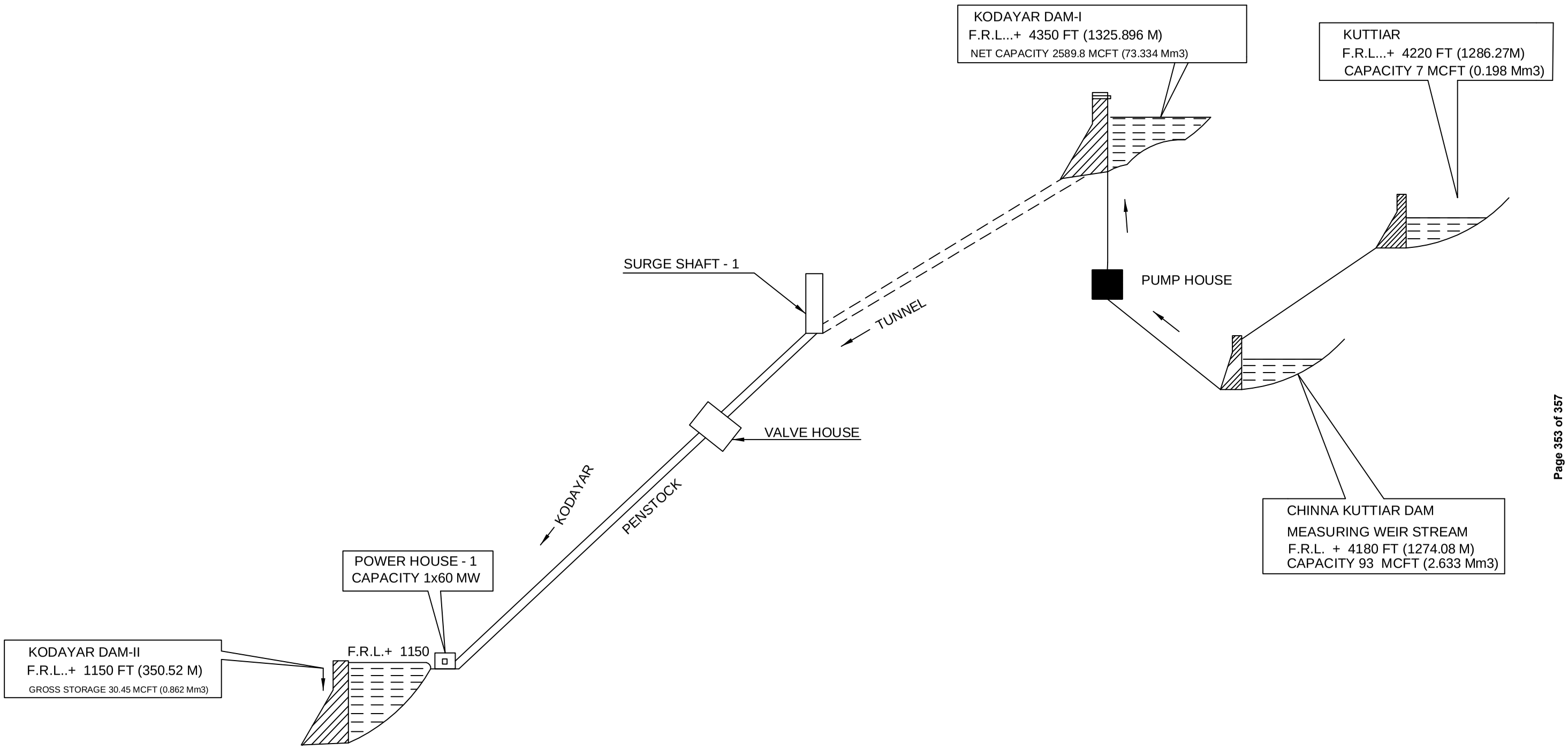
1.50 x 1.50 - CC SET SUPPORTING PILLAR PLLNTH

0.35 - WIDTH PARAPET WALL

SPECIFICATION NO. HE2367

KODAYAR HYDRO - ELECTRIC POWER HOUSE-1 (1 X 60 MW)

IN KANYAKUMARI DISTRICT



DETAILS OF EXISTING FACILITIES

1. TUNNEL
LENGTH - 10400 FT (3169.96 M)
SHAPE - HORSE SHOE
DIAMETER- 7 FT (2.133 M)

2. PENSTOCK
LENGTH - 7000 FT (2133.63 M)
DIAMETER - 6 FT TO 4.5 FT (VARIES FROM)
THICKNESS- 22.28 MM TO 38.10 MM (VARIES FROM)

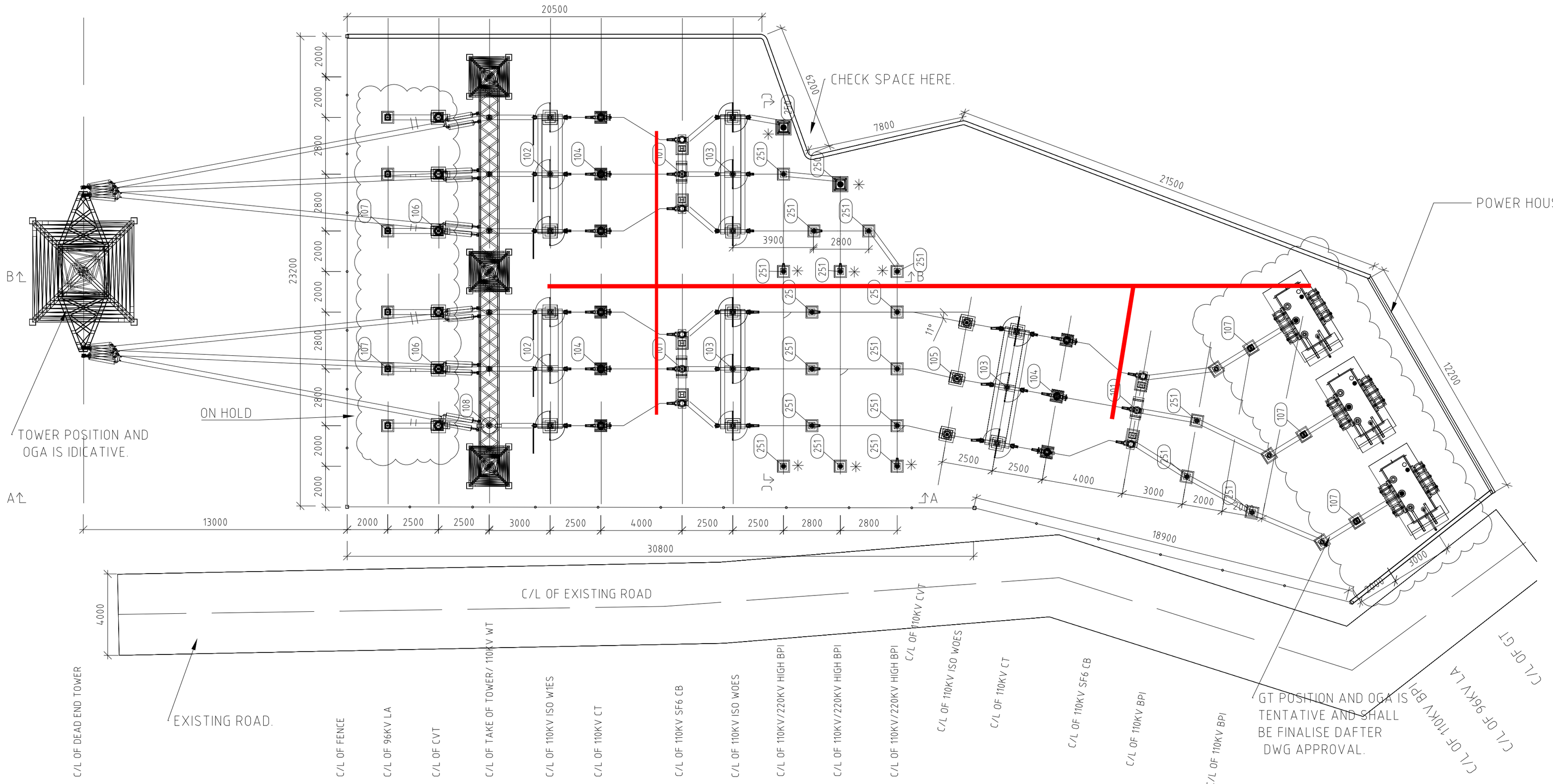
3. SURGE SHAFT
TYPE - OPEN PLANE
DEPTH - 434 FT (132.28M)
DIAMETER- 20 FT (6.096 M)

4. POWER HOUSE
LENGTH - 32.91 M)
WIDTH - 21.41 M
HEIGHT - 19.18 M)

SPECIFICATION NO. HE 2367

DRAWING No. TB-417-310-003

TB-417-607-003-KOD-PKG-I



PLAN VIEW– 110KV SWITCHARD

SYSTEM PARAMETERS		
SL.NO.	DESCRIPTION	110 kV
01	HIGHEST SYSTEM VOLTAGE	132kV(r.m.s.)
02	SYSTEM OPERATING VOLTAGE	110kV
03	P.F. WITHSTAND VOLTAGE	230kV(r.m.s.)
04	LIGHTING IMPULSE WITHSTAND VOLTAGE	550kVP
05	SWITCHING IMPULSE WITHSTAND VOLTAGE	---
06	SYSTEM FAULT LEVEL	40KA FOR 3 Sec.
07	CREEPAGE	25MM/KV
08	SYSTEM EARTHING	EFFECTIVELY EARTHED

