

**BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP
SUBCONTRACTS MANAGEMENT**

**10th Floor, Plot no.:- C-20, 1A/1, Joy towers,
C Block, Phase 2, Industrial Area Sector-62,
Noida, Distt. Gautambudh Nagar, UP-201309**



TENDER DOCUMENTS

FOR

“TENDER SPECIFIC STRATEGIC TIE-UP FOR EXECUTION AND HANDING OVER OF FOLLOWING 400 KV TRANSMISSION LINE WORK INCLUDING ARRANGEMENT /SETTLEMENT OF RIGHT OF WAY ON EPC BASIS) FOR TSTRANSCO’S TENDERS AT TELANGANA UNDER KALESWARAM LIFT IRRIGATION PROJECT”.

**DETAILS OF TRANSMISSION LINE UNDER THE TSTRANSCO’S TENDER BID NOTICE NO.:-
e-TSTLI-03/2021:**

- 1) LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS to Kachapur Switching Station -line Length 2 X 3.5 KM in Karimnagar (old) district.**
- 2) LILO of 400kV QMDC Line from Telangana STPP NTPC (2X800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district.**
- 3) 400kV QMDC Line from 400kV Kachapur (Vadkapur) Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district.**

CUSTOMER

M/S TRANSMISSION CORPORATION OF TELANGANA LIMITED (M/S TSTRANSCO)

TENDER SPEC. NO.: TBSM/KACHAPUR /STE-04/TENDER /21-22

DATE: 30.04.2021

TRANSMISSION BUSINESS GROUP
SUBCONTRACTS MANAGEMENT
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BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS GROUP

SECTOR-62, NOIDA -201309

e-mail:-tbsm@bhel.in

NOTICE INVITING TENDER

REF.: TBSM/KACHAPUR/STE-04/TENDER /21-22

DATE: 30.04.2021

SUB: OPEN TENDER ENQUIRY FOR "TENDER SPECIFIC STRATEGIC TIE-UP FOR EXECUTION AND HANDING OVER OF FOLLOWING 400 KV TRANSMISSION LINE WORK INCLUDING ARRANGEMENT /SETTLEMENT OF RIGHT OF WAY ON EPC BASIS) FOR TSTRANSCO'S TENDERS AT TELANGANA UNDER KALESWARAM LIFT IRRIGATION PROJECT.

DETAILS OF TRANSMISSION LINE UNDER THE TSTRANSCO'S TENDER BID NOTICE NO.:- e-TSTLI-03/2021:

- 1) LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS to Kachapur Switching Station -line Length 2 X 3.5 KM in Karimnagar (old) district.
- 2) LILO of 400kV QMDC Line from Telangana STPP NTPC (2X800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district.
- 3) 400kV QMDC Line from 400kV Kachapur (Vadkapur) Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district.

Dear Sirs,

1. Sealed tenders are invited for the identification of a suitable Transmission Line Contractor (to cater execution and handing over of following 400 KV Transmission Line work including arrangement /settlement of right of way on EPC basis) for tender specific strategic tie-up in order to jointly address the TSTRANSCO's tenders for Substation & Transmission Line works at various locations in Telangana under Kaleswaram Lift Irrigation Project following:

NAME OF WORK	TIME OF COMPLETION	EARNEST MONEY DEPOSIT (Rs.)	TENDER SUBMISSION DATE AND TIME	TENDER OPENING DATE & TIME
1) LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS to Kachapur Switching Station - line Length 2 X 3.5 KM in Karimnagar (old) district.	15 Months from the date of handing over of profile	NIL	07.05.2021 14.30 hrs.	07.05.2021 15.30 hrs. (Technical bid only) and Price bid opening date will be intimated later to Techno commercially acceptable parties
2) LILO of 400kV QMDC Line from Telangana STPP NTPC (2X800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district.	(Please refer the Note-I as below)	Please refer Note-II below		
3) 400kV QMDC Line from 400kV Kachapur (Vadkapur) Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district.				

Note-I :- The Bidders may please be noted that the aforesaid work has to be delivered within a timeline of Fifteen (15) months from the date of Handing over of profiles by TSTRANSCO. The supply of materials and equipment for the above work shall be completed within Twelve (12) months from the date of handing over of profiles by TSTRANSCO. The time extension shall be governed as per the end customer's (M/s TSTRANSCO) contract.

Note-II: - EMD is waived off for this tender at the time of bidding.

However after finalization of the L1 Bidder for strategic tie up, the bidder has to be submit the EMD of 2% of the finalized value as a "Bid Security; before quoting the tender by BHEL to end Customer (M/s TSTRANSCO). For details may please refer clause no. 06 mentioned below.

In case of non-submission of the same action shall be initiated as per as per extant guidelines of the BHEL available on [www. bhel.com](http://www.bhel.com) and/or under applicable legal provisions".

2. PREAMBLE:-

BHEL intends to participate in the tenders invited by M/s Transmission Corporation of Telengana Limited (M/s TSTRANSCO) for the 400kV Class substations along with the 400kV Transmission lines on turnkey basis under their Kaleswaram Lift Irrigation Project at various locations in Telangana (Please refer the tender details & description given as under).

As per the tender qualification requirement of M/s TSTRANSCO, bidder as a prime Contractor/as a Lead Partner must meet the requisite experience criteria specified for 400kV Substation as well as for 400kV Transmission Line.

Bidders who meets the qualifying criteria of only one Part (Substation or Transmission Line) are also eligible to participate if they meet the criteria of the other part with the support of a JV partner.

BHEL fully comply the qualification criteria specified for 400kV Substation. However, have very limited experience in Transmission Line domain to comply the relevant requisite experience criteria. Since, BHEL does not comply the QR w.r.t. Transmission Line on standalone basis, BHEL is looking for the technically and financially qualified bidders/partners for transmission line works for the tender specific strategic tie up in order to jointly address the tenders invited by M/s TSTRANSCO.

In view of the above, following Six separate tenders are invited by BHEL for Strategic tie up with qualified transmission line contractors; -

Sl no.	Location	Transmission line tentative scope
1	400/11KV Namapur (Pegadapally) Substation • TSTRANSCO Bid Notice No:- -e-TSTLI-04/2021	1) 400 KV TMDC line from Namapur Substation Switchyard to Transformer Deck of Pump House of length 2 Km 2) 400kV QMDC Line from 400kV Kachapur Switching station to 400/11kV Namapur (Pegadapally) SS of Line length 19.3 Km. 3) 400kV QMDC Line from 400kV Velgatoor Switchyard to 400/11kV Namapur (Pegadapally) SS of line length 22.5 Km. The arrangement/settlement of ROW shall be in the scope of Transmission line Bidder
2	400/11kV SS at Velgatoor: • TSTRANSCO Bid Notice No:- -e-TSTLI-05/2021	1) 400 KV TMDC line from Velgatoor Substation Switchyard to Transformer Deck of Pump House of length 2.11 Km 2) 400kV QMDC Line from 400kV Kachapur Switching

		station to 400/11kV Velgatoor SS of Line length 26 Km. The arrangement/settlement of ROW shall be in the scope of Transmission line Bidder
3	400 KV Switching Station at Kachapur • TSTRANSCO Bid Notice No:- -e-TSTLI-03/2021	4) LILO of 400kV QMDC Line from STPP Jaipur-Gajwel 400/220/132kV SS to Kachapur Switching Station -line Length 2 X 3.5 KM in Karimnagar (old) district. 5) LILO of 400kV QMDC Line from Telangana STPP NTPC (2x800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district. 6) 400kV QMDC Line from 400kV Kachapur(Vadkapur)Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district. The arrangement/settlement of ROW shall be in the scope of Transmission line Bidder
4	400/220 KV Annaram Substation • TSTRANSCO Bid Notice No:- -e-TSTLI-01/2021	1) 400 KV QMDC line (approx . 22.5 KM) from STPP(Jaipur) to proposed 400 KV SS at Annaram pump house near Gunjapadugu village The arrangement/settlement of ROW shall be in the scope of Transmission line Bidder
5	400/11kV Veljipur Sub-Station • TSTRANSCO Bid Notice No:- -e-TSTLI-06/2021	1) 400KV QMDC Line from existing 400/11KV Tippapur SS to proposed 400/11KV SS Veljipur of line length of 5.5 Kms in Rajanna Sircilla district. 2) 400 KV TMDC line (Pressure Main Towers) from 400/11KV LIS Veljipur Switch yard Gantry to Transformer Deck (2 km) The arrangement/settlement of ROW shall be in the scope of Transmission line Bidder
6	400/11KV Yellaipally Substation • TSTRANSCO Bid Notice No:- -e-TSTLI-07/2021	1) 400 KV QMDC Line from Existing 400/13.8/11 KV Chandlapur SS to proposed Yellaipally 400/11 KV Substation -13.0 Km. The arrangement/settlement of ROW shall be in the scope of Transmission line Bidder

- a) All the above mentioned six tenders are hosted at our web page (www.bhel.in) and also available on <https://eprocurebhel.co.in>. The estimated value of each tenders are available in "Commercial Schedule ". Bidders are requested to visit the website and go through each tender for better understanding.
- b) All the six tenders will be finalized separately. Bidders may submit their bid separately for all locations or any nos of locations of above mentioned tender.
- c) The Bids shall be opened privately and successful bidder shall be informed for signing of the Consortium agreement with BHEL for separate tenders.
- d) The transmission line tenders will be sorted in descending order/sequence in terms of BHELs internal cost assessment (Highest value transmission line package will be opened first). Lowest Bidder (L1) for each tender/transmission line package shall be finalized independently.
Separate project specific JV agreement/MOU will be signed between BHEL & selected TL company for each package for submission to TSTRANSCO.
- e) As per TSTRANSCO's tender specification, in case of firm quoting for more than one work/tender for similar works opened during same period and becomes lowest in more

than one work/ tender, the aggregate requirement of erection experience, satisfactory performance, manufacturing capacity and experience, availability of TSE's (Tension Stringing Equipment) and financial capability will be examined at the time of awarding based on the works already awarded/ to be awarded/under consideration by end user M/s TSTRANSCO.

- f) BHEL will assess the financial capability of the bidder to undertake the project(s) and will reserve the right to accept/ reject the party based on the currently available bid capacity for which relevant details of the project under execution, available bid balance capacity shall be furnished by the bidder.
- g) In case bidder becomes L-1 in a particular tender and does not have the required financial capability to be qualified for other tender(s) considering the aggregate tender(s) requirement, his bid shall not be considered for price bid opening.
- h) The decision of BHEL shall be final & binding for all the bidders on the above aspect as mentioned from point no. (a) to (g).

3. Bidder **has** to submit offer directly through E-PROCUREMENT 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 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. 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).

4. Bidders may also submit their bids through unique common e mail ID.

Procedure to submit the bid through E mail ID are as below:-

- A) The bidder may also allowed to submit their bid /offers to the common e-mail addresses as below **(Without copy to any other e mails).** Following procedure may be followed by bidders in this regard.

A.1 Bidders have to submit their bid into two parts: - Technical Bid and Price bid in two separate folders. The folders names shall be clearly specified as technical bid & Price bid in e-mail folder.

A.2 Folders of Technical Bid and Price Bids are to be submitted separately at two different e-mail ids as per procedure mentioned below:

A.2.1 Submission of Technical Bid

- i) Folder containing Technical Bid shall be submitted to Common E Mail Address : tbsmtenderbox@bhel.in.
- ii) The subject of the e-mail for offer submission shall be clearly specified as “ ***Kachapur Transmission Line; Enquiry No: - TBSM/KACHAPUR /STE-04/TENDER /20-21***”
- iii) All the works credentials relevant for meeting PQR shall be submitted in Technical bid folder.
- iv) The technical bid shall be in **Pdf or in Zip forms and the capacity of the folder should not be more than 10 MB.**
- v) If the capacity of the folder shall be more than 10 MB, the technical bid folder shall be split into like the folders “**Technical Bid- Part-1, Part-2, part -3, part4** and shall be submitted through subsequent e mails mentioning Mail – **part-1 of total nos of mail , Mail-Part-2 of total nos of e mails**
- vi) Offers sent to any other e-mail IDs shall not considered for evaluation purpose.
- vii) Please note that Price Bid Folder is not to be submitted at E Mail id tbsmtenderbox@bhel.in. Price bid is to be submitted at separately as per details given below.

A.2.2 Submission of Price Bid:-

- i) Folder containing **Price Bid** shall be submitted to Common E Mail Address:
A) tbsmtender.pricebidbox@bhel.in.
- viii) The subject of the e-mail for offer submission shall be clearly specified as “**PRICE BID for Tender for “KACHAPUR Transmission Line; Enquiry No: - TBSM/KACHAPUR /STE-04/TENDER /20-21**”

Same shall be submitted simultaneously along with the Technical bid.

- ii) The price bid shall be in **Pdf or in Zip forms and the capacity of the folder should not be more than 10 MB.**
- iii) Price bid sent to any other e-mail IDs shall not considered for evaluation purpose.

A.2.3 Summary:-

Thus from above, bidders may clearly note that for submission of complete offer, bidders have to use below mentioned emails:-

- (a) Mail For Technical Bid on :- tbsmtenderbox@bhel.in**
- (b) Mail for Price Bid on:- tbsmtender.pricebidbox@bhel.in**

A.2.4 Apart from above e mails, Bidders are requested to **“intimate the submission of their bid without attaching any tender documents”** to the e- mail **“tbsm@bhel.in”** . Bidders may also inform over phone to the concerned executive on the “date of opening of the tender” in this regard.

A.2.5 In case, “the bid of any bidder was left to open / process” due to non-availability of the intimations as mentioned in point no. – A.2.4 above, BHEL shall not be responsible and their bid shall not be considered for further processing.

BHEL’s decision for all the points mentioned in “A” under head **“Procedure to submit the bid through E mail ID** shall be final in case of any disputes and is binding to the bidders.

- 5. Bidders may please note that no other mode of bid submission shall be considered for evaluation apart from Clause no. 02 to 04 mentioned above.**
- 6. EMD is waived off for this tender at the time of bidding.** However, after finalization of the L1 Bidder for strategic tie up, the bidder has to be submit the EMD of 2% of the finalized value as a “Bid Security; before quoting the tender by BHEL to end Customer (M/s TSTRANSCO). The mode of deposit of EMD shall be as below:-
 - 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.
 - vi) No other form of EMD remittance shall be acceptable to BHEL.
 - 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.
 - 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.

- In the case of unsuccessful bidders, the Earnest Money will be refunded to them within a reasonable time after award off the work (Subject to receipt of the order from M/s TSTRANSCO)
- EMD shall not carry any interest.
- EMD of successful bidder shall be retained as part of Security Deposit
- 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.
- The Format for submission of Bank Guarantees (wherever required as per Tender documents) shall be provided by BHEL to Bidders whenever required in due course of time
- No MSE benefits shall be given to MSEs bidder for WORKS CONTRACT.
- 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, 10TH FLOOR, JOY TOWER, PLOT NO. C-20, 1/1A, C BLOCK, PHASE 2, INDUSTRIAL AREA, SECTOR-62, NOIDA – 201301 (U.P.)
NAME OF BANK	HDFC BANK
NAME OF BANK BRANCH	ARERA COLONY, BHOPAL
CITY	BHOPAL
ACCOUNT NUMBER	00620320000021
ACCOUNT TYPE	CASH CREDIT
IFSC CODE	HDFC0000062
MICR CODE	462240002

7. The list of list of nationalised and scheduled banks for submission of EMD & Performance security (Subject to receipt of the order by BHEL from M/s TSTRANSCO) is attached herewith as per Section X of Volume-I .
 8. Bidders may please be noted that the GCC, GCE, GTC, GCES , SCC shall be on back to back basis as per end Customer’s (M/S TSTRANSCO) tender documents and applicable for the transmission line bidder. Please be noted that in TSTRANSCO tender document, wherever Bidder/contractor is mentioned may understand as “Transmission line Bidder/contractor” and wherever Customer/purchaser is mentioned “M/s TSTRANSCO “ may be considered. In Post award stage, In case of any dispute on any terms & Conditions of M/s TSTRANSCO & BHEL’s tender documents, the decision of BHEL shall be final and binding to the bidders.
 9. Bidder may please be note that, being strategic tie up, the bidder shall be jointly & severally responsible for all the contractual obligations pertaining to tender for which bid shall be submitted jointly by BHEL as lead bidder and selected Transmission line party in project specific JV mode.
 10. Since the contract is unit rate contract and BOQ (as defined by TSTRANSCO in the tender document) is on back to back basis, hence any variation in the contract value wrt variations in BOQ items shall be governed by end customer’s contract/ decisions. BHEL’s decision in this regard is final
 11. Any extra (additional) items/works identified during the course of execution of the work, which is originated by end Customer (M/s TSTRANSCO) for the completion of the project and same is beyond the scope of the subject contract, such extra/ additional items shall be settled with the Transmission line contractor on mutually agreed price and T&Cs; subsequent to M/s TSTRANSCO’s agreement for the payment against the said additional work/scope.
- At the time of execution of works at site, Site In charge identifies the extra items/ works, required to be executed at site which are not covered in BOQ of sub-contractor but required to be executed as per RFC/ site requirement / customer requirement to completion the scope of work.

- All rectifications / modifications, revamping, and reworks required for any reasons, not due to the fault of the contractor, but needed due to any change in deviation from drawings and design of equipment, operation / maintenance requirements, mismatching, or due to damages in transit, storage and erection / commissioning, and other allied works which are **not very specifically indicated in the drawings**, but are found essential for satisfactory completion of the work, will be considered as extra works.
- Extra works arising on account of the contractor's fault, irrespective of time consumed in rectification of the damage / loss, will have to be carried out by the contractor free of cost. Under such circumstances, any material and consumable required for this purpose will also have to be arranged by the contractor at his cost.
- All the extra work should be carried out by a separately identifiable gang, without affecting routine activities.
- 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.
- The TL contractor, on receipt of drawing/ / instruction 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 for submission of claim to TSTRANSCO.
- Extra/substituted Works shall be regulated as per customer's (TSTRANSCO) technical Specification / Tender documents

12. BONDS, GUARANTEES, SECURITY

- At Bidding Stage, for lodging the bids to TSTRANSCO, the Consortium Leader shall furnish the bid guarantee (as applicable for the complete project) as per the bid specification requirement from TSTRANSCO. Consortium Partner (Transmission Line contractor (party)) shall provide a counter guarantee (for a value in proportion to the value of its Share of Scope of the complete project/package) beforehand in favour of the Consortium Leader.
- In case of emergence of consortium as the lowest bidder and subsequent award of Contract and contract split from TSTRANSCO, each Party will be responsible to furnish the required guarantees (VIZ. Performance security, Security deposit, Bond etc.) of their respective Contracts, if acceptable to the Customer (TSTRANSCO). If not, then the Consortium Leader will furnish all such guarantees to Customer and other Party (Transmission Line Contractor) shall furnish counter guarantees to the Consortium Leader prior to submission of guarantees to Customer (TSTRANSCO).
- If these bonds of guarantees are invoked by the Customer in terms of the provisions of the Contract, the parties shall be liable in accordance with relevant clauses of BHEL /Customer's contract
- The counter Guarantees will remain valid till the main guarantees stay valid with Customer or settlement of claims/ dues between Parties are carried out fully, whichever is later. The counter guarantees are to be extended by the Party as communicated by the Consortium Leader time to time failing which Consortium Leader will have full right to invoke the counter guarantees.

13. BID PRICE

- The consortium leader shall prepare and determine the prices to be quoted to the customer as single percentage, i.e. excess / on par / less on the total Estimated Contract Value of customer.
- The Consortium partner (transmission line contractor) shall provide the prices of Transmission Line scope to the consortium leader and shall be eligible to claim the prices as quoted to the Consortium leader only (irrespective of the values quoted by the consortium

leader to the customer due to reasons arising out of the requirement of quoting for the complete tender/package on single %age basis.

- In the event if the quoted prices to customer (for transmission line scope) is less (due to quoting the tender of single %age basis) than the price quoted by consortium partner (transmission line contractor) to consortium leader, the prices (unit rate prices) as quoted by transmission line contractor (Consortium partner) shall be ensured by BHEL. In the event if the quoted prices to customer (for transmission line scope) is in excess (due to quoting the tender of single %age basis) than the price quoted by Consortium Partner (Transmission line contractor) to the consortium leader, consortium partner shall not make any additional claim on this account.

14. The pre-selected party associating with BHEL for the purpose of joint bidding for TSTRANSCO tender(s) shall not be allowed to participate as a bidding company directly; or indirectly through their Subsidiaries, Partnership, Ownership, Individual firm; or through any other Consortium. The party shall submit an undertaking in this respect.
15. Each Party shall use all reasonable efforts to secure the award of the Contract. No Party shall, however, have a claim against any other Party arising out of a failure to secure a Contract for the Project except as a result of material breach of this Agreement.
16. The Bidders may please be noted that the aforesaid work has to be delivered within a timeline of Fifteen (15) months from the date of Handing over of profiles by TSTRANSCO. The supply of materials and equipment for the above work shall be completed within Twelve (12) months from the date of handing over of profiles by TSTRANSCO. The time extension shall be governed as per the end customer's (M/s TSTRANSCO) contract.
17. Bids shall remain valid for 04 months from the date of opening of the bid or Contract finalization date from TSTRANSCO's end (whichever is later).
18. 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.
19. Offers should be strictly in accordance with the Tender Specifications and General Instructions to Tenderer (ITB) enclosed herewith.
20. All documents submitted with the offer shall be signed and stamped in each page by authorized representative of the bidder.
21. 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.
22. **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).**
23. **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.**

- 24. 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 TSTRANSCO's Tender document.**
- 25.** The Bidders are advised to visit Site to have better understanding of job.
- 26.** 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.
- 1.0 Integrity commitment, performance of the contract and punitive action thereof:
- 1.1. 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.
- 1.2. Commitment by Bidder/ Supplier/ Contractor:
- 1.2.1. The bidder/ supplier/ contractor commit to take all measures to prevent corruption and will not directly or indirectly influence any decision or benefit which he is not legally entitled to nor will act or omit in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India.
- 1.2.2. 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.
- 1.2.3. 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".
- 27.** 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.
- 28.** 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."
- 29.** 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.

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

31. 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.

32. 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	Phone & E- mail
1	Shri Arun Chandra Verma, (IPS (Retd.))	Acverma1@gmail.com
2	Shri Virendra Bahadur Singh. IPS (Retd.)	vbsinghips@gmail.com

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

(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:- Mukesh Paswan Department :- TBG, Subcontracting Address:- BHEL/ TBG, Noida Phone:- 01206748454 E mail:- paswan@bhel.in	2) Name:- Rajiv Ranjan Department :- TBG, Subcontracting Address:- BHEL/ TBG, Noida Phone:- 01206748575 E mail:- rajiv_ranjan@bhel.in

33. 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. Bidders representative may be present during technical bid opening for technical discussion, if required. The price bids will be opened subsequently, after Technical Bids of all the bidders have been evaluated and frozen. 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. However if the bidder insists on any technical or commercial deviations, from the specification 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 superscribed "Price Implication for withdrawal of deviations".

34. 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.

35. Any materials (if required) for erection 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.
36. The purchase preference for central P.S.U.s shall be given as per the prevailing Government policy.
37. 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.
38. 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.
39. 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.
40. 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 technical capability will be discussed and ascertained by the committee.
41. Performa for Consortium Agreement/ JV Agreement between BHEL and "Transmission Line bidder" is as per "Annexure-BHEL-06" attached with the tender documents. Detailed Consortium /JV with successful L-1 bidder will be entered in accordance with Terms & conditions mutually agreed between BHEL & L-1 bidder.
42. **The subject enquiry is for tender specific strategic tie-up in order to jointly address the TSTRANSCO's tenders by BHEL as lead bidder. Subject to BHEL bagging the contract from the Customer (M/s TSTRANSCO), BHEL will place the work order on L-1 bidder which shall be in line with the terms and conditions as per this tender document as well as the Consortium Agreement .**
43. **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.**

Thanking you,

Yours faithfully,
For and on behalf of BHEL,

(Mukesh Paswan)
AGM /TBSM

TO BE FILLED BY TENDERER OVER THEIR LETTERHEAD

REF.: TBSM/KACHAPUR /STE-04/TENDER /21-22

DATE: 30.04.2021

SUB: OPEN TENDER ENQUIRY FOR "TENDER SPECIFIC STRATEGIC TIE-UP FOR EXECUTION AND HANDING OVER OF FOLLOWING 400 KV TRANSMISSION LINE WORK INCLUDING ARRANGEMENT /SETTLEMENT OF RIGHT OF WAY ON EPC BASIS) FOR TSTRANSCO'S TENDERS AT TELANGANA UNDER KALESWARAM LIFT IRRIGATION PROJECT".

DETAILS OF TRANSMISSION LINE UNDER THE TSTRANSCO'S TENDER BID NOTICE NO.:- e-TSTLI-03/2021:

- 1) LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS to Kachapur Switching Station -line Length 2 X 3.5 KM in Karimnagar (old) district.
- 2) LILO of 400kV QMDC Line from Telangana STPP NTPC (2X800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district.
- 3) 400kV QMDC Line from 400kV Kachapur (Vadkapur) Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district.

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 competitiveness 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

ANNEXURE-I**Qualifying Requirement**

1. Qualification of Bidder will be based on meeting the minimum pass/fail criteria specified in Part-A below regarding the Bidder's technical experience, manufacturing facilities, financial capability as demonstrated by the Bidder's responses in the corresponding Bid Schedules. The Bidder shall also be required to furnish the information specified in Part-B in their Bid. **Technical experience and Financial resources of the proposed sub-contractor shall not be taken into account in determining the Bidders compliance with the qualifying criteria.** The bid can be submitted by an individual firm This is a Local Competitive Bidding. This invitation of bid is open to all Bidders who had incorporated and registered in India as per Companies Act, 1956.
2. **BHEL/TSTRANSCO** may assess the capacity and capability of the Bidder, to successfully execute the scope of work covered under the package within stipulated completion period. This assessment shall inter-alia include (i) document verification; (ii) Bidders works/manufacturing facilities; (iii) manufacturing capacity, details of work executed, works in hand, anticipated in future & the balance capacity available for the present scope of work; (iv) details of plant & machinery manufacturing and testing facilities, manpower and financial resources; (v) details of quality system in place;(vi) past experience and performance; (vii) customer feedback; (viii) banker's feedback etc.

1.0 PART-A**1.1 Technical Experience:****For Transmission line at Kachapur Location**

The Bidder must have successfully executed 400kV Line or higher voltage class transmission line(s) of minimum length of **400 KV Line length now proposed in INDIA** during last Seven (7) years as on the original **date of bid opening of TSTRANSCO tender (i.e. 16.04.2021)**. The 400kV Line of proposed length **(21 km)** must be in satisfactory operation for at least one (1) year **during the last Seven years as on the original date of bid opening of TSTRANSCO tender(i.e.16.04.2021)**

The Transmission Line executed for PGCIL/ TSTRANSCO/ State Power Utilities shall only be considered.

The Bidder shall enclose the proof of successful operation of One(1) year **during the last Seven years as on the original date of bid opening of TSTRANSCO tender (i.e. 16.04.2021)** obtained from the Power Utility (PGCIL/TSTRANSCO/Any State Power Utilities) issued by an Officer not below the rank of Executive Engineer or equivalent cadre indicating date of commissioning, failing which the bid may become non-responsive. In case of PGCIL the

certificate issued by Chief Manager/Contract Division/ Gurgaon is also accepted.

The Bidder who is having own manufacturing facilities for the Transmission Line towers and shall have the following minimum manufacturing capacities and manufacturing experience: -

Manufacturing capacity: The Manufacturing capacity per financial year shall be double of the quantity (i.e. 200%) of proposed tower parts in this tender specification **i.e 5904 MT** . Necessary certificate as per Annexure shall be enclosed.

Manufacturing experience: The quantity of Towers manufactured and supplied (400kV or above voltage) to PGCIL/ TSTRANSCO / Any Other State Power Utilities **in India** in any One financial year during the last Two years should not be less than 100% of the quantity proposed (**i.e 2952 MT**) .

If the Bidder partner is not a Tower Manufacturer and intends to participate, can propose to supply towers from a manufacturer who meets the manufacturing facilities as mentioned above. In such case, the Bidder shall furnish a Joint Deed of Undertaking along with the manufacturer to guarantee quality & timely supply of towers and confirming to furnish an additional guarantee of 10% of the cost of such towers from the manufacturer/Bidder *separately which shall be valid up to completion of supplies of tower parts.*

This is in addition to the 10% Supply Performance Guarantee to be submitted by the Contractor on Award of Contract.

Note :If the Bidder meeting the above Qualifying requirement is also manufacturer of Tower parts and confirms the same in the Bid as the case may be that the material will be supplied by them for the subject work the 10 % Additional Performance Bank Guarantee for the material need not be furnished.

The tower manufacturer proposed by the Bidder should have manufactured and supplied towers (400kV or above voltage) to PGCIL/TSTRANSCO/Any Other State Power Utilities. The said supply shall be evidenced by documentary proof from any of aforesaid utilities.

1.2 Financial Position:

Financial Position :-

(a) Annual Financial Turnover (AFT) in any one year during the last five financial years of the Bidder should be minimum **Rs. 106,73,77,365/-**

(b) Bidder shall have balance Cash Credit and LC facilities of not less than minimum **Rs. 32,02,13,210/-**

1.3.4 AWARDING CONTRACT FOR MORE THAN ONE WORK DURING THE SAME PERIOD in TSTRANSCO:

In case of firm quoting for more than one work/tender for similar works opened during same period and becomes lowest in more than one work, the aggregate requirement of erection experience, satisfactory performance, manufacturing capacity and experience, availability of TSE's and financial capability will be examined at the time of awarding based on the works already awarded/ to be awarded/under consideration by BHEL/TSTRANSCO.

2.0 PART-B**2.1 Equipment capabilities:**

The Bidder should own or have access to the following key erection equipment.

- i) Tension Stringing Equipment of 15Tonnes Capacity (**Bundled Quad Conductor**): The Bidder should own Minimum Six (6) nos.TSE of 15Tonnes capacity and required no. of rollers for Bundled Quad Conductor shall also be made available.
The Bidders should also have access to engage the above facilities from other agencies. In such case they should furnish the details of such agencies along with their consent letters.
- ii) Bidder should also have adequate Sub-station and Transmission line design infrastructure and erection facilities and capacity and procedures including quality control.
- iii) The Bidder should own / lease / procure the minimum tools & plants required for the execution of the works in time as per the contract period. The required T & P shall be indicated together with quantity (Annexure-).
- iv) The Bidder should indicate number of technical persons (Annexure-)along with their qualifications available with them for execution of each work as follows.

Project Manager	2 Nos.	Graduate Engineer (Elec.) – 1 No. Graduate Engineer (Civil) – 1 Nos.
Planning Engineer	2 Nos.	Graduate Engineer (Elec.) – 1 No. Graduate Engineer (Civil) – 1 No.
Section In-charge	2 Nos.	Graduate Engineer (Elec.) – 1 No. Graduate Engineer (Civil) – 1 No.
Site Engineers	2 Nos.	Graduate Engineer (Elec.) – 1 No. Graduate Engineer (Civil) – 1 No.
Supervisors	3 Nos.	Electrical Diploma holders (1 No.)+
		Diploma Civil (2 Nos.)

2.2 The Bidder shall also furnish following documents/details with its bid:

- (i) The Banker certificate furnished as per Annexure of Volume – I with balance Cash Credit limits and LC limits indicated **(not more than one month prior to the date of bid submission closing date including extensions if any)** only will be considered for evaluation.

It is the responsibility of the Bidder to ensure that the Banker Certificate indicates the CC & LC limits separately. BG limits will not be considered. In case the limits are not indicated as specified above, their Bid will be liable for rejection.

- iii) Such certificate should have been issued not earlier than one month prior to the date of bid submission closing date **including extensions if any**. Wherever necessary TSTRANSCO may make queries with the Bidder's bankers.

- iv) The Bankers certificate furnished with balance available limits indicated only will be considered for evaluation.

The complete annual reports together with Audited statement of accounts of the company for last five years of its own (separate) immediately preceding the date of submission of bid.

3.0 Bids not meeting any of the above requirements may be treated as incomplete and will be liable for rejection.

The Bids with Record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc will be liable for rejection.

4.0 LITIGATION HISTORY:

The Bidder should provide detailed information on any litigation or arbitration arising out of contracts completed or under execution by it over the last five years in **Annexure-XIX**

A consistent history of awards involving litigation against the Bidder or any partner of JV may result in rejection of Bid.

4.0 QUALIFICATION REQUIREMENTS FOR SUB-VENDOR:

The Bidder shall procure sub-vendor items required for complete project from reputed manufacturers who are approved sub vendors of PGCIL/TSTRANSCO having Qualifying requirements as detailed below:

Requirement of registration:

Any bidder from a country which shares a land border with India will be eligible to bid any procurement whether of goods, services (including consultancy services and non-consultancy services) or works (including turnkey projects) only if the bidder is registered with the Competent Authority, as specified in Annexure.

a. Tower Accessories and Earthwire

- i) For supply of materials covered under sub-vendor items, the sub-vendor should have designed, manufactured, tested and supplied (each of material) quantity equivalent to the quantity as mentioned in tenders for which the Bidder quotes in any consecutive period of twelve (12) months during the last five (5) financial years.
- ii) The type tests of earthwire should be done within 5 years as per the relevant IS / IEC standard in a recognized laboratory and the test report should be submitted during the sub-vendor approval. If the Purchaser feels if it is necessary to conduct the type test for his satisfaction, then it should be done at free of cost.

b) Moose Conductor, Insulators and Hardware & Accessories

- (i) The Sub-Vendor should be a manufacturer who must have designed, manufactured, tested as per IS/ IEC of similar/ higher grade materials offered and supplied from the unit now proposed to Power Utilities atleast 40% of the quantity of each materials indicated in the Supply Schedule of this tender in a continuous period of 12 months and atleast 20% of the quantity of similar material/ higher-grade materials indicated in the Supply Schedule of this tender should be in successful operation since Two(2) years as on the date of opening of the Bid.
Its financial turnover during any one year of the last five years should have been equal or more than 100% value of the material mentioned in tenders.

- (ii) Submission of type test reports:

The successful Bidder at the time of sub-vendor's approval shall furnish Type test Reports in complete shape as per the relevant IS/IEC Standards in a recognized laboratory as per the latest revision of the Technical specification not later than 5 years subject to no alteration in the design.

If the Purchaser feels if it is necessary to conduct the type test for his satisfaction, then it should be done at free of cost.

c) OPGW and Hardware &Accessories:

- i) The Bidder shall offer OPGW from a manufacturer, who has been manufacturing OPGW for the last three (3) years and at least 400kM of OPGW manufactured and supplied from the unit now proposed to power utilities in a continuous period of 12 months and atleast 200kM of OPGW should be in successful operation on 400kV or higher voltage class EHV transmission lines since 2 years as on the date of opening

of the Bid. Its financial turnover during any one year of the last five years should have been equal or more than 100% value of the material mentioned in tenders.

ii) Submission of type test reports :-

The successful Bidder at the time of sub-vendor's approval shall furnish Type test Reports in complete shape as per the relevant IS/IEC Standards in a recognized laboratory as per the latest revision of the Technical specification not later than 5 years subject to no alteration in the design. If the Purchaser feels if it is necessary to conduct the type test for his satisfaction, then it should be done at free of cost.

- 5.1. The Qualification Requirement for Substation equipment is specified in the technical specification for each equipment.

6.0 APPROVAL OF SUB-VENDOR:

The list of sub-vendors, as per Section X of Vol-I, from (invariably from approved sub vendors of TSTRANSCO / PGCIL) whom the Bidders intends to procure the material may be furnished along with the bid. After the award of contract the Contractor should submit Qualification Requirements of sub-vendors along with credentials as detailed below for approval:

- i) Documentary evidence (client's certificate) in support of information on past supplies and satisfactory operation of the material as specified.
- ii) Copies of original documents defining the constitution or legal status, place of registration and principle place of business of the company or firm or partnership etc.
- iii) The sub-vendor should furnish a brief write-up, backed with adequate data, explaining his available capacity and experience (both technical and commercial) for the manufacture and supply of the required material without the specified time of completion after meeting all their current commitments.
- iv) The sub-vendor should clearly confirm that all the facilities exist in his factory for inspection and testing and these will be made available to the Purchaser or his representative for inspection.

7.0 QUOTING OF TENDERS WITH FULL QUANTITY:

The Bidders should quote for full quantity of material mentioned in the tenders. Part bids will not be accepted.

8.0 FURNISHING OF DETAILS/ DOCUMENTS ALONG WITH BID:

The following details shall be furnished along with the bid for evaluation of the Bidder's eligibility to perform the contract.

- a) Authenticated documentary evidence by the Chartered Accountant in support of qualifying requirements in prescribed format in specification (Annexure-IVA and Annexure-XXIII).
- b) Commercial confirmations and statement of technical and commercial deviations (Annexure-I & II).
- c) The proposed methodology of construction, backed with the details of their construction equipment, planning and deployment organization, duly supported with broad calculations and quality control procedures proposed to be adopted, justifying their capability of achieving the completion of work as per mile stones within the stipulated period of completion.
- d) Copies of Original documents defining the constitution or legal statutes, article of association, place of registration, and principal place of business, written power of attorney of the signatory to participate in the bid.
- e) Experience in works of a similar nature and quantum of each work during the last Seven (7) years, and details of works under way or contractually committed by the Bidder and the other manufacturer, and name and address of clients whom the Purchaser may contact for further information on those contracts.
- f) Qualifications and experience of key site management and technical personnel proposed for the contract.
- g) A certificate from Banker (as per format in Annexure-XVof Vol-1) with balance cash and LC available limits indicated (one month prior to the date of bid submission).
- h) Copy of PAN card and latest income tax returns and proof of GST registration.
- i) Authority to seek references from the Bidders Bankers Name & Address, Telephone No. & FAX Nos. of the Bidder's Bankers who may provide details if contacted by Purchaser.
- j) Information regarding any litigation, current or during the last five years, in which the Bidder is involved, the parties concerned, and disputed amount.
- k) Testing facilities available at the manufacturer's works.
- l) Satisfactory performance certificate for the period of at least One(1) year issued by a PGCIL/ TSTRANSCO / Any Other State Power Utility issued by an officer not below the rank of Executive Engineer or equivalent cadre indicating date of commissioning of similar work failing which the bid may become non-responsive.
In case of PGCIL the certificate issued by Chief Manager / Contract Division / Gurgaon is also accepted.
- m) Certificates supporting the following shall be furnished.
 - Supply of fabricated towers (400kV or above voltage class) in case of Bidder for tower supply.

- Erection including foundations towers, stringing, testing and commissioning of line in case of Bidder for line erection.
- For Supply of fabricated towers and erection including laying of foundations, towers, stringing, testing and commissioning of line in case of Bidder for supply and erection of line.
- n) Details of contracts of similar nature and complexity to be furnished (as per the proforma enclosed with the bid document) at Annexure –IIIB and VA.
- o) Proposal for survey, manufacturing and erection methods & Schedules, in sufficient details to demonstrate the adequacy of the Bidder proposal to meet the technical specification for supply and erection and completion period referred to in the bidding documents.

9.0 DISQUALIFICATION:

Even though the Bidder meets the qualifying criteria, they are subject to disqualification if they have.

- Made misleading or false representation in the forms, statements and attachment submitted in proof of the qualification requirements, and/or.
- Record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history or financial failures etc
- Participated in the previous bidding for the same work and had quoted unreasonably low or high bid prices and could not furnish rational justification to the employer.

10.0 BHEL reserves the right to:

- 1) Accept or reject any bid received at its discretion without assigning any reasons whatsoever.
 - (a) Postpone the above mentioned date, split and distribute the work among more than one bidder without assigning any reason whatsoever.
 - (b) May ask for further qualification during techno commercial scrutiny of bids received.
 - (c) May ask for further proofs including TDS certificates/ Final bill/Form 26AS/ payment detail for the said job for cross- verification.
- 2) BHEL shall not be responsible for any delay, loss, damage for bids sent by post.
- 3) BHEL shall not be liable for any expenses incurred by bidder in preparation of bid irrespective of whether it is accepted or not.
- 4) Quotations received from bidders who do not fulfil the PQR shall be summarily rejected without any further evaluation and information to bidders.
- 5) 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.

- 6) 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.
- 7) Bidder's selection is subject to approval of BHEL's customer for this work.
- 8) All corrigenda, addenda, amendments and clarifications to this Tender will be hosted in web page, www.bhel.com and not in the newspaper. Bidders shall keep themselves updated with all such amendments.
- 9) Notwithstanding anything stated above, BHEL/TSTRANSCO reserves the right to assess the Bidders/associates capability and capacity to perform the Contract, should circumstances warrant such assessment, in the overall interest of the Purchaser. **Further BHEL reserves the right to cancel the Tender at any stage, even after awarding the contract**

ANNEXURE-XIX

LITIGATION HISTORY

TO BE FILLED BY TENDERER OVER THEIR LETTERHEAD

REF.: TBSM/KACHAPUR/STE-04/TENDER /21-22

DATE: 30.04.2021

SUB: OPEN TENDER ENQUIRY FOR "TENDER SPECIFIC STRATEGIC TIE-UP FOR EXECUTION AND HANDING OVER OF FOLLOWING 400 KV TRANSMISSION LINE WORK INCLUDING ARRANGEMENT /SETTLEMENT OF RIGHT OF WAY ON EPC BASIS) FOR TSTRANSCO'S TENDERS AT TELANGANA UNDER KALESWARAM LIFT IRRIGATION PROJECT".

DETAILS OF TRANSMISSION LINE UNDER THE TSTRANSCO'S TENDER BID NOTICE NO.:- e-TSTLI-03/2021:

- 1) LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS to Kachapur Switching Station -line Length 2 X 3.5 KM in Karimnagar (old) district.
- 2) LILO of 400kV QMDC Line from Telangana STPP NTPC (2X800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district.
- 3) 400kV QMDC Line from 400kV Kachapur (Vadkapur) Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district.

Dear Sir,

NO LITIGATION HISTORY/LITIGATION HISTORY

Note:-

The Transmission line Bidder should upload the Litigation history of his own. If No-Litigation history is present same has to be declared by the Transmission Line Bidder.

(Signature of Tenderer)

Name and Designation of Authorised person (s)

Signing the tender on behalf of the tenderer

PROJECT INFORMATION

1.0 CUSTOMER :

M/S TRANSMISSION CORPORATION OF TELANGANA LIMITED (M/S TSTRANSCO)

2.0 PROJECT LOCATION AND DETAILS :

Project details :- TENDER SPECIFIC STRATEGIC TIE-UP FOR EXECUTION AND HANDING OVER OF FOLLOWING 400 KV TRANSMISSION LINE WORK INCLUDING ARRANGEMENT /SETTLEMENT OF RIGHT OF WAY ON EPC BASIS) FOR TSTRANSCO'S TENDERS AT TELANGANA UNDER KALESWARAM LIFT IRRIGATION PROJECT".

DETAILS OF TRANSMISSION LINE UNDER THE TSTRANSCO'S TENDER BID NOTICE NO.:- e-TSTLI-03/2021:

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- 3) 400kV QMDC Line from 400kV Kachapur (Vadkapur) Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district.

3.0 CONTACT PERSON: FOR CONTRACTUAL ISSUES / CONSORTIUM AGREEMENT RELATED ISSUE

- 1) MUKESH PASWAN, AGM (TBSM)
PHONE: 0120-6748454/09560989092, E-mail: paswan@bhel.in;
- 2) Parthasarathi Das, AGM/ Marketing
PHONE: - 0120-6748138/ 09810401728 E mail:- pdas@bhel.in

TRANSMISSION BUSINESS GROUP,
10TH Floor, Plot no.:- C-20, 1A/1, Joy towers,
C Block, Phase 2, Industrial Area
Sector-62, Noida, Distt. Gautambudh Nagar, UP-201309

4.0 CONTACT PERSON: FOR ENGINEERING ISSUES

Vivek Kapil
Sr DGM / TBEM
TRANSMISSION BUSINESS GROUP,
10TH Floor, Plot no.:- C-20, 1A/1, Joy towers,
C Block, Phase 2, Industrial Area
Sector-62, Noida, Distt. Gautambudh Nagar, UP-201309

PHONE: 0120-6748539/ 9818080691
E-mail : Vivekk@bhel.in

Customer:	Transmission Corporation of Telangana Limited (TSTRANSCO)	TB-TL-316-701B
Transmission Line work:	i. LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS - line to Kachapur (Vadkapur) Switching station. ii. LILO of 400kV QMDC Line from Telangana STPP NTPC (2x800MW) - 400/220/32kV Narsapur SS to Kachapur (Vadkapur) Switching station. iii. 400kV QMDC Line from 400kV Kachapur(Vadkapur) Switching station to 400/220kV Ramadugu SS	Rev 00

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES

1.0 INTENT OF SPECIFICATION

M/s TSTRANSCO has invited bids from the qualified bidders for 400kV class Substation along with 400kV Transmission Line (Including settlement of Right of way) on EPC basis.

As per the tender qualification requirement, prime Contractor/ Lead Partner must meet the requisite experience criteria specified for 400kV Substation as well as for 400kV Transmission Line. BHEL meets the qualifying criteria of only one Part (i.e. 400kV Substation) and wishes to participate in the tender by making a pre-bid tie-up with a Transmission Line Contractor meeting qualifying criteria of Transmission Line part.

Intent of this specification is to invite a potential 400kV Transmission Line contractor with whom BHEL can form a project specific JV/Consortium and can jointly participate in TSTRANSCO tender.

1.1 GENERAL

Scope of Transmission Line JV partner includes design, engineering, manufacturing, testing before dispatch, loading, supply for destination including transportation, civil & construction works, erection, testing and commissioning of following works on turnkey basis (Including settlement of Right of way):

- i. **LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS - line Length 2 X 3.5Km to Kachapur (Vadkapur) Switching station.**
- ii. **LILO of 400kV QMDC Line from Telangana STPP NTPC (2x800MW) - 400/220/32kV Narsapur SS - Length 2 X 2.5Km to Kachapur (Vadkapur) Switching station.**
- iii. **400kV QMDC Line from 400kV Kachapur(Vadkapur) Switching station to 400/220kV Ramadugu SS: Length 9 Km**

Name of customer : Transmission Corporation of Telangana Limited (TSTRANSCO)
JV Partner : BHEL (LEAD PARTNER)
Customer Tender No. : e-TSTLI-03/ 2021

1.2 SCOPE FOR TRANSMISSION LINE CONTRACTOR

1.2.1 Scope of the bid includes the following:

- (a) Furnishing of technical details of the material to be supplied.
- (b) Complete manufacture of all the items including their shop testing and galvanization.

Customer:	Transmission Corporation of Telangana Limited (TSTRANSCO)	TB-TL-316-701B
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- (c) Proto type assembly at works before dispatch, supply including packing, loading and transportation from the manufacturer's works to the Contractor's site stores/ TSTRANSCO stores with unloading and stacking and safe keep until these material are utilized for erection as specified.
- (d) Furnishing of reproducible / AUTO CAD structural drawings of towers (including Multi-circuit towers if any), shop drawings, bills of materials and foundations drawings, data, test reports, operation/instruction manuals etc., for Purchaser's approval and on approval submission of bound volumes of the same for future record wherever applicable in 10 sets.
- (e) The Structural drawings for Towers (including Multi-circuit towers if any) and their foundations shall be provided by TSTRANSCO as available. Wherever the drawings and designs are provided by TSTRANSCO, the suitability of these design and drawings shall be verified by the Bidder for design requirements as per standards, site and soil conditions based on the soil investigation and furnish the detailed design verification calculations before execution if sought by TSTRANSCO. Standard BOMs for towers, stubs will be communicated to the Contractor after placement of Purchase Order. Substitutions if any of steel sections of the tower parts with higher size due to non-availability or otherwise, shall be to the Contractor's account. The Purchaser will not accept any liability on this account. The supplier shall raise the invoices as per standard BOMs. In case of minor variation in BOM approved after proto inspection, only the approved standard BOM will be invoiced and paid.

All the templates required shall be manufactured and got proto inspected and approved by the Purchaser before starting the erection work. **New set each of the templates for all types of towers & their extensions shall be handed over to TSTRANSCO after completion of Tr. Line erection work.**

- (f) Where design of a particular Tower/Tower extension /Leg extension for Tr. Line (including Multi-circuit towers) is not available with the Purchaser or where any modification in the design or new design is required, the Bidder shall have to design the same to TSTRANSCO at no additional cost, including detailing, proto testing, furnishing of Bill of Material (BOMs) drawing etc. All the relevant drawings in AUTO CAD to the scale with reproducible tracings in such cases shall also be supplied to the Purchaser by the successful Bidder at free of cost. The new tower designs developed shall be got approved by CPRI Bangalore.
- (g) The scope of work also includes redrawing of existing structural and shop drawings of all the towers (including Multi-circuit towers) being used in the project using AutoCAD with scale duly certifying their correctness and to be handed over to TSTRANSCO in hard and soft copies before clearing the material for mass fabrication.
- (h) Soil investigation including soil resistivity measurement.