EQUIPMENTS			
POS	DESCRIPTION	SHORT NAME	Q.TY.
101	110KV, 1250A, 40KA/3S, 3-PH, OUTDOOR SF6 BREAKER	110KV CB	3
102	110KV, 1250A, 40KA/3S, 3-PH, HDB ISOLATOR WITH SINGLE EARTH SWTICH (MOTORISED)	110V ISO W1ES	2
103	110KV, 1250A, 40KA/3S, 3-PH, HDB ISOLATOR WITHOUT EARTH SWTICH (MOTORISED)	110V ISO W0ES	3
104	110KV, 1250/1A, 40KA/3S, 1-PH, 5 CORE, CURRENT TRANSFORMER	110KV CT	9
105	110KV, 3 CORE, 1-PH, EMVT	110KV EMVT	3
106	110KV, 3 CORE, 1-PH, CAPACITIVE VOLTAGE TRANSFORMER	110KV CVT	6
107	96KV, 1-PH SURGE ARRESTER	96KV LA	9
108	110KV, 1250A, 0.5mH, 40KA/3S, 1-PH WAVE TRAP	110KV WT	1
250	220KV, 6KN, 25MM/KV CREEPAGE POST INSULATOR	220KV BPI	2
251	110KV, 6KN, 25MM/KV CREEPAGE POST INSULATOR	110KV BPI	21

TOWER/ GANTRY		
POS	DESCRIPTION	Q.TY.
14	TOWER	3
806	Beam Gantry	2

NOTES:

✳ THESE HIGH LEVEL BPIs ARE USED IN BUS BAR AND HEIGHT OF BUSBAR IS 6.8 MTR.

ADDITIONAL INFORMATION
W.O.No. S20TB00004

STATUS OF DRAWING
DISTRIBUTION OF PRINTS

ग्राहक/परियोजना का नाम NAME OF CUSTOMER/PROJECT: TAMIL NADU GENERATION AND DISTRIBUTION CO LTD. (TANGEDCO)
110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-1

BHEL भारत हेवी इलेक्ट्रिकल्स लिमिटेड
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BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

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स्वीकृत APPROVED	SKS	Sd/-	07.09.21

REV.	DATE	ALTERED / CHECKED / APPROVED
ZONE		

REV.	DATE	ALTERED	
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		APPROVED	SKS
ZONE			

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विभाग DEPT. TBEM | कोड CODE | अनुपात / SCALE NTS | कार्ड कोड CARD CODE

शीर्षक/TITLE
PLAN AND SECTION LAYOUT
FOR 110KV SWITCHYARD

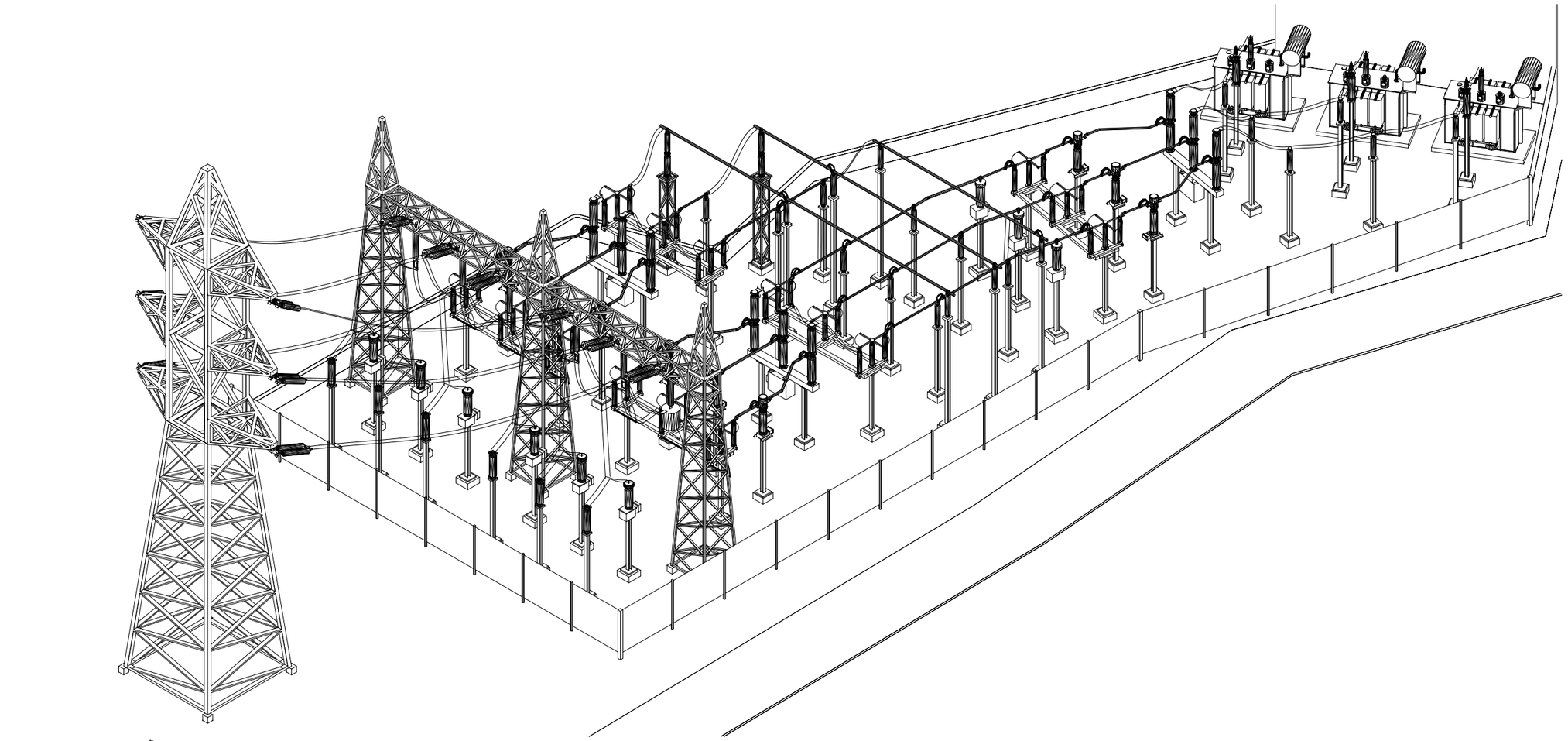
ड्राईंग क्र./DRAWING NO. TB-417-316-003 | पुनः/REV. 01

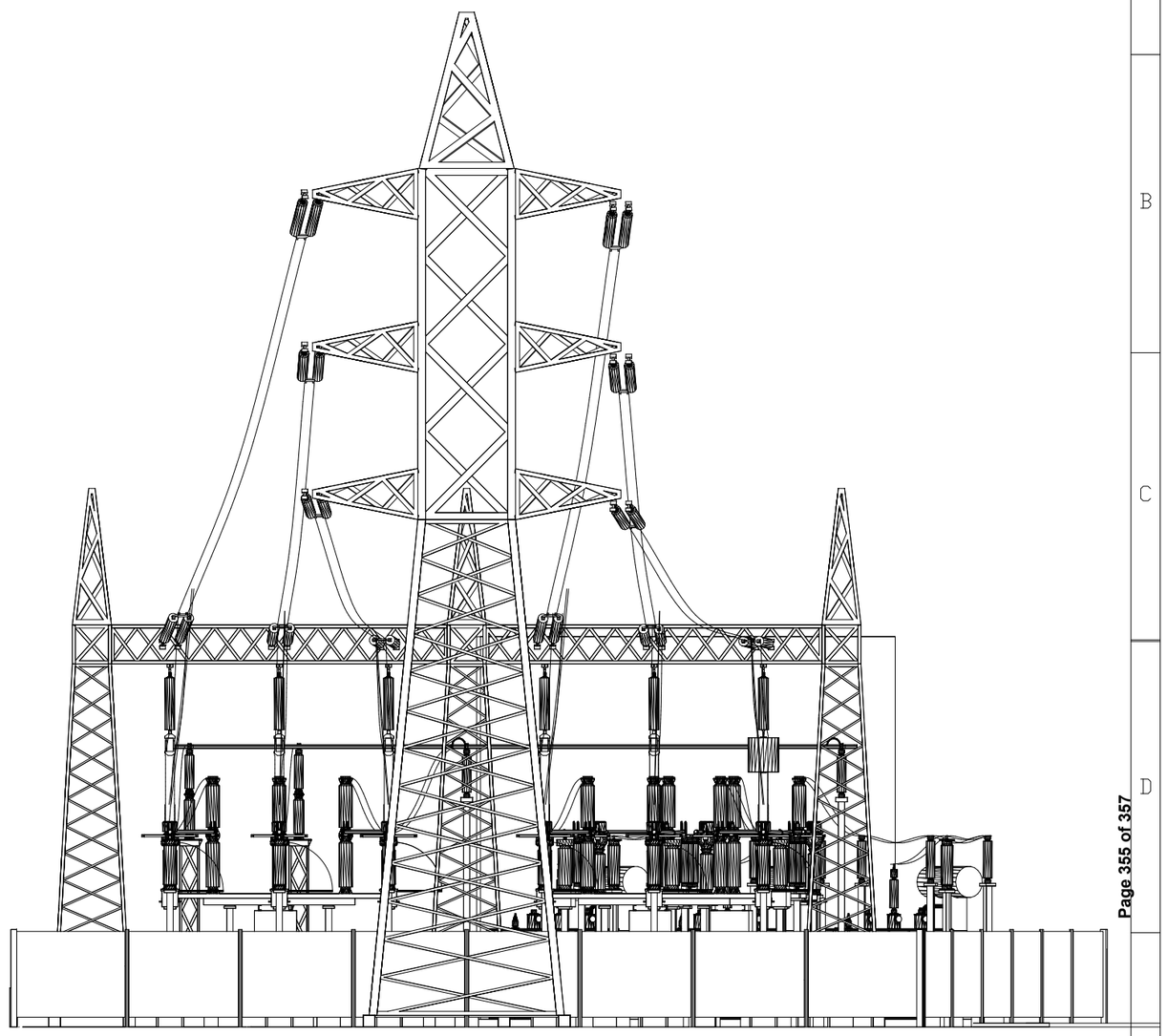
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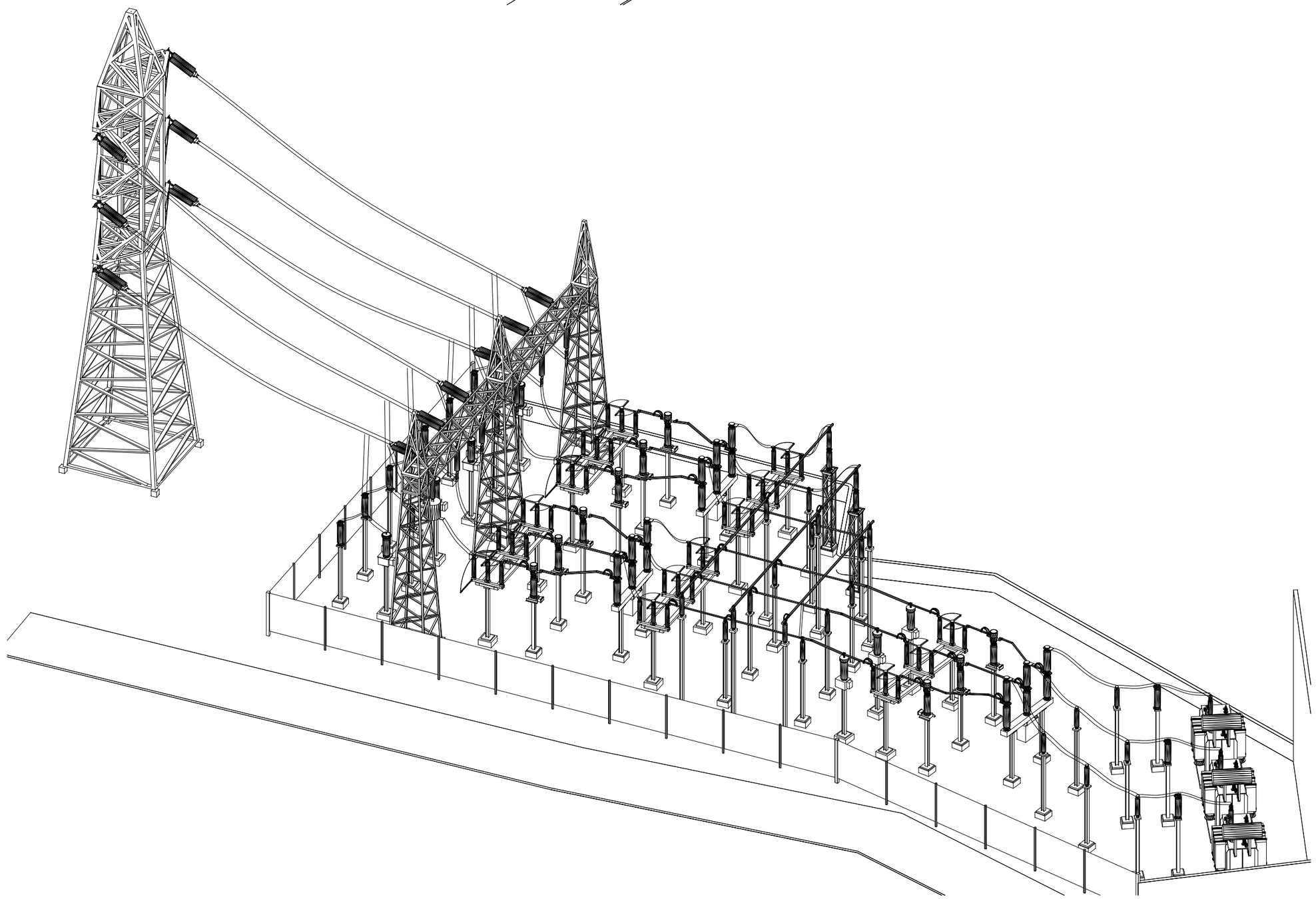
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TB-417-607-003-KOD-PKG-I







ISOMETRIC VIEW– 110KV SWITCHARD

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ADDITIONAL INFORMATION
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STATUS OF DRAWING
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ग्राहक/परियोजना का नाम NAME OF CUSTOMER/PROJECT: TAMIL NADU GENERATION AND DISTRIBUTION CO LTD. (TANGEDCO)
110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-1

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पारेषण परियोजना विभाग
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

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स्वीकृत APPROVED	SKS	Sd/-	22.07.21

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REV.	DATE	ALTERED / CHECKED / APPROVED
00	07.09.21	DS / JK / SKS
ZONE		

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विभाग DEPT. TBEM
कोड CODE
अनुपात / SCALE NTS
कार्ड कोड CARD CODE

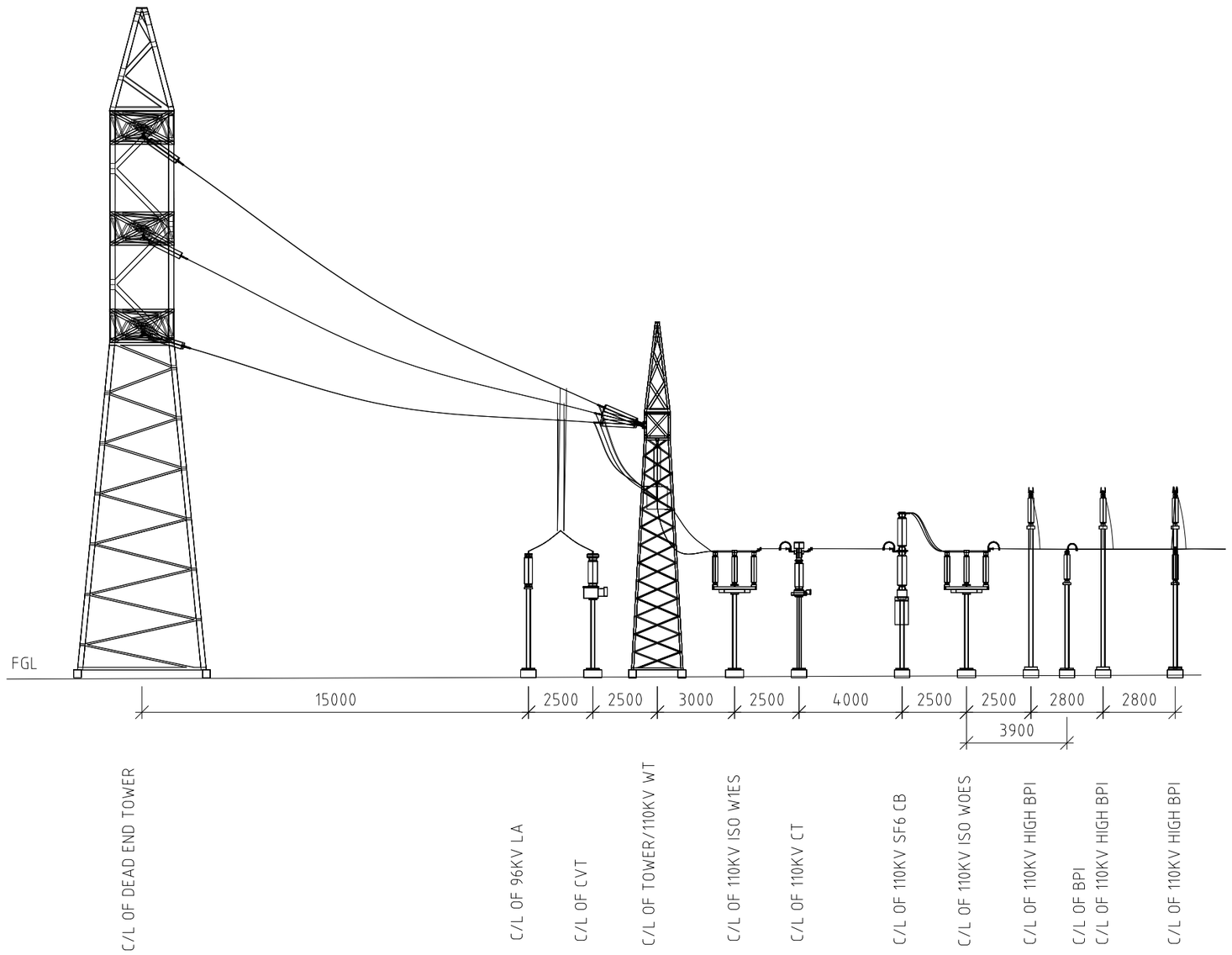
शीर्षक/TITLE
PLAN AND SECTION LAYOUT
FOR 110KV SWITCHYARD

ड्राईंग क्र./DRAWING NO. TB-417-316-003
पुनः/REV. 01
पृष्ठ क्र./SHEET No. 02
अगला पृष्ठ/NEXT SHEET 03