Customer:	Transmission Corporation of Telangana Limited (TSTRANSCO)	TB-TL-316-701B
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- (i) Supply of Tower accessories, 120 KN & 160KN Antifog Disc/Long rod Insulators, Moose ACSR CONDUCTOR, GSS Earthwire, OPGW, OFAC and Hardware & Accessories required for Earth wire and OPGW and GPS as detailed in technical specification. The type testing of these material should have been done within 5 years from the date of NIT. If the Purchaser feels that the type test has to be conducted for his satisfaction or any revision in the relevant IS, the tests should be conducted at free of cost. Please note that TSTRANSCO reserves the right to allot ACSR Moose Conductor and any surplus material from TSTRANSCO stores to project site and in such cases transportation charges which shall be inclusive of packing will be paid as per prevailing SSR rates and the Contractor has to transport such material invariably and the balance quantity of material shall only be offered for supply.
- (j) The scope also covers detailed survey (if and where required), check survey, laying of conventional /pile foundations, Design of foundations, river crossing works (if any), erection, testing and commissioning of the 400kV QMDC transmission lines employing Quad Moose bundled ACSR conductor per phase and one no. 7/3.66 mm GSS earth wire and 1 No. OPGW. The Bidder shall indicate whether the river crossing works (if any) including pile foundations will be carried out by them or by other agency in their name. In both cases the required proof of documentation (such as P.O., satisfactory completion and performance) as required by TSTRANSCO on execution of river crossing works shall be furnished in the bid for necessary approval. In case of other agency, an authorization letter to that extent shall be furnished in the bid for carrying out river crossing works on behalf of the Bidder for satisfactory completion as per the terms and conditions of the specification.
- (k) Scope also covers Supply of Scientific Instruments as indicated in Schedules.
- (l) Testing and Commissioning of the materials required for the line.

1.1.2 Design, Engineering, Manufacture, Testing, Supply on FAD site/ stores including Transportation, Insurance, Storage at site of mandatory spares.

1.2.3 Please note that the contract is on TURN KEY basis and hence any other items not specifically mentioned in the specification but which are required for erection, testing and commissioning for satisfactory operation of the Transmission line are deemed to be included in the scope of the specification unless specifically excluded and same shall be arranged by contractor unconditionally. Quantities wherever indicated in the Bidding documents (as defined by TSTRANSCO) are tentative only for the scope of the works and will be considered only for the evaluation of Bids. Actual quantity will be as per the approved design and drawings for the complete scope of the works based on system requirement.

1.2.4 Before proceeding with the construction work of the Transmission Line, the Contractor shall fully familiarize himself with the site conditions and General arrangements & scheme etc. Though the Purchaser shall endeavor to provide the information, it shall not be binding for the Purchaser to provide the same. The Bidders are advised to visit the sites and acquaint themselves with the

Customer:	Transmission Corporation of Telangana Limited (TSTRANSCO)	TB-TL-316-701B
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topography, infrastructure and also the design philosophy. The Bidder shall be fully responsible for providing all equipment, materials, system and services specified or otherwise which are required to complete the supply, construction and successful commissioning, operation & maintenance of the Substation/bay extensions in existing sub-stations in all respects. All materials including cement & steel required for the Civil and construction/installation work shall be supplied by the Contractor.

1.2.5 The complete design (unless specified otherwise in specification elsewhere) and detailed Engineering shall be done by the Transmission Line Contractor.

1.2.6 The Transmission Line Contractor shall also be responsible for the overall co-ordination with internal/external agencies, project management, training of Purchaser's manpower, loading, unloading, handling, moving to final destination including Purchaser supplied material if any for successful erection, testing and commissioning of the Transmission Line.

1.2.7 As per TSTRANSCO tender specification, TSTRANSCO reserves the right to allot any surplus material from TSTRANSCO stores to project site and in such cases transportation charges which shall be inclusive of packing will be paid as per prevailing SSR rates and the Contractor has to transport such material invariably and the balance quantity of material shall only be offered for supply.

1.3 SITE VISIT

The Bidders (Transmission Line Contractor) are advised to visit and examine the site and route of Transmission lines and obtain all information that may be necessary for preparing the bid such as access to site, communication, transport, leads and availability for water, sand, metal etc., right of way, the quantity of various items of work, the availability of local labour, availability and rates of materials, local working conditions, uncertainties of weather and working seasons etc. The cost of visiting the site shall be at Bidder's own expense. Ignorance of site conditions shall not be accepted by TSTRANSCO as basis for any extra claim or additional rates or any compensation at a later date. The submission of a bid by the Bidder will be construed as evidence that such an examination was made and later claims/disputes in this regard shall not be entertained.

It is the responsibility of the Bidder to satisfy himself that sufficient quantities of construction materials required for the works shall exist in the borrow areas or quarries sites. The TSTRANSCO does not accept any responsibility either in identifying the quarries or procuring the material or any other facilities in this regard. The Bidder will not be entitled for any extra cost/ rate or claim for the misjudgment on his part for quantity and quality of materials available in the quarries.

The Bidder (Transmission Line Contractor) shall also conduct survey for the proposed lines as per scope of work.

1.4 RIGHT OF WAY (ROW)

1.4.1 TREE / CROP COMPENSATION RIGHT-OF-WAY, CUTTING OF TREES ETC.

Customer:	Transmission Corporation of Telangana Limited (TSTRANSCO)	TB-TL-316-701B
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Payment of compensation for damaged crops or fruit bearing trees shall be initially made by the Transmission Line Contractor, which will be reimbursed by TSTRANSCO later on. The compensation so payable in respect of damaged crops shall be based on the assessment of MRO. In respect of the trees, compensation so payable is the lowest of the rates fixed by the Horticulture/NABARD/MRO. The Transmission Line Contractor shall take up the payment of compensation amount only after written approval by the Executive Engineer. The payment shall be made in the presence of representatives of LIS construction field officers, Accounts and Vigilance wings of TSTRANSCO. The Superintending Engineer/LIS shall finalize the compensation claims. Also refer technical specification of 400kV Line.

1.4.2 WAY LEAVES AND STATUTORY NOTICES: (ROAD CUTTING CHARGES) (IF APPLICABLE)

The successful bidder (Transmission Line Contractor) shall submit proposals for way leaves and right of way. The bidder (Transmission Line Contractor) is entirely responsible in getting permissions from the concerned Government Departments. The field officials of TSTRANSCO will assist to prepare required letters to apply for permissions. The cost payable to local authorities towards Road cutting / utility charges / permissions is to be paid by the successful bidder (Transmission Line Contractor) as per contract.

1.5 SPECIFIC TECHNICAL REQUIREMENTS

Specific technical requirements of 400kV Transmission Line shall be as per **Volume-IIB** of TSTRANSCO Tender specification (enclosed).

1.6 BILL OF QUANTITY

As per enclosed TSTRANSCO tender BOQ/ Price Schedule.

- Schedule – A2 :** Supply of Line Material for Jaipur- Gajwel Line (7KM)
Schedule – A3 : Supply of Line Material for Kachapur-Gajwel Line (9KM)
Schedule – A4 : Supply of Line Material for NTPC-Narsapur Line (5KM)
- Schedule – B2(a) :** Erection of Jaipur- Gajwel Line (7KM)
Schedule – B2(b) : Civil Works of Jaipur- Gajwel Line (7KM)
- Schedule – B3(a):** Erection of Kachapur-Gajwel Line (9KM)
Schedule – B3(b): Civil Works of Kachapur-Gajwel Line (9KM)
- Schedule – B4(a):** Erection of NTPC-Narsapur Line (5KM)
Schedule – B4(b): Civil Works of NTPC-Narsapur Line (5KM)

Customer:	Transmission Corporation of Telangana Limited (TSTRANSCO)	TB-TL-316-701B
Transmission Line work:	i. LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS - line to Kachapur (Vadkapur) Switching station. ii. LILO of 400kV QMDC Line from Telangana STPP NTPC (2x800MW) - 400/220/32kV Narsapur SS to Kachapur (Vadkapur) Switching station. iii. 400kV QMDC Line from 400kV Kachapur(Vadkapur) Switching station to 400/220kV Ramadugu SS	Rev 00

1.7 SUB-VENDORS

The list of approved makes of Main equipment/ material are enclosed in the specification and the equipment offered shall be from the manufacturers given in the list only. The Bought-out items required for main equipment/material offered from the sub-vendors should have already been supplied similar equipment / material for TSTRANSCO/ PGCIL and have proven performance. Before offering the material from a Sub-Vendor (even though the company name is indicated in the approved Sub-Vendors/Manufacturers list), the Transmission Line Contractor shall take approval from TSTRANSCO by submitting all the credentials to meet the qualifying requirements. The Bidder should own/lease/procure the minimum tools & plants, testing equipment required for the execution of works in time as per the contract. The required T&P and testing equipment shall be indicated together with quantity.

Approved sub-vendor list as per TSTRANSCO tender specification is enclosed as Section-X

1.8 BROAD SCOPE-SPLIT BETWEEN JV PARTNERS

- Complete Transmission Line work from Switchyard take-off gantry at one end to the take-off gantry of other end shall be the scope of Transmission Line Contractor.
- Transmission Line Work includes complete supply and erection of Stringing Hardware, conductor and earth wire upto Switchyard take-off gantries at both ends of Transmission Line.
- Telecom supply & ETC pertaining to Transmission Line shall be as per the TSTRANSCO BOQ/ Schedule.

1.9 PROJECT COMPLETION SCHEDULE

The supply of materials and equipment for 400kV Transmission Line work shall be completed within Twelve (12) months from the date of handing over of profiles and Erection, Testing & Commissioning of 400kV Transmission Line work within Fifteen (15) months from the date of handing over of profiles.

TSTRANSCO tender specification Programme chart (Bar chart) for Supply & Erection is enclosed as Section-XII.

1.10 GENERAL TECHNICAL CONDITIONS OF CONTRACT

Refer enclosed TSTRANSCO tender specification **Section-VII (GTC)**

1.11 GENERAL CONDITIONS FOR ERECTION

Refer enclosed TSTRANSCO tender specification **Section-VI (GCE)**

Customer:	Transmission Corporation of Telangana Limited (TSTRANSCO)	TB-TL-316-701B
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1.12 GENERAL CONDITIONS FOR ERECTION SUPERVISION

Refer enclosed TSTRANCO tender specification **Section-VIII (GCES)**

1.13 STORES FOR SUPPLY OF TOWERS (INCLUDING MATERIALS TO BE SUPPLIED BY THE CONTRACTOR)

- I. The Transmission Line Contractor shall be required to set up Store along the route of the transmission line.
- II. The cement, reinforcement steel and other line materials (to be supplied by the Transmission Line contractor) shall also be arranged in above stores as per the sequence of the work.
- III. The Transmission Line Contractor shall make arrangements to take delivery of all the materials and stock them properly.
- IV. Yards and stores for stocking provided by the Transmission Line Contractor shall be opened for inspection by the Purchaser's (TSTRANSCO) representative as and when desired.
- V. The cost of handling and storage shall be deemed to be included in the quoted erection prices and no extra charges towards, loading, transportation, unloading, stacking and storage etc. shall be payable.
- VI. In case of materials to be supplied by the Transmission Line Contractor himself, all the above provisions shall also apply. However, shortage and/or damage of the materials shall be made good within a reasonable time and without any extra charge to the Purchaser (TSTRANSCO) and without delaying the construction of transmission line.

1.14 CONSTRUCTION POWER AND WATER

Water supply and Electricity for construction work is to be arranged by the Transmission Line contractor at his own cost. Also, storage space for equipment and Transmission Line contractor's site office will be arranged by Transmission Line contractor.

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VOLUME – I :: SECTION –III

INFORMATION TO BIDDERS (ITB)

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SECTION – III :: INSTRUCTIONS TO BIDDERS (ITB)

1.0 Eligible Bidders: This is Local Competitive Bidding. This Invitation of Bids is open to all Bidders from India only.

2.0 Scope of Bid for Transmission Lines :

Scope of the bid includes the following:

- (a) Furnishing of technical details of the material to be supplied.
- (b) Complete manufacture of all the units including their shop testing and galvanization.
- (c) Proto type assembly at works before dispatch, supply including packing, loading and transportation from the manufacturer's works to the Contractor's site stores/ TSTRANSCO stores with unloading and stacking and safe keep until these material are utilized for erection as specified.
- (d) Furnishing of reproducible / AUTO CAD structural drawings of towers (including Multi-circuit towers if any), shop drawings, bills of materials and foundations drawings, data, test reports, operation/instruction manuals etc., for Purchaser's approval and on approval submission of bound volumes of the same for future record wherever applicable in 10 sets.
- (e) The Structural drawings for Towers (including Multi-circuit towers if any) and their foundations shall be provided by TSTRANSCO as available. Wherever the drawings and designs are provided by TSTRANSCO, the suitability of these design and drawings shall be verified by the Bidder for design requirements as per standards, site and soil conditions based on the soil investigation and furnish the detailed design verification calculations before execution if sought by TSTRANSCO. Standard BOMs for towers, stubs will be communicated to the Contractor after placement of Purchase Order. Substitutions if any of steel sections of the tower parts with higher size due to non-availability or otherwise, shall be to the Contractor's account. The Purchaser will not accept any liability on this account. The supplier shall raise the invoices as per standard BOMs. In case of minor variation in BOM approved after proto inspection, only the approved standard BOM will be invoiced and paid.

All the templates required shall be manufactured and got proto inspected and approved by the Purchaser before starting the erection work. **New set each of the templates for all types of towers & their extensions shall be handed over to TSTRANSCO after completion of Tr. Line erection work.**

- (f) Where design of a particular Tower/Tower extension /Leg extension for Tr. Line (including Multi-circuit towers) is not available with the Purchaser or where any modification in the design or new design is required, the Bidder shall have to design the same to TSTRANSCO at no additional cost, including detailing, proto testing, furnishing of Bill of Material (BOMs) drawing etc. All the relevant drawings in AUTO CAD to the scale with reproducible tracings in such cases shall also be supplied to the Purchaser by the successful Bidder at free of cost. The new tower designs developed shall be got approved by CPRI Bangalore.
- (g) The scope of work also includes redrawing of existing structural and shop drawings of all the towers (including Multi-circuit towers) being used in the project using AutoCAD with scale duly certifying their correctness and to be handed over to TSTRANSCO in hard and soft copies before clearing the material for mass fabrication.
- (h) Supply of Tower accessories, 120 KN & 160KN Antifog Disc/Long rod Insulators, Moose ACSR CONDUCTOR, GSS Earthwire, OPGW, OFAC and Hardware & Accessories required for Earth wire and OPGW and GPS as detailed in technical specification. The type testing of these material should have been done within 5 years from the date of NIT. If the Purchaser feels that the type test has to be conducted for his satisfaction or any revision in the relevant IS, the tests should be conducted at free of cost. Please note that TSTRANSCO reserves the right to allot ACSR Moose Conductor and any surplus material from TSTRANSCO stores to project site and in such cases transportation charges which shall be inclusive of packing will be paid as per prevailing SSR rates and the Contractor has to transport such material invariably and the balance quantity of material shall only be offered for supply.
- (i) The scope also covers detailed survey (if and where required), check survey, laying of conventional /pile foundations, Design of foundations, river crossing works (if any), erection, testing and commissioning of the 400kV QMDC transmission lines employing Quad Moose bundled ACSR conductor per phase and one no. 7/3.66 mm GSS earth wire and 1 No. OPGW. The Bidder shall indicate whether the river crossing works (if any) including pile foundations will be carried out by them or by other agency in their name. In both cases the required proof of documentation (such as P.O., satisfactory completion and performance) as required by TSTRANSCO on execution of river crossing works shall be furnished in the bid for necessary approval. In case of other agency, an authorization letter to that extent shall be furnished in the bid for carrying out river crossing works on behalf of the Bidder for satisfactory completion as per the terms and conditions of the specification.
- (j) Scope also covers Supply of Scientific Instruments as indicated in Schedules.
- (k) Testing and Commissioning of the materials required for the line.

For Detailed scope of work bidders may please refer the scope of work attached separately with the tender document)

- 2.1 **Please note that the contract with end User M/s TSTRANSCO is on TURN KEY basis and hence any other items not specifically mentioned in the specification but which are required for erection, testing and commissioning for satisfactory operation of the Substation, Transmission line and Bay extensions, are deemed to be included in the scope of the specification unless specifically excluded and same shall be arranged by contractor unconditionally.** Quantities wherever indicated in the Bidding documents are tentative only for the scope of the works and will be considered only for the evaluation of Bids. Actual quantity will be as per the approved design and drawings for the complete scope of the works based on system requirement.

(For Details Please refer the scope of work attached separately with the tender document)

2.2 **SUBMISSION OF BIDS:**

Procedure for Bid submission:

2.2.1 **GENERAL INSTRUCTION**

- 2.2.1.1 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.
- 2.2.1.2 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.

2.2.1.3 PROCEDURE FOR SUBMISSION OF SEALED TENDERS

- Bidders may please refer Cl no. 03 to 05 of the Notice inviting tender.
- The tenders received after the specified time of their submission shall be treated as 'Late Tenders' and shall not be considered under any circumstances.
- 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 authorised representative may witness the bid opening.
- 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.
- Before submission of offer, the tenderer are 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.
- 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.
- 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.
- **The tenderer shall quote a percentage above/ below/At Par the rates shown in the "Schedule-C i.e Summary of Commercial Schedule A & Schedule B" of subject tender.**
- **Price Bid format is uploaded on <https://eprocurebhel.co.in> and also attached with the tender in section price schedules.**
- **The quoted percentage will apply to the individual items of all the schedules (Schedule A & Schedule B) uniformly.**
- 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.
- The tenderer must provide the registered e-mail of their registered office along with the addresses and authorised phone/mobile nos.

2.2.1.4 EVALUATION OF TECHNICAL BIDS

- 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.
- 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) 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.

b) 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 bidders 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

- In case the qualifying experience is claimed by private organizations based on Work Order and completion certificates, BHEL reserves the right to ask for further proofs including submission of TDS certificates/ form 26AS /bills for the said job.
- 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.
- 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.
- BHEL may conduct onsite verification of at least one of the qualifying work to verify completion of the work and evaluate capability and performance of the bidder.
- 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.

2.2.1.5 EVALUATION OF PRICE BIDS

- Price Bids of unqualified bidders shall not be opened.
- **The offers will be evaluated on the basis of total price basis I,e as per Schedule C - "Schedule-C i.e Summary of Commercial Schedule A & Schedule B".**
- Reasons for rejection of the bid shall be intimated in due course after successful formation of MOU / strategic tie up with successful bidder

2.2.1.6 DOCUMENTS TO BE ENCLOSED:

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

- 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
- 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.
- AUDITED BALANCE SHEET AND INCOME TAX RETURN:
Copy of Audited Balance sheets and income tax return for last three financial years (financial years as specified in PQR)
- 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.
- DOCUMENT RELATED TO INCORPORATION OF BUSINESS ENTITY:
- IN CASE OF INDIVIDUAL TENDERER:
His/her full name, address and place & nature of business.
- 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.
- 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.
- Offer forwarding letter over the letterhead
- Declaration sheets (As per Prescribed format) over the letter head

- No Deviation certificates (As per Prescribed format) over the letterhead
- 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.

Apart from the above documents, bidders are requested to go through the List of Schedule & Annexures as per (Annexure- List of Documents / schedules) and PQ Templates. Bidder has to furnish the same 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.

2.2.1.7. REJECTION OF TENDER & OTHER CONDITIONS:

- 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.
- 8Conditional 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.
- 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.
- 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.
- Offers with inadequate Tools & Plants, Manpower Deployment Plan, and Method Statement are liable for rejection.
- 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.

- 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.
- 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.
- 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.
- 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.
- 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 mobilisation schedule of such sub-contractor. Such request are 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.
- The Tender submitted by a tenderer shall become the property of BHEL who shall be under no obligation to return the same to the bidder.
- 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.
- 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.
- 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.

3.0 Bidders ineligible to Tender:

- (i) A retired officer of the Govt. of Telangana or Govt. of India executing works is disqualified from tendering for a period of two years from the date of retirement without the prior permission of the Government.

- (ii) The Bidder who has employed any retired officer as mentioned above shall be considered as an ineligible Bidder.
- (iii) The Bidder himself or any of his employee is found to be Gazetted Officer who retired from Government Service and had not obtained permission from the Government for accepting the Bidder's employment within a period of 2 years from the date of his retirement.
- (iv) The Bidder or any of his employees is found at any time after award of contract, to be such a person who had not obtained the permission of the Government as aforesaid before submission of the tender or engagement in the Bidder's service.
- v) Bidder shall not be eligible to tender for works in TS Transco where any of his near relatives are employed in the rank of Assistant Engineer or Assistant Executive Engineers and above on the Engineering side and Assistant Accounts Officer and above on the accounts side. The Bidder shall intimate the names of persons who are working with him in any capacity or are subsequently employed. He shall also furnish a list of Gazetted/Non-Gazetted State Government Employees related to him. Failure to furnish such information Bidder is liable to be removed from the list of approved Bidders and his contract is liable for cancellation.

Note: Near relatives include

Sons, step sons, daughters, and step-daughters.

Son-in-law, and daughter-in-law.

Brother-in-law, and sister-in-law.

Brothers and Sisters.

Father and Mother.

Wife / Husband.

Father-in-law and Mother-in-law

Nephews, nieces, uncles and aunts

Cousins and

Any person residing with or dependent on the Bidder.

4.0 Last date / time for Submission of the Tenders.

1. Tenders must be submitted online not later than the date and time specified in NIT.

2. The tender inviting authority may extend the dates for issue and receipt of Tenders by issuing an amendment in which case all rights and obligations of the tender inviting authority and the Bidders will remain same as previously.
3. The Bidders are requested to check / verify the web site before scheduled closing date & time for any changes/ amendments in the tender.

5.0 Late Tenders:

Tenders will not be considered which are uploaded after Bid closing date and time as prescribed in NIT.

6.0 Modification to the Tender:

Bidders can modify their **Tender percentage** online before the last date/time prescribed in NIT.
No Tender shall be modified after the last date /time of submission of Tenders.

7.0 Language of the bidding documents:

Bids shall be submitted in English language only.

8.0 Cost of Tendering :

The Bidder shall bear all costs associated with the preparation and submission of his Tender and the tender inviting authority will in no case be responsible and liable for those costs.

9.0 PRICES: Refer Bill of Quantity Cum Price Schedule

Bidder shall indicate bid prices in Indian Rupees only.

10.0 (a) TREE / CROP COMPENSATION RIGHT-OF-WAY, CUTTING OF

TREES, ETC.

Payment of compensation for damaged crops or fruit bearing trees shall be initially made by the Contractor, which will be reimbursed by TSTRANSCO later on. The compensation so payable in respect of damaged crops shall be based on the assessment of MRO. In respect of the trees, compensation so payable is the lowest of the rates fixed by the Horticulture/NABARD/MRO. The Contractor shall take up the payment of compensation amount only after written approval by the Executive Engineer. The payment shall be made in the presence of representatives of LIS construction field officers, Accounts and Vigilance wings of TSTRANSCO. The Superintending Engineer/LIS shall finalize the compensation claims. Also refer technical specification of 400kV Line.

b) WAY LEAVES AND STATUTORY NOTICES: (ROAD CUTTING CHARGES) (IF APPLICABLE)

The successful bidder shall submit proposals for way leaves and right of way. The bidder is entirely responsible in getting permissions from the concerned

Government Departments. The field officials of TSTRANSCO will assist to prepare required letters to apply for permissions. The cost payable to local authorities towards Road cutting / utility charges / permissions is to be paid by the successful bidder as per contract.

11.0 PRICE VARIATION (PV) Clause

11.1 The Price Variation clause for steel and cement utilized in civil works:

The Price Variation applicable in respect of steel and cement utilized in civil works shall be as per G.O.Ms.No.94, Dt: 16-04-2008 and T.O.O CE (Civil) Ms.No.24, Dt: 23-04-2008 of TSTRANSCO with subsequent amendments subject to the following conditions:

a) The Price adjustment shall be applicable for both upward and downward variation in prices of respective items within original contract period or period extended on grounds of the departmental delays and valid reasons and shall not be applicable to the extensions granted on account of the Contractors fault.

b) The price adjustment shall be applicable for actual components of items of works actually carried out during the period of bill and allow to adopt price adjustment for steel and cement utilized in civil works by the absolute variation between the estimated rate and the rate approved by the Govt. based on the recommendation of Board of Chief Engineers for the month.

The basic rate for Cement and Steel rates adopted in the estimate is as follows:

(i) Substations and Bays :

For Cement and Steel rates adopted in the estimate is Oct ' 2020.

Cement :- 5,600/1MT

Structural Steel :- 39,000/-1MT

Reinforcement Steel :- 44,000/1MT

(ii) 400 kV Lines:

For Cement and Steel rates adopted in the estimate is Oct' 2020.

Cement :- 5,600/1MT

Reinforcement Steel :- 44,000/1MT

c) i) The price adjustment will be applied where the variation in rates only to the extent where it is above 5% over the estimates rates. Thus if the price excess is

10%, payment will be made only to the extent of 5% (10% - 5%). Further, the same procedure should be also followed for Negative Price variation.

- ii) For the time extension period due to
 - a) Department fault, price variation (Both +ve and -ve) is applicable.
 - b) Contractors fault, only negative price variation is applicable.
- d) Necessary supplemental proposal regarding differential rate payable or difference rate recoverable on agreement rates of steel and cement utilized in civil works and structural steel due to price adjustment is to be submitted to the agreement concluding authority for approval.
- e) The completion schedule approved in the form of bar chart shall be the basis for timing of the each activity for calculating the Price Variation during a month. If the schedule is not complied by the Contractor as per the above programme due to the reasons like right-of-way, the particular activity or task can be rescheduled by moving upward or downward on the time axis of the bar chart within the agreement period, as agreed by the Concerned Executive Engineer (field officer), as per the actual site conditions. In such cases, the concerned Executive Engineer will record the reasons for re-scheduling / delay of the work.
- a) In specific cases like Substation site being not handed over to the Contractor in time by the TSTRANSCO due to delay in land acquisition, natural calamities, right-of-way problems, for which the Contractor is not responsible, extension of the agreement period may be given duly rescheduling the programme of completion with the approval of competent authority. In all such cases, TSTRANSCO will consider application of Price variation clause case to case.

11.2 PRICE VARIATION CLAUSES FOR TRANSMISSION LINES ITEMS :

(I) For supply

The Price Variation applicable in respect of the items i.e 400 kV Transmission towers including Bolts & Nuts, Moose ACSR Conductor and GSS earth wire is subject to the following conditions:

- (a) Price variation shall be applicable for both upward and downward variation in prices.
- (b) The indices adopted for calculation of price variation shall be

For 400kV Transmission line towers including Bolts & Nuts - IEEMA

For ACSR Moose Conductor - CACMAI

For Earth wire - CACMAI

- (c) The price variation is limited to maximum of 50% over the Price quoted/accepted mentioned above (own manufactured / bought out items as the case maybe). However there is no ceiling for negative variation.
- (d) If the delivery of the material is within the scheduled delivery period, the Price variation applicable will be based on the actual delivery (the date on which Transmission line towers are notified as being ready for inspection / dispatch) for transmission towers and check measurement date as per Form-13 in case of conductor and earth wire.
- (e) In the case the Purchaser advance the delivery, the price variation applicable will be based on the actual delivery (the date on which Transmission line towers are notified as being ready for inspection / dispatch) for transmission towers and check measurement date as per Form-13 in case of conductor and earth wire.
- (f) If the date of delivery as defined in the P.V. formula is beyond the schedule delivery date, the scheduled delivery date or the actual delivery date (the date on which Transmission line towers are notified as being ready for inspection / dispatch) for transmission towers and check measurement date as per Form-13 in case of conductor and earth wire whichever is advantageous to the Purchaser will form the basis for calculation of price variation.
- (a) Notwithstanding the formula applicable for regulating the price variation, if at any time any documentary evidence or certificate in regard to the price variation bills is required by the Purchaser, the supplier will have to furnish the same to the Purchaser.
- (h) The proportionate taxes and duties on such increase or decrease in the price is to the TSTRANSCO's account, as per actual on production of the gate pass relating to the consignments for which price variation is claimed.
- (b) The price variation amount can be claimed for each batch of supplies made from time to time (out of total quantity) and will be payable after due verification.
- (j) In specific cases for which the Contractor is not responsible, extension of the agreement

period may be given duly rescheduling the programme of *delivery* with the approval of competent authority. In all such cases, TSTRANSCO will consider application of Price variation clause case to case.

(c) **Applicable formula for calculating Price Variation for 400 Kv Transmission towers including Bolts & Nuts**

“Price variation clause in the Tender specification are provisional and all modification/updates issued by IEEMA from time to time are applicable for TSTRANSCO turnkey projects. The Price variations will be calculated using IEEMA PV CALCULATOR(whenever applicable) which includes all modifications issued by IEEMA from time to time.”

Prices are variable . Price Variation will be calculated according to IEEMA formula as given below.

$$P = \frac{P_o}{100} \left\{ 11 + 32 \times \frac{SBLR}{SBLRo} + 25 \times \frac{SBI R}{SBI Ro} + 09 \times \frac{Zn}{Zno} + 23 \times \frac{W}{Wo} \right\}$$

Wherein,

P = Price payable as adjusted in accordance with the above formula.

Po = Price quoted/accepted

SBLRo = Price of Steel Blooms Retail

This price is as applicable on the 1st working day of the month,
One month prior to the date of tender opening.

SBI Ro = Price of Steel Billets Retail

This price is as applicable on the 1st working day of the month,
One month prior to the date of tender opening.

Zno = Price of Electrolytic high grade zinc

This price is as applicable on the 1st working day of the month,
One month prior to the date of tender opening.

Wo = All India average consumer price index number for industrial workers, published by the Labour Bureau, Ministry of Labour, Govt of India (Base : 2001 = 100). This index number is as applicable on the first working day of the month, three months prior to the date of tender opening.

SBLR	=	Price of Steel Bloom Retail This price is as applicable on the 1st working day of the month, Two months prior to the date of delivery.
SBIR	=	Price of Steel Billets Retail This price is as applicable on the 1st working day of the month, two months prior to the date of delivery.
Zn	=	Price of Electrolytic high grade zinc This price is as applicable on the 1st working day of the month, two months prior to the date of delivery.
W	=	All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt of India (Base : 2001 = 100). This index number is as applicable on the first working day of the month, four months prior to the date of delivery.

The date of delivery is the date on which Transmission line towers are notified as being ready for inspection / dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery).

(ii) PRICE VARIATION FOR ACSR MOOSE CONDUCTOR

The price shall be based on and subject to adjustment due to variation in the following factors:

- i) E.C. Grade Aluminium: The ex-works cost of indigenous E.C. grade aluminium wire rod based on average price of M/s. Nalco, Balco, Hindalco, and Malco as given in CACMAI circulars prevailing as on 30 days prior to the Bid opening.
- ii) HTGS Wire: The ex-works cost per MT of HTGS wire exclusive of duties and taxes prevailing as on 30 days prior to the Bid opening corresponding to 3.00 to 4.09 mm size, as given in CACMAI circulars prevailing as on 30 days prior to the Bid opening.
- iii) The above basic prices of raw materials will remain unaltered during the execution of contract.

- iv) For any variation up or down in the prices of raw materials as defined above, for every one rupee change in the rate of one MT of EC grade aluminium wire rod and HTGS wire the corresponding increase or decrease in price per KM of finished conductor allowable shall be as given below:

CONDUCTOR TYPE	Variation in Rs. Per Km of Conductor	
	For Aluminium	For HTGS wire 2.79 mm to 4.09 mm
MOOSE ACSR CONDUCTOR	1.467	0.537

$$P = P_o + (A_i - A_o) \times 1.467 + (S_t - S_o) \times 0.537 - \text{For Moose}$$

- v) For the purpose of calculation of price variation, the prices of HTGS wire and EC grade aluminium shall be taken as those prevailing on the first working day of the calendar month one month prior to the date of delivery.
- vi) The Base and final prices/ indices shall correspond to same manufacturers as given in the CACMAI.
- vii) The date of delivery shall be the date of receipt of materials in good condition at destination stores (i.e. check measurement date as per Form-13) for the purpose of the price variation calculations.
- viii) Irrespective of increase in the prices of raw materials, the price increase per kM of the conductor in the Price quoted / accepted will be limited to a maximum of 50% over the original Price quoted / accepted mentioned above (own manufactured / bought out items as the case maybe). However there is no ceiling for negative variation.
- ix) In case of conductors, where the supplier makes his own arrangements to get the Rod made out of Aluminium Ingots, the prices of Aluminium Rod as per CACMAI mentioned above will only be taken into consideration for arriving at the price variation claims irrespective of whatever expenditure the supplier might have incurred in getting the ingot converted into Rod.

(iii) PRICE VARIATION FOR GSS EARTHWIRE :

Prices are Variable:

- i) The formula for calculation of the price adjustment to be applied to the Price quoted / accepted component of Galvanised Steel Earth wire is as below:

$$EC_{EW1} = EC_{EW} [0.15 + 0.74 (A_1/A_0) + 0.11(L_1/L_0)] - EC_{EW} \text{ Where,}$$

EC_{EW1} = Price adjustment amount payable on Price quoted / accepted of Earth wire, shipment-wise.

EC_{EW} = Ex-works price for Earth wire, shipment-wise.

A = Published price indices for high tensile steel galvanized wire, as published by CACMAI.

L = All India consumer price index for industrial workers as published by Labour Bureau, Shimla (Govt. of India).

- a) **Subscript '0' refers to indices in the circular as on thirty (30) days prior to date of opening of Bids, for materials & labour.**
 - b) **Subscript '1' refers to indices in the circular as on 60 (sixty) days prior to the date of delivery for materials & labour.**
- ii) The Base and final prices/ indices shall correspond to same manufacturers as given in the CACMAI.
- iii) The date of delivery shall be the date of receipt of materials in good condition at destination stores (i.e. check measurement date as per Form-13) for the purpose of the price variation calculations.
- iv) Irrespective of increase in the prices of raw materials, the price increase per KM of the conductor in the Price quoted/accepted will be limited to a maximum of 50% over the

original Price quoted/accepted mentioned above(own manufactured / bought out items as the case maybe. However there is no ceiling for negative variation.

However, the PV calculations for above material/equipments will be calculated as per the latest amendments (if any) for formulas issued by IEEMA/CACMAI.

(II) For Erection:

- i) Price variation shall be applicable for both upward and downward variation in prices of respective items if the delivery of goods / work completion is within the stipulated period mentioned in the purchase order.
- ii) The rate approved by the Govt. based on the recommendation of Board of Chief Engineers for the month will be considered for the items cement, reinforcement steel.
- iii) Not Applicable.
- iv) Price adjustment shall be calculated separately for reinforcement steel & cement components in proportion to the cost of work done involving the above materials during the billing period. The percentage of reinforcement steel & cement components is based on estimated rate only. The price variation amount so obtained will be added to the cost of work done calculated on quoted rate, put up for billing.
- v) The concerned Field Executive Engineer will calculate the Price Variation for the billing period, preferably monthly. For this purpose the Contractor shall submit invoice supported by calculation as per formula specified along with documentary evidence for different indices applicable for Price Adjustment.
- vi) Price variation will be limited to the amount arrived based on schedule date of completion or actual date of completion whichever is earlier. Lower of the two indices values will be considered.

- vii) In specific cases like right-of-way problems, for which the Contractor is not responsible, extension of the agreement period may be given duly rescheduling the programme of completion with the approval of competent authority. In all such cases, TSTRANSCO will consider application of Price variation clause case to case.

12.0 TAXES AND DUTIES:

- 12.1 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.
- 12.2 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.
- 12.3 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 required from time to time by BHEL. BHEL will not be held to be responsible for any non-compliance of the Contractor in respect of GST laws as framed from time to time.
- 12.4 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.
- 12.5 The GST amount shall 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.
- 12.6 Statutory variation, if any, on account of GST will be payable by BHEL (if Payable by TSTRANSCO) at actuals on submission of documentary evidence within the contractual delivery schedule only.

12.7 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.

12.8 New Taxes & duties:

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 (if Payable by TSTRANSCO) subject to submission of documentation as per statute within the contractual delivery schedule Only..

13.0 STATUTORY VARIATION:

Any variation up or down in statutory levy or new levies introduced after calling of tender date under this specification will be to the account of BHEL/ TSTRANSCO and which shall be regulated in the contract agreement by the agreement concluding authority.

The successful Bidder has to declare the own manufactured and bought out items at the time of acceptance of LOI.

Any increase in statutory levies will be granted by the competent Authority on production of documentary evidence of such increase by the Supplier provided the variation is within the scheduled completion period of contract. This is allowed only once during delivery period i.e. at the time of delivery of goods at factory.

In cases where the Bidder does not adhere to schedule of completion date of Supply/ works and if there is any upward variation/revision in taxes & duties after the agreed schedule completion of programme of works, the Bidder shall bear such impact of levies and if there is any downward variation/revision, the credit shall be passed on to TSTRANSCO to that extent irrespective of scheduled completion of period of contract.

In case of sub-vendor (bought out) items, no statutory variation is applicable after the acceptance of LOI by the successful Bidder.

14.0 Import License:-

Obtaining import license shall be of Contractors' responsibility for imported goods considered in the Bid. The Purchaser has no responsibility what so ever in this regard and any customs duty incurred by the Bidder on the imported goods considered in the bid will not be borne/reimbursed by the Purchaser.

15.0 BID FORM:

The Bidder shall complete the Bid Form and all the bidding schedules for Part-I of the bid and Price schedules for Part- II furnished in the bidding documents.

16.0 Bid Currency:

The bid prices shall be quoted in **Indian rupees only**.

17.0 Validity of Tenders:

Bids shall remain valid for 04 months from the date of opening of the bid or Contract finalization date from TSTRANSCO's end (whichever is later)

The rates in the Tender shall be kept valid for acceptance 04 months from the date of opening of the bid or Contract finalization date from TSTRANSCO's end (whichever is later). 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.

During the above-mentioned period no plea by the Bidder for any sort of modification of the tender based upon or arising out of any alleged misunderstanding of misconceptions or mistake or for any reason will be entertained.

18.0 Corrupt or Fraudulent Practices:

The TS Transco require that the Bidders / suppliers / Contractors under Government financed contracts; observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, the Government .

(a) Define for the purposes of the provision, the terms set forth below as follows:

- i) "Corrupt practices" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a Government official in procurement process or in contract execution: and
- ii) "Fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Government and includes collusive practice among Bidders (prior to or after Tender submission) designed to establish in Tender prices at artificial non-competitive levels and to deprive the Government of the benefits of free and open competition.

- (b) Will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question.
- (c) Will blacklist / or debar a firm, either indefinitely or for a stated period of time, if at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing a Government Contract.
- (d) Further more, Bidders shall be aware of the provisions stated in the General Conditions of Contract.

The decision of Chief Engineer/LIS/TS Transco/Vidyut Soudha/ Hyderabad, to accept any tender and to reject any or all tenders is final.

19.0 PURCHASER'S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS:

The Purchaser reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to Award of contract, without thereby incurring any liability to the affected Bidder or Bidders.

20.0 Process to be Confidential:

1. Information relating to the examination, clarification, evaluation and comparison of Tenders and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced by the tender accepting authority. Any effort by a Bidder to influence the processing of Tenders or award decisions may result in the rejection of his Tender.
2. No Bidder shall contact the officer inviting tenders or any authority concerned with finalization of tenders on any matter relating to this Tender during the period from the date of Tender opening to the date of award of Contract.
3. Before recommending/accepting the tender, the tender recommending/ accepting authority shall verify the correctness of certificates submitted to meet the eligibility criteria.
4. Tenders will be finalized by the authority inviting tenders on the recommendation of the competent technical authority. The authority will scrutinize the tenders in accordance with the conditions stipulated in the tender document. In case of any discrepancy or non-

adherence to the conditions, the same shall be communicated to the Bidder, which will be binding on the Bidder. The decision taken by the concerned authority on the tender shall be final.

21.0 LOCAL CONDITIONS:

21.1 It will be imperative on each Bidder to fully inform himself of all local conditions and factors, which may have any effect on the execution of the works/supplies covered under these documents and specifications.

21.2 It must be understood and agreed that such factors have properly been investigated and considered while submitting the proposals. No claim for financial adjustment to the contract awarded under these specifications and documents will be entertained by the Purchaser. Neither any change in the time schedule of the contract nor any financial adjustments arising there of which are based on the lack of such clear information, its effect on the cost of the works to the Bidder shall be permitted by the Purchaser.

22.0 PERFORMANCE SECURITY:

Within One (1) month of the issue of Letter of Intent from the Purchaser, the successful Bidder shall furnish the Performance Security for an amount equivalent to sum of 10% of the supply value and 5% of the erection value of the contract along with additional performance securities if any in accordance with the contract, in the Performance Security form provided in the bidding documents or any other form acceptable to the Purchaser.

The Performance Security/additional performance securities shall cover the Twelve (12) months over and above completion period, with a further claim period of two (2) months from the date of check measurement of material/equipment.

- (i) The Bank Guarantee furnished by Line Tower Manufacturer towards 10% of cost of total towers shall be valid upto complete supplies of tower parts.
- (i) The Transformer Manufacturer shall submit an additional Bank Guarantee for value equivalent to 10 % of the cost of the Transformers and which shall be valid up to completion of supplies of Transformers.
- (ii) The Reactor Manufacturer shall submit an additional Bank Guarantee for value equivalent to 10 % of the cost of the Reactor and which shall be valid up to completion of supply of Reactor.

All the Bank Guarantees shall be furnished as per the specific validity mentioned in specification with additional Two(2) months claim period.

Note: Further, the Transformer/Reactor along with accessories supplied shall be under warranty for the satisfactory functioning as per the specification for a minimum period of 60 months from the date of check measurement in Form-13 i.e date of receipt of Reactor in full shape at store/site in good condition.

The Purchaser will discharge the Performance Security after completion of the warranty/ Guarantee period.

Failure of the successful Bidder to furnish the Performance Security as specified within One (1) month after issuance of Letter Of Intent shall constitute sufficient grounds for the annulment of the Award and forfeiture of the bid guarantee, in such case the Purchaser may Award the said contract to the next lowest evaluated Bidder or call for new bids. Any further correspondence made by the Bidder in this regard will not be entertained.

However, the successful bidder has to extend the validity of the bid security bank guarantee till submission of all Performance Bank Guarantees.

Performance security may in the form of

- (i) A Bank Guarantee from Nationalized Banks as per list under Section IX(b) in favour of Chief Engineer / LIS/TSTRANSCO.
- (ii) A Banker cheque, crossed Demand Draft, pay order on any Nationalized Banks as per list under Section IX(b) in the Headquarters in favour of Pay Officer/ TSTRANSCO.

All Bank Guarantees, which are executed in accordance with this specification, shall be only on Non- Judicial Stamp paper purchased in **TELANGANA State** to the value of not less than Rs.100/- (Rupees one hundred only). Bank Guarantee executed on the Non- Judicial stamp paper of value less than Rs.100/- will not be accepted.

In case of the non-execution of works within the stipulated completion period the Bidder shall extend the bank guarantee suitably to cover the 12 Months performance and 2 Months claim period from the expected date of commission of the project.

In case of replacement/repair of any material/works after commissioning of the Sub-Station/Bay Extension and before expiry of Guarantee / Warranty period, the Contractor shall furnish separate

bank guarantee valid for 12 Months with 2 months claim period from the date of repair / replacement covering the value of such materials / works.

The Purchaser will discharge the Performance Security after completion of the contract and within 60 days of the expiry of the warranty.

23.0 FORFEITURE OF PERFORMANCE SECURITY:

The Performance Securities will be forfeited in the following cases :

1. When the successful Bidder does not fulfill the obligations under the contract or proven to be false submission of the information either in the bid or the information relating to the contract.
2. When the successful Bidder fails to execute the work in accordance with the clauses under this specification.
3. When the successful Bidder executing the work with in-ordinate delays or with poor quality which hampers the prime object of the contract, the securities will be en-cashed and will be adjusted towards such losses incurred by TSTRANSCO or towards risk purchase.
4. When the successful Bidder pleads his inability to erect the Substation / Bay Extensions/Transmission Lines and backs out of his obligations after issue of the preliminary acceptance letter or the letter of intent, the TSTRANSCO will forfeit his performance/ additional/ bid securities and also recover the loss, if any, sustained by the TSTRANSCO as a consequence of such backing out. In addition, the company will be blacklisted.

24.0 COMPLETION PERIOD:

The Contractor shall take up and commence the work as per the instructions of concerned Superintending Engineer/LIS/Karimnagar and complete the work as indicated in **Schedule-D**.

25.0 EXCESS DELIVERY PERIOD / COMPLETION PERIOD:

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.
 - d) 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.
 - e) 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.

26.0 VARIATIONS IN QUANTITIES:

The quantities indicated in the Schedule-A (Materials / Equipment) and Schedule-B (Works) are only provisional and are likely to change during actual execution.

For material and equipment covered in Schedule – A and Works items covered in Schedule – B :

The rates accepted for individual items of material / equipment covered under Schedule-A and works items covered in Schedule –B shall hold good for the actual quantities of material supplied and works executed, including any increase necessitated during actual execution.

27.0 PURCHASER'S RIGHT TO VARY THE SCOPE DURING THE PERIOD OF CONTRACT:

Purchaser/ BHEL may change the scope of the contract (No. of line bays etc.) based on the priorities and may subsequently extend for balance scope with the prices quoted if required.

Purchaser reserves the right to increase or decrease the scope stated above as per requirement up to + or - 50% during the execution of the order with quoted prices.

28.0 SUPPLEMENTAL/NEW ITEMS AND PROCEDURE FOR WORKING OUT RATES

The Contractor is bound to execute Supplemental / new items that are found essential, incidental and inevitable during execution of the contract at the rates to be worked out as below:

For the items relating to the Schedule-B where the rate can be deduced from the estimate or TSTRANSCO / DISCOMS/ Common SSR, the rate applicable will be the estimated / SSR rate +/- tender percentage quoted/ accepted by the Bidder for Schedule –B. The schedule of rates adopted for supplemental items / new items shall be from the current SSR applicable during the execution period.

For the items relating to the Schedule-A or Schedule-B where the rates of new items cannot be deduced from the estimate / SSR, the rate payable will be arrived based on the prevailing market rates duly enquiring/collecting quotations and observing the reasonableness of the rates by the Purchaser.

The Schedule time required to complete the new/supplemental items including the balance work will be indicated in the approval letter issued for new / supplemental items.

The Contractor shall plan and procure the materials indicated in the Schedule 'A' duly verifying with the approved layout and profile so that the procured quantities match with actual requirement to avoid excess supply of materials. The Executive Engineer shall give the details of the materials such as quantities of type wise towers and extensions and other line materials

based on the line approved profile and the quantities of type wise structures and other materials based on the approved layout on the date of Kickoff meeting without fail.

29.0 Performance Guarantee / Warranty:

The materials/equipment supplied and erected shall be guaranteed for satisfactory operation for a minimum period of 12 months from the date of commissioning of project. Where the suppliers/Manufacturers provided longer period of warranty than the period mentioned above, TSTRANSCO shall be entitled for such longer warranty. By the time of completion of commissioning, Bank Guarantee for performance security and Bank Guarantee for final payment shall be valid to cover Guarantee/warranty period with a claim period of two months. The supplier will further guarantee that the material/equipment will conform to the technical specification.

Equipment, sub-assemblies or mandatory spare parts replaced under warranty will have further warranty from the date of acceptance, for a further period of 12 months.

The supplier will warrant that the materials/equipment supplied under the contract are new, unused, of the most recent or current models, and that they incorporate all recent improvements in design and materials unless provided otherwise in the contract. The supplier will further warrants that all materials/equipment supplied under the contract will be free from defects, arising from a design and/ or use of materials as required by the Purchaser's specifications or from any act of omission of the supplier that may develop under normal use of the supplied materials / equipment.

All the material will be of the best class and will be capable of satisfactory operation in the topics under the service conditions indicated without distortion or deterioration. No welding, filling or plugging of defective parts will be permitted. Unless otherwise specified, they will conform to the requirements of the appropriate Indian Standards. (Where a standard specification covering the material in question has not been published, the standards of the American Society for Testing of Materials should be followed).

The entire design and construction will be capable of withstanding the severest stresses likely to occur in actual service and be capable of resisting rough handling during transport.