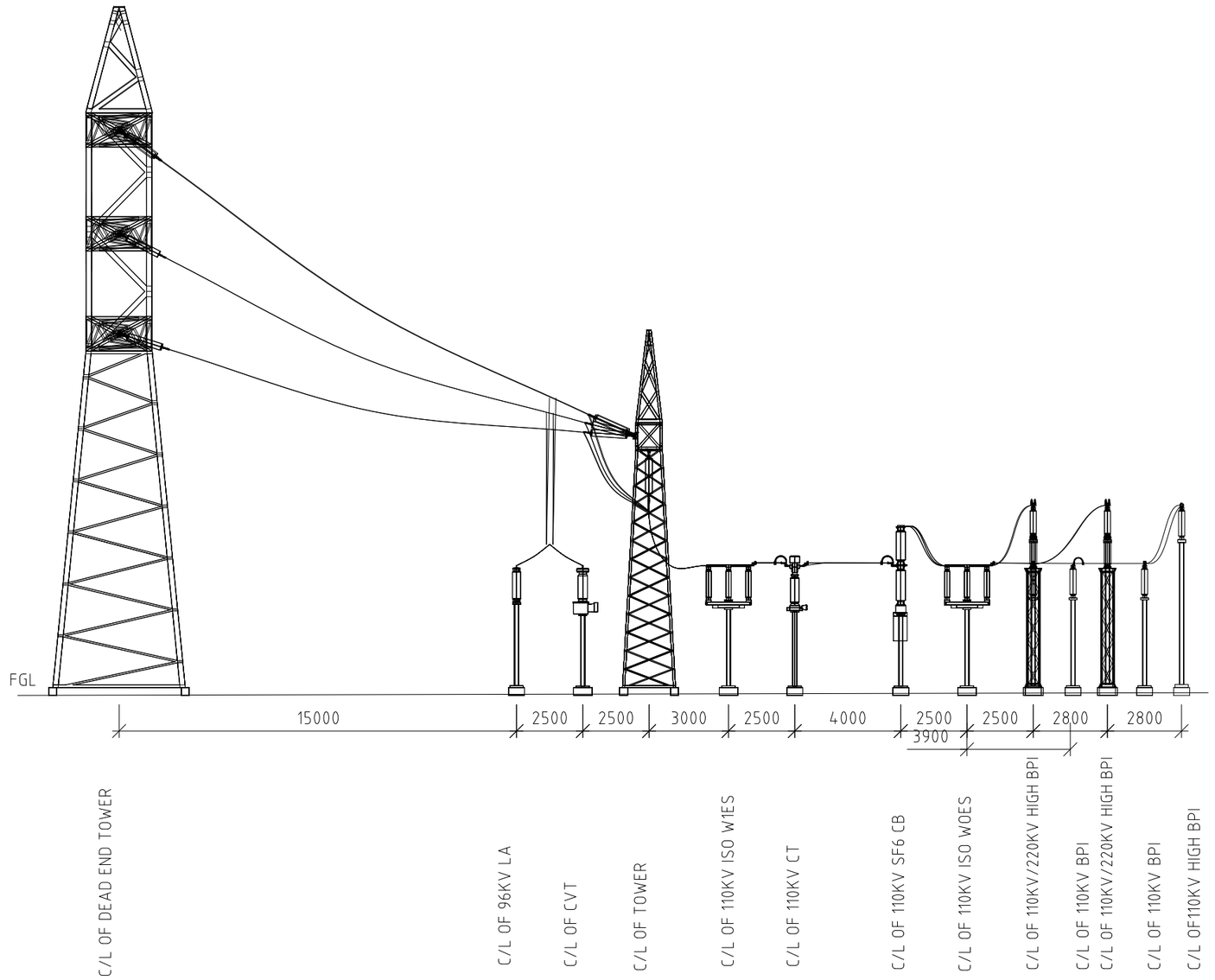
DRAWING No. TB-416-316-003

TB-417-607-003-KOD-PKG-I

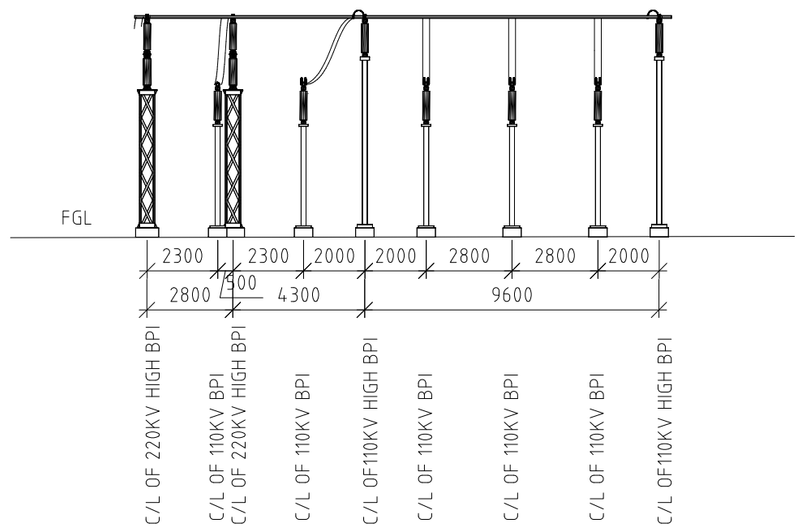
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SECTION A-A- 110KV BAY-2 (LINE-1 WITH WAVETRAP)



SECTION B-B- 110KV BAY-3 (LINE-2)



SECTION C-C- 110KV BUS-BAR

NOTE:

1. ALL DIMENSIONS ARE IN MM UNTIL OTHERWISE SPECIFIED.
2. DEAD END TOWER AND STRINGING TO TAKE OF TOWER INCLUDING STRING INSULATORS ARE NOT IN BHEL SCOPE. BHEL SHALL PROVIDE SUSPENSION INSULATOR AT TAKE OF TOWER AND JUMPERS TO LINE SIDE EQUIPMENTS..
3. LAYOUT IS PREPARED ON THE BASIS OF INPUT RECEIVED FROM SITE VISIT AND TENDER SPECIFICATION.
4. PROPOSED SWITCHYARD AREA WORK I.E.RETAINING WALL IN BETWEEN KODAYAR DAM II (RESERVOIR LEFT BANK SIDE) AND PROPOSED YARD AREA, AND PROVIDING ADEQUATE FILLING TO CREATE SPACE, REORIENTATION OF APPROACH ROAD TO POWER HOUSE TOWARDS ROCK FACE ADJACENT TO ROAD AND DEMOLITION OF EXISTING GUARD HOUSE, DG SET FOUNDATION, OIL SHED, TRANSFORMER BURNT OIL PIT ETC., REQUIRED SPACE TO BE DONE BY TANGEDCO SCOPE..
5. DEAD END TOWER IS SHOWN ONLY FOR INDICATION PURPOSE..M/s TANGEDCO SHALL PROVIDE ACTUAL OGA OF THE TOWER..
6. LOCATION AND OGA OF GENERATOR TRANSFORMER IS TENTATIVE AND SHALL BE FINALIZED AFTER GT DRAWINGS APPROVAL.

CONDUCTOR & STRINGING DETAILS

SL.NO.	DESCRIPTION	LEVEL FROM PLINTH	SUB-CONDUCTOR
1.	MAIN BUS	(AT 6.8M HEIGHT)	3" IPS AL. TUBE
2.	DROPPERS/JUMPERING	– – –	TWIN MOOSE ACSR CONDUCTOR WITH 225MM SUB-CONDUCTOR SPACING
3.	EQUIPMENT INTERCONNECTION	(AT 4.6M HEIGHT)	3" IPS AL. TUBE / TWIN ACSR MOOSE CONDUCTOR WITH 225MM SPACING

ADDITIONAL INFORMATION
W.O.No. S20TB00004

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

ग्राहक/परियोजना का नाम NAME OF CUSTOMER/PROJECT: TAMIL NADU GENERATION AND DISTRIBUTION CO LTD. (TANGEDCO)
110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-1

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जाँचा CHECKED	JK	Sd/-	22.07.21
स्वीकृत APPROVED	SKS	Sd/-	22.07.21

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ZONE			00	07.09.21	DS / JK / SKS	

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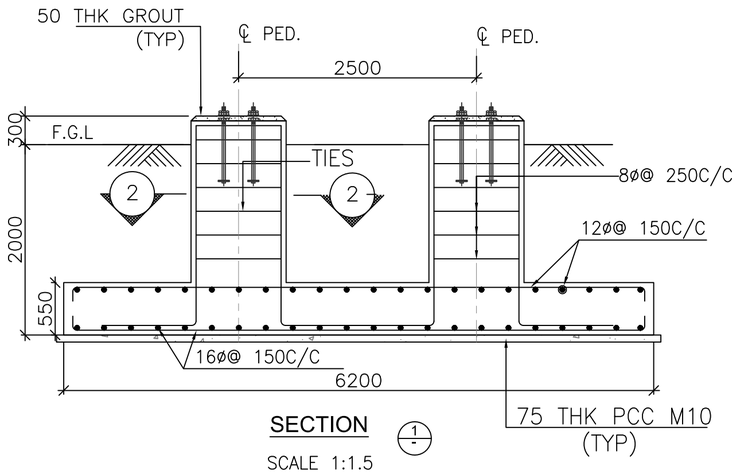
विभाग DEPT. TBEM | कोड CODE | अनुपात / SCALE NTS | कार्ड कोड CARD CODE

शीर्षक/TITLE: PLAN AND SECTION LAYOUT FOR 110KV SWITCHYARD

ड्राईंग क्र./DRAWING NO. TB-417-316-103 | पुनः/REV. 01

पृष्ठ क्र./SHEET No. 03 | अगला पृष्ठ/NEXT SHEET 03

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SIGN. & DATE
INVENTORY No.

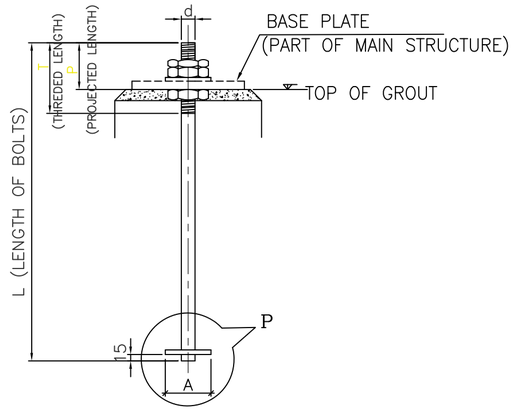


SECTION (1/-)

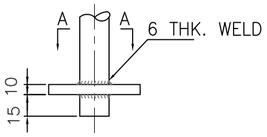
SCALE 1:1.5

DETAIL OF FOUNDATION BOLT

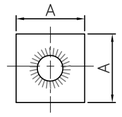
S.No.	DIA OF BOLTS (d) MM	TOTAL LENGTH OF BOLT (L) MM	THREADED LENGTH OF BOLT (T) MM	PROJECTED LENGTH OF BOLT (P) MM	(A) MM
1	40	800	160	110	100



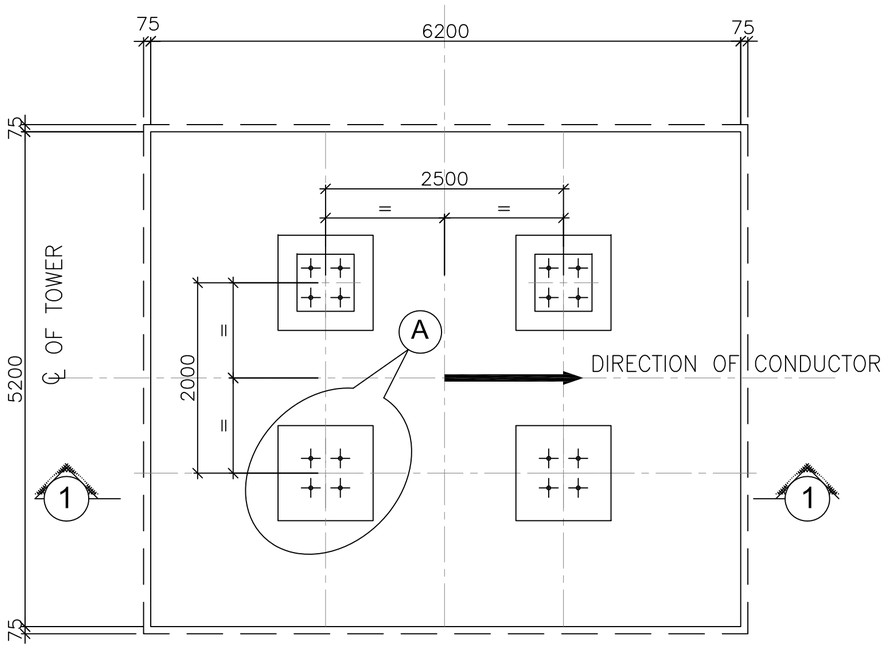
TYPICAL DETAIL OF FOUNDATION BOLT



DETAIL AT 'P'

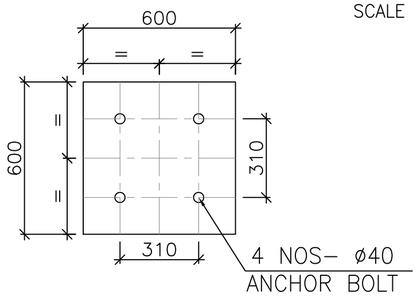


VIEW A–A



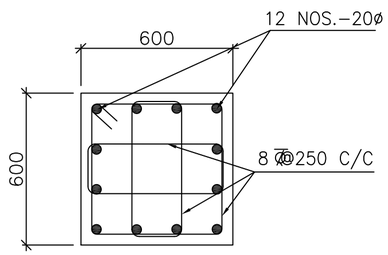
FOUNDATION PLAN

SCALE 1:1.5



DETAIL (A/-)

(N.T.S)



SECTION (2/-)

(N.T.S)

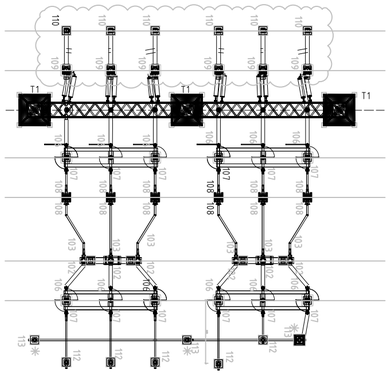
IMPORTANT NOTES:

1. ORIENTATION OF FOOTING SHALL BE CHECKED BEFORE STARTING EXCAVATION.
2. BEFORE CASTING OF PEDESTALS, BOLT ARRANGEMENT SHALL BE CHECKED.

LEGEND:–

FGL – FINISHED GRAVEL LEVEL

TB-417-607-003-KOD-PKG-I



KEY PLAN

REFERENCE DRAWINGS:

S.No.	DRAWING TITLE	DRAWING NUMBER
1.	LAYOUT OF FOUNDATION, ROAD & FENCE FOR 110KV SWITCHYARD AT KODAYAR	TB–2–417–607–601
2.	PLAN AND SECTION LAYOUT FOR 110KV SWITCHYARD AT KODAYAR	TB–417–316–003
3.	STRUCTURE DRAWING OF 110KV TOWER & BEAM	TB–2–417–618–010

NOTES:–

1. ALL DIMENSIONS ARE IN MM. & ELEVATIONS ARE IN METRE UNLESS NOTED OTHERWISE.
2. RCC CONCRETE WORK SHALL BE OF GRADE M30 WITH CORROSION INHIBITORS OF APPROVED MAKE.
3. ALL REINFORCEMENT FOR STEEL BARS (DENOTED AS ø)SHALL CONFORM TO IS:1786 OF GRADE Fe 415 OR HIGHER GRADE.
4. UNLESS NOTED OTHERWISE LAP/ANCHOR LENGTH SHALL BE 50 TIMES THE DIA. OF BARS.
5. CLEAR COVER TO MAIN REINF. SHALL BE AS FOLLOWS:–

ITEMS	TOP	BOTTOM	SIDE
a) FOUNDATIONS	50MM.	50MM.	50MM.
b) COLUMNS	50MM.	–	50MM.

6. THE GROUTING SHALL BE OF NON–SHRINKING GROUT AS PER TECHNICAL SPECIFICATION.
7. BOTTOM 300MM OF EXCAVATION TO BE DONE CAREFULLY TO AVOID OVER EXCAVATION.
8. ORIENTATION OF FOOTING SHALL BE CHECKED WITH ELECTRICAL LAYOUT DRAWING BEFORE STARTING EXCAVATION.
10. BEFORE CASTING OF PEDESTALS, BOLT ARRANGEMENT SHALL BE CHECKED WITH RESPECTIVE STRUCTURE DRAWING. DISCREPANCY, IF ANY, SHALL BE BROUGHT TO THE NOTICE OF THE CONCERNED ENGINEERS.
11. THIS DWG SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATION.
12. F.G.L SHALL BE MATCHED WITH EXISTING YARD.

ADDITIONAL INFORMATION
W.O.No.

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

REV.	DATE	ALTERED / CHECKED / APPROVED
ZONE		

REV.	DATE	ALTERED / CHECKED / APPROVED
ZONE		

ग्राहक/परियोजना का नाम TAMIL NADU GENERATION AND DISTRIBUTION CO LTD. (TANGEDCO)

NAME OF CUSTOMER/PROJECT 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE–I

BHEL भारत हेवी इलेक्ट्रिकल्स लिमिटेड
ट्रांसमिशन परियोजना विभाग
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION PROJECTS DIVISION

	नाम /NAME	हस्ता ./SIGN.	दि./DATE
बनाया DRAWN	KB	–SD–	20.08.22
जाँचा CHECKED	VG/SV	–SD–	20.08.22
स्वीकृत APPROVED	PLK	–SD–	20.08.22

विभाग DEPT. | अनुपात / SCALE | कार्ड कोड CARD CODE | कोड CODE

STRUCTURE AND FOUNDATION DESIGN OF 110KV TOWER & BEAM

शीर्षक/TITLE
RCC DETAILS OF 110KV TOWER FOUNDATION MKD. "FT1"

ड्राईंग क्र./DRAWING NO. TB-3-417-607-015

पुनः/REV. 00

पृष्ठ क्र./SHEET No. 01 | अगला पृष्ठ/NEXT SHEET __

GENERAL INSTRUCTION FOR EARTHING:

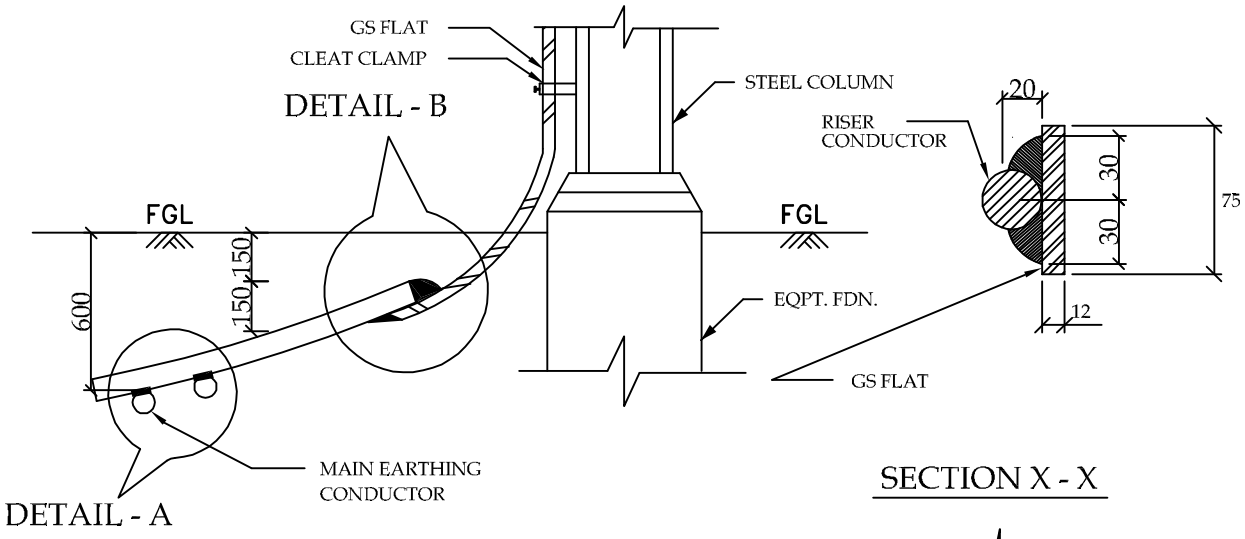
1. Location of earthing conductors / risers shown in the earthing drawing may change to suit the site condition.
2. Two different risers of one structure/equipment shall be connected to different conductors of main earthmat.
3. Earthing conductor around the building shall be burried at a minimum distance of 1500 mm from the outer boundary of the building.
4. Minimum distance of 6000 mm shall be maintained between two treated (pipe) electrode.
5. For surge arrester, earthing lead from surge counter to to main earthmat shall be shortest in length as pratically as possible. Earthing lead from surge arrester shall not be passed through any pipe.
6. No welding is allowed in the over ground earthing leads/risers if the length is less than 6m .

7. All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.
8. All arc welding with MS ROD shall be done with low hydrogen content electrodes. the welds should be treated with red oxide primer and afterwards coated with two layers bitumen compound to prevent corrosion.
9. Wherever earthing conductor crosses cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid minimum 300 mm below them and shall be circumvented in case it fouls with equipment/structure foundations.
10. Earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building.

RELEASED FOR CONTRUCTION

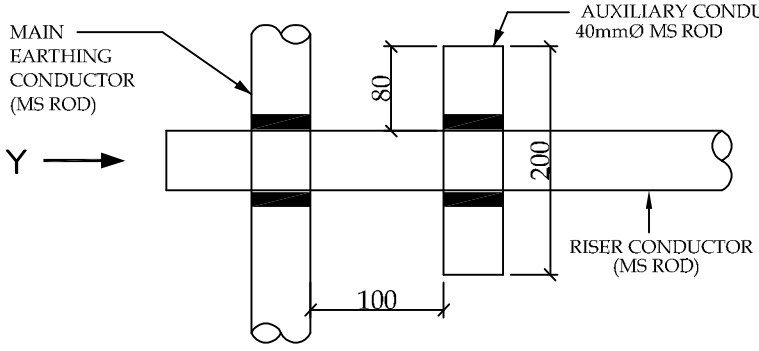
11. Earthing conductors crossing the road shall be laid 300mm below road or at greater depth to suit the site conditions.
12. Earthing conductors embedded in the concrete shall have approximately 50mm concrete cover

TITLE:- STANDARD EARTHING DETAILS			
KKParkar	KKParkar	Dec-2013	Drawing No.: C/ENG/STD/EARTHINGS/09
CKD BY	PRPD BY	Date	SHEET # 1

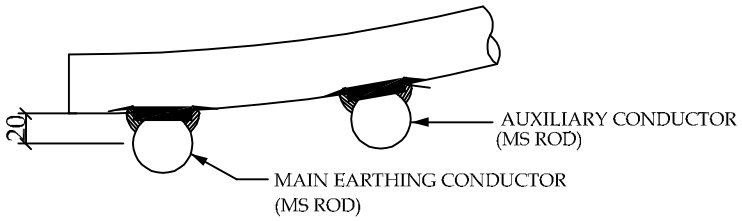


SECTION X - X

TYPICAL DETAILS OF RISER

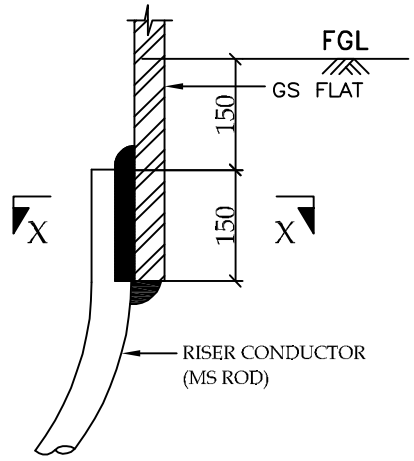


PLAN



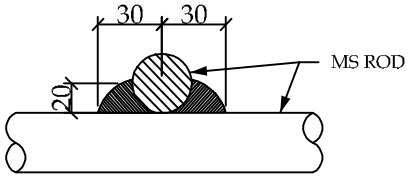
ELEVATION

DETAIL - A



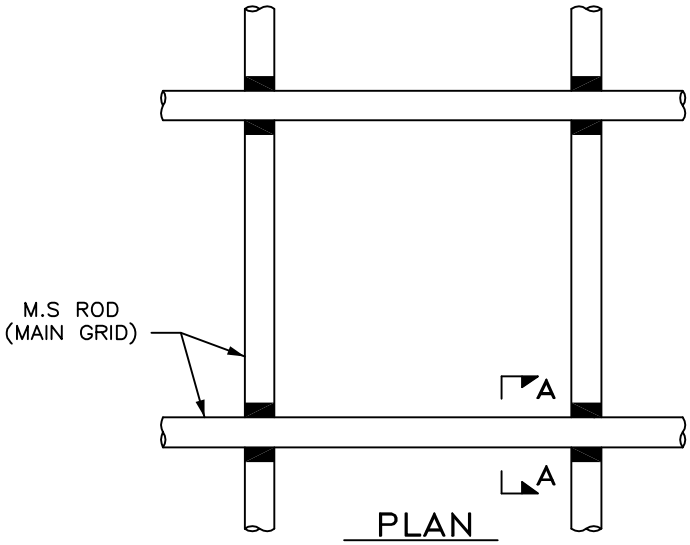
ELEVATION

DETAIL - B

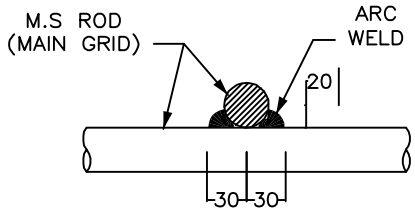


VIEW - Y

TITLE:- STANDARD EARTHING DETAILS			
KKParkar	KKParkar	Dec-2013	Drawing No.: C/ENG/STD/EARTHINGS/09 SHEET # 2
CKD BY	PRPD BY	Date	

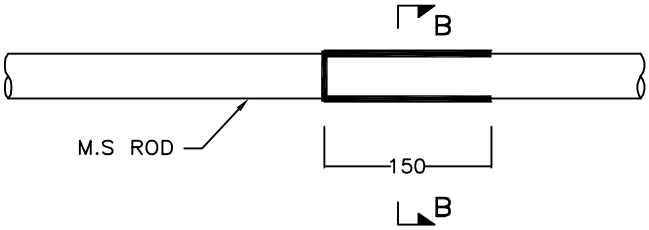


PLAN



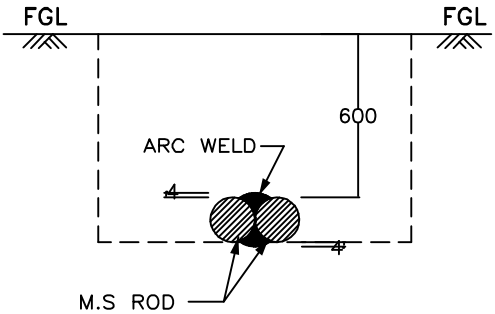
SECTION A – A

DETAIL OF CROSS JOINT

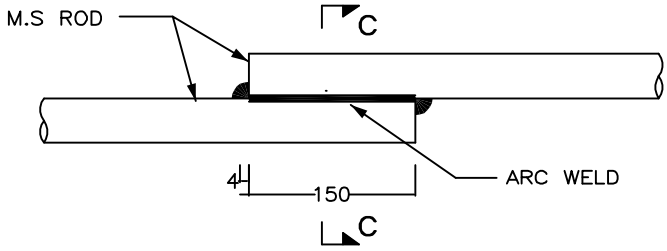


ELEVATION

(CONDUCTORS KEPT ON SIDES)

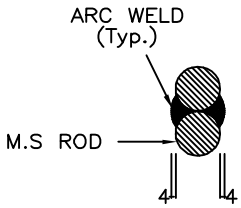


SECTION B – B



ELEVATION

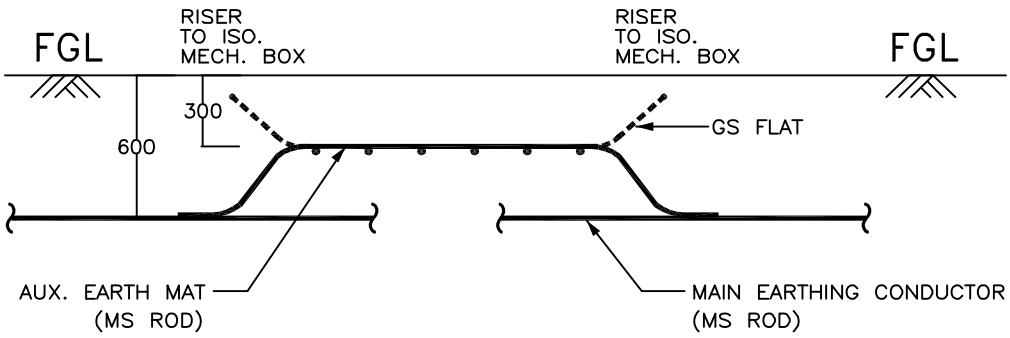
(CONDUCTORS ONE ABOVE THE OTHER)