The supplier will in addition, comply with the performance guarantees specified under the contract. If, for reasons attributable to the supplier, these guarantees are not attained in whole or in part, the supplier will at its discretion either,

- (a) make such charges, modifications, and / or additions to the materials / equipment or any part thereof as may be necessary in order to attain the contractual guarantees specified in the contract at its own cost and expense and to carry out further performance tests as per the relevant standards.
- (b) Replace the material / equipment at his own expense.

The Purchaser will promptly notify the supplier in writing of any claims arising under this warranty.

Upon receipt of such notice, the supplier will within 15 days repair or replace the defective materials / equipment or parts thereof, free of cost at the ultimate destination. The supplier will take over the replaced parts / materials / equipment at the time of their replacement. No claim whatsoever will lie on the Purchaser for the replaced parts / materials / equipment thereafter. In the event of any correction of defects or replacement of defective material during the warranty period, the warranty for the corrected / replaced material will be extended to a further period of 12 months.

If the supplier, having been notified, fails to remedy the defect(s) within the above period, the Purchaser may proceed to take such remedial action as may be necessary, at the supplier's risk and expense duly deducting the expenditure from subsequent bills / bank guarantee and without prejudice to any other rights which the Purchaser may have against the supplier under the contract. Should any damage occur to any other equipment covered under this bidding document due to defective part supplied under this contract, the Bidder should be responsible for making good, the said damage.

If the work or any portion thereof shall be damaged in any way excepting by the acts of the TSTRANSCO, or if defects not readily detected by prior inspection shall develop before the final completion and acceptance of the whole work, the CONTRACTOR shall forthwith make good, without compensation, such damage or defects in a manner satisfactory to the TSTRANSCO. In no case shall defective or imperfect work be retained.

If the Contractor fails to remove or repair any defect within a reasonable time, the Purchaser shall do so by themselves or by any other agencies at the Contractor's cost and risk and cost of such repairs/removals will be adjusted against the amount due to the Contractor.

The Contractor shall not be entitled to claim compensation on account of delays or hindrances to the works for any cause whatsoever. Should the cause of delay or hindrance not be the responsibility of the Contractor, the Chief Engineer *may* consider extension of time to compensate for this delay or hindrance based on the merits of the case. The Contractor will not, however, be eligible for any compensation by way of increase in the rates for the works executed beyond the contract period.

31.0 Extension of time for contract completion:

When a work cannot be completed within the completion period indicated for reasons beyond the control of the Contractor, the Contractor shall represent for the same and extension of time shall be granted only on the issue of an undertaking by the Contractor that he will not put forth at a later date, claims for extra payments towards increased overheads, labour costs etc.

32.0 Mile Stones:

Bar chart assigning definite time period for each of the activity to be ensured for total completion period of work is enclosed for strict adherence to the payment terms mentioned in Clause No.15 of GCC (Terms of payment). The Bidders are requested to give specific acceptance in the form of an undertaking as per Annexure -28 of PQ Template at the time of bidding. **Bids received without this undertaking are liable to be overlooked.**

33.0 Technical Audit on Completed Works:

- i) All the completed works shall be technically audited by Quality Assurance wing within two months of the completion/commissioning of the project for the correctness of project in terms of agreements, specifications, detailed project report / technical sanction, deviation in quantities & rates.
- ii) All the remarks which are pointed out by Quality Assurance Wing in the above technical audit shall invariably attend by LIS Field Wing within one month and in case the remarks are pertaining to the execution of work which is in the scope of the agreement, the Contractor has to attend the remarks without insisting of any additional payment.

34.0 Model Conciliation Clause For Conducting Conciliation Proceedings Under The BHEL Conciliation Scheme, 2018

- iii) The Parties the if at any time (whether before, during or after the arbitral or judicial proceedings), any Disputes (which terms shall means and include any dispute, difference, question or disagreement arising in connection with construction, meaning, operation, effect, interpretation or breach of the agreement, contract or the Memorandum of Understanding (delete whichever is inapplicable), which the parties unable to settle mutually), arise inter-se the Parties, the same may, be refereed by

either party to conciliation to be conducted through Independent Experts Committee to be appointed by competent authority of BHEL from the BHEL Panel of Conciliators.

- iv) Notes:
- v) 1. No serving or a retired employee of BHEL/Administrative Ministry of BHEL shall be included in the BHEL Panel of Conciliators.
- vi) 2. Any other person(s) can be appointed as Conciliator(s) who is/are mutually agreeable to both the parties from outside the BHEL Panel of Conciliators.
- vii) 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 Annexure-A to this GCC.
- viii) The Annexure-A together with it's appendices will be treated as if the same is part and parcel hereof and shall be as effectual as if set out herein in these GCC."
- ix) Guidelines for settlement of claims for compensation on accidents
- x) The amount of compensation paid by BHEL under its guidelines on Settlement of claims for compensation on accidents as applicable for BHEL, i.e. Rs 10,00,000/- (Rs Ten Lakh) in the event of death or permanent disability resulting from Loss of both limbs and Rs 7,00,000/-(Rs Seven Lakh) in the event of permanent disability: shall be recoverable in full from the contractor, agency or firm, if the accident is attributable to negligence of contractor, agency or firm or any of its employees, except in case of work/ service contract etc. being of less than ` 5,00,000/- value, in which case the entire amount of compensation shall be borne by BHEL.

35.0 RIGHTS OF BHEL: -

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

- 35.1 To withdraw any portion of work (after due opportunity given to contractor to meet schedule) &/or to restrict/alter quantum of work as indicated in the contract during the progress of construction and get it done through other agency to suit BHEL's commitment to its customer or in case BHEL decides to advance the date of completion period due to other emergent reasons/BHEL's obligations to its customer.
- 35.2 To restrict or increase the quantity and nature of work to suit site requirements, since the tender specification is based on preliminary documents and quantities furnished therein are indicative and approximate.. Quantity/ contract variation clause may also be read in conjunction with this clause.
- 35.3 To terminate the contract or to restrict the quantum of work and pay for the portion of work executed in case BHEL's contracts with its customer are terminated/ altered/ deferred/ disputed/on hold for any reason as per mutual agreement.
- 35.4 To effect recovery from any amounts due to the contractor under this or any other contract or in any other form, the moneys BHEL is statutorily forced to pay to anybody, due

to contractor's failure to fulfill any of his obligations. BHEL shall levy overheads of 5% on all such payments.

- 35.5 While every endeavour will be made by BHEL to this end, they cannot guarantee uninterrupted work due to conditions beyond their control. The Contractor will not be normally entitled for any compensation/extra payment on this account unless otherwise specified elsewhere in the contract. No idle labour charges will be payable by BHEL in any case.
- 35.6 To deploy BHEL's skilled and unskilled workmen in case of emergency/poor progress/deficiency in skill on the part of the employees of the contractor and to recover the expenditure on account of the same from the moneys due to the contractor.
- 35.7 In event of termination of contract/ withdrawal/ the contractor shall have no claim to compensate for any loss sustained by him by reason of having purchase of any material or entered into agreement or made any advance on account of execution of work/ contract on account of any profit or advantage which he might have derived from the execution of the works in full but which he did not derive in consequence of the termination/ withdrawal of works.
- 35.8 In the event of any dispute of technical nature, the decision of BHEL shall be final and binding on the Contractor.

35.9 Risk & Cost Clause

In case of fault of the contractor, BHEL reserves the following rights without entitling the contractor for any compensation:

- 35.9.1 To terminate the contract or withdraw portion of work and get it done through other agency, at the risk and cost of the contractor after due notice **of a period of 14 days' by BHEL** in any of the following cases:
- i) Contractor's poor progress of the work vis-à-vis execution timeline as stipulated in the Contract, backlog attributable to contractor including unexecuted portion of work does not appear to be executable within balance available period considering its performance of execution.
 - ii) Withdrawal from or abandonment of the work by contractor before completion of the work as per contract.
 - iii) Non-completion of work by the Contractor within scheduled completion period as per Contract or as extended from time to time, for the reasons attributable to the contractor.
 - iv) Termination of Contract on account of any other reason (s) attributable to Contractor.
 - v) Assignment, transfer, subletting of Contract without BHEL's written permission.
 - vi) Non-compliance to any contractual condition or any other default attributable to Contractor.

35.9.2 **Risk & Cost Amount against Balance Work:**

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

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

Where,

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

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

H = Overhead Factor to be taken as 5

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

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

Difference of Contract Quantities and Executed Quantities as on the date of issue of Letter for 'Termination of Contract', shall be taken as balance scope of Work for calculating risk & cost amount.

Contract quantities are the quantities as per original contract. If, Contract has been amended, quantities as per amended Contract shall be considered as Contract Quantities.

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

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

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

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

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

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

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

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

- iii) Let the Total Executable Value of work for which inputs/fronts were made available to contractor and were planned for execution till termination of contract = Y
- iv) Delay in executed work attributable to contractor i.e. $T2 = [1 - (X/Y)] \times T1$
- v) LD shall be calculated in line with LD clause of the Contract for the delay attributable to contractor taking "X" as Contract Value and "T2" as period of delay attributable to contractor.

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

Following sequence shall be applicable for recoveries from contractor after informing the contractor of the total proposed recovery:

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

36.0 **ARBITRATION**

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 any 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.

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.

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GENERAL CONDITIONS OF CONTRACT (G C C)

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Note:-

- 1) Wherever Bidder/contractor is mentioned in this document may understand as “Transmission line Bidder/contractor” and wherever Customer/ purchaser is mentioned “M/s TSTRANSCO” may be considered.**
- 2) In Post award stage, In case of any dispute on any terms & Conditions of M/s TSTRANSCO & BHEL’s tender documents, the decision of BHEL shall be final and binding to the bidders.**

**SECTION: IV
GENERAL CONDITIONS OF CONTRACT (GCC)**

1.0 DEFINITIONS:

1.1 DEFINITION OF TERMS:

In the Contract, the following expression shall, unless the Contract otherwise requires, have the meanings hereby respectively, assigned to them.

- I The 'Purchaser/Owner/Engineer' shall mean the Bharat Heavy Electricals Limited/Transmission Corporation of Telangana Limited (TSTRANSCO) and shall include its successors and permitted assigns.

- II The 'Contractor / Supplier' shall mean the Bidder whose bid has been accepted by the Purchaser and shall include the Bidder's heirs, legal representatives, successors and permitted assigns.

- III The 'Sub-vendor' shall mean the person, firm/company named in the Contract for any part of the work or any person, to whom any part of the Contract has been sublet with the consent in writing of the Engineer, and the heirs, legal representatives, permitted successors and assigns of such persons.

- IV. The 'Engineer' shall mean the officer placing the order for the work with the Contractor or such other officer as may be authorized and appointed in writing by the Purchaser to act as Engineer for the purpose of the Contract.

- V. The 'Supervising Engineer' shall mean such officer as may be duly appointed from time to time by the Purchaser or his Engineer to take general control and supervision of work.

- VI. The 'Inspector' shall mean any person or persons nominated by the Purchaser and/or the Engineer to inspect stores or works under the agreement and/or his duly authorized representative appointed to act as the Inspector.

- VII. The 'Contract' shall mean and include the bid and acceptance thereof, the general conditions, special conditions, specifications, schedules, drawings, Bid document,

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covering letter, schedules of prices, the final general conditions and the Agreement executed on the stamp paper.

- VIII. The 'Specification' shall mean collectively all the terms, stipulations, and conditions of Contract, technical provisions and annexure thereto and list of corrections and amendments mutually agreed upon by both Purchaser and Contractor from time to time in writing.
- IX. The "Goods" means all of the equipment, machinery, and/ or other materials, which the Contractor / Supplier is required to supply to the Purchaser under the Contract.
- X. The "Services" means services to be provided as a part of contract and/or ancillary to the supply of the goods, such as transportation and insurance, and/or any other incidental services, such as erection, erection supervision, testing, commissioning, provision of technical assistance, training and other such obligations of the Contractor / Supplier covered under the Contract.
- XI. 'Tests on completion' shall mean such tests, as are prescribed by specification, to be made by the Contractor to the satisfaction of the Purchaser before the work is taken over by the Purchaser.
- XII. Contract Price: Contract Price means the price payable to Contractor/ Supplier under the Contract for the full and proper performance of its Contractual obligations.
- XIII. 'Commissioning' shall mean the satisfactory operation of the equipment/work as specified, after all necessary tests, checks and adjustments required at site, if any, have been satisfactorily completed and the equipment/works have been in continuous and uninterrupted commercial use for at least 30 days.
- XIV. 'Commercial use' shall mean the use of the work/equipment, which the Contract contemplates or of which it is commercially capable.
- XV. 'Approval' shall mean the written *approval* of the Engineer and/or of the statutory authorities wherever such approval of such authorities are required under any codes or otherwise.
- XVI. 'Month' shall mean calendar month.

XVII. 'Writing' shall include any manuscript, typewritten or printed, statements, with under or over signature or seal as the case may be.

XVIII. 'Letter of Intent' shall mean the Purchaser's letter conveying his acceptance of the bid, subject to such reservations as may have been stated therein.

XIX. **ECV**: Shall mean Estimated Contract Value.

XX. **RTGS**: Shall mean Real Time Gross Settlement.

2.0 APPLICATION/APPLICABILITY:

These general conditions shall apply to the extent that provisions in other parts of the Contract do not supersede them.

3.0 STANDARDS: (Clause 15.0 GTC)

3.1 use of the work/equipment in real time as envisaged in the contract fulfilling the purpose for which it is included.

3.1.1 The goods and services supplied under this Contract shall conform to the standards mentioned in the technical specifications, and when no *applicable* standard is mentioned, to the Indian Standard.

3.1.2 Materials conforming to any other National or International standards are also acceptable provided such standards always are equivalent to or better than the corresponding standards specified in the respective specifications. However, in such an event the salient points of comparison between the standards adopted and the standards quoted herein shall be detailed in the appropriate schedule with an authentic English version of such standards. Two copies of such standards in English language shall be submitted along with the bid

3.1.3 The Indian Electricity Act, Indian Standards and Indian Electricity Rules can be obtained on payment from:

Kitab Mahal
State Emporium Building
Baba Kharak Singh Marg
New Delhi - 110 001
INDIA.

3.2 DEVIATIONS:

3.2.1 Constructional / manufacturing details specified in this specification are for guidance of the Bidder. Minor deviations from the specifications, if any, proposed by the Bidder will be considered on merit, provided they are Manufacturer's proven standards or necessary either to improve utility performance and efficiency or to secure overall economy, but provided further that these do not affect competitive comparison of the proposal. The Purchaser has the right to monetarily evaluate any or all such deviations in accordance with their judgment. The Purchaser also reserves the right to reject any deviation without any consideration.

3.2.2 All commercial and technical deviations shall be specifically and clearly mentioned in schedule for deviations with justifications. Deviations not specifically mentioned in these schedules and if mentioned elsewhere shall not be treated as deviations and the bid may also be rejected in view of this deviation. Even when no deviations are taken, still these schedules should be filled in as follows 'No Deviations taken'. If there are no deviations, Bidder should specifically indicate as "No deviations". **It may be noted that there shall not be any deviations in commercial terms & conditions. Bids with commercial deviations will be rejected.**

4.0 USE OF CONTRACT DOCUMENTS AND INFORMATION:

4.1 The Bidder shall not, without the Purchaser's prior written consent, disclose the Contract, or any provision thereof, any specification, plan, drawing, pattern, sample or information furnished by or on behalf of the Purchaser in connection therewith, to any person other than a person employed by the Bidder in the performance of the Contract. Disclosure to any such employed person shall be made in confidence and shall extend only so far as may be necessary for purposes of such performance.

The Bidder shall not, without the Purchaser's prior written consent, make use of any document or information enumerated in para 4.1 except for the purposes of performing the Contract.

4.2 Any Documents other than the Contract itself, enumerated in Para 4.1 shall remain the property of the Purchaser and shall be returned to the Purchaser on completion of the Contractor's / Supplier's performance under the Contract if so required/insisted by the Purchaser.

5.0 PATENT RIGHTS AND ROYALTIES:

5.1 Royalties and fees for patents covering materials, articles, apparatus, devices, equipment's or processes used in the works shall be deemed to have been included in the Contract price. The

Bidder / Contractor shall satisfy all demands that may be made at any time for such Royalties or fees and he alone shall be liable for any damages or claims for patent infringements and shall keep the Purchaser indemnified in that regard. The Contractor shall, at his own cost and expense, defend all suits or proceedings that may be instituted for alleged infringement of any patents involved in the works, and in case of an award of damages, the Contractor shall pay for such award. In the event of any suit or other proceedings instituted against the Purchaser, the same shall be defended at the cost and expenses of the Contractor who shall also satisfy/comply any decree, order or award made against the Purchaser. But it shall be understood that no such machine, plant, work, material or thing has been used by the Purchaser for any purpose or any manner other than that for which they have been furnished and installed by the Contractor and specified under these specifications, final payment to the Contractor by the Purchaser will not be made while any such suit or claim remains unsettled. In the event any apparatus or equipment, or any part thereof furnished by the Contractor is in such suit or proceedings held to constitute infringement, and its use is enjoined, the Contractor shall, at his option, and at his own expense, either procure for the Purchaser, the right to continue the use of said apparatus, equipment or part thereof, replace it with non-infringing apparatus or equipment or modify it, so that it becomes non-infringing apparatus or remove the equipment and refund the Purchase price plus transportation and installation cost thereof.

- 5.2 The Contractor shall indemnify and keep indemnified the Purchaser, his Successors or assignees for and against any and all claims, suits, damages, losses, actions, demands, costs, charges, royalties and expenses arising from or for infringement, real or claimed of patents, copy rights or other protected rights, if any, designs, plants, device, machine, diagrams, drawings in respect of the material supplied by the Contractor or any of the construction methods of processes followed by the Contractor for the construction of the constructed portion of the 'Project' or for the operation of the constructed portion of the project, are found to have infringed any such rights.
- 5.3 In the event of any claim being made or action being brought against the Purchaser in respect of any of the matters referred to in Clause-5.2 above, the Contractor shall promptly be notified and he shall, at his own expense, conduct all negotiations for the settlement of the same and any litigation that may arise therefrom.

6.0 PERFORMANCE SECURITY: (Refer ITB)

7.0 INSPECTIONS AND TESTS: (Refer GTC)

- 7.1 The Purchaser or his representative shall have the right to inspect and/or to test the goods to confirm their conformity to the Contract specifications. The specifications shall specify what inspections and tests the Purchaser requires and where they are to be conducted. The Purchaser shall notify the Supplier in writing of the identity of the representatives being deputed for these purposes.
- 7.2 The inspections and tests may be conducted at the premises of the Supplier or its Sub-vendor(s), at the point of delivery and/or at the good's final destination. Where conducted on the premises of the Supplier or its Sub-vendor(s) all reasonable facilities and assistance including access to drawing and production data shall be furnished to the inspectors at no charge to the Purchaser. The Bidder should clearly confirm that all inspection facilities exist at his works and shall be made available to the inspecting agency to check the reliability of the equipment.
- 7.3 Should any inspected or tested Goods fail to conform to the specifications, the Purchaser may reject them and the Supplier shall either replace the rejected goods or make all alterations necessary to meet specification/requirements free of cost to the Purchaser.
- 7.4 The Purchaser's right to inspect, test and where necessary, reject the goods after the goods' arrival in the Purchaser's site shall in no way be limited or waived by reason of the goods having previously been inspected, tested and passed by the Purchaser or his representative prior to the goods' shipment from the place / country of origin.
- 7.5 Nothing in clause 7 shall in any way release the Bidder from any warranty or other obligations under this Contract.
- 7.6 All consumables, instruments (T & P), testing instruments and other needs if any, for the above inspections and tests shall be arranged by the Contractor at no cost to the Purchaser.
- 7.7 The Contractor / Supplier shall give the Purchaser/Inspector twenty-one (21) days notice by letter / fax / email of any material being ready for testing.
- 7.8 In case of inspection of imported goods at the manufacturers premises all the costs towards local transport, accommodation etc. for two Inspector's Engineers/ including Inspection/Test Charges shall be borne by the Contractor. **The Contractor or his authorized quality person**

shall accompany the inspector's from TSTRANSCO without fail at the time of inspection of material/ equipment/ works at sub-vendor/ Contractor's work sites and shall sign on the inspection reports. The Contractor shall dispatch the material immediately after issuing of dispatch instructions with test reports *approval*. In case of any delay by more than one month, TSTRANSCO has every right to ask the Contractor to reconduct the inspection and tests at free of cost due to the Contractor's delay.

8.0 PACKING AND MARKING:

8.1 The Bidder shall provide such packing of the goods as is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall take into considerations, where appropriate, the remoteness of the goods final destination and the absence of heavy material handling transporting facilities at all points in transit.

8.2 The packing, marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract and, subject to clause 7 above, in any subsequent instructions given by the Purchaser.

8.3 In general each package shall be marked to indicate:

- a) Name of the Supplier
- b) Details of items in the package
- c) Name of the consignee
- d) Purchase order number
- e) Gross, net and tare weights of the items
- f) Destination.

8.4 Refer packing and marking of the Technical Specifications for further details.

9.0 DELIVERY/COMPLETION PERIOD AND DOCUMENTS:

9.1 Refer Schedule D of Vol- I

9.2 Documents to be submitted by the Supplier/ Contractor are specified as under.
Original and four copies of

- (i) Insurance certificate;
- (ii) Supplier's certificate certifying that the defects if any pointed out during inspection have been rectified (3 copies).
- (iii) The Suppliers invoice showing Purchase Order No. Goods description, quantity, unit price, total amount.
- (iv) Delivery note/ packing list/ lorry receipt.
- (v) Manufacturers/Suppliers guarantee certificate.
- (vi) Certificate of origin.
- (vii) GST receipts, wherever *applicable*, indicating payment mode.
- (viii) Any other document evidencing payment of statutory levies.
- (ix) The items and quantity so far supplied including the present package.
- (x) Manuals in six sets and one set of reproducible drawings.

The Purchaser shall receive the above documents soon after the dispatch of materials and if not received, the Contractor /Supplier will be responsible for any consequent expenses.

Note: The nomenclature used for the item description in the invoices/ packing lists and delivery notes etc., should be identical to that used in the Purchase order. The dispatch particulars including the name of transporter, L.R. No., and date should also be mentioned in the invoice (s).

10.0 INSURANCE: (Refer GCE)

10.1 This clause shall be read with the relevant Clause of GCE.

The Goods supplied under the Contract shall be fully insured against loss or damage incidental to manufacture or acquisition, transportation, storage, delivery and erection. In case of domestic goods the insurance shall be at least for an **amount equal to 110% of the cost of the goods** from "warehouse to warehouse (final destination)" and **storage up to commissioning of goods** thereafter on "All Risks" basis including War Risks and Strike Clauses.

The Contractor shall arrange secure and maintain insurance as may be necessary and for all such amounts to protect the materials of the Purchaser against all risks till the Goods and services is taken over as detailed herein. The form and the limit of such insurance as defined herein together with the underwriter thereof in each case shall be acceptable to the Purchaser. However irrespective of such acceptance the responsibility to maintain insurance at all times during the period of "Contract" shall be that of Contractor alone. The Contractor's failure in this

regard shall not relieve him of any of his Contractual responsibilities and obligations.

The Contractor shall take Insurance cover in their name on behalf of TSTRANSCO. The above insurance shall be made in freely convertible currency. The Contractor shall be responsible for preferring all claims and releasing the amounts from insurance. The scope of such insurance shall cover the entire value of the “Goods and Services”.

The Contractor shall a) Initiate and pursue insurance claim till settlement and b) Promptly arrange for repair and/or replacement of any damaged items in full, irrespective of settlement of insurance claim by the under-writers.

All costs on account of insurance liabilities covered under the Contract will be to the “Contractor’s” account. The Contractor shall provide the Purchaser with a copy of all insurance policies and documents taken over by him in pursuance of the ‘Contract’. Such copies of documents shall be submitted to the Purchaser immediately after such insurance coverage. The Contractor shall also inform the Purchaser in writing at least sixty (60) days in advance, regarding the expiry, cancellation and / or change in any of such documents and ensure revalidation / renewal etc., as may be necessary, well in time. The Purchaser shall assist the Contractor, if required, in obtaining Licenses/port clearances, etc., in respect of foreign supplier required for the purpose of replacement of Goods lost in transit. The risks that are to be covered under the insurance shall be comprehensive and shall include, but not be limited to, the loss or damage in transit, storage, due to theft, pilferage, riot, civil commotion, weather conditions, accident of all kinds, fire, flood, war risk (during ocean transportation) bad or rough handling etc. The scope of such insurance shall cover the entire value of the ‘Works’.

All costs on account of insurance liabilities covered under the ‘Contract’ **will be to the Contractor’s account** and will be included in ‘Contract Price’. However, the Purchaser may from time to time, during the pendency of the ‘Contract’, ask the Contractor in writing to limit the insurance coverage risks and in such a case, the parties to the “Contract” will agree for a mutual settlement, in reduction in ‘Contract Price’ to the extent of reduced premium amounts. **The insurance beneficiary shall be TSTRANSCO.**

Contractors are advised to claim the bills for Supplies / works and insurance separately. Insurance claims will be paid only after getting confirmation from the Insurance companies. Wherever the bills are claimed combined, the insurance amount will be excluded initially and paid only after getting the confirmation from the insurance companies, so that the main bills are paid without delay.

11.0 TRANSPORTATION:

- 11.1 The Bidder is required, under the Contract, to deliver the Goods free at Destination. Transport of the goods to the destination, shall be arranged and paid for by the Contractor /Supplier, and the cost thereof shall be included in the Contract price. It shall be the total responsibility of the Bidder/Contractor to ascertain transportation limitations if any before he bids or supplies.
- 11.2 Where the Contractor is required to effect delivery under any other terms, for example, by post or to another address, the Contractor/Supplier shall be required to meet all transport and storage expenses until delivery.
- 11.3 In all of the above cases, transportation of the goods after the delivery to destination site/ stores shall be the responsibility of the Contractor unless specified otherwise.

12.0 INCIDENTAL SERVICES:

- 12.1 As specified below the Supplier may be required to provide in addition to erection, testing and commissioning the following services.
- (a) Performance or supervision of on-site erection/ assembly, testing and commissioning and/or start-up of the supplied goods;
 - (b) Furnishing of list of tools required for the assembly, testing & commissioning and/or maintenance of the supplied goods and also detailed operations and maintenance procedures for each appropriate unit of the supplied Materials/ equipment.
 - (c) Performance or supervision or maintenance and/or repair of the supplied Goods, for a period of time agreed by the parties, provided that this service shall not relieve the Supplier of any warranty obligations under this Contract;
 - (d) Conduct of training of the Purchaser's personnel, at the Supplier's plant and / or on-site in assembly, start-up, operation, maintenance and/or repair of the supplied Material/equipment.
- 12.2 Prices for the above shall be included in the total Bid price.

13.0 SPARE PARTS:

- 13.1 As specified below the Contractor may be required to provide any or all of the following materials and notifications pertaining to spare parts manufactured or distributed by the

Contractor:

- (a) Such spare parts as the Purchaser may elect to purchase from the Contractor / Supplier, provided that this selection shall not relieve the Supplier of any warranty obligations under the Contract, and
- (b) In the event of termination of production of the spare parts:
 - (i) Advance intimation to the Purchaser of the pending termination, in sufficient time to permit the Purchaser to procure the needed requirements, and
 - (ii) Following such termination, furnishing at no cost to the Purchaser, the blue prints, drawing and specifications of the spare parts, when requested.

14.0 WARRANTY/GUARANTEE

14.1 The Contractor shall guarantee, among other things the following:

- i. Quality and strength of materials /equipment used.
- ii. Adequate factors of safety for the material/equipment to withstand the mechanical and/or electrical stresses developed therein. These shall be stated in the Bid.
- iii. The delivery and erection periods given in the Bid.
- iv. The Contractor shall warrant further that the services to be carried out under this Contract shall conform with generally accepted professional standards and Engineering principles.
- v. The materials/equipment supplied and erected shall be guaranteed for satisfactory operation for a minimum period of 12 months from the date of commissioning of works/project. Till the time of completion of satisfactory operation period, Bank Guarantee for performance security and Bank Guarantee for final payment shall be valid to cover Guarantee/warranty period with a claim period of two months.

However, any Engineering error, omission, wrong provision, Goods failure etc., shall be attended to by the Contractor up to and on the date of actual Commissioning of the Goods / services without any revision in the price or extra cost.

14.2 If during the period of guarantee, any of the materials found defective and/or fail in test or

operation, such materials, shall be repaired or replaced by the Contractor free of cost to TSTRANSCO irrespective of the reimbursements from the insurance company within reasonable time which shall in no circumstance be more than 30 days or such other reasonable time as the TSTRANSCO may deem proper to afford failing which the cost of the failed material will be deducted from the subsequent bills/Bank Guarantee of the Contractor.

- 14.3 The Contractor shall bear all the expenses incurred in connection with the repair or replacement against such defective Goods inclusive of all freight both inland and overseas, insurance, customs levies, forwarding and clearing and demurrage and other incidental charges involved in delivering the said Goods to the Purchaser's specified destination. The decision whether correction of the defects should be by the repair or replacement shall be the sole discretion of the Purchaser.
- 14.4 Provision of this clause shall also apply to all materials and services repaired or replaced under the provision of this until the expiration of period of 12 (twelve) months from the date of such repair or replacement. In case of replacement/repair of any material/works after commissioning of the Sub-Station/Bay Extension/Tr. Line and before expiry of Guarantee/Warranty period, the Contractor shall furnish separate bank guarantee valid for 12 Months with 2 months claim period from the date of repair / replacement covering the value of such materials / works.
- 14.5 The cost of any special or general overhaul rendered necessary during the guarantee period due to defective Goods and Services furnished by the Contractor shall be borne by the Contractor.
- 14.6 The taking over of the Goods and services by the Purchaser shall in no way relieve the Contractor of his obligation under this clause.
- 14.7 The Contractor shall co-operate with the Purchaser in all ways in repair or replacement of the defective part, so as to minimize, to the extent possible, the interruption in operation of Goods.
- 14.8 Where the Sub-vendors provide longer periods of warranty than mentioned above, the Purchaser shall be entitled for such longer guarantees.
- 14.9 If the Contractor /Supplier, having been notified, fails to rectify the defect(s) (or) replace the defective goods within a reasonable period, the Purchaser may proceed to take such remedial action as may be necessary, at the Supplier's risk and expense and without prejudice to any other rights which the Purchaser may have against the Supplier under the Contract.

14.10 The Contractor's full and extreme liabilities under this clause shall be satisfied by the payments to the Purchaser of the extra cost, of such replacement procured including erection as provided for in the Contract, such extra cost being the ascertained difference between the price paid by the Purchaser for such replacements and the Contract price portion for such defective plants. Should the Purchaser not to wish replace the defective plant, the Contractor's extreme liability under this clause shall be limited to repayment of all sums paid by the Purchaser under the Contract for such defective plant.

14.11 Bid Proposals offering any other terms of warranty/guarantee, will be treated as non-responsive and rejected.

14.12 Guarantee for Works: Refer Clause No. 48 of G.C.E.

15.0 TERMS OF PAYMENT:

15.1 For Supply (equipment/material) :

i) 80% payment will be made within 30days for the material / equipment supplied and received in complete shape at destination stores/site in good condition (i.e. from Check measurement date in Form-13). The concerned AEE/ Field will receive the equipment/material in full shape at site and the concerned EE/Field will do the check measurement and issue the Form-13. The check measurement shall be done within five days from the date of receipt of materials. The due date for payment will be reckoned from the date of check measurement mentioned in Form-13.

ii) 10% payment will be made after successful erection of equipment/material.

iii) Balance 10% payment will be made after commissioning of equipment / material.

The Contractor will have to predefine the bank details while entering into Contract. The payments will be transferred to the Contractor's bank account by the Purchaser. The bank details of Bidder as above are final and shall not be revoked under any circumstances. The bank charges will be made to the account of Contractor. An amount of Rs. 50/- (Rupees Fifty only) will be recovered from the bill amount per each disbursement raised by the unit officer of TSTRANSCO.

No interest will be payable in case payment is delayed for whatever reason.

The 80% payment mentioned above is subject to submission of performance security by the Contractor /Supplier.

The Supplier should invariably submit test certificates and other documents as specified by the Purchaser before dispatch is made so that they can be checked and approved well in advance.

The performance guarantees to be executed in accordance with this specification will be furnished on a stamp as per of TS for a value of Rs.100/-. The Bank Guarantee will be extended suitably if required.

The payments are subject to providing performance security with validity of 12 months with 2 months claim period as on the date of check measurement of materials or works.

If the Supplier has received any over payments by mistake or if any amounts are due to TSTRANSCO due to any other reason, when it is not possible to recover such amounts under the Contract resulting out of this specification, the TSTRANSCO reserves the right to collect the same from any other amount and / or Bank Guarantees given by the company due to or with TSTRANSCO.

When the Supplier does not at any time, fulfill his obligations in replacing / rectifying etc. of the damaged / defective materials in part or whole promptly to the satisfaction of the TSTRANSCO Officers, TSTRANSCO reserves the right not to accept the bills against subsequent dispatches made by the Supplier and the Supplier only will be responsible for any demurrages, wharf ages or damage occurring to the consignments so dispatched.

Summary sheet of shall be submitted by the contractor with each bill duly providing the details of item wise quantity supplied until the present consignment, quantity delivered in this consignment and balance to be delivered and corresponding amounts of payment.

The payment will be made to the Supplier under this Contract in Indian Rupees only.

The following documents specified below shall be submitted to the paying officer.

- a) Original buyer invoice.
- b) Delivery Challan Acknowledged by the consignee (S) (6 copies)
- c) Insurance Certificate
- d) Manufacturers/Suppliers Warranty Certificate
- e) *Approval* of routine and Acceptance test reports.
- f) 6 copies of packing list

g) Copy of Acceptance Letter of Performance Security issued by Purchaser.

The quoted rates are variable for following items of Equipment & Materials

Sub station/Bay extensions:

Circuit Breakers, Instrument transformers, Lightning arresters, Isolators, Substation Structures, M.S Rod/Flat, G.I Flat, Moose ACSR Conductor, Power and Control cables, Power Transformers and Reactors are VARIABLE.

Transmission Line:

Tower parts including Bolts and Nuts, ACSR Moose conductor, GSS Earth wire are VARIABLE.

Except for the above items, for the remaining items in the tender the prices are firm.

No payments will be made for the supplies made prior to schedule delivery or for material which are not in full shape.

15.2 PAYMENT FOR ERECTION: (Clause No. 54 of GCE) :

- a) Ninety percent (90%) payments of the periodical progressive bills for the erection works will be made for the items of work done. For this purpose, the Contractor shall submit bills to the concerned Executive Engineer regularly to ensure payments in time. The Contractor shall give the full details of items of works done against each location in support of the bill along with the summary sheet of payment particulars with the details of item wise quantity of work completed until the present claim, quantity of work completed against this claim and balance work to be carried out and corresponding amounts of payments. Bills submitted without supporting details will not be taken in to cognizance. Payment is subject to submission of performance security by the Supplier/Contractor.
- b) Out of the balance 10% amounts, 5% payments will be released after completion of all the works & submission of Material Accounts subject to submission of the following certified by the field Engineer of TSTRANSCO.
 - a. As built drawings.
 - b. Instruction, O&M manuals and installation manuals as *applicable*.
 - c. Reconciliation of bill of material and order as executed.
 - d. Distribution copies of all drawings.
 - e. Tools and plants.
 - f. Equipment drawings, shop floor drawings and design calculation as *applicable*.

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- c) The balance (final) 5% will be paid after completion of one-year performance guarantee period from the date of completion of all the works as per Contract and settlement of material account.
- d) **The date of commissioning/ energizing the equipment will not be considered for reckoning the performance guarantee period and the date of completion of all the works will only be considered as start date of Guarantee period.**

Price variation is *applicable* for the items cement and reinforcement steel which is as per Price Variation clause mentioned in ITB.

- e) In case, the balance materials are returned to TSTRANSCO well before the completion of the performance guarantee period, the 5% amount will be released against a bank guarantee for equal amount, which shall be valid for the performance guarantee period with a claim period of two months along with "Performance Security Bank Guarantee". All bank charges should be to the account of the Contractor".
- f) Contractor shall not be entitled to the said 5% retention amount under following,
- Non Settlement of material accounts
 - Pending any Statutory remarks if any even after defect liability period (Guarantee period).
 - Non completion of replacement/rectification of defective material during defect liability period(Guarantee period).

If any unsatisfied work remains after all the payments are made to the contractor, he shall refund to the Purchaser, all moneys that the latter may be compelled to pay in discharging such including all costs and the attorney's fees so incurred.

- g) The Contractor will have to predefine the bank details while entering into Contract. The payments will be transferred to the Contractor's bank account by the Purchaser. The Bank details of Bidder.as above are final and shall not be revoked under any circumstances. The bank charges will be made to the account of Contractor. An amount of Rs. 50/- (Rupees Fifty only) will be recovered from the bill amount per each disbursement raised by the unit officer of TSTRANSCO.

The payments are subject to providing performance security with validity of 12months with 2months claim period as on the date of check measurement of materials or works.

15.2.1 FINAL PAYMENT (Clause No. 55 of GCE):

Whenever, in the opinion of Purchaser /Owner, the work covered by the Contract has been completed, he shall prepare a final abstract showing the total amount of work done by Contractor and its value under and according to the terms of the Contract. From the total value thus arrived at, shall deducted all previous payments and all deductions made in accordance with the provisions of the Contract. The remainder shall be paid by Purchaser/Owner to Contractor within three months after the date of Purchaser's /Owner's final certificates.

Payment of the retention amount shall be due after the Defects Liability period (Guarantee period) of 12 calendar months, as per conditions stipulated in Clause 48 and clause 54.1 b and c of GCE.

- 15.3 Where the Contractor requests for the payment in advance before the “scheduled date of payment”, would be examined by the **Executive Director(Finance)/ TSTRANSCO** to decide whether such facility could be extended or not and if found acceptable the Contractor should agree to offer a rebate /discount @ 0.3 % per week or part there of for the advancement. Based on the decision, the Finance & Accounts wing will release priority payment to such Contractor after availing of the rebate/discount.

15.6 However, followings may please be noted by the bidders:-

- **All payments (as agreed between the parties) shall be made by BHEL to the party after receipt of payments from end customer not later than 30 (Thirty) days after receipt of payment from M/s TSTRANSCO.**
- **No interest shall be payable to contractor on account on any delayed payments:**

16.0 PRICES : (Refer Section - III : ITB)

16.1 Price Variation Clause: (Refer Section – III : ITB)

17.0 CHANGE OF ORDERS / SERVICES / WORKS:

17.1 The Purchaser may at any time, by a written order given to the Contractor / Supplier pursuant to clause 30, make changes within the general scope of the Contract in any one or more of the following:

- (a) Drawings, designs or specifications, where goods to be furnished under the Contract are to be specifically manufactured for the Purchaser.
- (b) The method of shipment or packing;
- (c) The place of delivery; or
- (d) The services to be provided by the Supplier.

However, if any suggested changes would, in the opinion of Contractor, prevent him from fulfilling any of his obligations or guarantee under the Contract, he shall notify Purchaser thereof in writing, and Purchaser shall decide forthwith whether or not the same shall be carried out, and if Purchaser confirms his instructions Bidder's obligations and guarantee shall be modified to such an extent as may be mutually agreed.

17.2 If any change caused under clause-17.1 results in (a) an increase or decrease in the cost of, or the time required for, the Supplier's performance of any part of the work under the Contract, whether changed or not changed by the order, an equitable adjustment shall be made in the Contract price or delivery schedule, or both, and the Contract shall accordingly be amended. In any case in which Contractor has received instructions from Purchaser as to carrying out the changes which either then or later will, in the opinion of Contractor, involve a claim for additional payment for extra work or for extra materials, Contractor shall, as soon as reasonably possible after receipt of such instructions, advise Purchaser that effect. However, Purchaser / owner shall not be liable for payment of any charge in respect of any such changes, unless instructions for making the same shall have been given in writing by Purchaser after receipt of such advice from Contractor.

17.3 In case Purchaser and Contractor are unable to arrive at a mutual agreement on the issue of whether or not certain changes ordered by Purchaser involve extra work and/or extra material entitling Contractor to claim for extra payment, Contractor nevertheless shall, if so required by Purchaser carryout the same and the matter in dispute shall be decided by arbitration as provided elsewhere in this specification. Items not covered by the schedule of Quantities but are similar in nature to the items already covered shall be paid for, the rates being worked out

on the basis of rates quoted for similar items. The written authorization for extra work shall be in the form of 'Modification permit'. All such modifications shall be executed under the provisions and conditions of the original Contract.

18.0 CONTRACT AMENDMENTS:

- 18.1 Subject to clause 17, no variation or modification of the terms of the Contract shall be made except by written amendment issued to the Purchase order.

19.0 ASSIGNMENT:

- 19.1 The Contractor shall not assign, in whole or in part, its obligations to perform under the Contract, except with the Purchaser's prior written consent.

20.0 SUB-CONTRACTS:

The Contractor may after informing the Purchaser and getting his written approval, assign or sublet the Contract or any part thereof other than for raw materials, for minor detail or any part of the work identified in the Contract.

The Contractor shall guarantee that any and all sub-contractors of Contractor for performance of any part of the work under the Contract will comply fully with the terms of the Contract applicable to such part of the work. Any assignment as above without prior written approval of Purchaser shall be void.

Suppliers of the Goods not identified in the Contract or any change in the identified supplier shall be subject to approval by the Purchaser. The experience list of the Supplier under consideration by the Contractor for this Contract shall be furnished to the Purchaser for approval prior to procurement of all such Goods.

Such assignments/sub-letting shall not relieve the Contractor from any obligation, duty or responsibility under the Contract and he shall be responsible for the acts, defaults and neglects of any sub-contractor, his agents, servants or workmen as fully as if they were acts, defaults or neglects by Contractor, or his agents, servants or workmen.

The Contractor shall guarantee that any and all sub-contractors of Contractor for performance of any part of the work under the Contract will comply fully with the terms of the Contract applicable to such part of the work. Any assignment as above without prior

written approval of Purchaser shall be void.

- 20.1.1 The Supplier shall guarantee that any and all the Sub-vendors of Supplier for performance of any part of the work under the Contract at will comply fully with the terms of the Contract *applicable* to such part of the work.
- 20.1.2 Should any Sub-vendor fail to carry out any portion of the 'Work' satisfactorily, this work shall be cancelled by the Supplier on written notice to the effect from the Purchaser. The 'Work' however shall be continued by the Supplier himself or through another approved Sub-vendor and completed as per agreed schedule.
- 20.1.3 The quality plans called for from the Sub-vendor shall set out during the various stages of manufacturer and installation, the quality practices and procedures followed by the Sub-Supplier's quality control organization, the relevant reference documents/standards used, acceptance level, inspection of documentation raised etc. Such quality plans of the successful Sub-Supplier's shall be discussed and finalized in consultation with the Purchaser and shall perform a part of the Purchase order/Contract between the Sub-Supplier and the Supplier. Within 3 weeks of the release of the same Purchase order/ Contracts for such bought out items/components, a copy of the same without price details but together with detailed Purchase specifications, quality plans and delivery conditions shall be furnished to the Purchaser by the Supplier.

21.0 DELAYS IN THE SUPPLIES AND SERVICES:

- 21.1 Delivery of the goods/ equipment and performance of services shall be made by the Contractor in accordance with the completion period specified.
- 21.2 An unexcused delay by the Supplier/Contractor in the performance of its delivery obligations or performance of incidental services as per Clause-12 above would render the Supplier/Contractor liable to any or all of the following sanctions: forfeiture of its performance security, imposition of Penalty, and/or termination of the Contract for default.
- 21.3 If at any time during performance of the Contract, the Supplier or its Sub-vendor(s) should encounter conditions impeding timely delivery of the goods and performance of services, the Supplier/Contractor shall promptly notify the Purchaser/Owner in writing of the fact of the delay, its likely duration and its cause(s). As soon as practicable after receipt of the Supplier's/Contractor's notice, the Purchaser/ Owner shall evaluate the situation and may at its

discretion extend the Contractor's time for performance, in which case the extension shall be ratified by both the parties by amendment of the Contract.

- 21.4 Even if the work gets prolonged due to some reasons or other, beyond the specified completion period, the Contractor should remain at site and complete Contracted work subject to the terms and conditions provided in the Contract.

22.0 PENALTY FOR LATE SUPPLIES / COMPLETION:

The completion period mentioned in Schedule-D is the essence of contract. Penalty will be levied as follows for the delay in executing the works or supply of material.

a) Penalties after overall completion period:

"In case of delay in erection of the works or supply of material / equipment beyond overall completion period, whatever may be the reasons; the TSTRANSCO shall levy and collect the penalty @ **0.5%** per week of the delay on the delayed value of the works / Materials / Equipment.

However, the sum of the penalties stated above are subject to a **maximum of 10% of the total value** of the contract. Once the maximum is reached, TSTRANSCO may consider termination of the contract.

In case the Contractor fails to execute the supplies/works as per the program or in the opinion of Purchaser, the supplies/works are progressing at a slow pace, TSTRANSCO reserves its right to get the balance or part of supplies/works executed through other agencies at the risk and cost of the successful bidder, this is in addition to the right of the TSTRANSCO to recover any damage from the contractor and also blacklisting.

SPECIFIC ACCEPTANCE OF THIS CLAUSE SHOULD BE BOLD IN THE BID. IF SUCH ACCEPTANCE IS NOT INDICATED, THE BID IS LIABLE TO BE OVERLOOKED/Rejected.

- (ii) The date of receipt of materials/equipment at the destination stores in good condition (The date of Check measurement in Form-13) will be taken as the date of delivery.

For penalty, the number of days of delay would be rounded off to the nearest week

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and interest calculated accordingly. Materials / equipment which are not of acceptable quality or are not conforming to specification would be deemed to be not delivered. The penalty specified shall be levied and would be adjusted against same bill / subsequent pending bills.

‘Penalty shall be calculated while admitting the final bill, duly taking into account, extension of completion period if any, and the penalty shall be recovered along with applicable GST.

However, to ensure availability of sufficient amount for deducting penalty a recovery of 0.5% of the value of supply/work, delayed, per week (or part thereof, as the case may be) shall be adjusted against the penalty (+GST) levied while admitting the final bill’

- (iii) Deficiency in quality of works in deviation from the specification: Instance wise minimum penalty leviable and debarred from participating in future tenders for a minimum period of one year, indicated as below.

S. No.	Deficiency in quality of works in deviation from the specification/ Agreement such as	Instance wise Minimum penalty leviable in Rupees during the same work by the Contractor	Duration of disqualification of the Contractor in participation the tenders of TSTRANSCO in the event of further instance.
		1 st Instance 2 nd Instance 3 rd Instance	
1	2	3	4
Cat eg ory -I	Not using (i) prescribed shoring, shuttering and dewatering equipment, (ii) measurement boxes, (iii) Form boxes for different types of foundations and steel measuring boxes, (iv) not providing adequate number of chairs to the steel reinforcements, (v) not carrying out back filling and compaction of the foundation pits in layers and leveling the tower footings properly, (vi) not ensuring that the excavated earth is dumped at least 2 meters away from	5000 10000 15000	Debarred from participating in future tenders for a minimum period of one year.

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	the pit etc., and (vii) not providing copings to the tower legs/stubs (viii) not providing water tanker, Earth rammers/earth vibrators.		
Cat eg ory -II	Use of reinforcement steel without ISI marking, not using vibrators for effective consolidation of the concrete during foundation works, not using proper templates for firmly keeping the stubs in position when templates are supplied by the Contractor and improper fixing of stubs, non ensuring of tower verticality, use of rusted stubs and tower parts if supply is by the Contractor, non painting of butt joints and rusted stubs with zinc rich paint immediately after erection of the towers and stringing, non fixing of earth flat to the stub, non deployment of technical personnel for supervision of works by the Contractor.	7500 15000 22500	Debarred from participating in future tenders for a minimum period of one year.
Cat eg ory -III	Use of improper grade/quality of raw material like HBG metal, water and sand for concreting using clogged and/or lump/ clotted cement for concreting not ensuring proper curing for foundation concrete, not ensuring that all the members of the tower are placed in position and firmly fixed with bolts and nuts immediately after erection of tower.	10000 20000 30000	Debarred from participating in future tenders for a minimum period of one year.

The penalty in the first instance shall be finalised by Executive Engineer concerned based on the report of Assistant Divisional Engineer concerned after giving an opportunity to the Contractor to submit explanation.

Penalty for second instance shall be finalised by the Superintending Engineer concerned based on the report of Executive Engineer concerned after giving an opportunity to the Contractor to submit explanation.

Penalty for third instance shall be finalised by the Chief Engineer concerned based on the report of Superintending Engineer concerned after giving an opportunity to the Contractor to submit explanation.

For the fourth instance of deficiency, the Chief Engineer concerned shall report to the Director, concerned proposing for debarring the Contractor from participating in future tenders for a minimum period of one year. Technical Committee shall examine the facts and figures of the case and take a final view in the case.