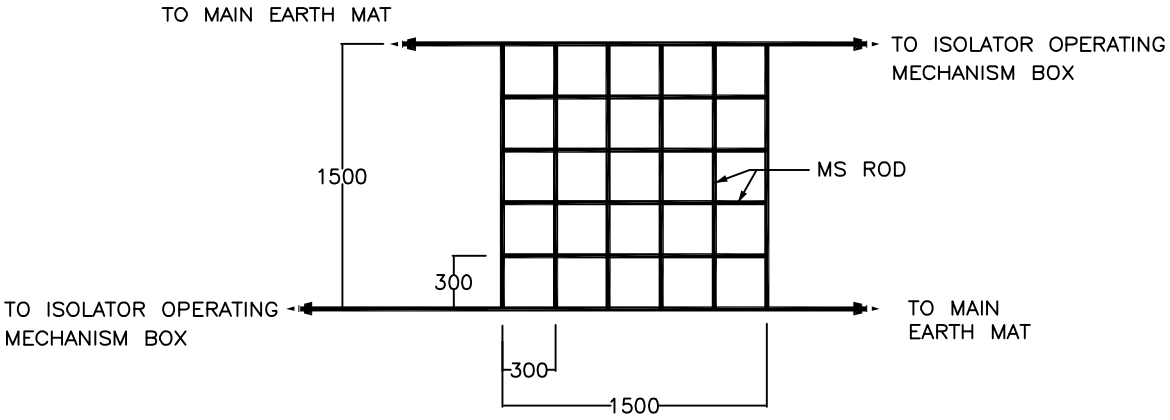
SECTION C – C

DETAIL OF LAP JOINT

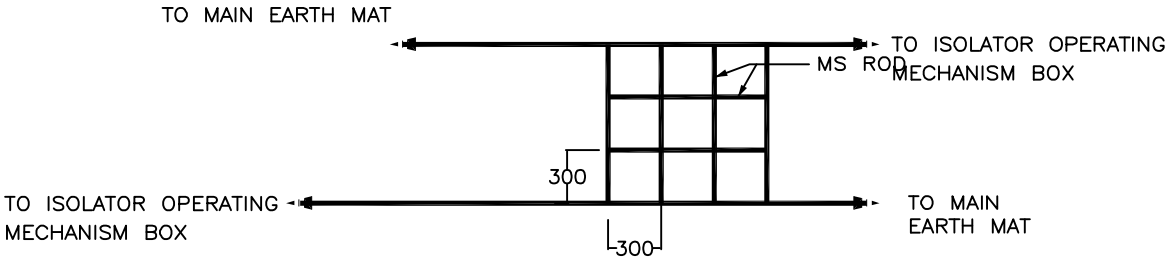
TITLE:- STANDARD EARTHING DETAILS			
KKParkar	KKParkar	Dec-2013	Drawing No.: C/ENG/STD/EARTHINGS/09
CKD BY	PRPD BY	Date	SHEET # 3



ELEVATION

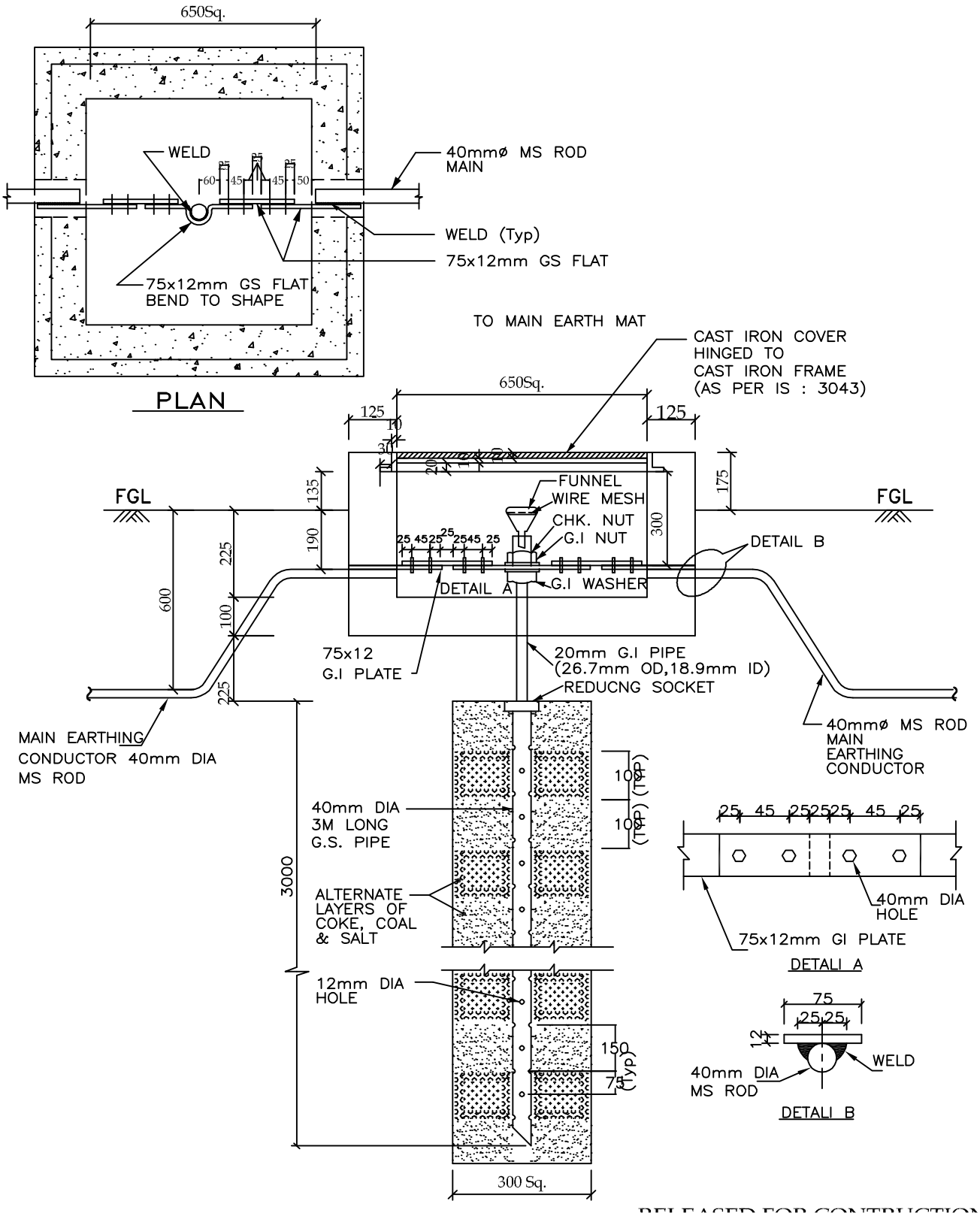


PLAN (For 220kV & above class isolators)



PLAN (For 132kV & below class isolators)

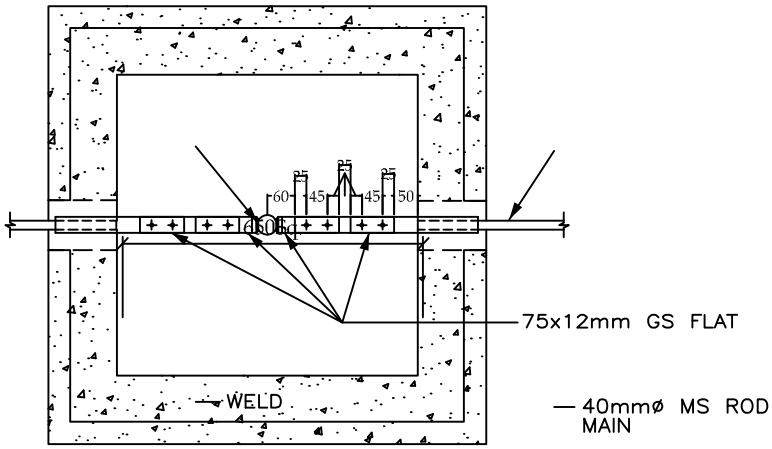
TITLE:- STANDARD EARTHING DETAILS			
KKParkar	KKParkar	Dec-2013	Drawing No.: C/ENG/STD/EARTHINGS/09
CKD BY	PRPD BY	Date	SHEET # 4