23.0 TERMINATION FOR DEFAULT:

The Purchaser may, without prejudice to any other remedy for breach of Contract, by written notice of default sent to the Supplier/ Contractor, terminate the Contract in whole or in part:

- a) If the Supplier/Contractor fails to deliver any or all of the goods and to complete any or all works commensurate with progress of completion within the time period(s) specified in the Contract or any extension thereof granted by the Purchaser.
- b) If the Supplier/Contractor fails to perform any other obligation(s) under the Contract.
- c) If the Supplier/Contractor, in the judgment of the Purchaser has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.

Termination of Contract:

If it is found that progress of works are not commensurate with the program of completion or if the Contractor does not fulfill his obligations as per the terms of the specification TSTRANSCO will be entitled to terminate the Contract in part or full by giving 15 days notice and get the balance works completed through other agencies at the Contractor's cost and risk.

Warning letters have to be issued by Superintending Engineer concerned and /or Chief Engineer/LIS if the progress is not satisfactory. If the progress continues to be poor even after the second warning letter, show cause notice/final notice will be issued by the Chief Engineer/ LIS. If no satisfactory reply is received or the progress of the works are not improved within 15 days of issue of the final notice/show cause notice, the Chief Engineer/ LIS shall terminate the agreement, which will be followed by stoppage of all payments to the Contractor, encashment of the BGs, and after termination of Contract the balance works/supplies shall be completed through alternate agencies at Contractor's risk and cost. **The Contractor so**

penalized shall be blacklisted for 3 years from the date of termination of Contract.

In the event of termination of Contract due to delay attributable to the Contractor, TSTRANSCO is entitled to get back equipment/material from the Contractor for the payment already made but the material is not put to use, and then get the works done by other agency/agencies for completion of Contract by using the said recovered material. The Contractor shall have no objection in this regard.

However, the Supplier /Contractor shall continue performance of the Contract to the extent not terminated.

24.0 FORCE MAJEURE:

24.1 Notwithstanding the provisions of clauses 21, 22 and 23, the Contractor/Supplier shall not be liable for forfeiture of his Performance Security, Penalty or termination for default, if and to the extent that, its delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure.

24.2 For purposes of this clause, "Force Majeure" means an event beyond the scope of Contractor /Supplier and not involving the Supplier's/Contractor's fault or negligence and not foreseeable. Such events may include, but are not restricted to, wars or revolutions, fires, earthquakes, floods, epidemics, quarantine restrictions, freight embargoes, riots, civil commotions etc.

24.3 If a Force Majeure situation arises, the Supplier shall promptly notify the Purchaser in writing of such condition and the cause thereof. Unless otherwise directed by the Purchaser in writing, the Supplier shall continue to perform his obligations under the Contract as far as is reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event. **No price variance will be allowed during the period of force majeure.**

24.4 Bids of Bidders offering any other terms other than what is stated above will be treated as non-responsive.

25.0 TERMINATION FOR INSOLVENCY:

25.1 The Purchaser may at any time, terminate the Contract by giving written notice to the

Supplier/Contractor, without compensation to the Supplier/Contractor, if the Supplier/Contractor become bankrupt or otherwise insolvent. In this event, termination will be without compensation to the Supplier, provided that such termination will not prejudice or affect any right of action or remedy, which has accrued or will accrue thereafter to the Purchaser.

26.0 SUSPENSION, TERMINATION BY PURCHASER FOR CONVENIENCE:

- 26.1 The Purchaser reserves the right to suspend and re-instate execution of the whole or any part of the 'Works' without invalidating the provisions of the 'Contract'. Orders for suspension or reinstatement of the 'Works' will be issued by the Purchaser or Engineer to the Contractor in writing. The time for completion of the works will be extended suitably to account for duration of the suspension.
- 26.2 The Purchaser may, by a written notice sent to the Supplier/Contractor, terminate the Contract, in whole or in part, at any time, for its convenience. The notice of termination shall specify that the termination is for the Purchaser's convenience, and the extent to which performance of work under the Contract is terminated, and the date upon which such termination becomes effective.
- 26.3 The goods / equipment that are complete and ready for dispatch within 30 days after the Supplier's receipt of notice of termination shall be purchased by the Purchaser at the Contract terms and prices.
- 26.4 The Purchaser shall have the right to seek the discontinuance of the work, in whole or in part, for such time as may be necessary, should the condition of the weather or flood or other contingencies make it desirable to do so, in order that the works shall be well and properly executed. Extension of time shall be granted to Contractor for discontinuance of work so ordered and Contractor shall not claim for compensation or damage in relation thereto.
- 26.5 The Contractor /Supplier will be further required to transfer the title and provide the Purchaser with the drawings, information and Contract rights as the Supplier as specifically performed, produced or acquired for the performance of the 'Contract'.

27.0 RESOLUTION OF DISPUTES:

All and any disputes or differences arising out of or touching the order based on this specification shall be decided by a panel of arbitrators as detailed below:

Value of Claim	Panel of Arbitrators
i) Disputes involving amounts up to Rs.10,000/-	Superintending Engineer of the TSTRANSCO other than the and below. circle to which the disputes relate.
ii) Disputes involving amounts ranging from Rs.10,001 to Rs.50,000/-	Any Chief Engineer of the TSTRANSCO.

There shall not be any reference of disputes, the value of which is above Rs.50,000/- to arbitration. The parties shall approach the competent Civil Courts situated in Hyderabad/ Secunderabad twin cities only, if any such disputes shall arise involving amounts more than Rs.50,000/-.

A reference for adjudication under this clause shall be made by either party to the Contract, within one year from the date of intimating the Contractor of preparation of final bill or his having accepted the payment.

28.0 GOVERNING LANGUAGE:

28.1 The Contract shall be written in the **language of English**, as specified by the Purchaser in the Instructions to Bidders. All correspondence and other Documents pertaining to the Contract which are exchanged by the parties shall be written in that same language.

29.0 APPLICABLE LAW:

The Contract shall be interpreted in accordance with the laws in India.

30.0 NOTICES:

30.1 Any notice given by one party to the other pursuant to this Contract shall be sent in writing or fax and confirmed in writing to the address specified for that purpose. **PURCHASER:** Chief Engineer / LIS, TSTRANSCO, 2nd Floor, B-Block, Room No.203, Vidyut Soudha, Hyderabad-500 082 (TS) INDIA.

Supplier: To be filled.

30.2 A notice shall be effective when delivered or on the notice's effective date, whichever is later.

31.0 TAXES AND DUTIES:

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.
2. 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.
3. The Contractor is responsible to furnish documentary evidence towards GST Registration of the State wherein the site is located or any other documents as per GST Act which may be required from time to time. BHEL will not be held to be responsible for any non-compliance of the Contractor in respect of GST laws as framed from time to time.
4. 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.)
5. The GST amount shall 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.
6. Statutory variation, if any, on account of GST will be payable by BHEL (if Payable by TSTRANSCO) at actuals on submission of documentary evidence within the contractual delivery schedule Only..
7. 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.
8. 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 (if Payable by TSTRANSCO) subject to submission of documentation as per statute within the contractual delivery schedule Only..

32.0 **SECRECY:**

Bidder shall not disclose any information furnished by owner nor any drawings, reports and other information prepared by Contractor for the project, without the prior written *approval* of Purchaser except in so far as disclosure is necessary for the performance of Contractor's work and services under this Contract.

33.0 **INDEMNIFY THE PURCHASER:**

33.1 Bidder shall indemnify owner/Purchaser in respect of all actions, suits, claims and demands brought or made against Purchaser by the workmen of Contractor or any other person or persons whomsoever in connection with the works or in respect of any matter or thing done or omitted to be done by Contractor in the execution of or in connection with the works not withstanding that all reasonable and proper precautions may have been taken by Contractor and against any loss or damage to Purchaser in consequence of any action or suit being brought against owner for anything done or committed to be done in connection with the execution of the work. The indemnity given by Contractor as aforesaid shall extend to making good all claims and demands arising out of losses/penalty to property of every description and kind, the infringement of any legal right as well as injury or accident to any person resulting in death or otherwise.

33.2 The Purchaser shall have full power and right at his discretion to defend or compromise any suit or pay claim or demand brought or made against him as aforesaid whether pending or the rated, as he may consider necessary or desirable and shall be entitled to recover from Contractor all sums of money including the amount of penalty and compensation and all legal costs charges and expenses in connection with any compromise or award which shall not be called into question by Contractor and shall be final and binding upon him.

33.3 Bidder shall reinstate all penalty of every sort mentioned in this clause so as to deliver the whole of the Contract works completed and perfect in every respect and so as to make good or otherwise satisfy all claims for damage to the property of third parties.

34.0 **PATENT INDEMNIFICATION:**

34.1 Bidder shall indemnify and keep indemnified Purchaser, his successors or assignees for and

against any and all claims, suits, penalty, losses, actions, demands, costs charges, royalties and expenses arising from or for infringement, real or claimed, of patent-rights, copyrights or other protected rights, if any design plans, device, machine, diagrams, drawings or in respect of the material supplied by Contractor or any of the construction methods of processes followed by Contractor for the construction of the constructed portion of the project, or for the operation of the constructed portion of the project, are found to have infringed any such rights.

34.2 In the event of any claim being made or action being brought against Purchaser in respect of any of the matters referred to in clause 34.1 above, Contractor shall promptly be notified and he shall, at his own expenses, conduct all negotiations for the settlement of the same and any litigation that may arise there from.

34.3 In the event any designs, drawings, plans or diagrams or any of the construction methods of processes furnished/followed by Contractor for the construction of the portion of project or for the operation of the project, constitute infringement of patent or any of the protected rights and use thereof is restrained, Contractor shall procure for Purchaser, at no cost to the latter, the right to continue using the same or to the extent it is possible, replace the same with non-infringing work approved by Purchaser or modify them so that they become non-infringing, but such modifications shall otherwise to be the entire satisfaction of Purchaser. The provisions of this paragraph shall survive the completion, expiration or termination of the Agreement.

35.0 IMPORT LICENSE:

Obtaining Import License shall be of Contractor responsibility for imported goods offered against the Bid. However, the purchase on specific request by the Contractor will issue Project Authority Certificate.

36.0 URGENT WORKS

If any urgent work (in respect where of the decision of the Engineer-in-charge shall be final and binding) becomes necessary and the Contractor is unable or unwilling at once to carry it out, the Engineer-in-Charge may carry it out as he may consider necessary. If the urgent work shall be such as the Contractor is liable under the Contract to carry out at his expenses all expenses incurred on it by TSTRANSCO shall be recoverable from the Contractor and be adjusted or set off against any sum payable to him.

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VOLUME -I :: SECTION -V

SPECIAL CONDITIONS OF CONTRACT (S C C)

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Note:-

In this Tender document, wherever Bidder/contractor is mentioned may understand as "Transmission line Bidder/contractor" and wherever Customer/ Purchaser is mentioned "M/s TSTRANSCO may be considered.

In Post award stage, In case of any dispute on any terms & Conditions of M/s TSTRANSCO & BHEL's tender documents, the decision of BHEL shall be final and binding to the bidders.

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**SECTION - V
SPECIAL CONDITIONS OF CONTRACT (SCC)**

1.0 GENERAL:

The following Special Conditions of Contract shall supplement the General Conditions of Contract.
Whenever there is a conflict, the provisions stringent shall prevail over those in the General Conditions of Contract. The corresponding clause number of the General Conditions is indicated in parentheses.

2.0 DEFINITIONS (CLAUSE 1 of GCC):

- (a) The Purchaser is : **M/s TSTRANSCO.**
- (b) Name of Supplier is : (Successful Bidder)

3.0 COUNTRY OF ORIGIN : Country of origin shall be **INDIA (Cl.1.2 ITB) & (Cl.3.0 of GCC)**

4.0 DELIVERY AND DOCUMENTS: (CLAUSE 9 of GCC)

- i) Six copies of the Supplier's invoice showing Goods, description, quantity, unit price, total amount, P.O. No.;
- ii) Six copies of the packing list.
- iii) Six copies of delivery note/railway receipt/truck receipt;
- iv) Manufacturer's/Supplier's guarantee certificate;
- v) Inspection certificate issued by the nominated inspection agency and the Supplier's factory inspection report along with clearances for despatch issued by the Purchaser (3 copies);
- vi) Quantity so far supplied including the present package.
- vii) Insurance Certificate.

5.0 INSURANCE: (As per Clause 10 of GCC)

6.0 Incidental Services : (CLAUSE 12 of GCC)

The cost shall be included in the quoted price.

7.0 Terms of Payment : (As per clause 15 of GCC)

8.0 Resolution of Disputes: (Clause 27 of GCC)

- 8.1 The dispute resolution mechanism to be applied pursuant to Clause 27 of General Conditions for Contract shall be as follows:

In the case of dispute between the Purchaser and the Contractor the dispute shall be referred to

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adjudication/arbitration in accordance with the "Indian Arbitration and Reconciliation Act 1956" or any statutory modification thereof.

- 8.2** If any dispute or difference of any kind whatsoever will arise between the Purchaser and the Supplier/ contractor in connection with or arising out of the Contract, the parties will make every effort to resolve amicably such dispute or difference by mutual consultation.

If, after thirty (30) days the parties have failed to resolve their dispute or difference by such mutual consultation, then either the Purchaser or the Supplier/ contractor may give notice to the other party of its intention to commence arbitration, as hereinafter provided, as to the matter in dispute, and no arbitration in respect of this matter may be commenced unless such notice is given.

Any dispute of difference in respect of which a notice of intention to commence arbitration has been given in accordance with this Clause will be finally settled by arbitration. Arbitration may be commenced prior to or after delivery of the Materials / equipment under the Contract.

- 8.3** Arbitration proceedings will be conducted in accordance with the following rules of procedure. The dispute resolution mechanism will be as follows:

- a) In the case of a dispute or difference arising between the Purchaser and a Supplier/**contractor** relating to any matter arising out of or connected with this agreement, such dispute or difference will be settled in accordance with the Arbitration and Conciliation Act, 1996. The Arbitral Tribunal will consist of three Arbitrators one each to be appointed by the Purchaser and the supplier/**contractor** the Third Arbitrator will be chosen by the two Arbitrators so appointed by the parties and will act as Presiding Arbitrator. In case of failure of the two Arbitrators appointed by the parties to reach upon a consensus within period of 30 days from the appointment of the Arbitrator appointed subsequently, the Presiding Arbitrator will be appointed by The Institution of Engineers (India).
- b) If one of the Parties fails to appoint its Arbitrator in pursuance of Sub-Clause (a) within 30 days after receipt of the notice of the appointment of its Arbitrator by The Institution of Engineers (India), will appoint the Arbitrator. A certified copy of the order of the Institution of Engineers (India), making such an appointment will be furnished to each to the parties.
- c) Arbitration Proceedings will be held at Purchaser's Headquarters, and the language of the Arbitration Proceedings and that of all documents and communication between the parties will be English.

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- d) The decision of the majority of Arbitrators will be final and binding upon both parties. The cost and expenses of Arbitration Proceedings will be paid as determined by the Arbitral Tribunal. However, the expenses incurred by each party in connection with the preparation, presentation etc., of its proceedings as also the fees and expenses paid to the Arbitrator appointed by such party or on its behalf will be borne by each party itself.
- e) Where the value of the Contract is Rs. One Crore and below, the disputes or differences arising will be referred to the Sole Arbitrator. The Sole Arbitrator should be appointed by agreement between the parties; failing such agreement, by the appointing authority namely The Institution of Engineers (India).

8.4 Notwithstanding any reference to arbitration herein,

- (a) The parties will continue to perform their respective obligations under the Contract unless they otherwise agree; and
- (b) The Purchaser will pay the Supplier any monies due the Supplier / contractor.

9.0 Notices : (Clause 30 of GCC)

For the purpose of all notices, the following shall be the address of the Purchaser and

**Purchaser : AGM (TBSM), BHARAT HEAVY ELECTRICALS LIMITED,
TRANSMISSION BUSINESS GROUP, Sector-62, Noida, Distt. Gautambudh
Nagar, UP-201309 10TH Floor,
Plot no.:- C-20, 1A/1, Joy towers, C Block, Phase 2, Industrial Area
Sector-62, Noida, Distt. Gautambudh Nagar, UP-201309**

Supplier/Contractor.

Supplier: (To be filled in at the time of signing the Contract).

10.0 CONTRACT DOCUMENTS:

10.1 The term contract documents shall mean and include the following which shall be deemed to form to an integral part of the contract:

- a) Invitation to Bid, Instructions to Bidders, Contract Agreement, General Terms and Conditions of Contract, Tender Schedule and all other documents.
- b) Specifications of the Goods to be furnished and to be erected by the contractor.

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- c) Contractor's Bid proposal including the letters of clarifications thereto between the Contractor and Purchaser prior to the Award of Contract.
- d) All the materials, literature, data and information of any sort given by the Contractor pertaining to the Goods offered by him along with his Bid, subject to the approval of the Purchaser;
- e) Any agreed variation between the Purchaser and the Contractor to the conditions of the documents and specifications and special terms and conditions of contract, if any.
- f) Contract agreement inclusive of notification of acceptance and purchase order issued by purchaser.

10.2 In the event of any conflict between the above mentioned documents, the matter shall be referred to the Purchaser whose decision shall be the final and binding upon the parties.

The metric system of measurement shall be exclusively used under this 'Contract'.

10.0 CONTRACT AGREEMENT (Refer Section – III : ITB)**12.0 TIME AND THE ESSENCE OF CONTRACT:**

- 12.1 The time and the date of completion of the works as stipulated in the Contractor's proposal and accepted by the Purchaser without or with modifications, if any, and so incorporated in the Award letter, shall be deemed to be the essence of the contract. The Contractor shall so organise his resources and perform his work as to complete it not later than the date agreed to.
- 12.2 The Contractor shall submit a detailed PERT network within the time frame and shall discuss the network so submitted with the Engineer. The agreed network which may be in the form as submitted or in revised form in line with the outcome of discussions shall form part of the Contract to be signed within thirty (30) days from the date of Notice of Award of Contract. During the performance of the Contract, if in the opinion of the Engineer proper progress is not maintained, suitable changes shall be made in the Contractor's operations to ensure proper progress.
- 12.3 The above PERT network shall be reviewed and periodical review reports shall be submitted by the Contractor as directed by the Engineer.

13.0 DEMURRAGES, WHARFAGES, ETC.:

TENDER SPEC. NO.: TBSM/KACHAPUR /STE-04/TENDER /21-22 Date: - 30.04.2021

- 13.1 All demurrages, wharfages and other expenses incurred due to delayed clearance of the material or any other reason for delay in observing the formalities set out elsewhere in this document shall be to the account of the Contractor.

14.0 TROPICAL SERVICEABILITY:

- 14.1 All goods shall be suitably and wherever necessary treated and processed for delivery, storage and use under tropical conditions including high temperature, high humidity, mild dew & fungus conducive environment. All important component parts shall be specially protected with a protective coating and other measures to ensure prevention of rusting of the Goods surfaces during storage of the Goods prior to erection. Any special instructions for inspection and maintenance of such vital parts during storage deemed necessary by the Contractor to ensure the protection of such parts shall be supplied well in advance of the supply of such vulnerable parts. An approved drying agent such as silica gel shall be packed in containers or packages holding parts which should not be adversely affected by moisture or excessive humidity.

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VOLUME-I. :: SECTION-VI

GENERAL CONDITIONS FOR ERECTION (G C E)

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SECTION - VI**GENERAL CONDITIONS FOR ERECTION (GCE)****1.0 GENERAL:**

- 1.1 The following shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this 'Contract' to be performed at 'Site'. The definitions given under section-IV of Volume-I (GCC) are applicable to this section also.
- 1.2 The Contractor upon award of 'Contract' shall, in addition to a Project Coordinator, nominate another responsible officer as his representative at Site suitably designated for the purposes of overall responsibility and coordination of the Works to be performed at 'Site'. Such person shall function from the 'Site' office of the Contractor during the pendency of 'Contract'. This representative shall have full technical capability and complete administrative and financial powers to expeditiously and efficiently execute the works under this 'Contract'.
- 1.3 The Contractor shall proceed with the work to be performed under this 'Contract' and each and every part and details thereof, in the best and most skilled workman like manner by engaging qualified, careful and efficient workers, and do several parts thereof, at such time and in such order as the Purchaser /Owner may direct, and finish such work in strict conformity with the plans, drawings and/or specifications, and any changes, modifications or amplifications thereof made by the Purchaser /Owner.
- 1.4 The Contractor shall not sell, assign, mortgage, hypothecate, divert or remove equipment or materials which have been installed or which may be necessary for the completion of the 'Contract' without the written consent of the Purchaser /Owner.

1.5 SCOPE OF CONTRACT

The specifications of the Contract and the accompanying drawings are intended to describe and provide for a finished piece of work. It is to be understood and agreed by Contractor, that the work described shall be complete in every detail, even though every item necessarily involved is not particularly mentioned. Contractor shall be required to provide all labour, materials and equipment necessary for the entire completion of the work described and shall not avail himself

of any manifesting unintentional error, omission or inconsistency that may exist. Contractor shall carry out and complete the work in every respect in accordance with the Contract and to the satisfaction of Purchaser /Owner and the manufacturer's representatives, where owner has provided services.

2.0 REGULATION OF LOCAL AUTHORITIES AND STATUTES:

- 2.1 The Contractor shall ensure compliance with all statutes laws, rules and regulations of the Central or State Government or any other authority such as the Workmen's Compensation Act 1923, Payment of Wages Act, Minimum Wages Act 1948, Employees State Insurance Act, Employees Provident Fund Act, etc., and any and all statutory bodies concerned.
- 2.2 Modifications thereof in connection with employees engaged by him or his Sub-vendors in the work. The offer shall be presumed to include financial liabilities arising from the above and the Purchaser /Owner shall not be liable for any extra costs on this account.
- 2.3 The Contractor shall conform to the provisions of **Indian Boiler Regulation, Factory Laws, Indian Electricity Act** and rules made there under, and any other acts of legislature relating to the work and to the regulations and byelaws of any authority and of any matter, lighting and other companies and/or authorities with whose systems the plant/structure proposed to be connected and shall, before making variations from the drawings or specifications may be necessitated by so conforming, give to Purchase/owner written notice, specifying the variations proposed to be made and the reason for making it and apply for instructions thereof.
- 2.4 The Contractor shall arrange to give all notices required by the said Acts, Regulations or Byelaws to be given to any Authority or to any Public Officer and pay all fees that may be properly chargeable in respect of the 'Works' and lodge the receipts with the Purchaser/ OWNER, unless otherwise specified. Obtaining all permits and licenses required thereupon shall be the responsibility of the Contractor.
- 2.5 All registration and statutory inspection fees, if any, in respect of his work pursuant to this 'Contract' shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the statutory laws and its amendments from time to time during erection in respect of the plant and equipment ultimately to be owned by the Purchaser /Owner shall be to the account of the Purchaser / Owner. Should any such inspection or registration need to be re arranged due to the fault of the Contractor or his Sub-Vendor, the additional fees for such inspection and/or registration shall be borne by the Contractor.

3.0 PRICE FOR ERECTION:

The Bidder/Contractor shall consider all such costs as to account for payment of wages as per relevant statutes applicable in quoting percentage excess/on par/less on ECV and shall not raise any extra claim on that account.

4.0 OWNER'S LIEN ON EQUIPMENT:

The Purchaser /Owner shall have lien on all equipment including those of the Contractor brought to the 'Site' for the purposes of erection, testing and commissioning of the plant. The Purchaser /Owner shall continue to hold the lien on all such equipment throughout the period of 'Contract'. No material brought to the 'Site' shall be removed from the 'Site' by the Contractor and/or his Sub-Contractors without the prior written approval of the OWNER.

5.0 INSPECTION, TESTING AND INSPECTION CERTIFICATES

- 5.1 The provisions of the clauses entitled Inspection, Testing and Inspection Certificates shall also be applicable to the erection portion of the Works'. The OWNER shall have the right to re-inspect any equipment though previously inspected and approved by him, at the Contractor's works, before and after the same are erected at 'Site'. If by the above inspection, the Purchaser /Owner rejects any equipment, the Contractor shall make good for such rejections either by replacement or by modifications/repairs as may be necessary to the satisfaction of the Purchaser /Owner. Such replacements will also include the replacements or re execution of such of those works of other Contractors and/or agencies, which might have been damaged or affected by the replacements or rework done to the Contractor's work.
- 5.2 The Contractor shall correct any work that proves faulty immediately. The fact that the Purchaser /Owner or their representatives have not pointed out faulty work or work which is not in accordance with plans and specifications shall not relieve the Contractor from correcting such work when and as directed by the Purchaser /Owner without additional compensation.
- 5.3 When owner takes down any item of finished work for the purpose of inspection, the Contractor shall bear the entire expenses incident there to. However, no extension of time shall be given for completion of works on this account. If the Contractor shall fail to repair any defective work or replace any defective materials after reasonable notice, the Purchaser /Owner may cause such defective work to be repaired or defective materials to be replaced by other agencies and the expenses thereof shall be deducted from the amount to be paid to the Contractor
- 5.4 The Purchaser /Owner, their representatives and employees shall, at all reasonable times, have

free access to the works and/or to the workshops, factories or other places where materials are being prepared or constructed for the 'Contract' and also to any place where the materials are lying or from where they are being obtained, and the Contractor shall give every facility to the Purchaser /Owner and his representatives for inspection and examination and test of the materials and workmanship even to the extent of discontinuing portions of the work temporarily, or of uncovering or taking down portions of finished work.

6.0 ACCESS TO SITE AND WORKS ON SITE:

- 6.1 Suitable access to and possession of the 'Site' shall be afforded to the Contractor by the OWNER in reasonable time.
- 6.2 The work as far as it is carried out on the Owner's premises, shall be carried out when the Owner may approve.
- 6.3 In the execution of the Works, no persons other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the Site except by the special permission, in writing of the Engineer or his representative.
- 6.4 Access to the 'Site' at all times shall be accorded to the Purchaser /Owner and other authorized officials and statutory Public Authorities. Nevertheless, the Contractor shall not object to the execution of the work by other Contractors or tradesmen whose names shall have been previously communicated in writing to the Contractor by the Purchaser /Owner and afford them every facility for the execution of their several functions simultaneously with his expenses.

7.0 CONTRACTOR'S SITE OFFICE ESTABLISHMENT:

- 7.1 The Contractor shall establish a Site Office at the 'Site' and keep posted an authorized representative for the purpose of the 'Contract'. Any written order or instruction of the Purchaser /Owner or his duly authorized representative shall be communicated to the authorized representative of the Contractor at the Site Office and the same shall be deemed to have been communicated to the Contractor at his legal address. A complete set of specifications, drawings and a copy of the Contract agreement shall be kept in the site office at all times.
- 7.2 The Contractor shall employ at least one competent representative whose name or names shall have previously been communicated in writing to Purchaser /Owner by the Contractor, to

supervise the erection of the plant and to carry out the works. The said representative or if more than one shall be employed, then one of such representatives shall be present at the site during working hours, and any written orders or instructions which the Purchaser /Owner may give to the said representatives of the Contractor shall be deemed to have been given to the Contractor. It is essential that the supervisory personnel shall be capable of speaking and writing in English language.

- 7.3 When Contractor or his representative is not present on any part of the work where it may be desired to give directions in the event of emergencies, orders may be given by owner and shall be received and obeyed by the supervisors or foremen who may have charge of the particular part of the working reference to which orders are given. If requested to do so, owner shall confirm such orders in writing. Any such instructions, directions or notices given by owner shall be deemed to have been given to Contractor.

8.0 COOPERATION WITH OTHER CONTRACTORS.

- 8.1 The Contractor shall cooperate with all other Contractors or tradesmen of the Owner, who may be performing other Works on behalf of the Owner and the workmen who may be employed by the Owner and doing work in the vicinity of the Works under the Contract. The Contractors shall also so arrange to perform his work as to minimize, to the maximum extent possible, interference with the work of other Contractors and his workers. Any /or injury or damage that may be sustained by the employees of the other Contractors and the Owner, due to the Contractor's work shall promptly be made good at his own expense. The Engineer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workers of the Owner concerning their work. If the Works of the Contractor is delayed because of any acts or omissions of another Contractor, the Contractor shall have no claim against the Owner on that account other than an extension of time for completing his Works. However, extension of time will be considered after execution of its merits and at the discretion of the Purchaser/Owner.
- 8.2 The Purchaser /Owner shall be notified promptly by the Contractor, of any defects in the other Contractor's works that could affect the Contractor's 'Works'. The Purchaser /Owner shall determine the corrective measures, if any, required to rectify this situation after inspection of the 'Works' and such decisions by the Purchaser /Owner shall be binding on the Contractor. If any part of the Contractor's work depends, for proper execution, upon the work of any other

Contractor, the Contractor shall inspect and promptly report in writing to the Purchaser /Owner any defect in such work of other Contractors that may render it unsuitable for proper execution of the work under this 'Contract'. His failure to so inspect and report shall constitute an acceptance of 'others' work as fit and proper for the reception of his work, except as to defects which may develop in the work of 'OTHERS' after the proper execution of the work, the Contractor shall inspect work already in place and shall at once report to the Purchaser /Owner any discrepancy between the executed work and the drawings.

- 8.3 The Contractor shall be responsible to ensure that all embodiments relating to the equipment are in position before releasing for concreting.

9.0 DISCIPLINE OF WORKMEN:

- 9.1 The Contractor shall adhere to the disciplinary procedure set by the Purchaser /Owner in respect of his employees and the workers at 'Site'. The Purchaser /Owner shall be at liberty to object to the presence of any representative or employee of the Contractor at the 'Site', if in the opinion of the Purchaser /Owner such employee has misconduct himself or be incompetent or negligent or otherwise undesirable and then the Contractor shall remove such a person objected to and provide in his place a competent replacement at his own expense.

10.0 CONTRACTOR'S FIELD OPERATION:

- 10.1 The Contractor shall workout and furnish PERT 'Network schedule along with detailed activity schedule indicating the progress and schedule completion dates of various activities and shall work to this mutually agreed schedule. The schedule shall show approximately the date on which each part or division of the work is expected to begin, based on knowledge of the works of other Contractors and the date when the work is scheduled to be finished. Upon the request of owner, Contractor should be prepared to discuss his schedule in relation to the master schedule and shall coordinate his work with that of the other Contractors as determined by owner.
- 10.2 The Contractor shall keep the Purchaser /Owner informed in advance regarding his field activity plans and schedules for carrying out each part of the 'Works'. Any review of such plan or schedule or method of work by the OWNER shall not relieve the Contractor of any of his responsibility towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Purchaser /Owner or any of his representatives and no claim of the Contractor will be entertained because of the failure or in efficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequate and

efficiency of plant and equipment and his erection methods.

- 10.3 The Contractor shall have the complete responsibility for the conditions of the work site including the safety of all persons employed by him and/or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of his 'Contract' and shall not be limited to normal working hours. The construction review by the Purchaser /Owner is not intended to include review of the Contractor's safety measures, in or near the worksite, and their adequacy or otherwise.
- 10.4 The work so far as it is carried out on the Owner's premises shall be carried out at such time as the Purchaser /Owner may approve consistent with the construction schedule and so as not to interfere unnecessarily with the conduct of the Owner's business and the Purchaser /Owner will give the Contractor all reasonable facilities for carrying out the work.

11.0 PHOTOGRAPHS AND PROGRESS REPORT:

- 11.1 The Contractor shall furnish duly certified the progress/ status reports in respect of the material/ equipment received at site, the works carried out and the status of drawings for every 15 days.
- 11.2 Contractor shall also provide copies of photographs along with progress reports including soft copy whenever requested by TSTRANSCO as a record of significant events of progress.
- 11.3 Contractor shall furnish three (3) prints to the PURCHASER/ENGINEER of progress photographs of the work done at 'Site'. Photographs shall be taken when and where indicated by the PURCHASER/ENGINEER or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph. Normally photographs may be taken once every 15 days and for all special events.

The above photographs shall accompany the fortnight/ monthly progress report detailing out the progress achieved on all erection activities as compared to the Schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures wherever necessary. The Contractor shall furnish progress reports as and when requested by the PURCHASER/ ENGINEER. Photographs shall be taken by the Contractor at all important stages.

Photographs shall be taken by the Contractor for each tower location of EHT lines in the

following stages of

1. *After excavation is over in normal soils.*
2. *Before and after blasting in Hard rock soils.*
3. *During dewatering.*
4. *During concreting.*
5. *Shoring & strutting.*

For Substations:

At all important stages like leveling, foundations, laying of slab etc. before and after blasting in hardrock soils and stack photographs.

Note: The photographs should be clear and hard copy or soft copy (2 Nos) shall be submitted to the Engineer in charge immediately.

12.0 MANPOWER REPORT:

- 12.1 ERECTION STAFF: The Contractor shall furnish a list of all the Engineering, skilled, semi skilled personnel and unskilled labour along with the supervisory staff with their experience, who would be employed by him, for carrying out this specific installation, testing and commissioning work. Bidder shall also indicate the names, qualifications, experience of supervisory staff proposed to be stationed at site until the completion of work as indicated in Qualifying Requirements. The Contractor shall assign only qualified and senior supervisor Engineers and provide adequate no. of competent labour for job.
- 12.1 The Contractor shall submit to the Purchaser /Owner on the first day of every month, a man-hour schedule for the next month, detailing the man-hours scheduled for the month, skill wise and area wise.
- 12.2 The Contractor shall also submit to the Purchaser /Owner on the first day of every month, a manpower report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill wise and the areas of employment of such labour.

EMPLOYMENT OF TECHNICAL STAFF FOR SUPERVISION, SKILLED AND UNSKILLED LABOUR:

The Contractor shall provide experienced, technically qualified supervising Engineers for the supervision. The Chief Supervising Engineer of the Contractor or his agent shall have full power as the representatives of the Contractor who can negotiate at site in regard to execution of the Contract. The minimum qualification of site Engineer is a degree in Engineering. The Contractor must make his own arrangements for recruiting skilled, semi- skilled and un-skilled labour in sufficient numbers. The

Contractor shall engage only competent skilled workers. The Executive Engineer/ In-charge of the work will have the right to remove any skilled worker employed by the Contractor, if found not suitable.

The Contractor shall employ at least the following Technical Staff indicated against each work.

Project Manager	2 Nos.	Graduate Engineer (Elec.) – 1 No. Graduate Engineer (Civil) – 1 Nos.
Planning Engineer	2 Nos.	Graduate Engineer (Elec.) – 1 No. Graduate Engineer (Civil) – 1 No.
Section In-charge	2 Nos.	Graduate Engineer (Elec.) – 1 No. Graduate Engineer (Civil) – 1 No.
Site Engineers	2 Nos.	Graduate Engineer (Elec.) – 1 No. Graduate Engineer (Civil) – 1 No.
Supervisors	3 Nos.	Electrical Diploma holders (1 No.)+
		Diploma Civil (2 Nos.)

The Contractor shall have one of the above technical staff as a project manager with five year's experience in executing such Contract of comparable nature.

In case of failure of the Contractor to employ technical staff during execution as above, recovery shall be made from his bills at Rs. 10,000/- per month for each work, besides other penal action.

The Contractor shall make his own arrangements for engagement of all labour, local or otherwise, their transportation, housing, feeding and payment thereof, in accordance with labour law, unless the Contract otherwise provides. No idle labour payment will be made to the Contractor.

13.0 PROTECTION OF WORK:

13.1 The CONTRACTOR shall have total responsibility for protecting his 'Works until it is finally accepted by the Purchaser /Owner. No claim will be entertained by the OWNER for any damage or loss to the Contractor's works and the Contractor shall be responsible for the complete restoration of the damaged 'Works' to its original condition to comply with the specifications and drawings.

Should any such damage to the Contractor's 'Works' occur because of other party not under his claim directly with the party concerned. If disagreement, conflict, or dispute develops between the Contractor's 'Works', the same shall be resolved as per the provisions of the Clause entitled 'Cooperation with other Contractors'. The Contractor shall not cause 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 dispute.

- 13.2 During construction of the project, the Purchaser /Owner will continue to operate the plant and equipment already put in service. The Contractor shall protect all such plant, structures, piping, conduits, equipment and facilities against damage during the operations.
- 13.3 The Contractor shall perform his work in a manner that in no way endangers the operations of the existing steam and electric and other plants of the Purchaser /Owner which will have interconnections with the new plant in the construction of which the Contractor is engaged. In all cases where connections to existing plant and equipment occur, such connections shall be made only with specific and advance instructions and authorization from and issued by the Purchaser /Owner.
- 13.4 The Contractor and his Sub-Contractors shall be responsible during work for protection of the work, which has been completed by OTHERS. Necessary care shall be taken to see that their own men cause no damage to the same during the course of execution of the work.
- 13.5 All other work completed or in progress as well as machinery and equipment that are liable, to be damaged by the Contractor's work shall be protected by the Contractor and such protection shall remain and be maintained until its removal is directed by the OWNER.
- 13.6 The Contractor shall effectively protect all the works from action of weather and from penalty or defacement and shall cover finished parts where required for their thorough protection. Face work shall be perfectly clean and free from defects.
- 13.7 The work shall be carried out onto completion without damage to any work and property adjacent to the area of his work, to whom so ever it may belong, without interference with the operation of their existing machines or equipment.
- 13.8 The Contractor shall make available necessary temporary roadways, footways, guards as may be rendered necessary by reason of his work, for the protection and accommodation of foot passengers or other traffic of the Purchaser /Owner or occupier of adjacent property and of

public. The Contractor shall at all times provide sufficient temporary barriers, notice boards and lights to protect and warn the public and post necessary watchmen to guard the 'Site' and equipment. He shall take all precautions necessary and shall be responsible for the safety of the work to be performed by him. The Contractor shall also observe and display 'Safety First' signs and shall have proper safety and fire protection equipment.

- 13.9 Adequate lighting at and near all the storage, handling, fabrication, pre assembly and erection sites for properly carrying out the work and for safety and security shall be provided by the Contractor. The Contractor's work area should be adequately illuminated during night time also. The Contractor should also engage adequate electricians/wiremen, helpers, etc., to carry out and maintain these lighting facilities. If the Contractor fails to provide all the above listed facilities, the Purchaser /Owner may provide such facilities as he may deem necessary and charge the cost thereof to the Contractor. In any case, the Contractor shall be liable for all penalty and consequences arising out of his neglect in this regard.

14.0 EMPLOYMENT OF LABOUR:

- 14.1 The Contractor is expected to employ on the work only his regular skilled and trusted employees with experience in similar kind of work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.
- 14.2 The Contractor shall also furnish details of the qualifications and experience of his senior supervisors and Engineers assigned to the work, including their experience in supervising erection and commissioning of plant and equipment of comparable capacity.
- 14.3 All traveling expenses including provisions of all necessary transport to and from 'Site' lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.
- 14.4 The hours of work on the 'Site' shall be decided by the OWNER and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day (Monday to Saturday).
- 14.5 The Contractor's employees shall wear identification badges while on work at 'Site'.
- 14.6 The Contractor shall ensure that he pays his men regularly their wages, overtime and other compensations. The Contractor shall also furnish the Purchaser /Owner at fortnightly intervals a certificate that he has paid all the dues to his workers. In case such payments are not made regularly by the Contractor, the OWNER will be in his right to make such payments and deduct

the same from the payments due to the Contractor.

- 14.7 In case the Purchaser /Owner becomes liable to pay any wages or dues to the labourer or to any Government agency under any of the provisions of the Minimum Wages Act, Workmen's Compensation Act or any other law due to act of omission of the Contractor, the OWNER may make such payments and shall recover the same from the Contractor's bills.
- 14.8 None of the Contractor's superintendents, supervisors, Engineers or labour may be withdrawn from the work without due notice being given to the Purchaser /Owner. Further, no such withdrawal shall be made if, in the opinion of the Purchaser /Owner, it will jeopardize the required pace of progress and/or the successful completion of the work.
- 14.9 In connection with the performance of work under this 'Contract', the Contractor shall agree not to discriminate based on race, religion, colour, nationality or origin. It is also expected that the Contractor in his selection of personnel will give due regard to their ability to cooperate with the Purchaser /Owner and the manufacturer's erection supervisor's suggestions and the recommendations made by the Purchaser /Owner and the MANUFACTURER'S supervisors relating to the work and coordination thereof are to be carefully and courteously considered for implementation.
- 14.10 Contractor's employees shall be provided with identification badges showing employee's pay roll number, Contractor's name and project identification. All employees will be required to wear these badges during the time they are at project site, where these would be plainly visible to owner's watchmen and security staff. All workers, watchmen, supervisors, Engineers and other staff at work site shall be provided with safety helmets by Contractor and these shall be worn by them all the time they are at work site. Employees failing to do so shall, upon request of owner, be summarily discharged. No employee of Contractor shall be permitted to enter areas of construction/operation unauthorized.
- 14.11 Owner shall be at liberty to object to any representative or person or skilled, semiskilled or unskilled worker employed by Contractor in the execution, or otherwise, of the work, who shall misconduct himself, or be incompetent, or negligent or unsuitable and Contractor shall remove the person so objected to, upon receipt of notice in writing from owner requiring him to do so and shall provide in his place a competent representative at his own expense within reasonable time. Such persons who had been removed from the site at the request of owner shall not be again employed or allowed on the works without the permission of owner.

15.0 FACILITIES TO BE PROVIDED BY THE OWNER FOR SUBSTATION:**15.1 SPACE:**

The Contractor shall advise the Purchaser /Owner within thirty (30) days from the date of acceptance of the 'Letter of Intent' about his exact requirement of space for his office, storage area, pre assembly and fabrication areas, toilets, etc. The above requirement shall be reviewed by the Purchaser /Owner and space will be allotted to the Contractor for construction of his temporary structures like office, storage sheds, and other utilities, etc., for his own as well as his Sub-Contractor's use. The space allotted shall be within a distance of about 1.0km from the 'Site'. No space will be provided by the Purchaser /Owner for the Contractor's labour and facilities for labour housing shall be the sole responsibility of the Contractor.

The Contractor shall erect all temporary buildings, tool sheds, fabrication shops, stores and office, etc. at his own cost in the area allotted to him at work site by the owner. Contractor shall obtain owner's approval before removal of such temporary buildings. The Contractor shall indicate the area required for storage facilities inside the work site. The Contractor shall at all times keep the site free from accumulation of waste and debris and on completion of work dispose of all the surplus materials and temporary works, as directed by the owner and leave the works and site clean and tidy. The Contractor shall be responsible for taking all the safety precautions during construction and maintaining the site safe at all times. At the end of each working day and at all times, when the work is temporarily suspended he shall protect all the construction material, equipment and facilities from penalty.

15.2 ELECTRICITY:

The Contractor shall submit to the Purchaser /Owner within thirty (30) days from the date of acceptance of the 'Letter of Intent', his phased electrical power requirements to allow the planning of the temporary electrical distribution by the Purchaser /Owner. The Contractor shall be provided with construction power for the purposes of the 'Contract', at one point in the project 'Site' which shall be metered and chargeable to Contractor. The Contractor shall make his own further distribution arrangement. All temporary wiring must comply with local regulations and will be subject to the Purchaser /Owner's inspection and approval before connection to supply. Power supplied to Contractor's office, Contractor's works and Contractors residential colony will be charged at the rates in vogue at that time. The Contractor's temporary distribution shall be arranged so as to maintain a Power Factor of 0.8 minimum under all operating

conditions.

The owner will not be responsible for the consequences of any unintentional or unplanned interruptions to the above power supply. However, in case of power failure or due to any unavoidable circumstances, the Contractor has to make necessary arrangements like diesel generator sets etc. so as not to affect the progress of work. The Contractor shall make his own arrangement for the dismantling on completion of the works of his temporary distribution systems, distribution panel and other equipment he may require to take power from owner's supply point.

15.3 WATER:

Water supply by the Owner will be on chargeable basis. Supply of water, if available, will be made for the construction purposes at an agreed single point in the 'Site'. Any further distribution will be the responsibility of the Contractor. Drinking water will also be provided at one agreed single point in the 'Site', if available.

15.4 CONSTRUCTION TOOLS AND EQUIPMENT AND OTHER MATERIALS:

15.4.1 Except in case where the Owner's express permission is applied for and received in writing, no use of the Owner's plant facilities such as cranes, passenger elevator or machine shop shall be made by the Contractor or his employees.

15.4.2 The Purchaser /Owner shall not be responsible or held liable for any damage to person or property consequent upon the use, misuse or failure of any construction tools and equipment used by the Contractor or any of his Sub-Contractors, even though such construction tools and equipment may be furnished, rented or loaned to the Contractor or any of his Sub-Contractors. The acceptance and/or use of any such construction tools and equipment by the Contractor or his Sub-Contractors shall be construed to mean that the Contractor accepts all responsibility for and agrees to indemnify and save harmless the OWNER from any and all claims for said penalty resulting from said use, misuse or failure of such construction tools and equipment.

16.0 FACILITIES TO BE PROVIDED BY THE CONTRACTOR:

16.1 TOOLS, TACKLES AND SCAFFOLDINGS:

- 16.1.1 The Contractor shall provide at his own expense, all the construction equipment, false work, erection tools, machine tools, power tools, tackles, hoists, cranes, derricks, cables, slings, skids, scaffolding, work benches, tools for rigging, cribbing and blocking, welding machines, preheating and stress relieving equipment, X-ray and all associated protection equipment, instruments, appliances, materials and supplies required for unloading, transporting, storing, erection, testing and commissioning that may be required to accomplish the work under the 'Contract' unless otherwise to final determination of the Purchaser /Owner. He shall submit a list of all such materials to the OWNER before the commencement of pre assembly at 'Site'. These tools and tackles shall not be removed from the 'Site' without the written permission of the Purchaser /Owner.
- 16.1.2 The Contractor shall also furnish all necessary expandable devices like anchors, grinding and abrasive wheels, raw plugs, hacksaw blades, taps, dies, drills, reamers, chisels, files, stones, oil stones, wire brushes, necessary scaffolding, ladders, wooden planks, timbers, sleepers and consumable materials like oxygen, acetylene, argon, lubricating oils, greases, cleaning fluids, cylinder oil, graphite powder and flakes, fasteners, gaskets, temporary supports, stainless steel shims of various thickness as required, cotton waste, cheese cloth and all other miscellaneous supplies of every kind required for carrying out the works under the Contract.
- 16.1.3 The Contractor shall provide all reasonable facilities including tools, personnel etc., and ensure coordination with the OWNER and the Manufacturer's erection supervisors to enable them to carry out all supervision, measurements, checks, etc., in a satisfactory manner.
- 16.1.4 The Contractor shall not dispose of, transport or withdraw any tools, tackles, equipment and material Provided by him for the 'Contract' without taking prior written approval from the Purchaser /Owner, and the Purchaser /Owner at all times shall have right to refuse permission for disposal, transport or withdrawal of tools, tackles, equipment and material, if in his opinion, the same will adversely affect the efficient and expeditious completion the 'Project'.
- 16.1.5 The Contractor shall also arrange for storing of materials with weather protection wherever necessary and proper security arrangement till the installation is taken over by the Purchaser.
- 16.1.6 Mobile crane, if required for erection, shall have to be arranged by Contractor.
- 16.2 COMMUNICATION: The Contractor will make his own arrangement for his communication needs such as telephone, telex, etc., at his Site Office. The OWNER will assist the Contractor in getting

the above facilities, in case he finds any difficulties. The owner may install one telephone connection to the Contractor from the exchange if any provided at the site for internal communication.

16.3 FIRSTAID:

16.3.1 The Contractor shall provide necessary first aid facilities for all his employees, representatives and workers working at the Site. Enough number of Contractor's personnel shall be trained in administering first aid.

16.3.2 The Owner will assist the Contractor, in case of an emergency, in obtaining the services of an ambulance for transportation to the nearest hospital.

16.4 CLEANLINESS :

16.4.1 The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc., during the period of 'Contract'. The Contractor shall employ enough number of special personnel to thoroughly clean his work area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the OWNER. Materials and stores shall be so arranged as to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.

16.4.2 Similarly, the offices of the Contractor shall be kept clean and neat to the entire satisfaction of the Purchaser /Owner. Proper sanitary arrangements shall be provided by the Contractor, in the work areas and office of the Contractor and residential colonies.

16.4.3 If Contractor fails to comply with these requirements in spite of instructions from the Purchaser, the areas will be cleaned by Purchaser at Contractor's cost and the cost of the same will be deducted from the Contractor's due amounts.

17.0 LINES AND GRADES:

17.1 All the 'Works' shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the 'Works'. Basic horizontal and vertical control points will be established and marked by the Purchaser /Owner at 'Site' at suitable points. These points shall be used as datum for the 'Works' under the Contractor. The Contractor shall

inform the Purchaser /Owner well in advance of the times and places at which he wishes to do work in the area allotted to him, so that suitable datum points may be established and checked by the Purchaser /Owner to enable the Contractor to proceed with his 'Works'. Any work done without being properly located may be removed and/or dismantled by the Purchaser /Owner at Contractor's expense.

17.2 Where the Purchaser /Owner had already established the base lines and benchmarks adjacent to the various sections of work, the same must be carefully preserved by the Contractor, and in case of their unnecessary destruction by him or any of his employees, these will be reestablished by the Purchaser /Owner at the Contractor's expenses.

17.3 The Contractor shall be responsible for the accuracy of all dimensions within the various sections of the work according to the figures of dimensions in the drawings.

17.4 Contractor shall supply, fix and maintain at his cost during the execution of any work, all the necessary centering, scaffolding, staging, planking, timbering, strutting, shoring, pumping, fencing, hoarding, guarding and lighting by night as well as by day, required not only for the proper execution and protection of the said work, but also for the protection of the pumping and the safety of any adjacent roads, streets, cellars, vaults, ovens, walls, houses, buildings and all other erections, matters or things. Contractor shall take out and remove any or all such centering, scaffolding, staging, planking, timbering, strutting shoring, etc. as occasion shall require or when ordered to do so and shall fully reinstate and make good all matters and things disturbed during execution of the work, to the satisfaction of owner. Contractor shall be paid no additional amount for the above and for access roads to be made to reach the construction site.

18.0 FIRE PROTECTION:

18.1 The Work procedures that are to be used during the erection shall be those, which minimize fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the 'Site' at least once each day. Fuels, oils and volatile or inflammable materials shall be stored away from the construction and equipment and materials, storage areas, in safe containers. Untreated canvas paper, plastic or other inflammable flexible materials shall not at all be used at 'Site' for any other purposes unless otherwise specified. If any such materials are received with the equipment at the 'Site', the same shall be removed and replaced with acceptable material before moving into the construction area or storage.

18.2 Similarly, corrugated paper fabricated cartons, etc., will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans, etc., which are combustible but are essential for the 'Works' to be executed shall be protected against fire resulting from welding sparks, cutting flames and other similar fire sources.

18.3 All the Contractor's supervisory personnel and sufficient number of workers shall be trained for firefighting and shall be assigned specific fire protection duties. Adequate number of such trained personnel must be available at the 'Site' during the entire period of the 'Contract'.

18.4 The Contractor shall provide and maintain fire protection equipment, adequate in design and numbers for the warehouses, office, temporary structures, etc. Access to such fire protection equipment shall be easy and kept open at all times. The compliance of the above requirements under fire protection shall in no way relieve the Contractor of any of his responsibilities and liabilities due to fire accidents occurring either to his materials and equipment or to those of others working in the area.

19.0 SECURITY (WATCH & WARD) :

The Contractor shall have total responsibility for all equipment and materials in his custody stored, loose, semi assembled and/or erected by him at 'Site'. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and 'Works' from theft, fire, pilferage and any other damage and loss. All materials of the Contractor shall enter and leave the project 'Site' only with the written permission of the OWNER in the prescribed manner.

20.0 CONTRACTOR'S AREA LIMITS:

The Purchaser /Owner will mark out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel moves out of the areas marked out for his operations. In case of such a need for the Contractor's personnel to work out of the areas marked out for him, the same shall be done only with the written permission of the Purchaser /Owner.

21.0 CONTRACTOR'S COOPERATION WITH THE OWNER

21.1 In cases where the performance of the erection work by the Contractor affects the operation of

the system facilities of the Purchaser /Owner, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated to be performed by the Purchaser /Owner and the same shall be acceptable at all times to the Purchaser /Owner. The Purchaser /Owner may impose such restrictions on the facilities provided to the Contractor such as electricity, water etc., as he may think fit and the Contractor shall strictly adhere to such restrictions and cooperate with the Purchaser /Owner. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during startup and operation of the equipment systems which are erected by him.

The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished/and erected by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these documents.

21.2 The Contractor at all times shall work in coordination with the Purchaser /Owner's staff and offer them all reasonable facilities to become familiar with the erection, operation and maintenance of the equipment.

21.3 In respect of observations of local rules, administrative orders, working hours and the like, the Contractor and his personnel shall cooperate with the Purchaser /Owner.

22.0 COMMISSIONING:

The 'Commissioning' of the equipment/Material erected by the Contractor shall be the responsibility of the Contractor. The Contractor shall provide in addition, test instruments, calibrating devices, etc., and the labour required for the successful performance of these tests. If it is anticipated that the above tests may prolong for a long time, the Contractor's or his sub-vendor's workmen required for the above tests shall always be present at 'Site' during such tests.

23.0 MATERIALS HANDLING AND STORAGE:

23.1 All the equipment furnished under the Contract and arriving at Stores/Site shall be promptly received, unloaded, transported and stored in the storage space by the Contractor. It is Contractor's sole responsibility to keep in touch with Purchaser /Owner, and others to inform himself of the expected date and time of arrival of the carriers at site and ensure that his men and aids are available in time to unload the material/equipment and promptly release the carriers. Contractor shall plan in advance his requirements of jacks, cranes, sleepers etc., required

to unload the material/equipment promptly and efficiently.

- 23.2 The Contractor shall be responsible for examining all the shipments and notify the Purchaser /Owner immediately of any damage, shortage, discrepancy etc., for the purpose of Purchaser /Owner's information only. The Contractor shall submit to the Purchaser /Owner every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and/or in storage and erection of the equipment at the 'Site'. Any demurrage, wharfage and other such charges claimed by the transporters, railways, etc., shall be to the account of the Contractor.
- 23.3 The Contractor shall maintain an accurate and exhaustive record, detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Purchaser /Owner at any time. The schedule shall show approximately the date on which each part or division of the work is expected to begin, based on his knowledge of the works of other Contractors and the date when the work is scheduled to be finished. Upon the request of owner, Contractor should be prepared to discuss his schedule in relation to the master schedule and shall coordinate his work with that of the other Contractors as determined by owner.
- 23.4 All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc., shall be used for unloading and/or handling of the equipment without the specific written permission of the Purchaser /Owner. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage for such equipment at 'Site'.
- 23.5 The instructions of the manufacturers for storage and the conservation during storage shall be followed. All electrical panels, control gears, motors and such other devices, shall be properly dried by heating before they are installed and energized. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.
- 23.6 All the electrical equipment **such as motors, Transformers and reactors**, etc., shall be tested for insulation resistance at least once in a month from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor.

Such record shall be open for inspection by the Purchaser /Owner.

- 23.7 The Contractor shall ensure that all the packing materials, and protection devices used for various equipment during transit and storage are removed before the equipment are installed. All packing materials like wooden planks, wooden crates of insulators should be returned to TSTRANSCO.
- 23.8 The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage to deterioration in quality by storage.
- 23.9 All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame proof covering material where ever applicable.
- 23.10 If the materials belonging to the Contractor are stored in area other than those earmarked for him, the Purchaser /Owner will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.
- 23.11 The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment, which require indoor storage. Normally all the electrical equipment, such as motors, control gears, generators, exciters and consumables like electrodes, lubricants, etc, shall be stored in the closed storage space. The Purchaser /Owner, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.
- 23.12 The Contractor shall arrange for periodical inspection of material/equipment in his custody until taken over by the Purchaser /Owner and shall carryout all protective and preservative measures required thereupon.
- 23.13 The Contractor shall also keep a check on the deliveries of the equipment/material covered in his scope of erection and for those falling in the scope of supply by the Purchaser, shall advise the Purchaser /Owner well in advance regarding possible holdups in his work due to expected delays in delivery of equipment, to enable the Purchaser /Owner to expedite the deliveries. The Contractor shall also inform the Purchaser /Owner in right time regarding the repairs/replacement required towards the items damaged/lost in order to enable the Purchaser /Owner to arrange for repairs/replacements well in time and avoid delays due to non availability of requirement and parts.

24.0 CONSTRUCTION MANAGEMENT:

24.1 The field activities of the Contractor working at 'Site' will be coordinated by the Purchaser /Owner and the Purchaser /Owner's decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Purchaser /Owner regarding scheduling and coordination of work. Such decision by the Purchaser /Owner shall not be a cause for extra compensation or extension of time for the Contractor.

24.2 The Purchaser /Owner shall hold weekly meeting of all the Contractors working at 'Site', at a time and a place to be designated by the Purchaser /Owner. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Purchaser /Owner and shall strictly adhere to those decisions in performing his 'Works'. In addition to the above weekly meetings, the Purchaser /Owner may call for other meetings either with individual Contractors or with selected number of Contractors and in such a case the Contractor, will also attend such meetings.

24.3 Time is the essence of the 'Contract' and the Contractor shall be responsible for performance of his Works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the OWNER satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

25.0 FIELD OFFICE RECORDS:

The Contractor shall maintain at his 'Site' office up to date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc., effected at the field and on completion of his total assignment under the 'Contract' shall incorporate all such changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the 'Contract'. Such drawings and Engineering data shall be submitted to the Purchaser /Owner in required number of copies. A record of all readings taken during the alignment of the equipment shall be maintained by the

Contractor. This shall be signed by the Manufacturer's erection supervisor and/or the Purchaser /Owner as a token of their acceptance of the same. All such records shall be handed over to the Purchaser /Owner on completion of the 'Works'.

26.0 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE:

26.1 The Contractor shall bring to 'Site' all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the 'Works' under intimation to the Purchaser /Owner. All such goods shall, from the time of their being brought vest in Purchaser /Owner, but may be used for the purpose of the 'Works' only and shall not on any account be removed or taken away by the Contractor without the written permission of the Purchaser /Owner. But the Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.

26.2 The OWNER shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the 'Contract'. After giving a fifteen (15) days' notice in writing of his intention to do so, the Purchaser /Owner shall be at liberty to sell and dispose of any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.

26.3 After completion of the 'Works', the Contractor shall remove from the 'Site' under the direction of the Purchaser /Owner the materials such as construction equipment, erection tools and tackles, scaffolding, etc. with the written permission of the Purchaser /Owner. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Purchaser /Owner to do so, then the Purchaser /Owner shall have the liberty to dispose of such materials as detailed under Clause 26.2 above and credit/debit the proceeds there to the account of the Contract.

27.0 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY:

27.1 The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the Purchaser /Owner and the Purchaser /Owner and the employees of other Contractors and Sub-vendors and all public and private property including structures, buildings, other plants and equipment and utilities either above or below the ground.

27.2 The Contractor will ensure provision of necessary safety equipment such as barriers, signboards, warning lights, alarms, etc., to provide adequate protection to persons and property. The

Contractor shall be responsible to give reasonable notice to the Purchaser /Owner and the Purchaser /Owner of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance of his 'Works' and shall make all necessary arrangements with such Owners, related to removal and/or replacement or protection of such property and utilities.

27.3 Contractor shall not sell, assign, mortgage, hypothecate or remove equipment or materials which have been installed or which may be necessary for the completion of the Contract without the written consent of owner.

28.0 PAINTING: All exposed metal parts of the equipment including piping, structures, railings, etc., after installation, unless otherwise surface protected, shall be first painted with at least one coat of suitable primer which matches the shop primer paint used, after thoroughly cleaning all such parts of all dirt, rust, scales, greases, oils and other foreign materials by wire brushing, scraping or sand blasting, and the same being inspected and approved by the OWNER for painting. Afterwards, the above parts shall be finished with two coats of alloyed resin machinery enamel paints. The quality of the finish paint shall be as per the standards of ISI or equivalent and to be of the colour as approved by the OWNER.

29.0 INSURANCE : (Clause 10.0 GCC)

29.1 In addition to the conditions covered under the clause entitled 'Insurance' in 'General Conditions of Contract', the following provisions will apply to the portion of the 'Works' at site to be done at site beyond the Contractor's own or his Sub-Contractor's manufacturing works. Comprehensive Insurance of equipment during erection and commissioning, Workmen's Compensation Insurance, Comprehensive Automobile Insurance & Comprehensive General Liability Insurance shall be the responsibility of the Contractor. Contractor shall at his own expense arrange to effect and maintain until the completion of the Contract. Insurance policies, with an insurance company approved by owner, against all risks in respect of which Contractor is required under this clause to indemnify owner. In particular, Contractor shall effect and maintain an insurance policy of at least Rs.3.00 lacs for one person and Rs.5.00 lacs per accidental for injury or death and at least Rs.5.00 lacs per accident for third party property damage, to indemnify owner against all third party accident/damage claims which may arise in respect of the work or in consequence thereof. The Contractor shall also maintain an insurance policy against all claims which may be made upon owner whether under the Workmen's Compensation Act or any other statute in force during the currency of the Contractor or at common law in respect of any employee of Contractor or any Sub-

Contractor. All such insurance policies shall be in the joint names of owner and Contractor and shall be deposited with owner. The Contractor shall be responsible for anything which may be excluded from the insurance policies referred to above and also for all other damage to any property or persons out of and incidental to the negligence or defective carrying out of this Contract.

All costs on account of insurance liabilities covered under the Contract will be on Contractor's account and will be deemed to have been included in the Contract price.

29.2 WORKMEN'S COMPENSATION INSURANCE:

This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability, disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than :-

Workmen's Compensation - As per statutory provision

Employee's liability - As per statutory provision.

29.3 COMPREHENSIVE AUTOMOBILE INSURANCE:

This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability disease and death to members of public including the Owner's men and damage to the property of others arising from the use of motor vehicles during on or off the 'Site' operations, irrespective of the ownership of such vehicles.

The liability covered shall be as herein indicated:

Fatal injury : Rs.1,00,000 each person
: Rs.2,00,000 each occurrence

Property damage : Rs.1,00,000 each occurrence

29.4 COMPREHENSIVE GENERAL LIABILITY INSURANCE:

29.4.1 This insurance shall protect the Contractor against all claims arising from injuries, disabilities, diseases or death of members of public or damage to property of others due to any Act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-

Contractors from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the clause entitled 'Defense of Suits' under 'General Conditions of Contract'.

29.4.2 The hazards to be covered will pertain to all the works which and areas where, the Contractor, his Sub-Contractor, his agents and his employees have to perform work pursuant to the 'Contract'.

29.5 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the 'Contract'.

29.6 **FIRE INSURANCE:** Unless otherwise instructed by the OWNER, the Contractor shall, on signing the 'Contract', insure the works and keep them insured until the completion of the 'Contract' against loss or damage by fire, with the Company to be approved by the Purchaser /Owner, in the joint names of the Purchaser /Owner and the Contractor for such amount and for any further sum, if called upon to do so by the OWNER, the premium of such further sum being allowed to the Contractor as an authorized extra. Such policy shall cover the property of the Purchaser /Owner only and shall not cover any property of the Contractor or any Sub-Contractor, or his employees. The Contractor shall deposit the policy receipts for the premium with the Purchaser /Owner within twenty-one (21) days from the date of signing the 'Contract' unless otherwise instructed by the Purchaser /Owner. In default of the Contractor insuring as provided above, the Purchaser /Owner may so insure and may deduct the premiums paid from any moneys due, or which may become due to the Contractor. The Contractor shall, as soon as the claim under the policy is settled, or the work reinstated by the insurance office should they elect to do so, proceed with all due diligence with the completion of the 'Works' in the same manner as though the fire had not occurred and in all respects under the same conditions of 'Contract'. The Contractor in case of rebuilding or re installment after fire, shall be entitled to such extension of time for completion as the Purchaser /Owner may deem fit.

29.7 **Comprehensive Transport, Storage, Erection cum Commissioning Insurance:**

29.7.1 All the equipment and materials being supplied by the Contractor (as per Clause No.1.1 of this section) shall be kept completely insured by the Contractor at his cost from the time of dispatch from the Bidders Works, up to the completion of erection, testing and commissioning at site and taking over the equipment by the owner in accordance with the Contract.

29.7.2 Contractor shall take the delivery at site and jointly with the Purchaser, inspect all the material

received at destination store and furnish a loss/damage report to the Purchaser within a week of receipt of material at site and lodge insurance claims there upon. In case of loss to the Purchaser due to delays in submitting the loss/penalty report by Contractor, owner will be within his right to deduct such losses from the Contractor's progressive payments. **All the equipment and materials being supplied by TSTRANSCO shall also to be taken delivery from any of the designated stores of TSTRANSCO/at site and shall be insured by the Contractor against loss, damage, theft, pilferage, fire etc. from the point of unloading up to the time of taking over of equipment by TSTRANSCO including handling, transportation, storage, erection, testing and commissioning etc. and the Contractor shall be fully responsible for making good of any loss or damage at his own cost.** All costs for such insurance shall be to the Contractor account and shall be deemed included in the Contract price.

29.7.3 It will be the responsibility of the Contractor to lodge, pursue and settle all claims with the Insurance Company in case of any damage; loss, theft, pilferage or fire and the owner shall be kept informed about it. The losses, if any, will have to be borne by the Contractor, if the claims are not lodged and pursued properly or in time or if the insurance company does not settle the same. The Contractor shall replace the lost/damaged materials (own and owner supplied) promptly irrespective of the settlement of the claims by the underwriters and ensure that the work progress is as per agreed schedules. The losses, if any, in such replacement will have to be borne by the Contractor.

30.0 UNFAVOURABLE WORKING CONDITIONS:

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects, during inclement weather conditions, like monsoon, storms, etc., and during other unfavorable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such works and with the concurrence of the Purchaser /Owner. Such unfavorable construction conditions will in no way relieve the Contractor of his responsibility to perform the 'Works' as per the schedule.

31.0 PROTECTION OF MONUMENTS AND REFERENCE POINTS:

The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc., which he may come across during the course of performance of 'Works' either during excavation or elsewhere are properly protected and handed over to the Purchaser /Owner. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked out either with the help of

Purchaser /Owner or by the Purchaser /Owner shall not be disturbed in any way during the performance of his 'Works'. If any work is to be performed which may disturb such references, the same shall be done only after these are transferred to other suitable locations under the direction of the Purchaser /Owner. The Contractor shall provide all necessary materials and assistance for such relocation of reference points, etc.

32.0 WORK AND SAFETY REGULATIONS:

32.1 The Contractor shall ensure the safety of all the workers, materials and equipment either belonging to him or to others working at 'Site'.

32.2 The Contractor will notify the Purchaser /Owner of his intention to bring on to 'Site' any equipment or any container, with liquid or gaseous fuel or other substance that may create hazard. The Purchaser /Owner shall have the right to prescribe the conditions under which such equipment or container maybe handled and used, during the performance of the 'Works' and the Contractor shall strictly adhere to such instructions. The Purchaser /Owner shall have the right to inspect any construction plant and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition shall be entertained by the Purchaser /Owner.

32.3 Where it is necessary to provide and/or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying out such provisions and/or storage in accordance with the rules and regulations laid down in Petroleum Act, 1934, Explosives Act, 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approvals of Purchaser /Owner. In case any approvals are necessary from the Chief Inspector of Explosives or any statutory authorities, the Contractor shall be responsible for obtaining the same.

32.4 The Contractor shall be responsible for provision of all safety notices and safety equipment required both by the relevant legislations and the Purchaser /Owner, as he may deem necessary.

32.5 The Contractor shall be responsible for the safe storage of his and his Sub-Contractor's radioactive sources.

33.0 ELECTRICAL SAFETY REGULATIONS:

33.1 In no circumstances will the Contractor interfere with fuses and electrical equipment belonging to the Purchaser /Owner or other Contractors.

33.2 Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Purchaser /Owner, he shall

- a) Satisfy the Purchaser /Owner that the appliance is in good working conditions.
- b) Inform the Purchaser /Owner of the maximum current rating, voltage and phases of the appliances.
- c) Obtain permission of the Purchaser /Owner detailing the sockets to which the appliances may be connected.

33.3 The OWNER will not grant permission to plug in, until he is satisfied that:

- a) The appliance is in good condition and is fitted with a suitable plug.
- b) The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheath surrounding the cores.

33.4 No electric cable in use by the Purchaser /Owner will be disturbed without prior permission. No weight of any description will be imposed in any such cable and no ladder or similar equipment will rest against or be attached to it.

33.5 No work shall be carried out on any live equipment. The equipment must be made safe by the Purchaser /Owner and a permit to work issued before any work is carried out.

33.6 The Contractor shall employ the necessary number of qualified full-time electricians to maintain his temporary electrical installation.

34.0 FOREIGN PERSONNEL:

The expenditure incurred towards any foreign personnel brought to India for the services as warranted by the Contract including remuneration and taxes applicable thereof shall be born by the Contractor only. Any claim for payment by Purchaser on this account is not acceptable.

35.0 ENGINEER'S INSTRUCTIONS:

35.1 The Purchaser /Owner may, in his absolute discretion, from time to time, issue further drawings and/or written instructions, details, directions and explanations, which are collected referred to as "ENGINEER'S INSTRUCTIONS", in regard to:

- 35.1.1 Any additional drawings and explanations to exhibit or illustrate details.
- 35.1.2 Variation or modification of the design, quality or quantity of work or the additions or omission or substitution of any work.
- 35.1.3 Any discrepancy in the drawings or between the Schedule of Quantities and / or 'Specification'.
- 35.1.4 Removal from the 'Site' of any materials brought thereon by the Contractor and the substitution of any other materials thereof.
- 35.1.5 Removals and/or re execution of any work executed by the Contractor.
- 35.1.6 Dismissal from the work of any persons employed thereupon.
- 35.1.7 Opening up for inspection of any work covered up.
- 35.1.8 Amending and making good of any defects as per Clauses
- 35.2 The Contractor shall comply with and duly execute any work covered in such 'Engineer's Instructions' provided always that verbal instructions, directions and explanation given to the Contractor or his foreman upon the work by the Purchaser /Owner shall, if involving a variation, be confirmed in writing by the Purchaser /Owner within seven (7) days.
- 35.3 If compliance with the "Engineer's Instructions" as aforesaid involves work and scope beyond that contemplated by the 'Contract', unless the same were issued owing to some breach of this 'Contract' by the Contractor the Purchaser /Owner shall pay to the Contractor the price of the said work as an extra to be valued as hereinafter provided in Clause 39.0.
- 35.4 If the Contractor after receipt of written notice from the OWNER requiring compliance, with such further drawings and/or "Engineer's Instructions" fails to comply with the same within seven (7) days, the Purchaser /Owner may employ and pay other agencies to execute any such work whatsoever, as maybe necessary to give effect thereto; and all costs incurred in connection therewith shall be recoverable from the Contractor by the Purchaser /Owner on a certificate by the ENGINEER as a debt or may be deducted by the Purchaser /Owner from any money that may become due to the Contractor.

36.0 RIGHTS OF THE OWNER/ ENGINEER:

36.1 Right to Illustrate and Explain Plans:

- 36.1.1 The various parts of the 'Contract' are intended to be complementary to each other but should any discrepancy appear or any misunderstanding arise as to the import of anything contained herein,

the explanation of the Purchaser /Owner shall be final and binding.

- 36.1.2 The correction of any errors or omissions of the Drawings and Specifications may be made by the OWNER /ENGINEER, when such correction is necessary to bring out clearly the intention that is indicated by the reasonable interpretation of the Drawings and Specifications as a whole.
- 36.1.3 Whenever in the Specifications or on the Drawings which are a part of the 'Contract' or which may be furnished to the Contractor for directing this work, the terms and descriptions of various qualities of workmanship, materials, structures, processes, plant or other features of the 'Contract' are described in general terms, the meaning or fulfillment, of which must depend upon individual judgment, then in all such cases the question of fulfillment of such specifications or requirements shall be decided by the OWNER /ENGINEER and said material shall be furnished, said work shall be done, and said structure, process, plant or feature shall be constructed, furnished or carried on in full and complete accordance with his interpretation of the same and to his full satisfaction and approval, provided such interpretation is not indirect conflict with the Drawings and Specifications and generally accepted good practice.
- 36.1.4 Details shown either on the Drawings or in the Specifications shall be done and furnished as if shown in both except where expressly expected either in the specifications or on the Drawings. Figured dimensions shall in all cases be taken in preference to scale measurements, and detailed drawings consistent with general drawings in preference to the general drawings of the same part of the work.
- 36.1.5 The Purchaser /Owner may ask, from time to time, prepare estimates of quantities or bills of materials required for the work. Copies of such estimates or bills of materials which may be given to the Purchaser for his convenience, or any lists, weights or quantities of materials or structures which may appear on the drawings shall not be considered as finally correct, sufficiently complete, or accurately covering any portion or all of the work to be done under the 'Contract'. Such bills or estimates may be carefully assembled and prepared but their accuracy is not guaranteed. They may not be accurate as to any particular detail and are given only as the best information available at the time of issue of the information. It is understood that any such lists or estimates are furnished to the Purchaser/Owner for his convenience only and not as lists or estimates of work to be done, and many necessary items of work might have been omitted.
- 36.1.6 Additional drawings and explanations to exhibit or illustrate details may be provided by the OWNER/Contractor whenever necessary and if so provided, and if consistent with the Drawings and specifications, it shall be binding upon the Contractor to take cognizance of the same. The

written decision of the Purchaser /Owner as to the true construction and meaning of the Drawings and Specifications and of such additional drawings and explanations shall be binding upon the Contractor.

36.2 RIGHT TO DIRECT WORK:

The Purchaser /Owner shall have the right to direct the manner in which all work under this 'Contract' shall be conducted, in so far as it may be necessary to secure the safe and proper progress and the specified quality of the work, and all work shall be done and all material shall be furnished to the satisfaction and approval of the OWNER.

36.2.1 Whenever, in the opinion of the Purchaser /Owner, the Contractor has made marked departures from the schedule of completion laid down in the 'Contract' or when untoward circumstances force a departure from the said schedule, the OWNER / ENGINEER, in order to assure the compliance with the schedule and the provisions of the 'Contract' shall direct the order, pace and method of conducting the work, which shall be adhered to by the Contractor.

36.2.2 If, in the judgment of the Purchaser /Owner, it becomes necessary at any time to accelerate the overall plant erection work, the Contractor, when ordered and directed by the Purchaser /Owner, shall cease work at any particular point and transfer his men to such other point or points, and execute such portion of his work, as may be required, to enable others to hasten and properly engage and carry on their work, all as directed by the OWNER.

36.2.4 Night work will be permitted only with prior approval of the Purchaser /Owner. The Purchaser /Owner may also direct the Contractor to operate extra shifts over and above normal day shift to ensure completion of 'Contract' on Schedule if, in his opinion, such work is required.

36.3 RIGHT TO ORDER MODIFICATIONS OF METHODS & EQUIPMENT:

If at any time, the Contractor's methods, materials or equipment appear to the Purchaser /Owner to be unsafe, inefficient or inadequate for securing the safety of the workmen or the public, the quality of work or the rate of progress required, he may increase their efficiency and adequacy, and the Contractor shall promptly comply with such orders. If at any time, the Contractor's work force and equipment are in the opinion of the Purchaser /Owner, inadequate for securing the necessary progress, as herein stipulated, the Contractor shall, if so directed, increase the work force and equipment to such an extent as to give reasonable assurance of compliance with the schedule of completion. The absence of such demands from the Purchaser /Owner shall not

relieve the Contractor of his obligations to secure the quality, safe conducting of the work, and the rate of progress required by the 'Contract', and the Contractor alone shall be and remain liable and responsible for the safety, efficiency and adequacy of his methods, materials, working force and equipment, irrespective of whether or not he makes any change as a result of any order or orders received from the OWNER.

36.3 RIGHT TO PERFORM :

The Purchaser /Owner reserves the right to perform or have performed in and about the 'Works' during the time when the Contractor is performing his work here under, such other work as the Purchaser /Owner desires, and the Contractor shall make all reasonable effort to perform his work hereunder in such a manner as will enable such other work to be performed without hindrance and shall make no claim for damage against the Purchaser /Owner arising out of such other work or interference there from. The Contractor shall work in harmony with such other Contractors regardless of race, religion, colour, caste, gender, nationality or origin and any dispute between Contractors shall be arbitrated by the OWNER.

37.0 MEASUREMENT OF WORK AND PROGRESS PAYMENTS:

- 37.1 The Purchaser /Owner may, from time to time, intimate the Contractor that he requires the works to be measured and the Contractor shall attend or send a qualified agent to assist the Purchaser /Owner or his representative in taking such measurements and calculations and to furnish all particulars as may be required by him. Where the erection of equipment, vessels and structural steel is involved, the basis of such measurements and progress evaluation shall be weights specified in the shipping documents or invoices or drawings as decided by the Purchaser /Owner. Should the Contractor not attend, neglect, or omit to send such agents, then, the measurement taken by the Purchaser /Owner or approved by him shall be taken to be the correct measurements of the work. The Contractor or his agent may, at the time of measurement, take such notes of measurements as he may require. When measurements are affected by conditions already established, the Contractor shall take field measurements notwithstanding scale or dimensions shown on the drawings.
- 37.2 The measurements so taken and certified correct by the Purchaser /Owner shall be the basis for the progress payment to the Contractor. Where the breakup of 'Contract on unit basis price' is difficult to arrive at, the Purchaser /Owner and the Contractor shall workout at the commencement of the 'Contract', the weightages or the cost breakups to arrive at a mutually agreeable basis for computation of the progress estimates.

- 37.3 To the value so arrived at on the basis of the Contractor's monthly progress evaluated, shall be added the amounts earned by the Contractor under supplemental Contracts and orders, if any, till date of progress estimate. From the total thus computed, all previous payments plus any amounts due to the Purchaser /Owner in accordance with the terms of this Contract shall be deducted. The remainder shall be paid by the Purchaser /Owner to the Contractor under interim Certificates from the ENGINEER.
- 37.4 In case of work is nearly suspended, or incase only unimportant progress is being made, or in case it is apparent that the Contractor is about to forfeit his 'Contract' or that the money yet due to him shall not complete his 'Contract', the OWNER may at his discretion withhold any payment which may be due to the Contractor.
- 37.5 The Purchaser /Owner may withhold part or whole of any payment for erection claimed by the Contractor, which in opinion of the Purchaser /Owner, is necessary to protect himself from loss on account of :-
- a) Defective work not remedied or guarantees not met
 - b) Claims filed against the Contractor
 - c) Failure by the Contractor to make due payment for materials supplied or labour employed by him.
 - d) Damage to other Contractor's, Owner's or OTHERS' property.
 - e) Failure to meet the mutually agreed schedules.
- 37.6 When the grounds for withholding payments are removed, the Purchaser /Owner without delay shall make payments of the amount due to the Contractor.
- 37.7 The Contractor shall not demand nor be entitled to receive payment for the work or portion thereof, except in the manner set forth in this 'Contract' and only after the Purchaser /Owner shall have given a certificate for such payment.

38.0 ADHERENCE TO MANUFACTURER'S INSTRUCTION:

- 38.1 Adherence to instructions of the Manufacturer's supervisory Engineers, where provided is compulsory. The Contractor shall work under the guidance of the Manufacturer's supervisors to ensure that erection procedures adopted by the Contractor as well as completed erection of equipment is such as not to interfere with or prevent equipment from functioning as intended, as well as to the entire satisfaction of the Manufacturer's supervisor/OWNER. The Contract shall

also permit and provide all facilities for the Manufacturer's erection supervisors to carry out all checks that they may wish to, and approve any erection procedure and/or final setting and alignment of components, in order to satisfy themselves that erection has been carried out as intended by them. This shall, however, in no way relieve the Contractor of his responsibility for providing adequate and competent supervision and quality workmanship. In case of any dispute, the decision of the ENGINEER shall be final.

38.2 Manufacturer's drawings & instruction manuals: Manufacturer's drawings, instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of equipment and extreme care shall be exercised in handling equipment to avoid distortion to stationary structures, the marring of surface finish, damage to delicate instruments and electrical parts.

39.0 MODIFICATIONS:

The Contractor shall carry out all modifications at 'Site' as directed by the Purchaser /Owner to complete the work covered in this 'Contract'. It is the responsibility of the Contractor to get the prior approval for such modifications from the Purchaser /Owner before such works are taken up. The Contractor shall also get the estimates and actual time sheets certified. Time sheets will be the basis for processing his bills for such modification works, which are required to be carried out for no fault of the Contractor.

40.0 DEFECTIVE WORK:

40.1 If the work or any portion thereof shall be damaged in any way excepting by the acts of the Purchaser /Owner, or if defects not readily detected by prior inspection shall develop before the final completion and acceptance of the whole work, the Contractor shall forthwith make good, without compensation, such damage or defects in a manner satisfactory to the Purchaser /Owner. In no case shall defective or imperfect work be retained.

40.2 If the Contractor fails to remove or repair any defect within a reasonable time, the Purchaser shall do so by themselves or by any other agencies at the Contractor's cost and risk and cost of such repairs/removals will be adjusted against the amount due to the Contractor.

41.0 WORK OF OTHERS:

If any part of the Contractor's work depends, for proper execution, upon the work of any other

Contractor, the Contractor shall inspect and promptly report in writing to the Purchaser /Owner any defect in such work or other Contractors that render it unsuitable for proper execution of the work under this 'Contract'. His failure to so inspect and report shall constitute an acceptance of the other Contractor's work as fit and proper for the reception of his work, except as to defects which may develop in the work of other Contractors after the proper execution of the work. To ensure proper execution of his subsequent work, the Contractor shall inspect work already, in place and shall at once report to the OWNER/ ENGINEER any discrepancy between the executed work and the drawings.

42.0 HANDING OVER TO OWNER:

In the event of the Contractor being prevented by causes not attributable to him from proceeding with erection or from completing erection before he withdraws from the "Site", he shall hand over to the Purchaser /Owner for safe keeping during his absence such Contract material that he is unable to erect, and the Purchaser /Owner will furnish a receipt for material so handed over.

43.0 FACILITIES TO WORKERS:

Minimum facilities for workers as per Factory Act shall be provided for by the Vendor/Contractor. If the Vendor / Contractor fail to do so, the same shall be provided by the PURCHASER and deducted the same from the Vendor / Contractor's bills.

44.0 CODE REQUIREMENTS:

The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Boiler Regulations. ASME codes and accepted good Engineering practice, the Engineer's Drawings and other applicable Indian recognized codes and the laws and regulations of the Government of India.

45.0 COORDINATION WITH STATUTORY BODIES & OUTSIDE AGENCIES:

The Contractor is fully responsible for carrying out all coordination& liaison work to be required with Electrical inspectors, Factory inspector & other statutory bodies for implementation of the work. The application on behalf of the Purchaser for submission to the electrical inspector & other statutory bodies along with copies of drawings complete in all respects shall be done by the Contractor & approval/ certificates taken well ahead of time so that the actual commissioning of equipment is not delayed for want of inspection and approval by the inspector & statutory bodies. The actual inspection work by the electrical inspector shall be arranged by the Contractor.

However, any fees paid to electrical inspector/statutory bodies, etc. in this regard shall be borne by the Purchaser. Any modification on the installation suggested by the electrical inspector or any other statutory authority shall also be carried out by the Contractor at no extra cost by the Purchaser.

46.0 SCHEDULE OF QUANTITIES - VARIATION:

The quantities of the various kinds of work to be done and materials will be furnished at the time of award of Contract which have been estimated and set forth in the proposal or the Agreement or the lists of Contract prices, are the best available, but may not be accurate in any or all particulars and are only for the purpose of comparing, on a uniform basis, the bids offered for the work under the Contract. The Bidder agrees that neither owner nor any of the employee or agents thereof shall be held responsible if any of the estimated quantities should be found to be not even approximately correct in the construction of the work and that he shall not, at any time, dispute or complain of such statement nor assert that there was any misunderstanding in regard to the character, sizes and type of work to be done or the kind or amount of the materials to be furnished. Further, Contractor shall make no claim for anticipated profits, for loss of profit or for penalty because no work is ordered under certain items or because of a difference between the quantities of the various kind of work to be done or materials actually delivered and the estimated quantities set forth by owner.

47.0 BID PRICES:

- 47.1 Bid shall be submitted strictly as per the format outlined in the schedules, to enable Purchaser/Engineer to evaluate the bids expeditiously.
- 47.2 The quantities stated in price schedule are approximate only and unit price shall apply to actual quantities measured on the completed work in accordance with specification and drawings.
- 47.3 Contract price shall include all traveling expenses to and from the site, allowances, living expenses, wages, salaries, overtime, benefits and all compensations for his skilled and unskilled workmen, supervisors, Engineers, clerical staff, watch and ward staff, storekeepers, etc., insurance carried by Contractor for his workers, workmen's compensation, third party liability and any other insurance required by the specification, cost of all licenses and permits, loading, transport and unloading of all material, tools and tackles, instruments and construction aids to and from the site, as per the specification, cost of providing office, tools room, quarters, canteen, workshops and all facilities at site as may be required, under the Contract, performance of all services as required under the Contract and satisfactorily executing the complete work under the Contract. If

any fees are to be paid to the statutory authorities for testing, inspection or calibration, these shall be paid by Contractor and included in his cost.

48.0 GUARANTEE: (Clause 14.0 of GCC)

Twelve calendar months from the date of commissioning of the Substation/Bay Extensions/Tr. Line, unless otherwise agreed in writing by owner, will be deemed to be the '**Defect Liability Period (Guarantee Period)**'. The works shall not be considered as completed until owner has certified in writing that they have been virtually completed and the defect liability period shall commence from the date of such certificate. In case any defects in the work, due to bad materials, and/or bad workmanship, develop in the work before the expiry of the period, Contractor, on notification by Owner shall rectify or remedy the defects at his own cost and he shall make his own arrangements to provide materials, labour, equipment and any other appliances required in this regard. The performance security will be returned to Contractor only after the expiry of this defect liability period. In case even on due notification by Owner, Contractor fails to rectify or remedy the defects, Purchaser /Owner shall have the right to get this done by the other agents and recover the cost incurred by deductions from the retention amount or any other amount due to Contractor against this Contract, in case this cost is within the value of the performance security, and if not, Contractor shall be liable to pay to Owner the balance amount.

49.0 TIME FOR COMPLETION AND EXTENSION OF TIME:

49.1 Contractor shall be allowed admittance to the site on the 'date of commencement' and he shall there on and forthwith begin the works and shall regularly proceed with and complete the same on or before the schedule 'date of completion' as per the contract.

49.2 Contractor agrees that the work shall be commenced and carried on at such points, and in the order of precedence and at such times and seasons as may be directed by owner in accordance with the schedule for the completion of work as outlined in the Contract. Contractor declares that he has familiarized himself with the site and right of way, with all the local conditions, and with all the circumstances which may or are likely to affect the performance and completion of the work, and that he has allowed for such conditions in the preparation of this schedule. The progress of works shall be checked at regular monthly intervals and the percentage progress achieved shall be commensurate with time elapsed after the award of Contract.

49.3 However, it is not upon owner to notify Contractor when to begin, to cease or to resume the work,

nor to give early notice of the rejection of faulty work, nor in any way to superintend so as to relieve Contractor of responsibility or of any consequence of neglect or carelessness by him or his subordinates.

49.4 No necessity for an extension of time is anticipated, but if untoward or extraordinary circumstances should arise beyond the control of Contractor, which in the opinion of owner should entitle Contractor to a reasonable extension of time, such extension may be granted but shall not operate to relieve Contractor of any of his obligations.

49.5 Contractor shall promptly notify owner any event or conditions, which might delay the completion of erection work in accordance with the approved schedule and the steps being taken to remedy such situation.

49.6 If Contract is delayed at any time in the commencement or during the progress of the work by any act, delay or neglect of owner or his employees, or by any other Contractor utilized by owner or by changes ordered in the work by owner, or by force Majeure, or by the reason of proceeding taken or threatened by or disputes with public authorities the time of completion shall be extended by a reasonable period as maybe mutually agreed, upon application from Contractor at the time of such special circumstances occurring and not towards the end of the Contract period. Force Majeure is herein defined as(1)any cause which is beyond the control of Contractor or owner, as the case may be (2) natural phenomenon including but not limited to weather conditions, floods, drought, earthquakes and epidemics (3) acts of any governmental authority, domestic or foreign, including but not limited to war, declared or undeclared, priorities, quarantine, embargoes, licensing control or production or distribution restrictions(4)accidents and disruptions including but not limited to fires explosions, breakdowns of essential machinery or equipment and power shortages, (5) transportation delay due to force Majeure or accidents,(6) strikes, slowdown, lockouts and sabotage, (7) riots and civil commotions,(8)failure or delay in Contractor's source of supply due to force Majeure causes enumerated at 1 to 7.

50.0 DISCONTINUANCE OF WORK :

Owner shall have the right to require the discontinuance of the work, in whole or in part, for such time as may be necessary, should the condition of the weather or flood or other contingencies make it desirable to do so, in order that the works shall be well and properly executed. Extension of time shall be granted to Contractor for discontinuance of work so required, and Contractor shall not claim for compensation or damage in relation thereto.

51.0 PENALTY: (Clause 22.0 GCC)

The time stipulated in the Contract for the execution and completion of the works shall be deemed to be the essence of the Contract. In the event Contractor fails to execute, complete and deliver the works within the time specified in the Contract, penalty will be levied as per Penalty clause in GCC.

52.0 PRICES: Please refer Section-II (ITB) of Volume-I :

53.0 BIDDER INFORMED AS TO THE CONDITIONS:

53.1 Bidder shall inspect, examine and obtain all information and satisfy himself regarding all matters and things such as nature and character of work, site conditions and other relevant matters such as right of way, surface and subsurface water conditions to be encountered, the character of equipment and facilities needed for the execution of the work, the availability, location and suitability of all construction materials, the quantities of various sections of the work, and the local conditions, relating to the execution and maintenance of the works to be carried out under the Contract or any hindrance to or interference with construction and maintenance of the works from any cause whatsoever including any other operation of works, which may or shall be carried out on or adjacent to the site of these works, under the Contract and shall make allowance for all such contingencies in the Contract price and shall not raise any claims or objections against owner in any of such matters as mentioned above. The acceptance of the order or execution of the Contract shall be construed as evidence that such as examination was made and later claims for labour, equipment or materials required for difficulties encountered shall not be allowed.

53.2 Any record of subsurface condition, water records and other observations which may have been made by owner have been made with reasonable care and accuracy. Such records may be made available to the Bidder for his information, if available, but there is no expressed or implied guarantee, as to the accuracy of the records or any interpretation of the same.

53.3 Bidder shall recognize this and from own opinion of the character of materials to be excavated from an inspection of the ground and put his own interpretation on records. The prices quoted by Bidder shall be based on his own knowledge and judgment of the conditions and hazards involved and not upon any representation of owner.

54.0 TERMS OF PAYMENT:

The following terms of payment are only acceptable. Tenders received stipulating terms other than the following terms will be invalidated.

54.1 PAYMENT TERMS FOR ERECTION:

- a) Ninety percent (90%) payments of the periodical progressive bills for the erection works will be made for the items of work done. For this purpose, the Contractor shall submit bills to the concerned Executive Engineer regularly to ensure payments in time. The Contractor shall give the full details of items of works done against each location in support of the bill along with the summary sheet of payment particulars with the details of item wise quantity of work completed until the present claim, quantity of work completed against this claim and balance work to be carried out and corresponding amounts of payments. Bills submitted without supporting details will not be taken in to cognizance. Payment is subject to submission of performance security as per clause 15.0 of GCC by the Supplier/Contractor.
- b) Out of the balance 10% amounts, 5% payments will be released after completion of all the works & submission of Material Accounts subject to submission of the following certified by the field Engineer of TSTRANSCO.
 - a. As built drawings.
 - b. Instruction, O & M manuals and installation manuals as applicable.
 - c. Reconciliation of bill of material and order as executed.
 - d. Distribution copies of all drawings.
 - e. Tools and plants.
 - f. Equipment drawings, shop floor drawings and design calculation as applicable.
- c) The balance (final) 5% will be paid after completion of one year performance guarantee period from the date of completion of all the works as per contract and settlement of material account (including Reactor payments).

The date of commissioning/ energizing the equipment will not be considered for reckoning the performance guarantee period and the date of completion of all the works will only be considered as start date of Guarantee period.

In case however, the balance materials are returned to TSTRANSCO well before the completion of the performance guarantee period, the 5% amount will be released against a bank guarantee for equal amount, which shall be valid for the performance guarantee period with two months claim period along with "Performance Security Bank Guarantee". "All banking charges should be to the account of the Contractor".

- d) Contractor shall not be entitled to the said retention amount, until he shall deliver to the Purchaser, a complete release of all works & materials arising out of this Contract or receipts in full in lieu thereof, and in either case an affidavit that so far as he has knowledge or information, licenses and other commitments for which any part of work could be failed. If any unsatisfied work remains after all the payments are made to the Contractor, he shall refund to the Purchaser, all moneys that the latter may be compelled to pay in discharging such including all costs and the attorney's fees so incurred.
- e) The Contractor will have to predefine the Bank details while entering into Contract. The payments will be transferred to the Contractor's bank account by the Purchaser. The Bank details of Bidder as above are final and shall not be revoked under any circumstances. The bank charges will be made to the account of Contractor. An amount of Rs. 50/- (Rupees Fifty only) will be recovered from the bill amount per each disbursement raised by the unit officer of TSTRANSCO.

55.0 FINAL PAYMENT:

Whenever, in the opinion of owner, the work covered by the Contract has been completed, he shall prepare a final abstract showing the total amount of work done by Contractor and its value under and according to the terms of the Contract. From the total value thus arrived at shall be deducted all previous payments and all deductions made in accordance with the provisions of the Contract. The remainder shall be paid by owner to Contractor within three months after the date of owner's final certificates.

- 55.1 Payment of the retention amount shall be due after the Defects Liability period of 12 calendar months, as per conditions stipulated in Clause 48 and clause 54.1 b & c of this section.

56.0 TERMINATION OF CONTRACT BY OWNER:

- 56.0.1 If Contractor (being an individual or a firm) commits any 'Act of Insolvency', or shall be adjudged an Insolvent, or shall make an assignment or composition for the greater part in number of amount of his creditors, or shall enter into a deed of Assignment with his creditors, or being an Incorporated Company shall have an order made against him or pass an effective Resolution for winding up either compulsorily or subject to the supervision of the Court or voluntarily, or of the official Assignee of Contractor shall repudiate the Contract, or if the Official Assignee or the Liquidator in any such winding up shall be unable, within seven days after notice to his requiring

him to do so, to show, to the reasonable satisfaction of owner, that he is able to carry out and fulfill the Contract and if required by owner to give security thereof or if Contractor (whether an Individual, Firm or Incorporated Company) shall suffer execution to be issued, or if Contractor shall suffer any payment under the Contract to be attached to by or on behalf of any of creditors of Contractor or if Contractor shall assign or sublet the Contract without obtaining the consent in writing of owner, or if Contractor shall charge or encumber this Contract for any payments due or which may become due to Contractor there under, or if consultant shall certify in writing to the owner that in his opinion Contractor has abandoned the Contract, OR

- 56.1.1 Has failed to commence the work, or has without any lawful excuse under these conditions, suspended the progress of the works for seven days after receiving from owner written notice to proceed, OR
- 56.1.2 Has failed to proceed with the work with such due diligence and failed to make such due progress as would enable the works to be completed within the time agreed upon, OR
- 56.1.3 Has failed to remove materials from the site or to pull down and replace works within seven days after receiving from owner written notice that the said materials or work were condemned and rejected by consultant under these conditions, OR
- 56.1.4 Has neglected or failed persistently to observe and perform all or any of the acts, matters or things by this Contract to be observed and performed by Contractor for seven days after written notice shall have been given to Contractor requiring Contractor to observe or perform the same, OR
- 56.1.5 Has, to detriment of good workmanship or in defiance of owner instructions to be contrary, Sub-Contracted part of the Contract. Then and in any of the said causes, owner may, notwithstanding any previous waiver, after giving seven days notice in writing to Contract determine Contractor, but without thereby affecting the obligation and liabilities of Contractor, the whole of which shall continue to be in force as fully as if the Contract had not been so determined and as if the works subsequently executed, has been executed by or on behalf of Contractor. Any further, Owner by his agents or servants may enter upon and take possession of the works and all plant, tools, scaffolding, sheds, machinery steam and other power, utensils and materials, lying upon premises or adjoining lands or roads and use the same as his own property or may employ the same by means of his own servants and worsen in carrying on and completing the work or by employing any other Contractors or other person or persons to complete the works, and Contractor shall not in any way interrupt or do anything to prevent or hinder such other Contractor or other person or persons employed for completing and finishing or using the

materials and plant for the works.

When the work shall be completed, or as soon thereafter as convenient, owner shall give in writing to Contractor to remove his surplus materials and plant and should Contractor fail to do so within a period of 14 days after issue of such notice, owner shall dispose them by suitable means and shall give credit to Contractor for the amount realized. Owner shall, thereafter, ascertain and certify in writing under his hand what (if anything) shall be due or payable to or by Contractor, after considering the realized value of the said plant and materials so taken possession of by owner, the expenses or loss which owner might have incurred in getting the works so completed and the progress or any other payments which may be due but not paid to Contractor. The amount so certified shall be paid by owner to Contractor or by Contractor to owner as the case may be and the certificate of consultant shall be final and conclusive.