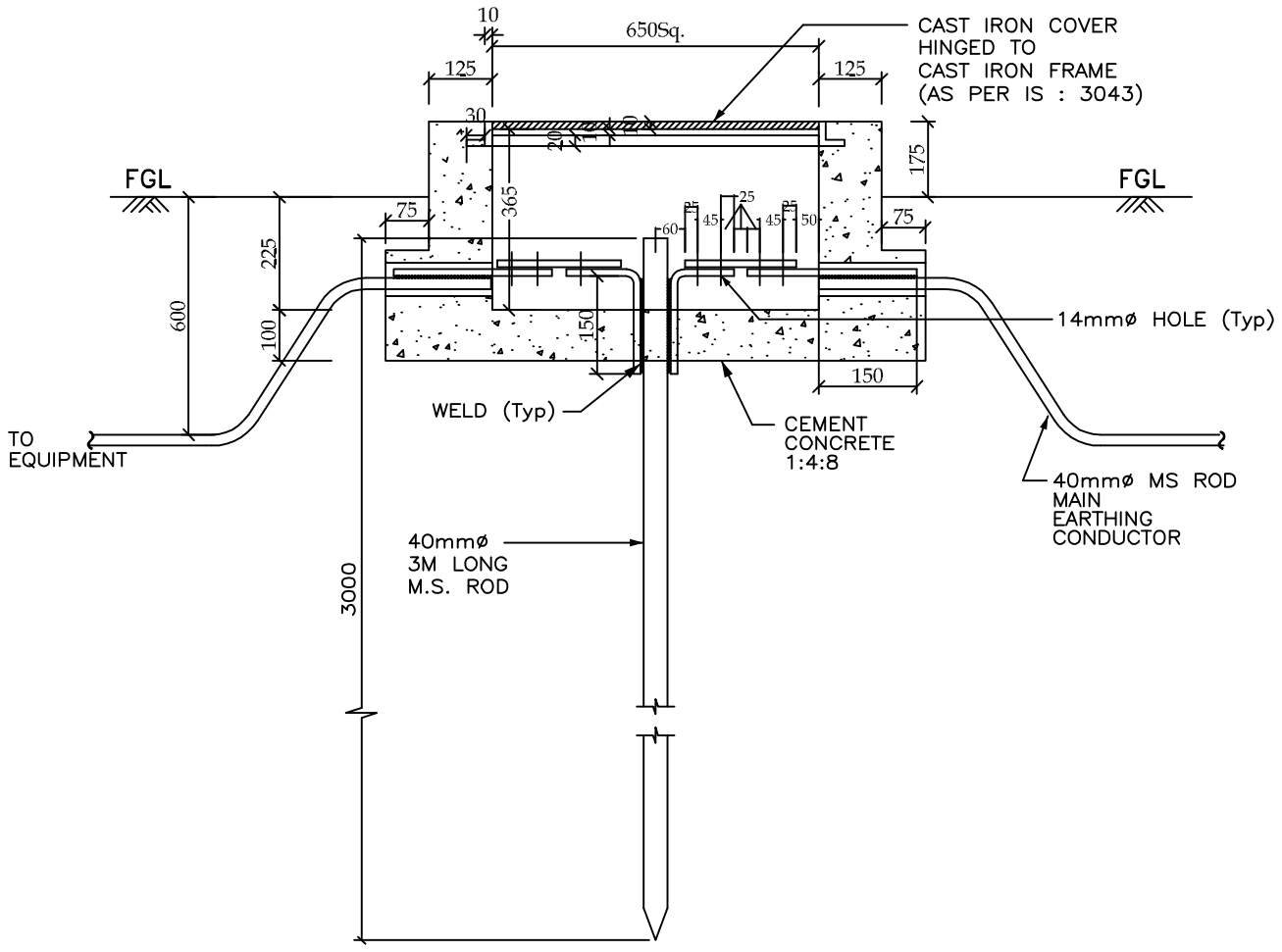
RELEASED FOR CONTRUCTION

KKParkar	KKParkar	Dec-2013	Drawing No.: C/ENG/STD/EARTHINGS/09 SHEET # 5
CKD BY	PRPD BY	Date	

ROD ELECTRODE WITH TEST LINK FOR LM, TOWER WITH PEAK, CVT, LA



PLAN



ELEVATION

RELEASED FOR CONTRUCTION

TITLE:- STANDARD EARTHING DETAILS			
KKParkar	KKParkar	Dec-2013	Drawing No.: C/ENG/STD/EARTHINGS/09
CKD BY	PRPD BY	Date	SHEET # 6

FORMAT OF NO DEVIATION CERTIFICATE
(To be submitted in the bidder's letter head)

REF: …….. **Dated**…….

BHARAT HEAVY ELECTRICALS LIMITED,
TRANSMISSION BUSINESS GROUP,
6th Floor, BHEL SADAN,
Plot No- 25, Sector- 16A, Noida,
Distt. Gautam Budh Nagar, UP-201301

SUB: TENDER FOR "EXECUTION AND HANDING OVER OF "CIVIL & EARTHING (UNDERGROUND) WORKS FOR 110KV SWITCHYARD FOR RMU OF KODAYAR POWER HOUSE-I AT TANGEDCO/110 KV KODAYAR IN TAMIL NADU".

Tender Ref.: TBSM/KODAYAR/CIVIL/TENDER/25-26, DATE: 18.04.2025

Dear Sir,

With reference to above, this is to confirm that as per tender conditions, we have visited subject 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 and in case of 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 and we hereby convey our unqualified acceptance to all terms and conditions as stipulated in the tender and NIT. 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 offer strictly in accordance with tender instructions.

Thanking you,

Yours faithfully,

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

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)

Ref: **Date……..**

To,
Sr. DGM/TBSM
Transmission Business Group,
Bharat Heavy Electricals Limited,
6th Floor, BHEL SADAN,
Plot No. 25, Sector-16A, Noida,
Distt. – Gautam Buddh Nagar, UP-201301

Dear Sir,

Sub: Declaration for relation in BHEL

Ref: 1) Tender Specification No.: TBSM/KODAYAR/CIVIL/TENDER/25-26, DATE: 18.04.2025

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:

a)

b)

Signature of the Authorized Signatory

Note:

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

DECLARATION BY AUTHORISED SIGNATORY OF BIDDER

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

To,

Sr. DGM/TBSM
Transmission Business Group,
Bharat Heavy Electricals Limited,
6th Floor, BHEL SADAN,
Plot No. 25, Sector-16A, Noida,
Distt. – Gautam Buddh Nagar, UP-201301

Dear Sir,

Sub : Declaration by Authorized Signatory regarding Authenticity of submitted documents.

Ref : 1**) NIT/Tender Specification No: TBSM/KODAYAR/CIVIL/TENDER/25-26, DATE: 18.04.2025**

2) **All other pertinent issues till date**

I/We, hereby certify that all the documents submitted by us in support of possession of "Qualifying Requirements" are true copies of the original and are fully compliant required for qualifying / applying in the bid and shall produce the original of same as and when required by Bharat Heavy Electricals Limited.

I / We hereby further confirm that no tampering is done with documents submitted in support of our qualification as bidder. I / We understand that at any stage (during bidding process or while executing the awarded works) if it is found that fake / false / forged bid qualifying /supporting documents / certificates were submitted, it would lead to summarily rejection of our bid / termination of contract. BHEL shall be at liberty to initiate other appropriate actions as per the terms of the Bid / Contract and other extant policies of Bharat Heavy Electricals Limited.

Yours faithfully,

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

Date:

Place

ANNEXURE-MII

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

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

To,
Sr. DGM/TBSM
Transmission Business Group,
Bharat Heavy Electricals Limited,
6th Floor, BHEL SADAN,
Plot No. 25, Sector-16A, Noida,
Distt. – Gautam Buddh Nagar, UP-201301

Dear Sir,
Sub: Declaration reg. minimum local content in line with Public Procurement (Preference to Make in India), Order 2017-Revision, dated 04th June, 2020 and subsequent order(s).
Ref:
1) NIT/Tender Specification No: **TBSM/KODAYAR/CIVIL/TENDER/25-26, DATE: 18.04.2025**
2) All other pertinent issues till date

We here by certify that the items/works/services/ offered by (specify the name of the organization here) has a local content of _____ % and this meets the local content requirement for – Class 1 Local supplier/ Class II local supplier** as defined in Public Procurement (Preference to Make in India), Order 2017-Revision dated 04.06.2020 issued by DPIIT and subsequent order(s).

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

1. _____ 2. _____

3. _____ 4. _____

Thanking you,

Yours faithfully,

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

** - Strike out whichever is not applicable.

Note:

1. Bidders to note that above format Duly filled & signed by authorized signatory, shall be submitted.
2. In case the bidders quoted value is excess of 10 crores, the authorized signatory for this declaration shall necessarily be the statutory auditor or cost auditor of the company (in the case of companies) or a practising cost accountant or practicing chartered accountant (in respect of suppliers/contractors other than companies).
3. In the event of false declaration, actions as per the above order and as per BHEL Guidelines shall be initiated against the bidder.

FORMATS FOR EPAYMENTS

To,

Sr.DGM (Finance)
Transmission Business Group
BHEL, TBG Finance,
Plot no. - 25, Sector - 16A
Noida - 201301; U.P.

Subject: E-Payments vide RTGS/NEFT

I/We request and authorise you to effect Epayment vide any of the above two modes to my/our bank account as per the details given below:

Vendor Name :

Title/Name of Account in the bank :

Account Type(Saving /current) :

Bank Account Number | | | | | | | | | | | | | | | | |

Name & address of Bank

Bank /Branch contact person's name :

Bank /Branch Tele Numbers with STD code :

Bank Branch MICR code | | | | | | | | | |

(please enclose a copy of a cheque. This cheque should not be a payable at par cheque)

Bank Branch RTGS IFSC code | | | | | | | | | | | |

Bank Branch NEFT IFSC code | | | | | | | | | | | |

(you can obtain this from branch where you have your account)

Your Email address : **(not more than 20 character)**

Name of the Authorised Signatory : (Please mention here name of person from your organization signing this letter.)

Contact Person's name : (please mention here the name of a person in your company/organization)

I/We confirm that information provided above is correct & any consequences due to any mistake in above will be borne by us.

Thanking you

For
(Autorised Signatory)

We confirm that we are enabled for receiving RTGS/NEFT credits and we further confirm that the account number of (Please mention here name of the account holder), the signature of the authorised signatory and the MICR and IFSC Codes of our branch mentioned above are correct.

Bank's Verification
(Manager's/Officers signature under
bank Stamp)

Note:- Please attach cancelled original Cheque leaf.