57.0 INDEMNITY BOND

All materials/equipment supplied by the Contractor and through the sub-vendors including **TSTRANSCO supplied material allotted for this project** shall be handed over to the owner on delivery note. All such material/equipment shall be provided to the Contractor for erection purpose after executing an indemnity bond as per proforma in Conditions of Contract, Volume-I in favour of the owner against loss, damage and any risks involved, for the full value of the materials. This indemnity bond shall be valid till the scheduled date of testing, commissioning and handing over of the equipment to the Engineer.

58.0 MATERIALS:

The materials to be supplied by the Owner shall be taken delivery by the Contractor at any of the designated TSTRANSCO's stores/ site. The Contractor shall submit particulars of additional materials required if any for the completion of the work over and above the materials already received at site stores within a reasonable period. The loading and unloading, proper packing suitable to transport, insurance and proper storage of those materials shall be at the cost of the Contractor. The Contractor shall be responsible for the proper handling and storage of these materials from the time of their receipt up to the time of taking over of the completed equipment by the Engineer. Yards and stores provided by the Contractor for stacking and storage of materials shall be open for inspection by the owner as and when required.

59.0 SURPLUS MATERIALS:

On completion of works, all the surplus material which has been already billed by Contractor to

TRANSCO but not used by Contractor in the project, shall be handed over designated TSTRANSCO stores at the cost of the Contractor within the time limit of 2 months of commissioning of the project. However, if the material is not handed over within such time limit or in the opinion of designate officer of TSTRANSCO who is in-charge of the works, such material is not in fit condition for use, such material shall be retained by the Contractor and recovery shall be made from Contractor at the rate as per the Contract rate.

In exceptional cases, in order to expedite work progress, whenever TSTRANSCO issues the material from its stores on returnable basis to the Contractor, the Contractor shall return such material within 30 days from the date of issue of such material along with interest on the value of such material at the rate of 2% per month or part thereof. However if Contractor fails to return material within 30 days of issue of such material, the material shall be deemed to have been sold to Contractor on the date of its issue to Contractor at a price which shall be 150% of the procurement cost and such cost shall be recovered from Contractor along with interest at 2% per month or part thereof from the date of issue of material till amount is recovered.

60.0 Technical Audit:

- i) All the completed works shall be technically audited by Quality Assurance wing within two months of the completion/commissioning of the project for the correctness of project in terms of agreements, specifications, detailed project report/technical sanction, deviation in quantities & rates.
- ii) All the remarks which are pointed out by Quality assurance wing in the above technical audit shall invariably attend by Construction wing within one month and in case the remarks are pertaining to the execution of work which is in the scope of the agreement, the Contractor has to attend the remarks without insisting of any additional payment.

61.0 QUALITY ASSURANCE PLAN :

The Quality Assurance Plan of TSTRANSCO is appended to this specification. The Bidders are advised to go through the same before quoting the bids. The successful Bidder will have to adhere to the Quality Assurance Plan during execution of works.

Contractor shall maintain the quality standards as per specification and shall attend the remarks of TSTRANSCO Quality Control wing on top most priority without any reminders from TSTRANSCO.

Setting up of Quality Control Laboratory at Site:

- (i) Appropriate grade of concrete and cement content for R.C.C. items may be scrupulously followed as envisaged in IS 456-2000 considering appropriate exposure conciliations.
- (ii) Using of M30 grade shall be mandatory for R.C.C. members of all structures located in coastal areas.
- (iii) A quality control laboratory shall be setup by the Contractor at the construction site for all major works in which the value of the civil works costing more than Rs. 2.00 Crore. List of testing equipment to be kept in the field laboratory is listed below.

Sl. No.	Description of testing Apparatus/Equipment
1.	Core Cutter Apparatus.
2.	Standard Cone Penetration Test Equipment.
3.	Proctor Density test Apparatus.
4.	Compression Testing Machine.
5.	Concrete Test Hammer.
6.	Slump Cone Test Apparatus.
7.	Vicat Needle Apparatus.
8.	Sieve Analysis Apparatus for fine and coarse aggregates.
9.	Screw guage, Vernier calipers.
10.	Auto level, Theodolite, Chains and Ranging rods.

Note: In addition to the above field tests, the Contractor has to be conduct necessary lab tests as requested by the Engineer-in-charge/QC wing at Govt. Labs or at any reputed Govt./Private Engineering College testing labs/NABL accredited lab.

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VOLUME - I. :: SECTION – VII

GENERAL TECHNICAL CONDITIONS OF CONTRACT (G T C)

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SECTION - VII
GENERAL TECHNICAL CONDITIONS OF CONTRACT

1.0 GENERAL:

- 1.1 This section covers technical conditions pursuant to the contract and will form an integral part of the contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out separately in Technical specifications.
- 1.2 The definitions in section-IV of Volume-I, (GCC) are applicable to this section also.

2.0 LIMIT OF CONTRACT:

- 2.1 Equipment furnished shall be complete in every respect with all mountings, fittings fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the respective specifications unless included in the list of exclusions. All similar standard equipment provided, shall be interchangeable with one another.

3.0 ENGINEERING DATA:

- 3.1 Furnishing of engineering data by the Bidder shall be in accordance with the "Schedule of Requirements" as specified in the Technical volumes. The review of these data by the Purchaser will cover only general conformance of the data to the specifications and documents interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect equipment layout. This review by the Engineer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Engineer shall not be construed by the Bidder, as limiting any of his responsibilities and liabilities for mistakes and deviation from the requirements specified under these specifications and documents.
- 3.2 All engineering data submitted by the Bidder after final process including review and approval by the Engineer shall form part of the Contract Documents and the entire works covered under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Engineer in writing.

4.0 DRAWINGS TO BE FURNISHED AFTER AWARD OF CONTRACT:

- 4.1 Soon after award of the contract, the bidder shall furnish the list of drawings (equipment/material/erection) to be furnished by him in accordance with the specification as required for the scope of Supply, erection & Commissioning.
- 4.2.1 Bidder shall submit for approval, as per the above schedule two sets of assembly drawing erection/construction and sufficient detailed drawings to demonstrate fully that the apparatus furnished and erection/construction work carried out shall conform to the provision and intent of these specifications. Detailed drawings or design data proving the adequacy of the Bidder's designs by calculations shall be submitted for approval by the purchaser.
- 4.2.2 The design data and the drawings submitted by the Bidder will be reviewed by the Purchaser as far as practicable within four (4) weeks of their receipt and shall be modified by the Bidder if any modifications and/or corrections are required by the Purchaser. The Bidder shall incorporate such modifications and/or corrections and submit the final drawings for approval. Any delays arising out of failure by the Bidder to rectify the drawings in good time shall not alter the contract completion date.
- 4.2.3 When revised drawings are submitted for approval, the changes from the previous submittals shall be clearly identified on the drawings, with every revision made during the life of the contract shown by number, date and subject, in a revision block and a notation shall be given in the drawing margin. The drawings shall be clear and legible in all respects. The corrected drawings shall be submitted with soft copies in three sets in CDs.
- 4.2.4 The Purchaser shall have the right to require the Bidder to make any changes in the design which may be necessary in the opinion of the Purchaser to make equipment construction cum erection work conform to the provisions and intent of these specifications, without additional cost to the Purchaser. One set of the drawings marked "APPROVED" will be returned to Bidder. He shall thereupon furnish the Purchaser with ten sets of prints (including one set of tracing cloth and another of velograph), soft copy in CD after incorporating all corrections.
- 4.2.5 Further work by the Bidder shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.
- 4.2.6 All manufacturing fabrication work and construction/erection in connection with the equipment before the approval of the drawings shall be at the Bidder's risk. The Bidder may make any changes

in the design, which are necessary to make the equipment construction/erection conform to the provisions and intent of the contract, and such changes will again be subject to approval by the Purchaser.

- 4.2.7 Approval of drawings by the Purchaser/Consultants shall not be held to relieve the Bidder of any part of his obligation to meet all the requirements stipulated in the specification of responsibility for correctness.
- 4.2.8 One month prior to dispatch of the equipment final approved drawing sets, operation, maintenance and erection manuals shall be supplied to the Purchaser in 6 copies. Also a soft copy of the drawings in Auto cad version shall also be supplied.
- 4.2.9 The Bidder shall mark in red in one (1) set of drawings all deviations/alterations carried out at site during construction work. After final testing and commissioning, any corrections in the, field test, actual erection, testing and commissioning shall be incorporated in the drawings and the Bidder shall furnish to Purchaser ten (10) copies of the revised drawings/manuals and marked as "As Built" drawings shall be supplied in the Office of the **Chief Engineer/LIS/Vidyut Soudha /Hyderabad**. However, no alternations/ deviations shall be carried out without the prior approval of the Purchaser.
- 4.2.10 The Bidder shall also furnish two sets of reproducible along with soft copy in CD of all reference drawings and documents/designs after approval and two sets of reproducible of all as built drawings as certified by the field engineer of TSTRANSCO.
- 4.2.11 Drawings shall include all installation and detailed piping drawings. All piping 100 millimeter and larger shall be routed in detail and smaller pipe shall be shown schematically or by isometric drawings.
- 4.2.12 Each drawing shall be complete with Bill of Materials and legends. It shall contain technical requirements of quality assurance to be observed at shop and technical requirements for work at site like welding length, weld size, type of electrodes etc.

4.3 QUALITY ASSURANCE PLAN:

Contractor shall furnish the Quality Assurance Plan for the Equipment/Material and erection under the contract (for details refer Cl.No.9.0 of this section).

4.3.1 DRAWINGS TO BE FURNISHED AFTER THE COMPLETION OF WORK

After completion of the erection work, the Bidder shall furnish 10 (ten) sets of copies of drawings in

bound volumes along with a soft copies in a Pen drive/CD discs, in addition to set of Auto CAD drawings the completion drawings listed below:

- i) All tender drawings specified under this clause 4.1 & 4.2 above,
- ii) Key diagrams and schematic drawings of all piping system, wiring diagrams for all electrical circuits including cabling arrangements, Cable laying and termination schedules etc.
- iii) Detailed drawings of the entire equipment which shall include separate drawings of the entire equipment and of all important component parts of the plant incorporating sufficient details for complete understanding of the design and working of the entire plant and containing all the necessary information required for the erection and maintenance.
- iv) Detailed shop drawings for critical spares.

In addition, such detailed drawings as may be necessary for erection, maintenance, repair, identification of plant components/parts and for making or ordering replacement parts shall be supplied by the Bidder as may be required by the Purchaser. In addition, the VENDOR/CONTRACTOR shall furnish two sets of soft copies in CDs in addition to the full size prints. Sets of above drawings in bound volumes shall contain the copy of the drawings of all the equipment erected including that of TSTRANSCO supplied material.

5.0 INSTRUCTION MANUALS

- 5.1 The Bidder shall submit to the Purchaser, instruction manuals for erection of the equipment, covered under the contract before commencement of erection of the same. The instruction manuals shall contain full details and drawings of all the equipment furnished, the erection procedures and testing procedures. These instruction manuals shall be submitted in the form of one reproducible original and copies.
- 5.2 After the commissioning and initial operation of the plant, If the instruction manuals require any modifications/additions/ changes, to the manuals furnished earlier, the same shall be incorporated and the updated final instruction manuals in the form of one reproducible original and ten copies shall be submitted by the Bidder to the Purchaser.
- 5.3 The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment as completed shall be supplied well before the commissioning and shall be in sufficient detail containing every drawing and information required for the installation, testing, setting and adjustment of all components after installation, commissioning, operation and

maintenance of the equipment and all the components, dismantling and repair besides the data needed for the servicing of the components and ordering the spares. Marked erection prints identifying the component parts of the equipment, as transported, with the assembly drawings. Detailed dimensioned assembly and cross-section drawings and description of all the auxiliaries and drawings identifying all spares for reorder. They shall give a step-by-step procedure for all operations likely to be carried out during the life of the plant/ equipment including erection, testing, commissioning, operation, maintenance, dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The 'Contract' shall not be considered to be completed for purposes of taking over until such instructions and drawings have been supplied to the Purchaser.

- 5.4 A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets, drawings and a list of parts with procedure for ordering spares. Maintenance instructions shall include charts showing lubrication checking, testing and replacement procedures to be carried out daily, weekly, monthly and at longer intervals to ensure trouble free operation. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or breakdown. A collection of the manufacturer's standard leaflets will not be accepted, to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

6.0 FIRST FILL OF CONSUMABLES, OILS AND LUBRICANTS

All the first fill of consumables such as oils, Multi purpose grease, Petroleum Jelly, Cotton waste and dungry cloth etc., which will be required to put the equipment covered under the scope of the specifications, into successful operation, shall be supplied by the Bidder unless specifically excluded.

7.0 MANUFACTURING SCHEDULE

The Bidder shall submit to the Purchaser his manufacture and delivery schedules for all equipment within thirty (30) days from the date of award letter. Such schedule shall be in line with the detailed network for all phases of the work of the Bidder. Such schedules shall be reviewed, updated and submitted to the Purchaser once every two months thereafter, by the Bidder. Schedules shall also include the materials and equipment purchased from outside supplier. They shall also provide the required number of photographs together with the negatives showing the actual progress during various stages of manufacture at no extra cost to the Purchaser.

8.0 DESIGN IMPROVEMENTS

- 8.1 The Engineer or the Bidder may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.
- 8.2 If any such agreed upon change, is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Bidder proceeds with the change. Following such agreement the provision thereof, shall be deemed to have been amended accordingly.
- 8.3 Any change in design or manufacturing process which the CONTRACTOR/ SUPPLIER incorporates in his produce as a measure of improvement on his own shall not entitle him for any extra payment.

9.0 QUALITY ASSURANCE PROGRAMME

- 9.1 To ensure that the equipment and services under the scope of this contract whether manufactured or performed within the Bidder's works or at his Subcontractor's premises or at the Purchaser's site or at any other place of work are in accordance with the specifications, the Bidder shall adopt suitable quality assurance programmes to control such activities at all points, necessary. Such programmes shall be outlined by the Bidder and shall be furnished as applicable. A quality assurance programme of the Bidder shall generally cover the following.
- a) His organization structure for the management and implementation of the proposed quality assurance programme;
 - b) Documentation control systems;
 - c) Qualification data for Bidders key personnel;
 - d) The procedure for purchase of materials, parts, components and selection of Sub-Contractor's service including vendor analysis, source inspection, incoming raw-material inspection, testing, verification of materials purchased, etc.
 - e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly controls;
 - f) Control of nonconforming items and system for corrective actions;
 - g) Inspection and test procedure both for manufacture and field activities
 - h) Control of calibration and testing of measuring and testing equipment;
 - i) System for indication and appraisal of inspection status
 - j) System for quality audits;
 - k) System for authorizing release of manufactured product to the Purchaser
 - l) System for handling storage and delivery;
 - m) System for maintenance of records; and
 - n) A quality plan detailing out the specific quality control procedure adopted for controlling

the quality characteristics relevant to each item of equipment/component furnished.

10.0 QUALITY ASSURANCE DOCUMENTS:

10.1 The Bidder shall be required to submit the following Quality Assurance Documents within before dispatch of the equipment

- i) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication,
- ii) Welder and welding operator qualification certificates,
- iii) Welder identification lists, listing welders and welding operator's qualification procedure and welding identification symbols.
- iv) Material mill test reports on components as specified by the specification.
- v) The inspection plan with verification, inspection plan check points, verification sketches, if used, and methods used to verify that the inspection and testing points, in the inspection plan were performed satisfactorily.
- vi) Sketches and drawings used for indicating the method of trace ability of the radiographs to the location on the equipment
- vii) Non-destructive Examination result, reports including radiography interpretation reports.
- viii) Factory test results for testing required as per applicable codes and standards referred in the specification.
- ix) Inspection reports duly signed by Quality Assurance personnel of the Purchaser and Bidder for the agreed inspection hold points. During the course of inspection, the following will also be recorded:
 - a) When some important repair work is involved to make the job acceptable; and
 - b) The repair work remains part of the accepted product quality.

11.0 ENGINEER'S SUPERVISION:

11.1 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Engineer and his decision shall be final.

11.2 The work shall be performed under the direction and supervision of the Engineer. The scope of the duties of the Engineer, pursuant to the Contract will include but not be limited to the following:

- a) Interpretation of all the terms and conditions of these documents and specifications;
- b) Review and interpretation of all the Bidder's drawings, engineering data etc.;
- c) Witness or his authorized representative to witness tests and trials either at the manufacturer's work or at site, or at any place where work is performed under the Contract;
- d) Inspect, accept or reject any equipment, material and work under the Contract;

- e) Issue certificate of acceptance and/or progressive payment and final payment certificates;
- f) Review and suggest modifications and improvements in-completion schedules from time to time; and
- g) Supervise the quality assurance programme implementation at all stages of the works.

12.0 DEPARTURE FROM SPECIFICATIONS:

- 12.1 While the Purchaser does not bind himself to accept the lowest or any other Bid, Due consideration shall be given to any special devices or equipment put forward by the Bidder with a view to increase the efficiency of the plant and to minimise the initial or maintenance cost of the plant as a whole.

13.0 TOOLS & PLANTS:

- 13.1 A complete outfit of tools, spanners, torque renches, powered hand drills , gauges, slings and other lifting devices, instruments and all other appliances necessary or convenient for the complete assembly, erection at site, dismantling and maintenance of the plant along with racks for holding them shall be supplied and included in the Contract. Spanners shall be single ended and made to fit each size, of nut and bolt of the plant. Two sets of spanners, tools and appliances etc,. as indicated in this specification shall be supplied. He shall also provide a durable storage box with lock for such tools. The prices for all items are deemed to have been included in the quoted bid price and no separate payment shall be made for these items. The details including make of Tools & Plants offered shall be given in the bid.

13.2 ERECTION AND MAINTENANCE TOOLS:

The tenderer is responsible for maintaining the required erection tools.

14.0 EXTRA WORK:

- 14.1 The Bidder shall, when asked in writing by the Purchaser, perform extra work and furnish extra material not covered within the scope as per specifications. Payments for such extra work or material shall be as per the provisions of General conditions of specification.

15.0 STANDARDS:

- 15.1 All material and equipment shall comply in all respects with the requirements of the latest edition of the relevant Indian, International Electro-Technical Commission (IEC). Commodities meeting Japan Industrial Standards (JIS) and other internationally accepted standards, which ensure equal or higher quality than the standards mentioned will also be accepted. However, wherever standards other than those specified are adopted, two copies of English Version of such Standards

are to be enclosed to the Bid.

15.2 Where a certain equipment is stated not to comply with the Indian, IEC or any other equivalent standard, the salient points of comparison between the standard adopted and those mentioned above shall be clearly brought out in the Bid making at the same time necessary corrections for operation under the conditions specified herein. Wherever a standard is specifically mentioned in these specifications, it is understood that the corresponding standard or standards from amongst the source mentioned above shall also apply. It is, however, understood that the plant and equipment offered shall comply with one consistent set of standards except as far as they are modified by the requirements of these specifications.

15.3 In case of a conflict between such codes and/or standards and the specifications, the latter shall govern. Such codes and/or standards referred to shall mean the latest revision, amendments/changes adopted and published by the relevant agencies. In cases of any further conflict in this matter, the same shall be referred to the Engineer, whose decision shall be final and binding.

15.4 For verification and according approval of the documents in respect of Technical data/ designs & drawings, test certificates of the equipment and material offered for Supply/ erection in the contract, the bidder shall support these documents with relevant Standards and Codes wherever requested by the Purchaser.

16.0 MANUFACTURER'S STANDARDS:

16.1 The general principal on whom these specifications are drawn up is to permit the adoption of modern manufacturing standards. The Bidders are requested to tender for their own standard equipment so far as possible provided these comply with the requirements of these specifications. However, should Bidder wish to depart from the provisions of these specifications either on account of manufacturing practice or for any other reasons, he shall draw the attention of the Purchaser to the proposed points of departure and shall submit such full information, drawings and specifications as will enable the relative merits of his proposals to be fully appreciated.

16.2 In the event of these specifications or a part thereof and the Bidder's drawings, specifications, forms, tables etc. being found to disagree during the execution of the Contract, these specifications shall be held as binding unless the departures have been duly approved in writing by TSTRANSCO.

17.0 FOUNDATION AND FIXTURES:

- 17.1 Designs for foundation and supporting structures for all equipments shall be prepared by the Bidder. All fixtures necessary for proper erection of embedded parts shall be supplied by the Bidder.

18.0 MATERIALS AND WORKMANSHIP:

18.1 GENERAL

- 18.1.1. All parts shall be manufactured true to drawing's dimensions. All tolerances shall be defined on the Bidder's drawings for both manufacturing and installation purposes. Holes shall be drilled full size or under size and reamed during shop assembly. Punched holes will only be permitted in plates 16mm or less in thickness, provided all such holes are subsequently reamed full size during shop assembly.

- 18.1.2. The materials used in the construction of the equipment/material shall be new, of high quality and selected particularly to meet the duties required of them. The material specification shall be indicated in Bidder's detailed drawings. The use of materials liable to attack by termites or other insects shall not be allowed. All workmanship shall be of the highest quality throughout to ensure smooth and vibration free operation under all possible operating conditions and the design, dimensions and materials of all parts shall be so chosen that the stresses to which they may be subjected shall not render them liable to distortion or damage under the most severe conditions encountered in actual service.

- 18.1.3 Materials and workmanship shall conform to the latest editions of the IEC/ISS standards.

18.2 PIPING

- 18.2.1. All pipes and fittings supplied by Bidders shall conform to the appropriate standards.

- 18.2.2 Each piping system shall be provided with an adequate number (to be approved by the Purchaser) of valves, drain plugs/ cocks, test plugs/ cocks, sight flow indicators, meters etc. so as to ensure ease and flexibility of operation coupled with reliability, soundness and ease of maintenance of the system.

- 18.2.3. All piping shall be clean inside and where ending in open connection for other work, the piping shall have the ends capped for protection. Valves shall be easily accessible and gauges and other operating or indicating devices shall be located so that they can be conveniently operated or read from the floor walkways. Valves shall be suitable for the services intended. Either blind companion flange or a pipe plug shall be provided, wherever necessary, to protect valves. Where piping

systems must be disconnected for servicing, flanges or unions shall be provided and the piping, valves and joints shall be arranged for minimum disturbance or interference with other parts during such operation.

18.2.4. As far as possible, the pipes shall not be embedded but shall run in trenches or shall be suitably supported by hangers, brackets, hooks, pedestals, or any other support suited to the requirement, care being taken to avoid vibration at the supports. An adequate allowance for the expansion of pipes under service conditions shall be made. Each pipe shall be kept suitably sloped to facilitate drainage and shall be suitably lagged where necessary. The material of piping for different services shall be stated in the Bid.

18.2.5. Flexible pipe connections to apparatus shall be provided wherever necessary.

18.2.6. For ready identification of different piping systems and their functions, each piping system shall be painted in code colors (to be approved by the Purchaser). All operating points and each separate section shall also be painted with two bands of approved coded colors, the wide band twice the width of the narrow one. An arrow showing the direction of flow shall be marked, generally the narrow band shall be in the direction of flow.

18.2.7. All operating valves on a piping shall also be painted with the same code colour. Each valve shall have, fitted to it, a suitable nameplate indicating the function of the valve.

18.3 FASTENINGS:

18.3.1. Nuts, bolts, studs and washers for incorporation in the plant shall conform to the requirements of the appropriate standards, where the contract includes nuts and bolts of different standards, then the tools shall be provided in compliance with this specification and shall include spanners. Taps and dies for these nuts and bolts. Nuts and bolts for pressure parts shall be of the best quality bright steel, machined on the shank, under the head and nut. All washers shall be included under the contract, including locking devices and anti-vibration arrangements. Taper washers shall be fitted, wherever necessary. Where there is risk of corrosion, bolts and studs shall be finished flush with the surface of the nuts. Bolts except for high strength friction grip bolts shall be designed so that with the nuts fully tightened, the stress intensity at the bottom of the thread shall not exceed half the yield point of the material under all conditions. All bolts, nuts and screws that shall be subjected to frequent adjustment or frequent removal in the course of operation shall be made of corrosion resistant steel or bronze. Spring type washers will not be permitted where they may damage any protective coatings. Special tools, wrenches and devices found to be necessary for the completion of the work shall be also provided under this Contract.

18.4 FORGINGS:

18.4.1 All forgings in excess of 150 mm. in diameter shall be subjected to examination internally for the detection of flaws and heat treatment for the relief of residual stresses. Particulars of the heat treatment proposed for all forgings shall be submitted to the Purchaser.

18.5 CASTINGS:

18.5.1. The parts of cast steel shall not contain damaging defects and shall be satisfactorily cleaned before use. The surfaces which are not machine-finished and which will be exposed after their final installation shall be such that grinding at the site will not be required before painting. The presence of defective material shall be determined and it shall be removed down to sound metal. The cast parts shall be homogeneous and free from excessive nonmetallic inclusions. An excessive concentration of impurities or a separation of the alloy elements in the critical points of a cast part shall be sufficient reason for its rejection.

18.5.2. The castings of the main parts, including all those subject to hydraulic pressure and all castings which undergo a major repair, shall be tested using radiographic, ultrasonic, dye penetration, magnetic particle or any other standard non-destructive test method. The expenses incurred on such tests shall be to the Bidder's account.

18.5.3. Minor defects or imperfections which definitely do not affect the strength or utilization of the cast parts may be repaired by welding, according to the accepted practice for the repair of such parts.

18.5.4. Thickness and other dimensions of the cast parts shall agree substantially with the dimensions shown on the drawings and shall not be reduced by shop or casting practices to such an extent that the effective strength of the cast parts do not exceed the stresses allowed by these specifications.

18.5.5. Use of cast iron for parts subjected to tension or impact shall not be permitted without the approval of the Purchaser.

18.6 WELDINGS

18.6.1 Bidder shall specify clearly on all relevant drawings, the amount and type of material for each type of weld. Bidder shall also provide detailed drawings showing joint preparation required for each type of welding to be carried out on site and at manufacturer's works.

18.6.2 PREPARATION OF BASE MATERIALS

The parts to be jointed by electric welding shall cut precisely to the correct size by machine methods suitable for the type of weld to be used and to allow the proper penetration and good fusion of the weld with the base metal. The cut surfaces shall not have visible defects such as scales; superficial defects caused by shearing or torch cutting operation or any other damaging defect. The surfaces of the edges to be welded shall be free from rust, oil, grease and other foreign matter.

18.6.3 ELECTRODES

Bidder shall indicate on the detailed drawings, the type, sizes and material of electrodes he proposes to use for shop and/or field welding. Unless otherwise stated, all non-destructive tests shall be carried out. All major welding and all welding carried out on tanks and vessels that will contain liquid under pressure or compressed air shall be subjected to a 100% radiographic examination. In those cases where it is impossible to carry out radiographic inspection, it may be replaced by ultrasonic examinations or by other non-destructive test systems.

19.0 ELECTRICAL EQUIPMENT - General:

The various auxiliaries and controls shall be suitable for 415/240 Volts,. A.C. 50 Hz and 220 V D.C. supplies respectively.

20.0 PUMPS:

- 20.1 Unless otherwise specified, all pumps shall be directly coupled to driving motors and their type, capacity and performance shall be best suited to the requirements. The efficiencies of the pumps shall be as high as practicable consistent with good design. As far as possible, the pumps shall be of standard size to facilitate replacement of parts. The pumps shall be of the self-priming type. If however, any external means of priming are employed, these shall be stated in the Bid and shall be subject to the approval of the Purchaser.
- 20.2 Driving motors to which pumps are coupled shall conform to the general standards laid down in this specification. Gear motors, if employed, shall be subjected to the Purchaser's approval. The pumps capacities and the rating of the driving motors shall have liberal margin over the requirements.
- 20.3 All pumps shall be designed and constructed to ensure a quiet and satisfactory operation without undue noise or vibration under all conditions of discharge and pressure. Centrifugal pump casings shall be designed to produce smooth flow with gradual changes in velocities. The pumps shall be

equipped with adjustable pressure relief bypass or unloading valves to protect against excessive pressure in case of blockage in the discharge line. In addition, the pumps shall be easily removable and replaceable. Suitable gaskets shall be provided for all pipe joints to ensure that they are leak proof. If any strainers are required with the pumps, these shall be included in the Bid and be duplex type to enable periodic cleaning.

- 20.4 All pumps shall be complete with the necessary piping, both on the suction and delivery sides and with all fittings suited to the size and duty of the pump. Adequate number of valves as stated earlier shall be furnished with each pumping unit to suit its operation and maintenance. Wherever necessary, pumps shall be provided with suitable flow meters or flow indicators and pressure gauges to measure the discharge and the pressure delivered by the pumps. Suitable eyebolts or lifting lugs shall be provided on each pumping set to facilitate handling.

21.0 ELECTRIC MOTORS AND MOTOR CONTROL GEAR:

- 21.1 All motors furnished by the Bidder, for driving the unit auxiliaries and other apparatus, shall be directly coupled to the apparatus driven and shall be suitable for operation on either (i) 415 volts, 3 phase 50 Hz AC or (ii) 240 volts, single phase, 50 Hz AC or (iii) 220 volts DC supply, as specified in the relevant clauses of this specification. All equipment offered by the Bidder shall operate safely and satisfactorily at any voltage $\pm 10\%$ of the above-specified voltage. The enclosure of each motor shall be of the type best suited to the service conditions of the motor and shall be subject to the approval of the Purchaser in every case. The motor shall generally conform to the relevant Indian or IEC/other equivalent standards. The insulation shall be moisture, oil and oil vapour proof and the motors shall be entirely suitable for the operation in the tropical climatic conditions prevailing at site. The motors shall conform to the specification detailed in Section "Auxiliaries".
- 21.2 Motor shall be provided with closed conduit box suitably located for ease of access and with eyebolts or lugs for lifting. The terminal box shall be fitted by means of terminating the external wiring for outdoor use. Varnished cambric or glass insulation shall be used for connections from the windings to the terminals. All motor-terminals shall be of the stud type and totally enclosed.
- 21.3 The capacity, speed and torque characteristics of the motors shall be suitable for the starting and operating requirements of the associated apparatus.
- 21.4 Necessary starting, protective and control gear shall be furnished by the Bidder with each motor. Instantaneous and thermal overload protection shall be provided for the motors together with remote indication of the operation of the protective gear, wherever necessary. In the case of

essential motors, stoppage of which would result in serious damage, the thermal overload protection devices shall be arranged to give alarm only without disconnecting the motors. Red and green indicating lamps shall be furnished for indication of the closed and open positions respectively of motor contactors. The control and indication equipment shall be suitable for operation with 220 volts DC supply.

- 21.5 Special type of motors, not adequately covered by this specification, may be offered for any special application, but these shall be subject to the approval of the Purchaser.

22.0 SMALL WIRING:

- 22.1 All small electric wiring of the various equipment panels, etc. shall be completed at the manufacturer's work as far as possible. All small wiring shall be arranged neatly into flat or rectangular groups and shall be adequately supported with cleats etc. The small wiring shall be so arranged as to reduce the number of bends or crossing to a minimum. There shall be no splices in the wire and all connections shall be made at the terminal studs or terminal blocks. Similar circuits shall be arranged to terminate as far as possible, on adjacent terminals to facilitate grouping and to minimise the number of interconnecting cables. Secondary or control wiring including leads from the current transformers, temperature detectors, alarm contacts, speed and pressure switches etc. shall be enclosed in conduits and shall be carried to dust and water proof and oil tight cabinets located conveniently for connection to the control cables.
- 22.2 Pressure circuits shall be suitably protected so that failure of one circuit shall not cause the progressive failure of adjacent circuits. Alternating current circuits, direct current circuits, and circuits operating at different voltages shall be grouped separately and the wiring for each of these groups shall preferably be segregated.
- 22.3 For the purpose of easy identification, tracing and reconnection, the wiring shall be colour coded and shall be fitted near the terminals with ferrules or such other cap indelibly marked with the identification number corresponding with that of the associated terminal blocks. When an electrical circuit is extended to several pieces of equipment necessitating sectionalising of circuit wiring at the terminal blocks of the corresponding equipment, common identification numbers shall be used for the designation of the circuits at all the terminal blocks and connections. The terminals and circuit designations for all wiring shall be subject to the approval of the Purchaser.
- 22.4 All small wiring of voltage of 1100V shall be switch board type single conductor, tinned annealed copper wire, PVC insulated cables as per relevant Indian or International Standards, insulated with

varnished cambric, which has proved its utility in tropical region against hot and moist climatic conditions and vermin, complying with the relevant International Standards. All small wiring shall have oil vapour-proof insulation. The sizes of the wiring for different circuits shall be so chosen as to provide ample margin for the purposes intended and shall be subject to the approval of the Purchaser.

23.0 MEASURING INSTRUMENTS:

- 23.1 All instruments and meters shall be suitable for operation under the climatic conditions prevailing at site. The instrument cases shall be dust proof, water tight, vermin proof and specially constructed to adequately protect the instruments against damages for deterioration due to high ambient temperatures and humidity, special care being taken in the protection of instruments for outdoor service. The details, pointers etc., shall be designed to facilitate accurate reading by minimising parallax and glare from instrument window and by providing clear, bold dial markings. The size of dial and length of the scales of indicating instruments shall be subject to the approval of the Purchaser in each case. The scale of the indicating instrument shall cover approximately 300 degrees movement of the indicator. The scale plates of panel mounted indicating instruments shall have a permanent white matt finish with black graduation. The pointers or the pointer indicating contact setting (in contact working instruments) shall be distinguished from the main pointer by a distinct colour and/or shape. The current transformer shall be designed for secondary current of One Ampere and Voltage transformer shall be designed for secondary voltage of 110 volts unless specified otherwise.
- 23.2 Instruments mounted on panels shall be of the semi flush type and shall be back-connected. All instruments on a switchboard or instrument panel shall be of matching pattern, shape and finish to present a pleasing appearance consistent with the functional requirements. The finish of the instrument case shall be subject to the approval of the Purchaser. All instruments shall be designed for accurate measurement of the quantity or state under all conditions of operations and any errors due to change in the ambient temperature, over the entire range of temperatures obtainable at site, shall be kept to a minimum. The instruments shall be provided with all the auxiliary appliances and any special tools required for their maintenance.
- 23.3 The metric units shall be used for marking the instrument dials. The range shall generally be such that the normal operating values are indicated in the middle third of the scale.
- 23.4 All electrical instrument coils shall be designed for continuous operation on at least 110 percent of

the full rated current and for potential of the instruments. The instrument coil rating shall be coordinated with those of the associated instrument transformers.

- 23.5 The VA burden of instrument coils shall be as low as possible, consistent with the best modern design.
- 23.6 Electrical indicating instruments shall comply generally with the requirements of the Indian/IEC or any other International Standards and shall be of the accuracy specified in relevant sections.
- 23.7 Recording instruments shall be of the strip chart type with chart scales having suitable width. The charts shall be gear-driven by a self-starting synchronous motor wound spring device having ample torque even at reduced voltage and with at least 8 hours spring reserves. The device for producing the record on the chart shall be a reliable ink recording or printing type and shall produce clear, legible record under all normal conditions of operation. The recording instruments shall be of withdrawal type for easy access to maintenance work. Sufficient number of chart rolls, recording ink for two years of operation and any special tools required for the maintenance of the instruments shall be furnished with each recorder.
- 23.8 Integrating watt-hour meters shall comply generally with the requirements of the International Standards and shall be first grade for the purpose of accuracy classification.
- 23.9 Contact making instruments shall have contacts suitable for 240 Volts, A.C. or 220 Volts D.C.Circuits.
- 23.10 All instruments shall have as high accuracy as possible consistent with best modern design. The construction of instruments shall be mechanically sound and shall ensure permanence in the accuracy. The limits of error for different instruments shall be stated in the Bid and their accuracy classification, where otherwise not specified, shall be subject to the approval of the Purchaser. All instruments shall be tested in accordance with the requirements of the standard, wherever specified. In case where no specific standards are mentioned, the Bidder shall submit the list of the standards in accordance with the Instruments proposed to be manufactured and tested and these shall be subject to the approval of the Purchaser in every case.
- 23.11 The instruments shall be capable of withstanding the following tests viz. effect of shock, effect of vibration and effect of humidity and dielectric tests of 2000 volts RMS to ground for one minute in accordance with relevant standards.

24.0 EARTHING:

24.1 The Bidder shall provide suitable earthing terminals on all the equipment supplied under the Contract and shall connect the earthing conductors to these terminals as approved or directed by the Purchaser.

24.2 Unless specified otherwise, the earthing conductors from the station earthing bus to the equipment will be provided by the Bidder and shall provide suitable test terminals at convenient points of the equipment to enable periodic testing the resistivity and insulation level of the equipment.

25.0 UNITS:

25.1 Metric units according to the latest edition of the relevant Indian/IEC publications shall be used for this Contract.

25.2 For the purpose of design/calculations, M.K.S. units shall be used.

26.0 DESIGN AND STRESSES:

26.1 The design, dimensions and materials of all parts of the equipment shall be such that they will not suffer damage under the most adverse service conditions. Mechanism shall be so constructed as to avoid sticking due to rust or corrosion.

26.2 The Bidder shall be responsible for an adequate design. The principal stresses in the materials used shall be indicated in the Bid.

26.3 The equipment shall be designed for operation in an earthquake zone. The equipment and each part of it shall be strong enough and sufficiently well connected to resist total operating stresses, including any stress resulting from an earthquake.

26.4 All equipment shall be designed to:

- i) Minimise the risk of fire and any consequential damage;
- ii) Prevent accidental contact with live parts;
- iii) Be capable of continuous operation or as required with minimum attention and maintenance under the conditions prevailing in a power development in a tropical climate.

26.5 The Bidder shall provide complete information regarding maximum unit stresses used in the design.

27.0 PROTECTION:

- 27.1 All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a nonmetallic protecting device. Ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather shall also be properly treated for normal life and satisfactory operation under the climatic condition prevalent at the site and shall be dust and vermin proof. All parts and surfaces which are subject to corrosion shall be made of such material and shall be provided with such protecting finish as would protect the equipments installed from any injurious effects of excessive humidity. All electrical auxiliary equipment shall be specially treated for tropical conditions and the materials and methods for this treatment shall be got approved in advance.

28.0 PRESERVATIVE SHOP COATING:

- 28.1 All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces, which will not be easily accessible after the shop assembly, shall beforehand be treated and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scale, oxide and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. All important component parts shall be specially protected with a protective coating and other measures to ensure prevention of rusting of the machine surfaces during storage of the material before erection. Any special instructions for inspection and maintenance of such vital parts during storage deemed necessary by the Bidder to ensure the protection of such parts shall be supplied well in advance of the supply of such vulnerable parts. Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade resistance enamel. The finished colour shall be as per manufacturer's standards, to be selected and specified by the Engineer later.
- 28.2 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Engineer.
- 28.3 Switchgear and all the auxiliary plant shall be given two coats of finishing paint of approved colour over a coat of filler paint. Outdoor equipment and all the allied plant shall be given two priming coats of approved rust resisting paint in plain colour before packing. Parts not so painted shall be protected against deterioration during shipment. All bright steel parts shall be given a thick coat

approved rust resisting paint in plain colour to prevent rusting during shipment and transport. All gun metal or brass parts shall be coated with a removable dark paint as a precaution against pilferage during transit. All unfinished surface in contact with oil shall be cleaned and painted with a special oil resistant paint.

- 28.4 All the seams and joints which will be riveted together at site shall be given a coat of varnish before dispatch from manufacturer's works. The interior metallic surface of oil filled apparatus shall be treated with oil resistant paint or varnish after thorough cleaning. Sufficient quantity of finishing paint shall be supplied for applying two further coats to all the parts, which are painted with unfinished paint after the complete erection of the machinery.

29.0 GALVANISING:

- 29.1 All materials to be galvanised shall be of the full dimensions shown or specified and all punching, cutting, drilling, screw tapping and the removal of burrs shall be completed before the galvanising process commences. All galvanising shall be done by the hot-dip process with smelter of purity not less than ninety-nine point nine five percent (99.95%) as per IS: 209 of which must be pure zinc. No alternative process may be used without the approval of the Purchaser. No components shall be galvanised which are likely to come into subsequent contact with oil. Bolts shall be completely galvanised including the threads, but the threads shall be left uncoated in the case of nuts. The zinc coating shall be uniform, clean, smooth and as free from spangle as possible. The fabricated tower(Main Structure) and equipment structure parts and stubs shall have a minimum overall zinc coating of 610 gms/sq.m of surface area. The average zinc coating for all sections and plates shall be maintained as 80 microns. All galvanising shall comply with the requirements of the relevant Indian or ASTM standards. All galvanised parts shall be protected from injury to the zinc coating due to differential aeration and abrasion during the period of transit, storage and erection. Damaged areas of the coating shall be touched up with an approved zinc-Rich paint or other approved flake metallic compound.

30.0 PROTECTIVE GUARDS:

- 30.1 Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

31.0 DESIGN COORDINATION:

- 31.1 The Bidder shall be responsible for the selection and design of appropriate equipment to provide the best-coordinated performance of the entire system. The basic requirements are detailed out in Technical Specifications. The design of various components, subassemblies and assemblies shall be so done so that it facilitates easy field assembly and maintenance. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical at or close to the operating range of the unit. The Vendor/Contractor shall cooperate with other Bidders executing other works of the project in coordinating design by exchange of information and such other ways.

Design /drawings provided by the Bidder for its suitability for Erection, Testing and commissioning and for satisfactory operation.

32.0 COORDINATION MEETINGS:

- 32.1 The Bidder will be called upon to attend coordination meetings with the Engineer, other Bidders and the Consultants of the Purchaser during the period of Contract. The Bidder shall attend such meetings at his own cost at a place mutually agreed as and when required and fully cooperate with such persons and agencies involved during those discussions.

33.0 ELECTRICITY RULES, ACTS and Local Legislations:

- 33.1 All works shall conform to the rules in force under the latest Indian Electricity Act, Electricity Rules and other applicable legislations.

34.0 COOPERATION WITH OTHER MANUFACTURERS:

- 34.1 Bidder shall exchange, with other manufacturers of items not covered in this specification or alternatively covered in these specifications but forming partial supply of others, all necessary drawings, templates, gauges and other information required to ensure the complete and proper design and coordinated manufacture of all connecting or related parts of the various equipment.

35.0 COORDINATION WITH OTHER CONTRACTORS:

- 35.1 It is envisaged that there will be a number of areas where there would be an inter-link between equipment to be supplied under this contract and equipment proposed to be purchased from other enquiries. The Bidder shall cooperate with the Purchaser to coordinate with all other

manufacturers involved in design, control & instrumentation system which will perform the role contemplated without any problem. There shall be no extra cost payable for performing this role.

36.0 STORAGE AT SITE:

36.1 Complete instructions regarding the storage of the equipment/material at site shall be furnished by the Bidder. If at any time after the arrival of equipment/material at site, Bidder or his representative desires to draw the attention of the Purchaser to the conditions of storage, which in his opinion might affect the state of the equipment stored, he shall do so in writing to the Purchaser. However, where supply cum erection is specified, storage is the responsibility of the Bidder.

37.0 RATING PLATES, NAME PLATES AND LABELS:

37.1 A rating plate of non-corrodible material shall be attached to each major and auxiliary item of equipment supplied. This plate shall be permanently engraved with the designed full load ratings, serial number, type number, date of manufacture and other identification deemed necessary. Where necessary, diagram plates shall also be supplied.

37.2 A nameplate shall be provided to identify the service of all items of plant supplied. The identifying inscription shall be approved by the Purchaser. Devices shall be identified by nameplates on both front and rear of all desks, panels, cubicles etc.

37.3 Nameplates or labels shall be manufactured of non-hygroscopic material with engraving of a contrasting colour or alternatively for indoor use of transparent plastic material with lettering engraved on the back and filled with enamel. These shall be in English language only. **Phase markings, equipment identification marking/numbering, display boards, key boards showing the layout of Substation equipment shall be provided by the Bidder.**

38.0 COMMISSIONING CUM ACCEPTANCE TESTS:

38.1 On completion of erection of the equipment/material and before commissioning, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser and the Bidder for correctness and completeness of installation and acceptability for commissioning, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Bidder's quality assurance program.

38.2 The Bidder's commissioning engineers, specifically identified as far as possible, shall be responsible

for carrying out all the pre-commissioning tests. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be placed on Initial Operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipment as a complete system.

- 38.3 The specific tests to be conducted on equipment have been brought out in the specifications.
- 38.4 The Contractor in charge of erection testing and commissioning shall provide, at free of cost, all testing instruments, control equipment etc. for conducting above tests, in fully calibrated condition along with valid Calibration Certificates. The Purchaser reserves the right to get the testing instruments/control equipment recalibrated before the test at a laboratory of his choice at the cost of the Bidder. The Purchaser will apply proper corrections in calculations, to take into account conditions that do not correspond to the specified conditions.
- 38.5 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Bidder, free of cost.
- 38.6 The guaranteed performance figures of the equipment shall be provided by the Bidder during these commissioning and acceptance Tests. Should the results of these tests show any decrease from the guaranteed values the Bidder shall modify the equipment as required to enable it to meet the guarantees. In such case, commissioning and acceptance Tests shall be repeated within one month, from the date the equipment is ready for re-test and all costs for modifications including labour, materials and the cost of additional testing to prove the equipment meet the guarantee, shall be borne by the Bidder.

38.7 TEST CODES:

The provisions outlined in the IEC test codes or other international and Indian standards and approved equivalents shall generally be used as a guide for all the above test procedure unless otherwise specified in the technical specifications.

38.8 TAKING OVER

Upon successful completion of all the tests to be performed at Site on equipment furnished and erected by the Bidder, the Purchaser shall issue to Bidder a taking over certificate as a proof of the final acceptance of the equipment. Taken over certificate will be issued by the Purchaser after all the as built drawings, equipment drawings, test reports, instruction manuals, O & M manuals, installation drawings, bill of material, shop floor drawings, reconciliation etc. are done and certified

by the Field engineer of TSTRANSCO. Such certificate shall not un-reasonably be withheld nor will the Purchaser delay the issuance thereof because of minor omissions or defects, which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificates shall not relieve the Bidder of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate. However, besides the specified conditions may be imposed and agreed to between the Purchaser and the VENDOR/CONTRACTOR depending on the outcome of the 'Performance Tests'.

39.0 SEISMIC FORCES:

The equipment shall be designed to withstand seismic forces corresponding to the seismic Zone in accordance with IS: 1893. Details of the calculations made for the designs of the various equipment taking into account the above seismic forces shall be furnished by the contractor to the Purchaser.

40.0 CORRESPONDENCE:

- 40.1 Any notice to the vendor/contractor under the terms of the 'Contract' shall be served by as well as the site Incharge as applicable, by mail/fax or by hand at the Vendor's / Contractor's principal place of business.
- 40.2 Any notice to the Purchaser shall be served at the Purchaser's/Purchaser's principal office in the same manner.

41.0 HANDLING ARRANGEMENTS:

Unloading of supplied materials at stores/site as specified, falls under the scope of supply of Bidder. Bidder has to make his own arrangements at stores/site for unloading the equipment/materials. No handling facilities from Purchaser's side will be made available either on rent or free of cost.

42.0 MISTAKES IN DRAWINGS:

- 42.1 The Vendor/Contractor shall be responsible for any discrepancies, errors, or omissions in the drawings and other particulars supplied by him, whether such drawings and particulars have been approved by the Engineer or not.

43.0. INSPECTION AND FACTORY TESTS

- 43.1.1 The Engineer, his duly authorized representative and/or 3rd Party inspection agency acting on behalf

of the Purchaser shall have at all reasonable times access to the Bidder's premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works, the Bidder shall obtain from the Purchaser and/or his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works. **The Purchaser reserves the right to witness any or all type (if any), acceptance and routine tests specified, for which at least 21 (twenty one) days notice in advance shall be given by the Bidder. Bidder shall ensure before giving notices for type test that all drawings and quality plans have been got approved.** The equipment shall be dispatched to site only after approval of test certificates by the Purchaser.

43.1.2 The Bidder shall give the Purchaser twenty one (21) days' written notice of any material being ready for testing, for each stage of testing as identified in the approved quality plan and CIP. Such tests shall be to the Bidder's account except for the expenses of the Inspector. The Purchaser/Inspector, unless witnessing of the tests is virtually waived, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Bidder may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Purchaser six copies of duly certified test reports.

43.1.3 The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, of any objection to any drawings and/or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Bidder shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser giving reasons therein, that no modifications are necessary to comply with the Contract.

43.1.4 When the factory tests have been completed at the Bidder's or Sub-Contractor's works, the Purchaser shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser the certificate shall be issued within fifteen (15) days of receipt of the Bidder's Test certificate by the Purchaser. Failure of the Purchaser/ to issue such a certificate shall not prevent the Bidder from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment, should it on further tests after erection, be found not to comply with the Contract.

43.1.5 In all cases where the contract provides for tests whether at the premises or works of the Bidder or of any Sub-Contractor, the Bidder except where otherwise specified shall provide free of charge

such items as labour, materials, electricity, fuel water, stores, apparatus and instruments as maybe reasonably demanded by the Purchaser/Inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser/Inspector or to his authorized representative to accomplish testing.

43.1.6 The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed quality assurance programme.

43.1.7 Material Inspection Clearance Certificate (MICC) shall be issued by the Purchaser after inspection of the equipment. Purchaser may waive off the presence of Purchaser's inspecting engineer. In that case, test will be carried out as per approved QP & test certificate will be furnished by the Bidder for approval. MICC will be issued only after review & approval of the test reports.

43.1.8 The Purchaser will have the right to insist on any test(s) of reasonable nature carried out at Bidder's premises or at site or in any other place to satisfy that the material comply with the specification.

43.1.9 The Purchaser reserves the right for getting any field tests conducted on the completely assembled equipment at site.

43.2 FACTORY TESTS

The equipment offered shall be of type tested and shall be subjected to all routine and acceptance tests as per the relevant standards specified.

43.3 ROUTINE TESTS:

43.3.1 After completion of manufacture of the equipment routine tests shall be performed as per relevant standards and requisite copies of test certificates shall be furnished to the Purchaser.

43.3.2 Various components of the equipment shall be routine tested in accordance with approved standards and manufacturer's standards.

43.3.3 Each completely wired cubicles/Panels shall be tested to ensure that all of its protective control systems are satisfactorily functioning as required.

43.4 TYPE TESTS:

43.4.1 The equipment/material offered against this tender should have been successfully type tested in line with the specified standards and this Technical Specification. These tests should have been conducted within a period of 5 years prior to the date of opening of the Part-I "Pre-qualification

and Technical Bid”, subject to no alteration in the design. The Bidder shall furnish 3 copies of the Type test reports within 15 days of Letter of Indent. In case these type tests were carried out earlier to the five years period mentioned above or some type tests were not carried out at all as per the present specification, all the relevant type tests as per relevant standards shall be carried out by the successful Bidder in the presence of Purchaser's representative at the cost of the successful Bidder.

- 43.4.2 If there is any change in the components or design in the equipment since after earlier passing of the Type Test, the Bidder shall bring out in his offer all such changes made in the components, materials, designs, etc. In such case the Bidder shall carry out the type tests at his cost and in presence of the Purchaser's representative.

If any change in design was made, latest type tests shall be furnished along with approved drawing.

- 43.4.3 The Purchaser reserves the right to conduct tests included in the list of Type Tests in the respective technical specifications on requisite number of samples/items from any of the lots during the tenure of the supply, at Purchaser's cost in the presence of Purchaser's representatives. If the equipment/material does not withstand the type test, the equipment/material supplied till then will be liable for rejection. The supplier, in such an eventuality, shall be allowed to modify the equipment and type test the same again at his cost in the presence of the Purchaser's representative. These type tests shall however be conducted by the Supplier within a reasonable time. After successful passing of the type tests, all the equipment/materials supplied earlier shall be modified in line with the equipment/materials which has successfully passed the type test. In case Supplier fails to carry out the type test within reasonable time or does not agree to carry out the type test at his cost his equipment/material supplied earlier shall be rejected and order placed shall be cancelled and payment made earlier for these Suppliers shall be recovered by the Purchaser.

- 43.4.4 The type tests should have been either conducted in a recognized institution or laboratory and should have been witnessed by a purchaser or an independent agency. The name(s) of the institutions/Laboratories where the bidder intends to get type testes performed shall be indicated in the bid.

- 43.4.5 Bids shall accompany with Type test reports.**

PLEASE NOTE THAT IF THERE ARE ANY CONTRADICTIONS IN CLAUSE REGARDING ANY TESTS EXISTING IN THIS VOLUME AND OTHER TECHNICAL VOLUMES OF THE SPECIFICATION THE ABOVE

CLAUSE SUPERCEDES THOSE IN OTHER TECHNICAL VOLUMES.**43.5 TEST REPORTS**

The Test Reports shall indicate clearly the standard values specified for each test, to facilitate checking of the test reports. These shall incorporate all tests carried out on all equipment and its components, as well as characteristic curves of the equipment, including reports on official tests, waves, failure, detention data and copies of final test oscillo-grams, as relevant in terms of the applicable technical specifications.

Reports of tests carried out on the equipment shall furnish the following information:

- i) Complete identification data including serial number.
- ii) Method of application and duration of tests and standards to which conforming.
- iii) A description of the test equipment with diagram showing arrangement of the test instruments and devices.
- iv) Sample computation, where necessary of desirable, to show the test values employed in the equations.
- v) Curves showing relation of tests quantities.
- vi) Data in tabulated form.
- vii) Comparison of the test results with the guarantee requirements of the specifications and explanation of deviations, if any.
- viii) Oscillograms, if any.

43.6 Testing Facility the Bidder shall state in the proposal, testing facilities available at his works. Should full capacity testing equipment be not available at his works, the Bidder shall state in his bid where he would arrange to get the full capacity tests carried out. For such of the characteristics for which he proposes to adopt any alternative to full capacity testing, he shall state in his bid the method proposed to be adopted giving detailed computations and full justifications for suitability of the method to reliably ascertain equipment characteristics corresponding to full capacity testing.

GENERAL CONDITIONS FOR ERECTION SUPERVISION (GCES)

1.0 GENERAL

1.1 The following shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern the scope of Contract related to the supervision of erection and performing, testing and commissioning as a part of the supply cum erection supervision Contract only.

1.2 The Contractor and the Purchaser upon signing of the Contract shall, in addition to their respective Project Managers, nominate one or two responsible officers as their alternate suitably designated for the purposes of overall responsibility and co-ordination of the services to be performed in respect of supervision of erection, etc.

1.3 NOTICE

The Purchaser shall advise the Contractor in writing at least thirty (30) days in advance of the date the supervisors are required at site for performance of their services.

2.0 SCOPE OF SERVICES

2.1 The scope of work and duties and responsibilities of the Contractor shall broadly include the following:

2.1.1 Indicate the requirement for adequate storage at site.

2.1.2 Assisting the Purchaser, whenever required by him, in checking and verification of plant and equipment and materials supplied by the Contractor.

2.1.3 Provision of detailed instructions regarding unloading, handling store and preservation of the equipment to be supplied under this Contract in advance including supplying of related manuals.

2.1.4 Supervision of unloading, handling, preservation and storage at site.

2.1.5 Technical supervision of erection including disassembly, pre-assembly etc. and performing trial and pre-commissioning tests, adjustments, calibration etc. of the plant and equipment supplied by the Contractor.

2.1.6 Technical supervision of the initial operation of the plant and equipment supplied by the Contractor till successful completion of trial operations.

- 2.1.7 Assisting the Purchaser in carrying out the performance and guarantee tests.
- 2.1.8 Technical supervision of the work of repairs, modifications and alternations, etc. of the plant and equipment, whenever necessary.
- 2.1.9 Providing technical assistance in training of personnel of the 'Purchaser' in erection, testing and operation and maintenance of the plant and equipment at site.
- 2.1.10 Rendering technical assistance, clarifications and guidance, on technical problems and drawings/documents relating to the plant and equipment supplied by the Contractor.
- 2.1.11 Providing necessary guidance for preparation of detailed programmes/schedules for erection and testing and commissioning activities of the plant and equipment including material and manpower planning.
- 2.1.12 Any other related supervisory services though not specifically mentioned herein before but necessary for proper execution of the work, as stipulated.
- 2.1.13 All temporary instrumentation measuring devices special tools and tackle etc., if any required for performing the services under this Contract will be provided by the Contractor.
- 2.1.14 **ERECTION LABOUR AND TOOLS**
 - i) The Contractor shall make available the required standard / special erection tools and hand tools during execution of works.
 - ii) The Supervisor may select to bring with him certain personal tools required for erection which are to remain his property at all times. Use of such personal tools for erection work shall not entitle the Contractor to any additional payment. Any assistance required by the Supervisor in securing entry and exit permits for such tools shall be rendered by the Purchaser.

3.0 FIELD ENGINEERING CLARIFICATIONS

The Contractor shall provide all necessary field engineering clarifications to the Purchaser that they may require for the purposes of their works. The Contractor shall also provide all engineering clarifications and details to the Purchaser for the overall engineering/start-up of the plant and equipment supplied by the Contractor.

4.0 IMPLEMENTATION AND FIELD QUALITY PLANS

- 4.1 It will be the responsibility of the Contractor to ensure through adequate supervision that

the erection of the equipment supplied by the Contractor is being carried out according to the quality plans and standard manufacturing practice/instructions as given by the Contractor. In case of any deviations noticed in performing the erection in accordance with such quality plans, etc. The Contractor shall forthwith inform the Purchaser of such deviations for taking necessary corrective action. In case the Purchaser fails to ensure such corrective action, the Contractor shall be absolved of any consequential liability.

The Purchaser / Contractor will further identify specific hold points beyond which work will not proceed without Purchaser's / Contractor's consent so as to further ensure that the Erection Contractor performs the above quality functions effectively.

4.2 ASSEMBLY

During the assembly the Contractor shall record all measurements, check measurements data at each stage. The Contractor should also give in writing all the precautions and steps to be taken in each stage of assembly to the Purchaser. However this does not absolve the responsibility of the Contractor in ensuring that each such step and precaution is actually taken during erection.

4.3 PRE-COMMISSIONING TRIALS AND INITIAL OPERATIONS

4.3.1.1 On completion of all works, all the measurements shall be jointly taken by the Contractor and the Purchaser and the record shall be signed by both. The tests and trial operations shall be conducted only after signing of the same.

4.3.2 The supervision of pre-commissioning trials and initial operations of the equipment/material supplied by the Contractor shall be the responsibility of the Contractor as per details in relevant clauses in the accompanying Technical specifications. The Contractor shall provide, in addition, any special instruments/ calibrating devices, etc., if required for the successful performance of these trials. If it is anticipated that the above test may prolong for a long time, the Contractor's personnel required for the above test shall be present at site during such trials charging any additional cost.

5.0 COMMISSION REPORT

The Purchaser and Contractor shall properly maintain in the agreed formats their respective records of all observations and measurements taken in respect of all tests and operations. Joint protocol shall be signed on completion of each and every test/check till the trial operation. During trial operations all readings shall be jointly maintained and signed. On successful completion of trial operations, a report shall be jointly prepared and signed indicating results of all the tests/checks and trial operation readings. 15 such copies of the reports in bound

volumes shall be supplied for each Substation.

6.0 DELAYS

In the event when delays occur during the period of field assembly erection or testing as a result of which, the services of the supervisory Contractor's personnel are not required, the Purchaser may direct that any or all of the supervisory staff to return to their head quarter or remain at the site of work whichever the Purchaser deems fit to be in his best interest. In case of erection work interrupted and the Contractor's personnel have returned to their headquarters, the Purchaser may request again the services of the same personnel if available or of others with similar experience and qualification.

7.0 GUARANTEE

By virtue of services rendered by the Contractor's supervisors the Contractor's guarantee for all equipment shall hold good. If any portion of the work supervised by the Contractor proves to be defective within one (1) year from the date of commissioning of equipment, the Contractor, if notified there of in writing shall at the Contractor's own expense either make repairs or supply replacement parts directly for the equipment as necessary to correct the defects in such equipment directly resulting from such defective work of supervision on the part of the Contractor, and shall at his own expense furnish the necessary supervision for such corrections. The Contractor's liability in connection with the Contractor's furnishing supervisor(s) hereunder shall in no event exceed the cost of correcting any such defective work of supervision in the manner herein provided, and upon the expiration of the said one (1) year, all such liability shall terminate. The Contractor shall not, however, be liable in any event for any loss or injury to persons or property (including the equipment/installed) caused in whole or in part by (a) the negligence or fault of the Purchaser, his employees, and the Contractor's employed agents or sub-contractors (b) failure to observe the Supervisor's instruction or (c) by the failure of malfunctioning of any tools, equipment, material, facilities or devices not furnished by the Contractor and in no event, shall be Contractor be liable for special, indirect or consequential damages.

8.0 REGULATION OF LOCAL AUTHORITIES AND STATUS

The Contractor shall, to the extent relevant and applicable, comply with all the rules and regulations of local authorities, during the performance of the Contractor's field activities. The Contractor's shall also comply with the minimum Wages Act 1948 and any modifications thereof the Payment of Wages Act (both of the Government of India) and the rules made thereunder, in respect

of employees or workmen employed or engaged by the Contractor, if any in addition to any other relevant act/rules.

9.0 CONSTRUCTION MANAGEMENT

9.1 The field activities of other Contractors working at site, will be coordinated by the Engineer and the Engineer's decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and the staff of the Purchaser regarding scheduling and coordination of work.

9.2 The Engineer shall hold meetings of all the Contractors working at site, at a time and a place to be designated by the Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Engineer and shall strictly adhere to these decisions in performing his services. In addition to the above weekly meetings, the Engineer may call for other meetings either with individual Contractor or with selected number of Contractors and in such a case the Contractor, if called, will also attend such meetings.

10.0 CONTRACTOR'S ASSISTANCE IN WORK PLAN FOR FIELD OPERATION

10.1 Erection organization or schedule submitted by the Contractor and discussed with the Purchaser and finalised with necessary modifications to form a part of Contract documents, will be the essence for planning erection activities.

10.2 First preparation of such erection plan will cover erection activities to be performed for three months period. Every subsequent plan in the last week of every month, will contain updated report for reflecting progress achieved upto 20th day of the month hereinafter 'reporting month'), a firm programme for the first ensuing month and tentative programme for the second ensuing month. The firm erection programme for the first ensuing month will reflect the progress of the reporting month, erectable equipment and material available at site, resources at the immediate disposal of the Contractor and the inputs to be provided by the Purchaser. The firm work plan shall be broken down in week-wise erection plan. The tentative work plan must set target for the complete month based on progress achieved in the reporting month, progress likely to be achieved through firm plan of first ensuing month and identify constraints.

10.3 The erection work plan will be reviewed by the Engineer with the assistance of the Contractor. The Contractor will advise the Engineer about appropriate actions for implementation of work plan.

10.4 The Contractor shall decide mutually with the Purchaser, from time to time, in regard to the

Contractor's supervision plans and schedules for providing the services under the Contract to match the erection programme of the Purchaser.

10.5 The Contractor shall also intimate the programme of the visit of the Contractor's personnel to site and departure from site. The Engineer will have the right to review the list of such personnel and ask for increase in the strength or reschedule the visits of such personnel, if in the opinion of the Engineer, the list of personnel furnished by the Contractor is not sufficient for effective performance of the Contract.

10.6 The Contractor shall have the complete responsibility for the safety of all persons employed by the Contractor, and all the properties under his custody during the Contract. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours.

11.0 ACCESS TO SITE

11.1 The Contract, so far as it is executed on the Purchaser's premises, shall be carried out at such time as the Purchaser may approve.

11.2 In the execution of the Contract, no person other than the Contractor or his duly appointed representatives, shall be allowed to work on the site, except by special permission, in writing, from the Engineer or his representative.

12.0 CONTRACTOR'S SITE OFFICE ESTABLISHMENT

The Contractor can establish a site office at the site and keep posted an authorized representative for the purposes of the Contract if felt necessary at his cost. In such a case any written order or instruction of the Engineer or his duly authorized representatives, shall be communicated to the Contractor at the site office and the same shall be deemed to have been communicated to the Contractor at his legal address.

13.0 COOPERATION WITH OTHER CONTRACTORS

13.1 The Contractor shall cooperate with all other Contractors and staff of the Purchaser, who may be performing other services on behalf of the Purchaser and the workmen who may be employed by the Purchaser and doing work in the vicinity of the Contractor's work site.

13.2 The Engineer shall be notified promptly by the Contractor of any defects in the Erection Contractor's work that could affect the performance of the equipment. The Contractor and the Engineer shall determine the corrective measures, if any, required to rectify this situation after inspection of the works.

14.0 QUALIFICATION OF CONTRACTOR'S SUPERVISORY PERSONNEL

14.1 The Contractor's supervisory personnel will be adequately qualified, trained and experienced so as to carry out the duties most efficiently and effectively as expected of them. The Contractor's personnel shall have adequate experience of working on similar type of the equipment and similar job. The Contractor's supervisory personnel shall be fluent in English for day to day Communications.

14.2 Notwithstanding above if any of the supervisory personnel is not found to be performing his services in a manner as expected of him, under the Contract, the Contractor on advice from the Engineer, shall replace such person(s) at his cost with those acceptable to the Engineer, by mutual agreement.

15.0 DISCIPLINE OF WORKMEN

The Contractor shall adhere to the disciplinary procedure set by the Engineer in respect of the employees of the Contractor, if any, at site. The Engineer shall be at liberty to object to the presence of any representative or employee of the Contractor at the site, if in the opinion of the Engineer, such employee has mis-conducted himself, or is incompetent or negligent or otherwise undesirable, and then the Contractor, after mutual agreement, shall replace such a person objected to.

16.0 MANPOWER REPORT

16.1 The Contractor shall furnish to the Engineer on the first day of every month, manpower report of the previous month detailing the number of persons scheduled to have been deployed and actually deployed.

16.2 The Contractor shall assist the Purchaser to review the 'Manpower Report' in line with Work Plan as brought out in Clause 12.0 of this section and accordingly advise the Engineer for timely and successful commissioning of the equipment and materials supplied under the Contract.

17.0 CLEANLINESS

The offices and the residential areas of the Contractor's employees shall be kept neat and clean to the entire satisfaction of the Engineer.

18.0 FIELD OFFICE RECORD

The Contractor shall maintain at his site office, up-to-date copies of all drawings, specifications and other Contract documents and any other supplementary data, complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract documents, drawings, specifications, supplementary data, etc.

effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other engineering data to indicate as installed conditions of the equipment furnished and erection supervised under the Contract.

Such drawings and engineering data shall be submitted to the Engineer in requisite number of copies as per terms of the Contract.

19.0 INSURANCE

19.1 The insurance of all Contractor's personnel against any accident during erection, testing and commissioning etc., shall be arranged by the Contractor at his cost. The Contractor shall also indemnify the Purchaser against all liabilities arising out of any accidents, loss and/or any other reasons. The personal insurance for the Contractor's personnel deputed to site under this Contract shall also be arranged by the Contractor at his cost.

19.2 COMPREHENSIVE AUTOMOBILE INSURANCE

This insurance shall be in such a form as to protect the Contractor against all claims for injuries, disability, disease and death to member of Public including the Purchaser's men and damage to the property of others arising from the use by the Contractor's personnel of motor vehicles during on or off the site operations, irrespective of the ownership of such vehicles.

19.3 WORKMEN'S COMPENSATION INSURANCE

This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability, disease or death of his or his subcontractor's employees which for any reason are not covered under the Workmen's Compensation Act, 1948. The liability shall not be less than Workmen's Compensation: As per statutory provisions Employee's Liability: As per statutory provisions.

19.4 COMPREHENSIVE GENERAL LIABILITY INSURANCE

This insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and subcontractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" under General Conditions of Contract of this Volume.

The hazards to be covered will pertain to all the works which and areas where the Contractor, his subcontractors, his agents and his employees have to perform work pursuant to the Contract.

19.5 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contractor.

20.0 SERVICES AND FACILITIES TO BE PROVIDED BY THE PURCHASER FOR SUBSTATION.

20.1 The Purchaser shall provide the following facilities to the Contractor.

20.1.1 Adequate unfurnished office accommodation at site for the Contractor's supervisory personnel with necessary provision of ceiling fans, lighting, drinking water and sanitary facilities. No charges shall be leviable for the electricity and water consumed for the site office.

20.1.2 The Contractor shall provide necessary first-aid facilities for all his employees, representatives working at the site. Enough number of Contractor's personnel shall be trained in administering first-aid.

The Purchaser will assist the Contractor, in case of an emergency, in obtaining the services of an ambulance for transportation to the nearest hospital.

20.1.3 One intercom telephone connection in Contractor's site office from the project's local telephone exchange without cost if available at the site.

20.1.4 Necessary assistance to the Contractor for getting P&T telephone connections for use in their office/residence on specific request from the Contractor.

21.0 RESIDENTIAL ACCOMMODATION:

No accommodation will be provided to the Contractor's personnel at site. The Contractor shall make his own arrangements in this regard. The Purchaser shall not provide any arrangement for the transportation of the contractor's personnel from the place of residence to the place of work.

22.0 DELETED

23.0 WORKING HOURS AND LEAVE, ETC., OF SUPERVISORY PERSONNEL

23.1 The personnel shall work normally 8 hours per day within the time from 6-00 to 8-00 PM including one hour rest and six days working per week. If the personnel has worked exceeding this time band, the wages shall be calculated on the basis of overtime payment rate to be mutually

agreed upon.

- 23.2 The personnel shall work normally from Monday to Saturday and shall be given holiday on Sunday every week. The personnel shall also be released from work on national holidays of India i.e., 26th January and 15th August.
- 23.3 If the personnel has worked in excess of 8 hours a day or worked on holidays, the wages shall be calculated on the basis of overtime payment rate. However, the total hours of overtime per month, should be adjusted not to exceed forty hours.
- 23.4 Any idle time during the work time schedule, not caused by responsibilities of the Contractor or his personnel, shall be regarded as working time. No payment shall be made for periods of absence.

24.0 GENERAL

Subject to the general terms and conditions applicable to erection supervisory service referred to in paragraphs (1.0) to (23.0) above the Contractor shall provide for competent and qualified supervisors to :

- a) assist the Purchaser in planning, coordination, directing and supervising all phases of work.
- b) erect the equipment; and
- c) start-up, test and commission the equipment.

25.0 SAFETY

The Contractor shall abide by all safety standards as covered in statutory provisions regulations and where such safety standards are not prescribed, the Contractor will ensure a safety standard as directed by the Engineer.

26.0 COMMISSIONING SPARES:

It will be the responsibility of the Contractor to provide all commissioning spares required for initial operation till the equipment is declared by the Purchaser as ready for Trial operation. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of letter of award and such list shall be reviewed by the Purchaser and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Purchaser.

These spares will be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of Trial operation of the respective equipment and utilized as and when required. The unutilized spares and replaced parts, if any, at the end of successful completion of performance and guarantee test shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of the Purchaser.

27.0 CONTRACTOR'S WORK PLAN FOR FIELD OPERATION:

- 27.1 In case during the course of construction or during the period of operation of the Contract, erection programme is reviewed by the Purchaser, the same shall be communicated to the Contractor for the purposes of his rescheduling the supervision activities. Such revision in the work programme carried out by the Purchaser shall not in any way be considered as an assumption of any risk or liability by the Purchaser.

28.0 RESPONSIBILITY:

By virtue of these services rendered by the Contractor's, supervisors, the Contractor shall assume full responsibility for the result of assembly and erection, and the subsequent performance of the equipment.

SECTION-IX(a)	
LIST OF NATIONALISED AND SCHEDULED BANKS FOR SUBMISSION OF BID SECURITY	
S.No.	NAME OF THE BANK
A	Nationalised Banks
1	Allahabad Bank
2	Andhra Bank
3	Bank of Baroda
4	Bank of India
5	Bank of Maharashtra
6	Canara Bank
7	Central Bank of India
8	Corporation Bank
9	Dena Bank
10	Indian Bank
11	Indian Overseas Bank
12	Oriental Bank of Commerce
13	Punjab & Sind Bank
14	Punjab National Bank
15	Syndicate Bank
16	UCO Bank
17	Union Bank of India
18	United Bank of India
19	Vijaya Bank
20	State Bank of India and other State Bank Group Banks / Associated Banks
B	Major Scheduled Banks
1	Kotak Mahindra Bank Ltd.
2	Indusind Bank Ltd
3	ICICI Bank Ltd
4	HDFC Bank Ltd
5	Centurion Bank Ltd
6	Axis Bank Ltd

Section IX(b)

List of Nationalised Banks (For submission of performance security)

LIST OF BANKS APPROVED BY TSTRANSCO FOR SUBMISSION OF
PERFORMANCE SECURITY BANK GUARANTEES

S.No. NAME OF THE BANK

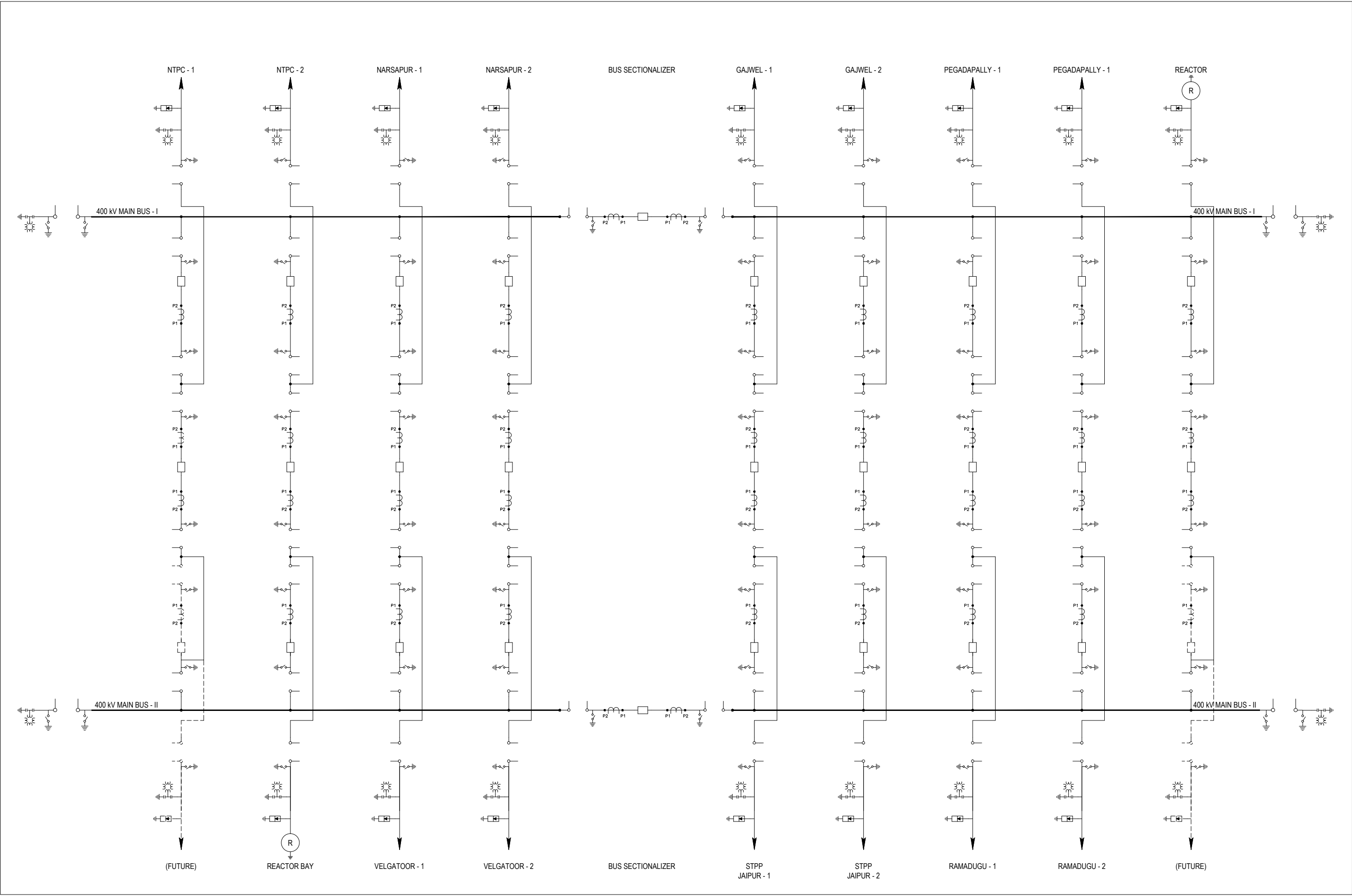
- 1 Allahabad Bank
- 2 Andhra Bank
- 3 Bank of Baroda
- 4 Bank of India
- 5 Bank of Maharashtra
- 6 Canara Bank
- 7 Central Bank of India
- 8 Corporation Bank
- 9 Dena Bank
- 10 Indian Bank
- 11 Indian Overseas Bank
- 12 Oriental Bank of Commerce
- 13 Punjab & Sind Bank
- 14 Punjab National Bank
- 15 Syndicate Bank
- 16 UCO Bank
- 17 Union Bank of India
- 18 United Bank of India
- 19 Vijaya Bank
- 20 State Bank of India and other State Bank Group Banks /
Associated Banks

LIST OF SUB-VENDORS

S.No.	Material	Existing Sub-Vendor
1.	Bolts & Nuts Foundation Bolts Anchor Bolts	1. M/s. Nexo Industries Pvt Ltd, Ludhiana. 2. M/s. Ravi Engineers, Amritsar. 3. M/s. ASP Pvt. Ltd, Howrah. 4. M/s. ISWP, Jamshedpur. 5. M/s. Trans Accessories & Forging Co. Mumbai. 6. M/s. Modern Engineering Works, Mumbai. 7. M/s. Maheshwari Fastners & Bright private limited, Hyderabad. 8. M/s. Anshika Fastners, Pvt. Ltd, Nagpur. 9. M/s. Isitva Fastners Pvt. Ltd. Hyderabad 10. M/s. Karamtara Engineering Pvt. Ltd, Thane, Maharashtra. 11. M/s. Remax (India) Ltd, Ludhiana
2.	Spring Washers	1. M/s. Naveen Metals, Kolkata. 2. M/s. Anshika Fastners, Pvt Ltd, Nagpur. 3. M/s. Karamtara Engineering Pvt Ltd, Thane, 4. M/s. Nexo Industries, Ludhiana. 5. M/s. Indian Steel & Wire Projects Ltd., Jamshedpur.
3.	Forged Items (D-shackles, Hangers / Links / Anti Climbing Device/ Pipe Type & Counter Poise Earthing / Bird Guards etc.)	1. M/s. Trans Accessories Forging Co. Mumbai 2. M/s. General Forging & Engg Works, Mumbai 3. M/s. Z. M. Engg. Mumbai 2. M/s. Modern Engineering, Mumbai 5. M/s. Aisha Transmission Products, Jaipur. 6. M/s. Lohar Engineers, Jaipur. 7. M/s. Rituraj Engifab Pvt Ltd., Jaipur. 8. M/s. M Power Infratech (India) Ltd, Hyderabad. 9. M/s. Supreme & Co Pvt Ltd., Howrah. 10. M/s. Sai Thirumala Fabricators, Hyderabad 11. M/s. Surana Wires Pvt Ltd, Hyderabad. 12. M/s. Reliance Wire, Thane. 13. M/s. Bharat Wire Ropes Ltd, Thane.
4.	Number Plate / Danger Plate/ Phase Plate / Circuit Plate	1. M/s. Hind Enameling Works, Mumbai. 2. M/s. Lohar Engineers, Jaipur / Mumbai. 3. M/s. Sai Thirumala Fabricators, Hyderabad 4. M/s. Pioneer Enameling Works, Mumbai 5. M/s. Kaveri Enamels & Allied Industries, Bangalore.
5.	Barbed Wire for Anti Climbing Device	1. M/s. Reliance Wire Products, Mumbai 2. M/s. Bedmutha Industries Ltd., Nasik. 3. M/s. Panel Pin Manufacturing Pvt Ltd., Howrah. 4. M/s. Surana Wires Pvt Ltd, Nacharam Hyderabad.

S.No..	Material	Existing Sub-Vendor
6.	7/3.66 mm G.S.S.Earth Wire	1. M/s. Bharat Wire Ropes Ltd., Mumbai 2. M/s. Gee Kay Wires Pvt, Ltd., Hyderabad 3. M/s. Bedmutha Industries Ltd., Nasik 4. M/s. Nirmal Wires Pvt. Ltd.,
7.	Earthing Material (Pipe Type, Counter poise type)	1. M/s. Reliance Engg. Co. Thane. 2. M/s. Lohar Engineers, Jaipur/ Mumbai. 3. M/s. Bharat wire Ropes Pvt Ltd. 4. M/s. Aisha Transmission Products, Jaipur (Pipe). 5. M/s. Modern Engineering works, Mumbai (Pipe) 6. M/s. General Forging & Engineering works, Mumbai 7. M/s. Z.M. Engineering Works, Thane. 8. M/s. Trans Accessories Forging Co., Thane. 9. M/s. Sai Thirumala Fabricators, Hyderabad. 10. M/s. Aster Teleservices Pvt Ltd, Hyderabad 11. M/s.Gurupreet Galvanising Pvt Ltd, Hyderabad.
8.	Disc Insulators	1.M/s. BHEL. Bangalore. 2. M/s. Aditya Birla Insulators (P) Ltd, Rishra (W.B) 3. M/s. Allied Ceramics Private Ltd, Kolkatta (120 kN) 4. M/s. Modern Insulators Ltd, Rajasthan (Long Rod Insulators) 5. M/s. IEC, Mandideep, M.P.
9	Hardware Fittings & Accessories for Conductor and Earthwire	1. M/s. EMI Transmission Ltd., Mumbai/ Nasik. 2. M/s. Modern Malleables Ltd., Kolkatta. 3. M/s. Tag Corporation, Chennai. 4. M/s. Mosdorfer India Pvt Ltd., Mumbai. 5. M/s. Nike Energy Manufacturing Pvt Ltd.
10.	ACSR Moose Conductor	1. M/s. Sterlite Power Transmission Ltd, Silvassa 2. M/s. Apar Industries, Silvasa. 3. M/s. Hind Aluminium Industries Ltd, Mumbai. 4. M/s. Galaxy Transmission Pvt Ltd, Sangli. 5. M/s. JSK Industries Pvt Ltd, Silvassa. 6. M/s. Cabcon India Pvt Ltd, Kolkata. 7. M/s. Hindustan Urban Infrastructure Pvt Ltd, Gwalior. 8. M/s. Gupta Cables, Bhubaneswar. 9. M/s. Shashi Cables Ltd. Lucknow.
11.	OPGW & Accessories	1. M/s. Jiangsu Zhongtian Technologies Co. Ltd, (ZTT). P.R.China/Sri city, Chittor (Dist) AP , India 2. M/s. LS Cables Co., Ltd, India / Korea

S.No..	Material	Existing Sub-Vendor
12	OLTE, MUX Equipment & Accessories	1. M/s.ABB Ltd, Bangalore, India. 2. M/s.NOKIA 3. M/s.TEJA 4.M/s. GE T & D India Ltd 5. M/s. Siemens Ltd.
13	Transmission Line Towers	1. M/s. KEC International Ltd. Butibori / Jaipur. 2. M/s. Larsen Toubro Ltd., Pondicherry / Indore. 3. M/s. Kalpataru Power Transmission Ltd. Gandhinagar & Raipur. 4. M/s. Bajaj Electrical Ltd. Pune. 5. M/s. Amithasha, Nagpur. 6. M/s. Maharashtra Power Transmission. 7. M/s. M/s. Power deal Energy Systems (I) Pvt Ltd. 8. M/s. ICOMM, Hyderabad. 9. M/s. TATA Projects Ltd, Nagpur 10. M/s. Skipper 11. M/s. Sawaria Pipes Pvt. Ltd, Hyderabad 12. M/s. M Power Infra Tech 13. M/s Karmatara Engineering Pvt. Ltd, Thane. 14. M/s Shilpa Steel & Power Ltd., Nagpur

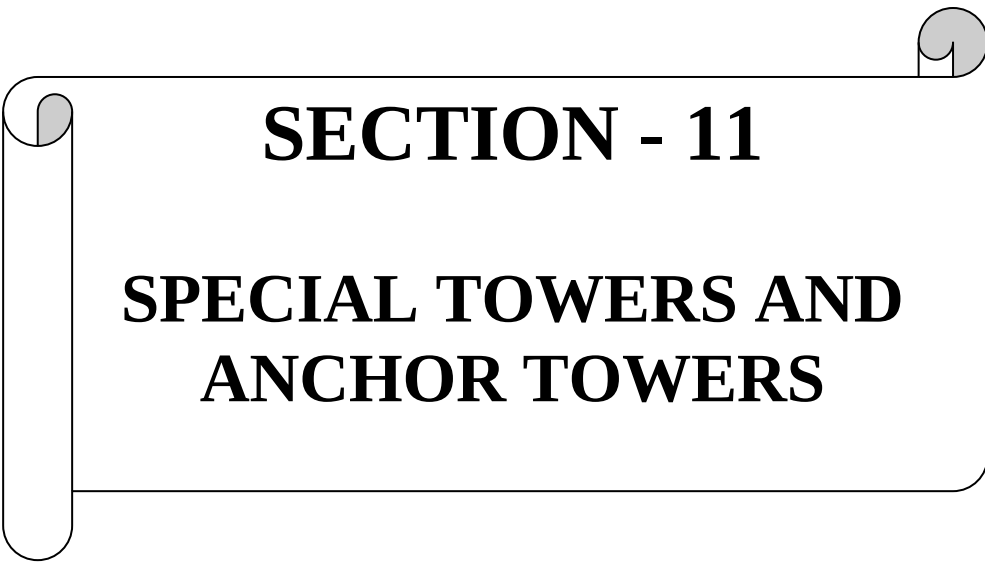


SCHEDULE OF 400 kV MAIN EQUIPMENTS		
SL.NO.	DESCRIPTION	SYMBOLS
1	CIRCUIT BREAKER [52] 420KV SF6 CIRCUIT BKR (3PH), 50kA	
2	420KV,3 POLE,HCB,3PH, ISO [89]	
2 (a)	ISOLATOR WITH 2-E/SW.	
2 (b)	ISOLATOR WITH 1-E/SW.	
3	420KV 1PH (5-CORE) CT	
4	420KV,1PH,CVT	
5	390 KV LIGHTING ARRESTOR (1 PH).	

TENDER PURPOSE ONLY

TITLE: SINGLE LINE DIAGRAM				PROJECT: KACHAPUR SWITCHING SUBSTATION		
DRN.	NAME	DATE		OWNERS: TRANSMISSION CORPORATION OF TELANGANA LTD.	REV. No. 0	
CHD.						
APPD.						
SCALE:-			N.T.S			
LOI. No.						
CONTRACTOR:				DRG. No.- TST-TENDER-SDL-01		
				SHEET No.- 1 OF 1		

[illegible]



SECTION - 11

SPECIAL TOWERS AND ANCHOR TOWERS

SECTION - 11**SPECIAL TOWERS AND ANCHOR TOWERS****1.0 GENERAL**

1.1 The Special towers are required for river crossings wherever necessary.

The scope covers supply of special towers, including stubs / anchor plates, Anchor Bolts & bolts and nuts.

1.2 The unit rates per ton for fabrication galvanising and supply of special towers including stubs, anchor plates, anchor bolts and bolts & nuts and rate for stub setting, tower erection and stringing is already included in the schedules. The total weight of river crossing towers is subject to alteration subsequent to finalization of route profile, number of towers and height of tower.

1.3 For anchoring of major river crossing towers, dead end / anchor towers shall be used. The requirement of anchor towers in all respects excluding design is included in the scope of work.

1.4 The Conductor, earthwire, conductor and ground wire accessories and insulator strings used for special towers shall be same as for the conventional towers except that the double suspension string and double tension string shall be provided with 24 insulator discs in each limb of the string and EMS rating of double suspension string shall be 160 kN instead of 120 kN.

2.0 TECHNICAL REQUIREMENT**2.1 TENSION LIMITS**

Conductor / Ground wire tension at everyday temperature and without external load should not exceed the following percentage of the ultimate tensile strength of the conductor

Initial unloaded tension	25 percent
Final unloaded tension for conductor and ground wire	20 percent

Provided that the ultimate tension under everyday temperature and 100% design wind pressure or minimum temperature and 36% design wind pressure does not exceed 70% of the ultimate tensile strength of the conductor/ground wire.

2.2 STRINGING CHARTS

The stringing charts are to be furnished by the successful bidder after obtaining the required data from the purchaser.

2.3 ALLOWABLE STRESS

Structural steel angle section manufactured according to the latest IS: 808 – 1989 (part –V and part VI) and tested according to the latest edition of the IS:2062-2006 or any other equivalent or superior International Standards will be used in the fabrication of the towers having its yield strength not less than 250N/sq.mm and where the yield strength required is 340N/sq.mm high tensile strength.

2.4 AXIAL STRESS IN TENSION

The estimated tensile stress on the net effective area in various members shall not exceed 250 N / sqmm for mild steel or the specified yield stress of the high tensile steel sections if proposed to be used in the fabrications of towers as per stresses value of high tensile steel according to IS : 2062 – 2006 or any other equivalent to International standards.

2.5 STRESSES IN BOLTS AS PER IS – 802 / PART-I / SEC -2 / 1992

For design of joints comprising of HT and MS members, the bearing on MS members in case of class 5.6 bolts shall be limited and 620N/sq.mm respectively.

2.6 TOWER STEEL SECTIONS

Steel sections in conformity to IS:808-1989 are to be used in towers ,extensions and stub setting templates and shall be of tested quality conforming to IS :2062-2006.No individual members shall be longer than 6000mm.Use of high tensile steel of yield stress 3600 Kg/sq.cm is permitted in towers and extensions.

The steel sections as per any other international standards, if used shall be of equal or superior quality with corresponding Indian standards

For designing of towers only rationalised steel sections shall be used. During execution of the project, if any particular section is not available the same shall be substituted by higher section at no extra cost to the purchaser. However, design approval for such substitution shall be obtained from the purchaser.

2.7 ERECTION STRESS

Where erection stresses combined with other possible co-existent stresses could produce a working stress in any member appreciably above the permissible stress, such additional strengthening of the member shall be effected or such other provision made as is necessary for bearing the working stress within the permissible limit.

The clearances at all cross arms for specified swing angles of the insulator strings shall also be checked for suspension / tension insulator strings.

2.8 MIDSPAN CLEARANCE

The minimum vertical mid span clearance between groundwire and the nearest power conductor shall not be less than the value specified in *Section - 9*. The minimum vertical mid span clearance shall mean the vertical clearance between groundwire and the nearest conductor under all temperatures conditions and still air in the normal ruling span. The groundwire sag shall not be more than 90 percent of the correspondence sag of power conductor under all conditions for the entire specified temperature range.

The successful tenderer in consultation with the purchaser / shall verify the string length and ensure that the specified clearances and other relevant requirements are fully met and submit the final clearance diagrams based on the exact lengths of insulator strings for approval of the purchaser.

2.9 INSULATOR STRINGS AND EARTHWIRE CLAMP ATTACHMENTS

- a) For the attachment of the 'I' type suspension insulator strings a suitable swinging hanger on the tower shall be provided so as to obtain requisite clearance under the extreme swinging conditions and free swinging of the string. The hanger shall be designed to withstand highest possible load, which may be imposed on it. A typical *outline drawing of the hanger* is enclosed in this specification.
- b) The suspension clamps for ground wire and insulator strings (suspension and tension) as per the reference drawing is enclosed in this specification. Earthwire peaks / cross arms are to be suitably designed to accommodate the shackle of the suspension clamp.

2.10 BIRD GUARDS

The bird guards for suspension towers shall be made of galvanised iron sheet and shall be as per drawing enclosed in this specification and shall conform to IS: 5613 (part-2 / Section – I)-1985

2.11 CLEARANCE:

The minimum clearance from lowest point of power conductor of crossing towers from highest flood level and the same shall not be less than the minimum ground clearance specified in relevant codes.

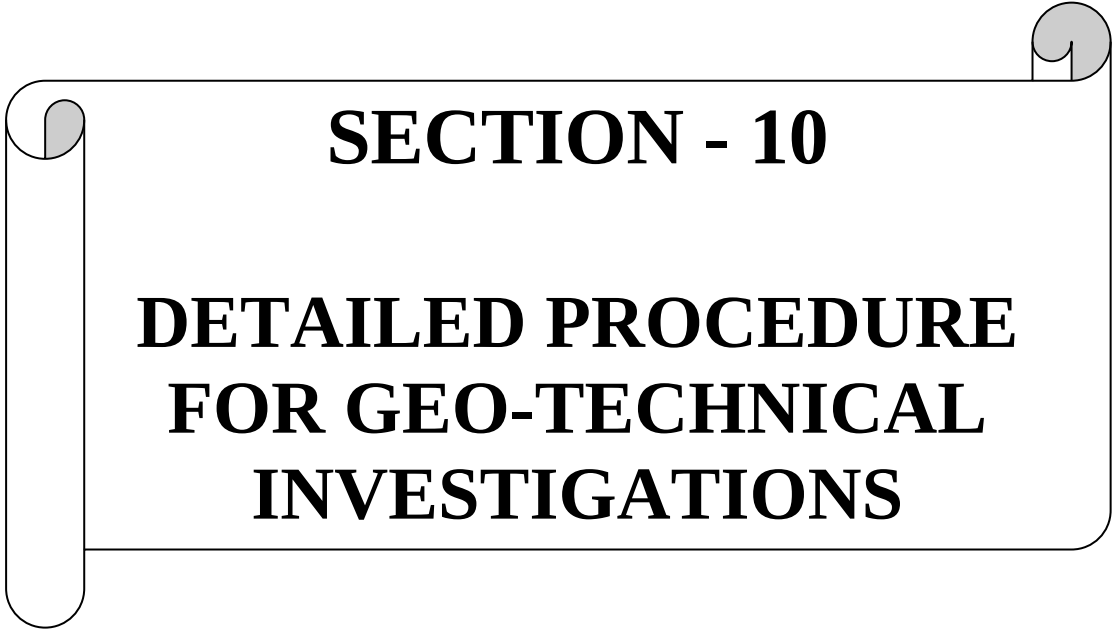
The minimum electrical clearance between live parts and tower body and cross arm will be same as for normal tower.

2.12 FOUNDATIONS

Please refer section-14.

The pile cap (top) shall be constructed at the river bed level. The reinforced column pedestal for supporting leg of river crossing tower shall be cast above the pile cap up to height 3 meters above maximum flood level. The contractor for supply and erection of line shall be responsible for supply of stubs with anchor plates, anchor bolts and bolts & nuts after obtaining purchaser's approval. The contractor for casting the pile foundations shall be responsible for fixing of foundation bolts as per the approved drawing. Anchor bolts base plate with stubs may be supplied in advance to coordinate with pile foundation agency with one-month notice from purchaser.

The drawing for earthing arrangement of the river-crossing tower shall be got approved from the purchaser and the tower footing resistance shall not be more than 10 ohms. The river-crossing tower shall be effectively earthed and the earthing device connecting the tower to the ground shall lie always below the minimum water level in the river. All the four legs to be earthed separately.

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SECTION - 10

DETAILED PROCEDURE FOR GEO-TECHNICAL INVESTIGATIONS

SECTION - 10

DETAILED PROCEDURE FOR GEO-TECHNICAL INVESTIGATIONS

1.0 GENERAL

Purchaser requires performing detailed geo-technical investigation at specified number of tower locations to provide sufficiently accurate information, both general and specific about the substrata profile and relevant soil and rock parameters at site on the basis of which the foundation of transmission line towers can be classified and designed rationally. The types of soils and rocks encountered on route the transmission line(s) are given in the specification for foundation.

2.0 SCOPE

- 2.1 The scope involves soil sampling and tests, the details of which vary according to tower locations in order to verify the bearing capacity, uplift resistance and settlement constraints, as described hereafter. Detailed soil investigation shall be carried out at all important locations such as the crossing of railway lines, national highways, power lines, and location identified by the purchaser. The contractor shall bore trial holes or excavate at test pit to at least 3 metres depth or more depending upon the design depth of foundation proposed in the bid and furnish bore log by data including depth of the ground water with table. Based on the soil parameters, contractor shall recommend the foundation type suitable for tower locations as qualified herein and as approved by the Purchaser. The Purchaser may modify the field exploration procedure both prior to and during the exploration process based on the actual findings.
- 2.2 These specifications cover the technical requirements for a detailed geo-technical investigation and submission of a detailed Geo-technical Report. The work shall include mobilization of all necessary tools, survey instruments and equipment and provision of necessary engineering supervision and technical personnel, skilled and unskilled labour, etc., as required to carry out the entire field investigation as well as laboratory tests, analysis and interpretation of data collected and preparation of the Geo-technical report. Contractor shall also collect data regarding variation of subsoil water table along the proposed line route.
- 2.3 Contractor shall make its own arrangements to establish the coordinate system required to position boreholes, tests pits and other field test locations as per the drawings / sketches approved by Purchaser. Contractor shall determine the reduced levels (R.L.'s) at these locations with respect to benchmarks used in the detailed survey. Two reference lines shall be established based on survey data / details.
- 2.4 The field and laboratory data / test results shall be recorded on the proforma recommended in relevant Indian standards on weekly basis verified by the Purchaser, Contractor shall submit to Purchaser two copies of field bore logs and all the field records soon after the completion of each borehole / test.

- 2.5 Whenever Contractor is unable to extract undisturbed samples, it shall immediately inform the Purchaser for his verification & concurrence. Special care shall be taken for locations where marshy soils are encountered and Contractor in such cases shall ensure that specified number of vane shear tests are performed and the results correlated with other soil parameters.
- 2.6 Contractor shall carry out all work expressed and implied in Clause 1.2 of IS specification in accordance with overall requirements of the specification.

3.0 GENERAL REQUIREMENTS

Wherever possible, contractor shall obtain information and review existing local knowledge of neighbouring streams, water resources, abandoned under ground works, nearby quarries, unlined wells, excavations, records of test pits, boreholes, recent land fills, land slides etc., types of foundations adopted and the behaviour of existing structures, particularly those similar to the present project. Study of the general topography of the surrounding areas will often help in the delineation of different soil types.

4.0 CODES AND STANDARDS FOR GEOTECHNICAL INVESTIGATIONS

All standards, specifications and codes of practice referred to herein including JIS shall be the latest editions including all amendments and revisions. In case of conflict between the present specifications and those referred to herein, the former shall prevail.

All work shall be carried out in accordance with the following Indian Standards and Codes.

Indian Standards (IS)	Title	International and Internationally Recognised Standard/ Code
IS : 1080	Codes of Practice for Design and Construction of Simple Spread Foundations.	
IS: 3025	Methods of Sampling and testing (Physical and Chemical) for Water used in Industry	
IS : 1498	Classification and Identification of Soils for General Engineering Purposes.	ASTM D 2487 ASTM D 2488
IS : 1888	Method of load tests on soils	
IS : 1892	Code of Practice for Subsurface Investigation for Foundation.	
IS: 2911	Code of Practice for Design and Construction of Pile Foundations	
IS : 1904	Code of Practice for Design and Construction of Foundation in Soils: General Requirements	
IS : 2131	Method of Standard penetration test for Soils	ASTM D 1586
IS : 2132	Code of Practice for Thin Walled Tube Sampling of Soils	ASTM D 1587
IS : 2720	Method of Test for Soils (Relevant parts)	ASTM D 420

Indian Standards (IS)	Title	International and Internationally Recognised Standard/ Code
IS : 2809	Glossary of Terms and symbols relating to soil engineering	ASTM D 653
IS : 2810	Glossary of Terms and symbols relating to soil engineering	
IS : 4078	Code of practice for indexing and storage of drill cores.	
IS : 4434	Code of practice for In-situ Vane Shear test for soils	ASTM D 2573 ASTM D 4648
IS : 4453	Code of Practice for exploration by pits, trenches, drifts and shafts	
IS : 4464	Code of practice for presentation of drilling information and core description in foundation investigation	
IS : 4968	Method for subsurface sounding for soils, dynamic method using cone and bentonite slurry	
IS : 5313	Guide for core drilling observation	
IS : 6403	Code of practice for determination of allowable bearing pressure on shallow foundation	ASTM D 194
IS : 6926	Code of practice for diamond core drilling for site investigation for river valley projects.	
IS : 6935	Method of determination of water level in a bore hole.	
IS : 7422	Symbols and abbreviations for use in geological maps. Sections and subsurface exploratory logs (relevant parts)	
IS : 8009 (Part-1)	Code of practice for calculation of settlements of foundations (shallow foundations subjected to Symmetrical vertical loads).	
IS : 8764	Method for determination of point load strength index of rocks	
IS : 9143	Method for determination of unconfined compressive strength of rock materials	ASTM D 2938
IS : 9179	Method of Preparation of rock Specimen for laboratory Testing	ASTM D 4543
IS : 9259	Specification for Liquid Limit Apparatus	ASTM D 4318

Indian Standards (IS)	Title	International and Internationally Recognised Standard/ Code
IS : 9640	Specification for Spilt Spoon Sampler	ASTM D 1586
IS : 10050	Method of Determination of Slake Durability Index of Rocks	ASTM D 4644
IS : 11315	Description of Discontinuities in Rock Mass – Core recovery and Rock Quality.	
	CBI&P Manual on Transmission Line Towers – Chapter 10: Foundation	

5.0 FIELD INVESTIGATION FOR SOILS

5.1 Boring requirement and Boring

5.1.1 Requirements

- a) One borehole shall be made in the centre point of tower to obtain information about the subsoil profile, its nature and strength and to collect soil samples for strata identification and for conducting laboratory tests. The minimum diameter of the borehole shall be 150 mm and boring shall be carried out in accordance with the provisions of IS:1892 and IS specification.
- b) All boreholes shall be 7 m deep or 2 ½ times the depth of foundation as approved by Purchaser for normal soil conditions. If a strata is encountered where the standard penetration test records N values greater than 100, with characteristics of rock, the borehole shall be advanced by coring at least 3m further in normal locations with prior approval of the Purchaser. When the boreholes are to be terminated in soil strata, an additional Standard penetration Test shall be carried out at the termination depth. No extra payment shall be made for carrying out Standard Penetration Test.
- c) Casing pipe shall be used when collapse of a borehole wall is probable. The bottom of the casing pipe shall at all times be above the test or sampling level but no more than 15 cm above the borehole bottom. In case of cohesion less soils, the advancement of the casing pipe shall be such that it does not disturb the soil to be tested or samples. The casing shall preferably advance by slowly rotating the casing pipe and not by driving.
- d) In-situ tests shall be conducted and undisturbed samples shall be obtained in the boreholes at intervals specified hereafter Representative disturbed samples shall be preserved for conducting various identification tests in the laboratory. Water table in the borehole shall be carefully recorded and reported following IS:6935. No water or drilling mud shall be used while boring above ground water table. For cohesion less soil below water table, the water level in the borehole shall at all times be maintained slightly above the water table.

- e) The borehole shall be cleaned using suitable tools to the depth of testing or sampling, ensuring least or minimum disturbance of the soil at the bottom of the borehole. The process of jetting through an open tube sampler shall not be permitted. In cohesive soils, the borehole may be cleaned by using a bailer with a tap valve. Gentle circulation of drilling fluid shall be done when rotary mud circulation boring is adopted.
- f) On completion of drilling, Contractor shall backfill all boreholes as directed by the Purchaser.

5.1.2 Auger boring and shell and auger boring shall be adopted depending on soil condition and water table.

5.2 Standard Penetration Test (SPT)

5.2.1 This test shall be conducted in all types of soil deposits encountered within a borehole of 150 mm dia and be carried at interval of 1.5m or change of strata up to the required depth g 2 ½ times the depth of foundation below existing surface elevation or refusal whichever occurs earlier to find the variation in the soil stratification by correlating with the number of blows required for unit penetration of a standard penetrometer. Structure sensitive engineering properties of cohesive soils and silts such as strength and compressibility shall not be inferred based on SPT values.

5.2.2 The spacing between the levels of standard penetration testing and next undisturbed sampling shall not be less than 1.0 m. Equipment accessories and procedures for conducting the test and for collection of the samples shall conform to IS:2131. All disturbed and undisturbed samples collected in the field shall be classified at site as per IS: 1498.

5.2.3 The test shall be discontinued when the blow count equal to 100 is recorded for 30 cm penetration. At the level, where the test is discontinued, the number of blows and the corresponding penetration shall be reported. Sufficient quantity of disturbed soil samples shall be collected from the spilt spoon sampler for identification and laboratory testing. The sample shall be visually classified and recorded at the site as well as properly preserved without loss of moisture content and labelled.

5.3 Ground Water

The elevation of ground water table in boreholes shall be determined as per IS:6935 and the instructions of the Purchaser. If any variation of the ground water level is observed in any specific boreholes, the water level in these boreholes shall be recorded during the course of the field investigation Levels in nearby wells, streams etc, if any, shall also be noted.

6.0 FIELD INVESTIGATION FOR ROCK

6.1 Rock Drilling

6.1.1 If, during the investigations, large hard fragments or natural rock beds are encountered, work shall proceed with core drilling methods. The equipment and procedures for this operation shall conform to IS:1892. The starting depth of drilling in rock shall be certified by the Purchaser. At the end of the investigation, the hole drilled in rock shall be backfilled with grout consisting of 1 part cement and 3 parts sand by weight. Attempt shall be made to recover cores of 1.5 m in length. Tungsten carbide (TC) bits shall normally be used. Change over to a diamond bit shall require the specific written approval of the Purchaser.

- 6.1.2 No drilling run shall exceed 1.5 m in depth. If the core recovery is less than 80% in any run, the length of the subsequent run shall be reduced to 0.75 m. During drilling operations, all the observations and other details on return water, rate of penetration, etc., shall be observed, recorded and reported as per IS:5313.

Core Sampling

The boxes for core samples shall be made from seasoned timber or any other durable material and shall be indexed on top of the lid according to IS:4078. The cores shall be numbered serially and arranged in the boxes in a sequential order. The description of the core samples shall be recorded as instructed in IS: 4464. Where no core is recovered, it shall be recorded as specified in the standard. Continuous record of core recovery and rock quality designation (RQD) are to be mentioned in the bore log in accordance with IS:11315 (Part-II).

7.0 LABORATORY TESTING

7.1 Essential Requirements

Depending on the types of substrata encountered, appropriate laboratory tests shall be conducted on soil and rock samples collected in the field in a approved laboratory. Calibration of all the instruments and their accessories shall be done carefully and precisely in an approved laboratory. Laboratory tests shall be carried out concurrently with the field investigation as initial laboratory test results could be useful in planning the later stage fieldwork. A schedule of laboratory tests shall be established by contractor to the satisfaction of the purchaser within one week of completion of the first borehole.

7.2 Tests

- 7.2.1 Tests, as indicated in these specifications and as may be required by the purchaser, shall be conducted. These tests shall include but may not be limited to the following.

- a) Tests of undisturbed and disturbed samples:
 - Visual and engineering classification/Nomenclature of soil
 - Sieve analysis and hydrometric analysis
 - Liquid, plastic and shrinkage limits / Atterberg's limit
 - Specific gravity
 - Swell pressure and free swell index determination;
 - Proctor compaction test
 -
- b) Tests of undisturbed samples:
 - Bulk density and moisture content
 - Relative density (for sand);
 - Unconfined compression test;
 - Box shear test (for sand);
 - Triaxial shear tests including angle of internal friction and cohesion (depending on the type of soil and field condition on undisturbed or remoulded samples):
 - a. unconsolidated undrained:
 - b. Consolidated drained test.
 - Consolidation

- c) Tests on rock samples:
 - Visual and engineering classification Nomenclature:
 - Moisture content, porosity and density.
 - Specific gravity
 - Hardness
 - Slake durability
 - Unconfined compression test (both saturated and at insitu water content);
 - Point load strength index
 - Deformability test (both saturated and dry samples)
- d) Chemical analysis of sub soil water;

7.3 Salient Test Requirements:

- a) Triaxial shear tests shall be conducted on undisturbed soil samples saturated by the application of back pressure. Only if the water table is at sufficient depth so that chances of its rising to the base of the footing are small or nil, the triaxial tests shall be carried out on a set of three test specimens from one sample at cell pressures equal to 100, 200 and 300 kPa respectively or as required depending on the soil conditions.
- b) Direct shear, test shall be conducted on undisturbed soil samples. The three normal vertical stresses for each test shall be 100, 200 and 300 kPa or as required for the soil conditions;
- c) Consolidation test shall have loading stages of 10,25,50,75,100, 200, 400 and 800 kPa. Rebound curve shall be recorded for all samples by unloading the specimen at its in-situ stress. Additional rebound curves shall also be recorded wherever desired by the Purchaser.
- d) Chemical analysis of subsoil shall include determination of pH value, carbonate, sulphate (both SO_3 and SO_4), chloride and nitrate contents, organic matter, salinity and any other chemicals which may be harmful to the foundation material. Their contents in the soil shall be indicated as percentage (%).
- e) Chemical analysis of subsoil water samples shall include the determination of properties such as colour, odour, turbidity, pH value and specific conductivity, the last two at 25 deg.C, and chemical contents such as carbonates, sulphates (both SO_3 and SO_4), chlorides, nitrates, organic matter and any other chemical harmful to the foundation material. The chemical contents shall be indicated as parts per million (ppm) based on weight.

8.0 GEOTECHNICAL INVESTIGATION REPORT

8.1 General

- a) Contractor shall submit a formal draft report for review by the purchaser containing geological information of the region, procedures adopted for geotechnical investigation, field observations, summarised test data, conclusions and recommendations. The report shall also include detailed bore logs, sub-soil sections, field test results, laboratory observations and test results both in tabular as well as graphical form, practical and theoretical considerations for the interpretation of test results, supporting calculations for the conclusions drawn, etc.
- b) Purchaser shall review the draft report and the contractor shall make available his Geotechnical Engineer for discussions to finalize this report. Contractor shall incorporate in the report the agreed modifications and resubmit the revised report for approval.

- c) The detailed final report based on field observations, in-situ and laboratory tests shall encompass theoretical as well as practical considerations for foundations for different types of towers as discussed in the specification.

8.2 Data to be furnished:

8.2.1 The report shall also include the following :

- a) A plot plan/location plan drawn to scale and dimensioned with reference to the established grid lines showing the locations and reduced levels of all boreholes, trial pits sites where static cone penetration and dynamic cone penetration tests, etc. carried out.
- b) A true cross section of all individual boreholes and test pits with reduced levels and coordinates showing the classification and thickness of individual stratum, position of ground water table, various in-situ tests conducted, samples collected at different depths and the rock stratum, if encountered.
- c) Plot of Standard penetration Test (uncorrected and corrected N values) with depth for each test site;
- d) Results of all laboratory tests summarised according to enclosed Table for each sample as well as for each layer, along with all the relevant charts, tables, graphs, figures, supporting calculations conclusions and photographs of representative rock cores.
- e) For all triaxial shear tests, stress vs strain diagrams as well as Mohr's circle envelopes shall be furnished. If back pressure is applied for saturation, the magnitude of the same shall be indicated. The value of modulus of elasticity (E) shall be furnished for all tests along with relevant calculations;
- f) For all consolidation tests, the following curves shall be furnished
 - i) e vs $\log p$:
 - ii) e vs p ;
 - iii) Compression vs $\log t$ or vs $\sqrt{t}$Depending upon the shape of the plot, for proper determination of coefficient of consolidation.

The point showing the initial condition (e_0 , p_0) of the soil shall be marked on the curves;

- g) The procedure adopted for calculating the compression index from the field curve and settlement of soil strata shall be clearly specified. The time required for 50% and 90% primary consolidation along with secondary settlements, if significant, shall also be calculated.

8.3 Recommendations:

Recommendations shall be provided for specified tower location and other tower locations in general duly considering soil type and tower spotting data. The recommendations shall provide all design parameters and considerations required for proper selection, dimensioning and future performance of tower foundations, as discussed in part but not limited to the specifications foundations and the following.

- a) The subsurface material must provide safe bearing capacity and uplift resistance by incorporating appropriate safety factors or other equivalent stipulations specified in the specification all the while experiencing small deformations throughout thereby avoiding rupture under ultimate loads;
- b) Movement of the foundation, including short and long term components under transient and permanent loading, shall be strictly controlled with regard to settlement, uplift, lateral translation and rotation.
- c) Co-efficient of permeability of various sub soil and rock strata based on in-situ permeability tests.
- d) Core resistance, frictional resistance, total resistance, relation between core resistance Standard Penetration Test N value, and settlement analysis for different sizes of foundation based on static cone penetration test.
- e) For shallow foundation the following shall be indicated with comprehensive supporting calculations.
 - i) Net safe allowable bearing pressure for isolated square, footing size 3.0 and 4.0 m and sizes determined during designing at three different founding depths of 2, 3m and 4m below ground level considering both shear failure and settlement criteria, giving reasons for type of shear failure adopted in the calculation.
 - ii) Net safe allowable bearing pressure for raft foundations of widths greater than 5m or as determined during designing at 2.0, 3.0 and 4.0m below ground level considering both shear failure and settlement criteria.
 - iii) Rate and magnitude of settlement expected of the structure.
 - iv) Net safe bearing capacity for foundation sizes mentioned in Para (i) above, modulus of subgrade reaction, modulus of elasticity from plate load test results along with time settlement curves and load settlement curve in both natural and log graph, variation of Modulus of subgrade reaction with size, shape and depth of foundation.
- f) The stable slopes for shallow and deep excavations, active and passive earth pressure at rest and angle of repose for sandy soils shall be furnished. The loading of the foundation shall not compromise the stability of the surrounding subsurface materials and the stability of the foundation shall be ensured against sliding or overturning.
- g) Depending on the subsurface material, water table level and tower type, recommendation for either reinforced concrete isolated pad and chimney or special foundations shall be made at various locations.
- h) Net safe allowable bearing pressure and uplift resistance shall be provided for the various sizes of isolated square footings founded at various depths below ground level considering both shear failure and movement criteria, rate and magnitude of movement expected of the tower (settlement, uplift, rotation) shall also be given.

- i) Where the subsoil water and soil properties are found to be chemically aggressive. Contractor shall take suitable precautions during construction including any protective coating to be applied on the foundations; susceptibility of soil to termite action and remedial measures for the same shall be dealt with.
- j) Suitability of locally available soils at site for filling, backfilling and adequate compaction shall be investigated.
- k) If expansive soil such as black cotton soil is encountered recommendation of removal or retainment of the same shall be given in the latter case, detailed specifications of special requirements shall also be given.
- l) Susceptibility of subsoil strata to liquefaction in the case of earthquake and remedial measures, if required, shall be considered.
- m) Any other information of special significance such as dewatering schemes, etc., which may have a bearing on the design and construction shall be provided.
- n) Recommendations for additional soil investigations, beyond the scope of the present work, shall be given if Contractor considers such investigations necessary.

8.4 Hydrological Conditions:

The maximum elevation of ground water table, amplitudes of its fluctuations and data on water aggressiveness with regard to foundation structure materials shall be reported. While preparing ground water characteristics the following parameters should be specified for each aquifer:

- a) Bicarbonate alkalinity – mg – eq/(degr):
- b) pH value;
- c) content of aggressive carbon dioxide, mg/l:
- d) Content of magnesia salts, mg/l, recalculated in terms of ions Mg^{2+} .
- e) Content of ammonia salts, mg/l, recalculated in terms of ions NH_4^+
- f) Content of caustic alkalis, mg/l, recalculated in terms of ions Na and K
- g) Contents of chlorides, mg/l, recalculated in terms of ions Cl^- :
- h) Contents of sulphates, mg/l, recalculated in terms of ions SO_4^{2-}
- i) Aggregate content of chlorides, sulphates, nitrates, carbonates and other salts, mg/l.

9.0 SCHEDULE OF QUANTITIES FOR GEOTECHNICAL INVESTIGATION INCLUDING LABORATORY TESTING

The terms of work are based on unit rate. It will be understood that the Bidder has fully studied the specification and Clause 13.9.0 in particular prior to bidding.

All quantities given in the specification are tentative and subject to change. Payment shall be made at quoted rates for actual quantities of work executed as approved by the Purchaser.

The provisional number of testing locations are furnished in respective Schedule of Quantities.

TABLE
SUMMARY OF RESULTS OF LABORATORY TESTS ON SOIL
AND WATER SAMPLES

1. Bore hole test pit No.
2. Depth (m)
3. Type of sample
4. Density (kg/m³)
 - a) Bulk
 - b) Dry
5. Water content (%)
6. Particle size (%)
 - a) Gravel
 - b) Sand
 - c) Silt
 - d) Clay
7. Consistency properties
 - a) LL
 - b) PL
 - c) PI
 - d) LI
8. Soil
 - a) Classification – IS
 - b) Description
 - c) Specific gravity
9. Strength test
 - a) Type
 - b) C (Cohesion)
 - c) (angle of internal friction)
10. Consolidation test
 - a) e_o
 - b) P_c
 - c) C_c
 - d) ΔP
 - e) m_v
 - f) C_v
11. Shrinkage limit (%)

12. Swell test

- a) S. Pr
- b) FS

13. Relative Density (%)

14. Remarks

Notations:

I. For Type of Sample

- DB Disturbed bulk soil sample
- DP Disturbed SPT soil sample
- DS Disturbed samples from cutting edge of undisturbed soil sample
- RM Remoulded soil sample
- UB Undisturbed block soil sample
- US Undisturbed soil sample by sampler
- W Water sample

II. For Strength Test

- SCPT Static Cone Penetration Test
- UCC Unconfined Compression Test
- VST Vane Shear Test
- Tuu Unconsolidated Undrained Triaxial Test
- Note: Replace T by D for Direct Shear Test
- Tcd Consolidated Drained Triaxial Test

III. For Others

- LL Liquid Limit (%)
- PL Plastic Limit (%)
- PI Plasticity Index (%)
- LI Liquidity Index (%)
- C Cohesion (kPa)
- Φ Angle of Internal Friction (degrees)
- S.Pr. Swelling Pressure (kPa)
- e_o Initial Void Ratio
- P_o Reconsolidation Pressure (kPa)
- C_o Compression Index
- ΔP Change in Pressure (kPa)
- m_v Coefficient of Volume Compressibility (m^2/kN)
- C_v Coefficient of Consolidation (m^2/hr)

IV. For Chemical Test

As per Specifications - Clause 4.1.8.4

SECTION-14**TECHNICAL SPECIFICATION of River crossing pile foundation****1.0. GENERAL :**

The specifications for various works should confirm to the relevant Clauses of A.P.S.S. and also the special specifications included in the Tender Schedule. If for any item of work detailed specifications are not indicated either in these Technical specifications or in the A.P.S.S. then the work shall be carried out as per the relevant Indian standard specifications latest.

1.1.0. SCOPE :

The scope of work covered by this specification is for Conducting soil investigation of each location, Design of pile foundations and providing cast-in-situ bored pile foundations including MS Liners, pile caps, beams, fixing of foundation bolts and hand railing etc., for special river crossing pile foundations for execution of 400kV Quad DC line. The scope includes the following.

1.2 LOADINGS :

The Department will furnish tower foundation loadings.

- 1.2.1 Geometry of Tower : 400 kV
- a. Type of tower : 400 kV Quad Double Circuit
Special type tower

1.3. PLAIN AND REINFORCED CEMENT CONCRETE WORKS:**1.3.1 Scope :**

The contractor shall furnish all labour, materials and equipment required for the construction of all concrete and associated work required for the work as mentioned in Detailed Tender Notice. All cement concrete, reinforced or plain shall conform to Indian Standard Code of Practice IS:456, with the latest amendments, unless otherwise specified herein, The concrete mixes used in various civil works shall be of the following grades, the proportions of fine and coarse aggregate for design mix shall be determined by independent test Laboratory.

1.3.2.

Grade of Concrete	Composition	Use
Nominal Mix M10	165 Kgs. of cement / each cubic meter of finished vibrated concrete with graded sand and crushed stone of size not exceeding 40 mm.	
Design Mix M30	400 Kgs. of cement / each cubic meter of finished vibrated Concrete with graded sand and 20 mm HBG graded metal.	

Any increase in cement content from those specifications in the above table over that required as per design mix shall be to the account of contractor.

1.3.3. Cement:

1.3.4 The cement required for the work will be supplied by the Contractor. The cement to be used for this line shall confirm the specification as given below:

Ordinary Portland cement of either 43 grade (confirming to IS 8112) or 53 grade (confirming to IS 12269) purchased from a well-established cement manufacturing company having production of more than 1,00,000 MT/year shall be used with the prior approval of Engineer-in-charge. The cement used shall satisfy the requirements as per Bureau of Indian Standards (latest).

Storage, certification, delivery and testing of the cement shall conform to IS:269, IS:8112 or the latest issue.

IS certification mark is obligatory.

Cement procured from major cement manufacturing plants such as 1) ACC Limited 2) Kesoram Cements 3) Orient Cements 4) Zuari Cements 5) CCI Limited 6) Andhra Cements 7) Coramandel Cement 8) Raasi Cement 9) Sri Vishnu Cements 10) Madras Cements 11) Ultra Tech Cement Limited – APCW 12) KCP Limited 13) Penna Cements 14) Panayam Cement 15) Grasim 16) Rajashree Cement 17) Mysore Cement 18) Century Cement 19) Ambhuja Cement , 20) Priya Cement, 21) Duncan cement, 22) Parashakthi cement and 23) Maha cement.24)Dalmia Cements will only be accepted for which prior approval shall be obtained from the employer. Copies of invoices and test certificates from the cement manufacturers shall be submitted by the contractor to the Engineer and his clearance obtained before actual use. Such clearance will be provided within a maximum period of one week.

If the contractor wants to use cement of brand other than the mentioned, prior approval/permission should be taken from Engineer-in-charge duly producing the test reports. However that approval does not absolves the contractor's responsibility for satisfactory performance of the cement as well as the foundations.

The contractor shall arrange to test the cement samples periodically as per the directions of Engineer-in-charge at his cost. And the contractor shall ensure its adequate and proper storage. Cement shall be kept in clean, dry, damp proof covered stores. It shall be adequately protected from condensation, raising dampness and atmospheric moisture. The storage arrangement shall be approved by the Engineer in-charge.

Should at any time the engineer has reasons to consider any cement defective, then, irrespective of its origin and / or manufacturer's test certificates, such cement shall be tested immediately at an approved laboratory and until the results of such tests are found satisfactory, it shall not be used in any work. The contractor shall not be entitled to any claim of any nature on this account.

The tests frequency should be as per relevant Indian standard codes.

For Nominal Mixes :

1.3.5. The cement is specified as the specific weight of cement to be used in the manufacture of 1 cum (or any other volumetric unit that the Executive Engineer may designate) of concrete as measured in the finished work after vibration, consolidation, setting and curing. The actual volume of different ingredients that would go in, in a block of concrete to produce the specified volumetric unit in place shall be determined by tests and the cement content specified shall be worked out for each batch supposed to produce the same unit of concrete in place as determined by the tests.

1.4 Admixtures :

(a) The Executive Engineer shall have the authority at any time, and from time to time to order the addition of any air entering agent or other admixtures, to any mix of concrete in such proportionate quantity or mode, as he may specify and the contractor shall comply with the same at his cost.

1.5 Aggregates :

All the aggregates shall conform to IS:383. The natural aggregates shall be chemically inert, strong, hard, durable, of limited porosity, free from adherent coatings, clay lumps, coal and coal residues and shall contain no organic or other admixtures that may cause corrosion of reinforcement or impair the strength or durability of concrete. The limits of the content of deleterious materials in aggregate are indicated below :

Limits of the content of Deleterious Materials (percent by weight of aggregate)				
Deleterious Substances	Fine aggregates		Coarse aggregates	
	Crushed	Uncrushed	Crushed	Uncrushed
Coal & lignite	1.00	1.00	1.00	1.00
Clay lumps	1.00	1.00	1.00	1.00
Soft fragments	-	-	3.0	-
Material passing 75 micron IS sieve	3.0	3.0	3.0	3.0
Shale	1.0	-	-	-

Approved natural sand and crushed stone for structural concrete and well washed, thoroughly cleaned and graded natural gravel, for lean and backfill cement concrete shall be used as aggregate. Representative samples of selected aggregates shall be tested at the contractor's cost for sieve analysis from time to time as required by the engineer for approval.

The tests frequency should be as per relevant Indian Standard codes.

1.5.1 Fine Aggregates :

The sand used for the concrete shall be confirmed to IS 2386 and composed of hard silicon materials. Fine aggregate (sand) shall be clean, sharp, coarse sand with a fineness modulus between 2.2 and 3.2 (fineness modulus is the sum of cumulative percentages retained on the IS sieves given below for gradation divided by 100). The contractor shall check and ensure that local sand will satisfy this requirement and if necessary shall include for and supply materials from other sources which comply with the specifications, it shall be graded as follows.

IS sieve designation	Percentage passing for		
	Grading Zone -I	Grading Zone -II	Grading Zone -III
10 mm	100	100	100
4.75 mm	90-100	90-100	90-100
2.36 mm	60-95	75-100	85-100
1.18 mm	30-70	55-90	75-100
600 microns	15-34	35-59	60-79
300 microns	5-20	8-30	12-40
150 microns	0-10	0-10	0-10

The objectionable foreign matter in sand shall be removed by screening or washing or both as required. The sand conforming to Zone I & II (IS 2386) shall be recommended for use in concrete works. The sand conforming to Zone IV shall not be used for concrete works.

1.5.2 Coarse Aggregate:

The coarse aggregate (crushed stone) shall conform to the following grading limits.

1.5.2.1 Grading Limits:

IS sieve designation	Percentage passing for grade aggregate			
	40 mm	20 mm	16 mm	12.5 mm
80 mm	-	-	-	-
40 mm	0-5	0	0	0
20 mm	30-70	0	0	0
16 mm	-	-	0-10	-
12.5 mm		-	35-59	-
10 mm	65-90	45-75	30-70	15-60
4.75 mm	95-100	90-100	90-100	90-100

The pieces shall be angular in shape and shall have granular or crystalline surfaces. Friable, flaky and laminated pieces, mica and shale, if present, shall be only in such quantities that will not, in the opinion of engineer, affect adversely the strength and durability of concrete. The maximum size of the aggregate shall be as specified in the drawings/specifications. The maximum size of coarse aggregate shall be the maximum size specified, but in no case greater than 1/4 of the minimum thickness of the member provided that the concrete can be placed without difficulty so as to surround all reinforcement throughout and fill the corners of the form. For heavily reinforced concrete members, the nominal maximum size of the aggregate shall be 5 mm less than the minimum clear distance between the reinforcing main bars or 5 mm less than the minimum cover to the reinforcement whichever is smaller.

1.5.2.2 Crushing Value:

The aggregate crushing value, when determined in accordance with IS:2386 (Part IV) shall not exceed forty five (45) percent for aggregate used for concrete other than for wearing surfaces and thirty (30) percent for concrete for wearing surfaces, such as roads, pavements and floor finishes.

1.5.2.2 Impact Value :

As an alternative the aggregate impact value may be determined in accordance with the methods specified in IS:2386 (Part IV). The impact value shall not exceed forty five (45) percent by weight for aggregate used for concrete other than for wearing surfaces and thirty (30) percent by weight for concrete for wearing surfaces, such as roads, pavements and floor finishes.

1.5.2.4 Abrasion Value :

Unless otherwise agreed to between the purchaser and the supplier, the abrasion value of aggregates, when tested in accordance with the method specified in IS:2386 (Part IV), using Los Angeles Machine, shall not exceed the following values :

A.	For aggregates to be used in concrete for wearing surfaces	Thirty (30) percent
B.	For aggregate to be used in other concrete (structural)	Fifty (45) percent

The amount of fine particles occurring in the free state or as loose adherents shall not exceed 1% when determined by laboratory sedimentation tests as per IS:2386. After 24 hours immersion in water, a previously dried sample shall not have gained more than 10% of its even dry weight in air, as determined by IS:2386. Should at any time the engineer have reason to consider any aggregate defective or of poor quality, then irrespective of any previous approval or tests, representative samples of such materials shall be immediately tested and until the results of such tests prove the material to be satisfactory, it shall not be used for any work. The contractor shall not be entitled to any claim of any nature on this account. The cost of these tests (including collection of samples and transportation) shall be borne by the contractor.

1.5.3 Storage of Aggregate:

All coarse and fine aggregates shall be stacked separately in stock piles to avoid mixing of different aggregates. While heaping the materials contamination with foreign materials and earth shall be avoided. The aggregate must be of specified quality not only at the time of receiving at site but particularly at the time of loading into mixer. The coarse aggregate shall be piled in layers not exceeding 1.20 meters in height to avoid segregation, each layer shall cover the entire stock piled and before placing the next layer. Aggregates that have become segregated shall be rejected, however, rejected material may be accepted after remixing if subsequent tests demonstrate conformance with required gradation.

1.6. Reinforcing Steel:

1.6.1 Reinforcement shall consist of any of the following types but shall conform to requirements shown on the drawings and should be corrosion resistant:

- Plain mild steel bars, Grade I (IS:432 Part I & IS:2062)
- Cold twisted or deformed bars (IS:1786) Grade Fe 415
- Mild steel and medium tensile steel deformed bars (IS:1139)
- Medium tensile steel bars (IS:432 Part I & IS:961)
- Hard drawn steel wire mesh, fabric (IS:1566 & IS:432 Part II)

1.6.2 The steel reinforcement rods required for the work have to be supplied by the contractor as per IS standards (IS 226, IS 1786 latest). The reinforcement steel manufactured from integrated steel plants viz SAIL, Vizag steel, TISCO confirming to the relevant IS standards bearing manufacturer trade mark embossed on each bar will only be accepted.

The contractor should obtain prior approval from the concerned Engineer-in-charge for the steel proposed (other than above integrated plants) to be used for the work duly submitting the test certificates and obtain prior approval before actual use. However this approval does not absolve the contractor's responsibility for the satisfactory performance of the steel and structure. The contractor shall arrange to test the reinforcement bar samples periodically as per the directions of Engineer-in-charge at his cost.

1.6.3 All steel shall be of grade I quality unless specifically permitted by the engineer. No rerolled scrap steel bars, pitted or otherwise defective bars shall be used. The contractor shall check and ensure that appropriate reinforcement bars are used for the work. Necessary tests shall be made by the contractor at his own cost to ensure that quality and physical properties of materials used, conform to the specifications. No complaints or claims shall be entertained on this account.

1.6.4 All reinforcing materials, before their final use shall be free from loose mill scale, rust, dust, oily or bituminous coating or any other injurious adherents.

1.6.5 Pitted and otherwise defective bars and rerolled scrap steel bars shall not be used. The contractor shall procure in time as necessary and check measure the reinforcing materials required for the continuous scheduled progress of work till the completion.

1.6.6 The reinforcement shall not be placed in direct contact with the ground but stacked on timber sleepers or such similar arrangement. The reinforcement shall be coated with cement slurry before stacking to prevent scale and rust. Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deterioration.

1.6.7 Welding may be permitted with the written approval of the engineer, provided the carbon content of steel used is less than 0.3 per cent. Welding so permitted shall be in accordance with IS:316. Tack welding of reinforcement bars as shown in drawings may be necessary. Substitution of different size bars will be permitted only when authorised by the engineer.

- 1.6.8 No part of the reinforcement, irrespective of whether the concrete work is under construction or completed, shall be used for conducting electrical currents. Electrical grounding connections shall be carefully isolated from reinforcement.
- 1.6.9 The number and size of all steel bars, ties, stirrups and other members of the reinforcement shall be in exact accordance with the drawings and the rods shall be bent cold by the gradual and uniform application of force to the shapes and dimensions given in the bar bending schedule supplied by the engineer. These schedules shall conform to IS:1566.
- 1.6.10 **Procedures for preparation and approval of Barbending schedules:**

For RCC works like special river crossing foundations, buildings, Sub-station switchyard foundations, Control House Buildings and all other works (other than conventional transmission line tower foundations), the respective field Executive Engineer in –charge of work shall take action, for preparation of BBS by contractor, after receiving approved drawings from Head quarters, duly incorporating all accessories required for keeping the R/F steel in position, based on the approved drawings. Such Bar bending schedules submitted by contractor shall be checked by site engineers and approved by field Executive Engineer in-charge of work, as per the details furnished in approved drawings, requirements as per site conditions, specifications of contract documents, and issued to contractor for taking up fabrication of R/F steel. In case of any major deviations/doubts, the matter may be referred to Head quarters. In other words the executive engineer at site has to approve BBS based on approved drawings..

- 1.6.11 Bars which have been bent wrongly shall not be straightened, rebent and used without the permission of the engineer.
- 1.6.12 Reinforcement shall be suitably supported by steel or concrete spacers, care being taken during the concreting operation to maintain the concrete cover specified. All hooks links and stirrups shall be such that the bars when tied together are properly braced. If possible, the reinforcement shall be fabricated with frames or mats before being fixed in the forms. Good quality ductile binding wire of 18 gauge shall be used to fix and secure the reinforcement so that no bars will be disturbed or displaced when the concrete is placed. Alternatively welding may be carried out to secure and fix the reinforcement instead of binding wire. No concreting shall be commenced until the bars have been properly fixed and tied at their specified location and have been inspected and approved by the engineer.

1.7 Water :

- 1.7.1 Water for all work shall be fresh, clean and free from oil, acids, alkali and all injurious or deleterious materials and conforming to IS:3025. Saltish or brackish water should not be used. The contractor shall provide at his own cost for distribution, storage, filtration and / or treatment, as necessary of the required quality of water. Quality of water to be used in concrete shall be such as to obtain the consistency specified. This quality of water shall be subject to approval by the engineer on the basis of test finding and shall in no case be changed without permission. The suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in IS:456.

The tests shall be carried out as per relevant Indian Standard Codes.

1.7.2 Gauging Water:

The general arrangements for the supply of water for mixing concrete shall be to the satisfaction of the engineer who will determine the quantity of water to be used to the mix according to the degree of moisture in the aggregate. The quantity of water thus determined shall be accurately measured for each separate mixing in a suitable container.

- 1.8 Samples shall be taken while concrete is being poured in the presence of representatives appointed by the engineer and the contractor. Proper record of work test shall be maintained and signed jointly. The preliminary test and works tests shall be at the contractor's expense. The contractor shall provide all sand, coarse aggregate, cement and concrete required for testing and all handling, transport and all other services entitled in supplying the samples to the testing laboratory. The cost of the supply of materials and facilities shall be deemed to be included in the quoted rates. The tests and frequency shall be as per relevant Indian Standard Codes.

1.9 Mixing of Concrete : (Design Mix)

The material for design mix like 20mm graded metal, sand, cement and water should be sealed by AP Transco and handed over to Independent test laboratory. The proportions of ingredients shall be determined by Independent testing laboratory. The design mix shall be got approved by AP Transco prior to commencement of work. The cost of materials, transport and testing charges shall be born by the contractors.

- 1.9.1 Cement, sand and crushed stone shall be measured by weight as directed by the engineer, the components of the concrete shall be batched in such a way that each batch contains a whole number of cement bags. Concrete shall be mixed in concrete mixers of a size and type previously certified acceptable to the engineer. Concrete shall be mixed in the machine for atleast one (1) minute dry and for atleast one and half (1 1/2) minutes after adding water. Mixed concrete shall be of even colour and uniform consistency.
- 1.9.2 Concrete shall be mixed only in such quantities as are required for immediate use. No more concrete shall be mixed in any one lot, than one that can be laid in position before the initial setting occurs. Partly set or re-tampered concrete shall not be used. After finish of each day's work the mixing plants shall be thoroughly washed and cleaned. On commencing work, the first batch shall have 10% additional cement.
- 1.9.3 The mixer and weigh batches shall be maintained in a clean, serviceable condition. The accuracy of weigh batches shall be periodically checked. They shall be set up level on a firm base and the hopper shall be loaded evenly. The needle shall be adjusted to zero when the hopper is empty. Fine and coarse aggregate shall be weighed separately. Volume batching will not be permitted. All concrete shall be mixed in mechanically operated batch mixers complying with IS:1791 and of approved make with suitable provision for directly controlling the water delivered to the drum.
- 1.9.4 The water-cement ratio to be adopted shall be determined in each case by the contractor as frequently as desired by the engineer and shall be approved by him.
- 1.10 Consistency and Workability of the Concrete:

1.10.1 Consistency and workability of concrete shall be checked by measuring the slump of a truncated cone of concrete straight from the mixer under normal working conditions. The conical mould shall be of metal, 300 mm high - 100 mm & 200 mm in diameter at the top and base respectively.

1.10.2 Moulds shall be prepared by the contractor.

1.10.3 Slump tests shall be performed as per IS:1199 at intervals established by the engineer at the contractor's cost in such a way as to check that the degree of consistency established by the engineer for work in progress is maintained. The table below gives the general slump range to be followed for various types of construction unless otherwise shown in drawings or instructed by the engineer.

Various types of construction -----	Slump in mm	
	<u>Max.</u>	<u>Min.</u>
Piles	180	100
Slabs, beams and reinforced walls	100	25
Pumps and other misc.equipment foundations	75	25
Building columns	100	25

1.10.4 The workability test by means of compaction factor tests as per IS:1199 shall also be carried out by the contractor at his cost.

1.11 Batching and Mixing of Concrete :

1.11.1 The materials and proportions of concrete materials as established by the preliminary tests for the mix design shall be rigidly followed for all concrete works in the project and shall not be changed except when specifically permitted by the engineer.

1.12 Transporting of Concrete:

1.12.1 Mixed concrete shall be conveyed and placed in the forms as rapidly as possible without segregation or loss of ingredients. Rehandling and flowing shall be minimum. Total time lapsed between addition of water to mixer to completion of placing shall not exceed thirty (30) minutes in any case, whatsoever. The concrete which has not been placed in the final position within such time and the concrete contaminated with foreign materials shall be rejected and disposed off as directed by the engineer.

1.12.2 The means adopted for transportation/ carriage/ flow of mixed concrete may be wheel borrows, concrete carts, mono rails, hoists, concrete chutes or any other method approved by the engineer. The free fall of concrete to be laid shall not exceed one and a half (1.5) meters to avoid segregation. In case segregation does occur during the transportation, concrete shall be got remixed before placing it in final position. On approval, intermediate hopper shall be used for intermittent operations. The concrete chutes or any other device should be thoroughly cleaned before and after each run.

1.13. Placing of Concrete :

Before placing the concrete, the contractor shall ensure that :

- all mixing and placing equipment is thoroughly cleaned.
- all concreting space is free from debris and rubbish.
- all forms have been thoroughly wetted or oiled and firmly installed in line and plumb to the engineer's approval.
- all reinforcement is cleaned of loose rust, scales and other injurious adherents and is firmly bound and correctly placed and has been so approved by the engineer.
- all inserts, sleeves, foundation bolts and embedded parts have been correctly and firmly installed to conform to the engineer's drawings and have been carefully checked to comply with the drawings. Special care shall be taken to locate and check sleeves or inserts which may not be symmetrically placed with respect to centre lines.

1.14.1 The contractor and the engineer shall separately inspect and check the above mentioned points and record and sign the results in a register which shall be maintained by the contractor in a approved form. No concrete shall be placed without the engineer having inspected and approved in writing. In spite of ensuring the above requirements the contractor shall fill pour cards furnishing the necessary details of the job, duly signed by the engineer. This however, will not absolve the contractor from his responsibility to correctly execute the work. Pour cards shall contain the following information.

Slump

Workability

Work test specimen

Type of finishing and admixture used (if any)

Period for removal of shuttering /props/forms.

1.14.2 The concrete pouring method shall be submitted to the engineer for approval and shall always be such as to avoid any possibility of segregation of the components or shifting of the reinforcement.

1.15 Jointing :

1.15.1 Concrete shall be cast, as far as possible, continuously until the parts of the structure to be built are finished. Should this not be feasible, the type, number and location of construction joints shall be approved by the engineer prior to placing concrete.

1.15.2 All such joints shall have continuous square bond grooves to produce a substantial and water tight key and the exposed faces of joints shall be monolithic with the main mass of concrete formed and completed under substantially shuttered faces. The contractor shall take all the necessary steps by means of timber edging etc., to ensure an exact horizontal straight finish to outside edge of any lift of concrete. Subject to the approval of the engineer, the contractor is at liberty to arrange his own construction joints but with the following restrictions are to be observed.

- There shall be no vertical construction joints.
- No longitudinal joints shall be made in the walls and floors of trenches and pits unless otherwise shown in the drawings.
- Concrete pouring shall be reasonably large, but in no case shall the height of pouring concrete exceed 1.5 meter without the engineer's firm approval. Such approval of the engineer shall not in any way relieve the contractor of his responsibility to ensure that no segregation takes place.

1.15.3 Laitance shall be removed from the surface of concrete before it has set hard by washing and wire brushing so as to expose the stones of the top layer without undue erosion of the mortar or damage to the underlying concrete.

1.15.4 All beds and joints in concrete faces, which have become set are to be picked all over and all loose materials removed before fresh concrete is deposited there on. The indentations shall be at least 12 mm deep and not less than seventy five (75) percent of the area of the existing concrete face to be covered over, care shall be taken to see that the indentations are not nearer than 38 mm to the exposed edge of the concrete.

1.15.5 Immediately before depositing fresh concrete the exposed surface shall be cleaned of foreign matter by further wire bushing, if necessary. It shall then be thoroughly ashed and surplus water removed. The surface while still moist shall be covered with layer of 1:1 cement mortar which must be vigorously stippled into the surface by means of a stiff brush, the depositing of the fresh concrete following on closely. Pockets to form keys shall be left in the surface of the concrete at construction joints 75 mm deep and approximately equal to twenty (20) percent of the exposed surface.

1.15.6 All costs in connection with the forming of construction joints shall be contingency of the contract and shall be included in the rates for concreting and shall not be separately paid for. In a column the joint shall be formed 75 mm below the lowest soffit of the beams including haunches if any.

1.15.7 Concrete in beams & slabs shall be placed throughout without a point.

1.16 Vibration :

Concrete to be vibrated shall be placed in level layers of suitable thickness not greater than the effective length of the vibrator needle. The concrete at the surface shall not be distributed as horizontally as possible, the vibration shall not be done in the neighbourhood of slopes. The internal vibrator shall not be used to spread the concrete for filling. It is advisable to deposit concrete well in advance of the point of vibration. When the concrete is being continuously deposited to a uniform depth along a member, vibrator shall not be operated too near to the free end of the advancing concrete, usually not within 1.20 meters of it. Every effort shall be made to keep the surface of the previously placed layer of concrete alive so that the succeeding layer can be amalgamated with it by vibration process. Following points shall be kept in mind while vibrating concrete.

1.16.1 The concrete shall be placed in shallow layers consistent with the method being used to place and vibrate the concrete. Usually concrete shall be placed in thickness not more than 300 mm and on initial placing in thickness not more than 150 mm.

- 1.16.2 The vibrator head shall be dipped through filling which is to be consolidated to further depth of 10 to 20 mm in the lowest layer which has already been consolidated.
- 1.16.3 Vibration shall be carefully controlled, the internal vibrator being systematically inserted at points minimum 450 mm and maintained in position for a fixed time. Immersion for periods of 5 to 15 seconds should normally be sufficient. The limit of action is judged by surface appearance. The surface shall neither be honey combed nor shall it contain excess mortar.
- 1.16.4 The vibrator shall be inserted vertically, with inclined or haphazard insertion it will be impossible to regulate the degree of compaction in all portions of the concrete. Care shall be taken to prevent contact of immersion vibrators with form work, reinforcement steel and finished surfaces. Immersion vibrators shall not come in contact with reinforcement steel if initial set of concrete around it has started.
- 1.16.5 The vibrator shall be allowed to penetrate on its own accord and should be withdrawn quite slowly, at the rate of about 75 mm per second, whilst still running, so as to allow the redistribution of the concrete in its wake.

1.16.6 Expansion Joints :

Expansion joints shall be provided as shown in drawings or as indicated by the engineer and shall be constructed in accordance with the details shown or as directed. The joints shall be filled with bitumen filler, bitumen felt or any other such material as specified.

1.17 Curing :

- 1.17.1 Concrete shall be kept damp for as long a period as possible. Concrete surfaces that are approximately horizontal shall be cured by ponding water being maintained at a depth of at least 25 mm for a minimum period of 14 days. Wall shall be damped with Hessian cloth as soon as practicable after pouring has been completed. The Hessian cloth shall be kept saturated by means of continuous pumped flow of water from perforated pipes or other methods, if approved for the period.
- 1.17.2 Arrangements shall be made by the contractor for a stand by supply of water in case of failure of the normal supply.

1.18 Sub-Standard concrete :

- 1.18.1 Should the work strength of concrete fall below the specified strength, the engineer shall decide :
 - (i) to reject the work, in which case the contractor shall replace the defective work with concrete of required strength and bear all costs for dismantling and replacing including the cost of associated form work, reinforcement, embedded parts and associated work.
- 1.18.2 Concrete of strength below ten (10) percent of the specified strength will not be accepted.

1.19 Optional Tests :

The test on materials shall be carried as per relevant Indian Standards in accordance with quantity assurance plan approved by AP Transco.

Tests on cement shall include

- (i) fineness test
- (ii) test for normal consistency
- (iii) test for setting time
- (iv) test for soundness
- (v) test for tensile strength
- (vi) test for compressive strength
- (vii) test for heat of hydration (by experiment and by calculations) in accordance with IS:269.

Tests on sand shall include

- (i) Moisture content
- (ii) test for organic impurities
- (iii) decantation test for determining clay and silt content
- (iv) specific gravity test
- (v) test for unit weight and bulkage factor
- (vi) test for sieve analysis and fineness modulus

Tests on coarse aggregate shall include

- (i) sieve analysis
- (ii) specific gravity and unit weight of dry, loose and rodded aggregate
- (iii) soundness and alkali aggregate reactivity
- (iv) petrographic examination
- (v) deleterious materials and organic impurities
- (vi) test for aggregate crushing value.

Any or all these tests would normally be ordered to be carried out only if the engineer feels the materials are not in accordance to the specification or if the specified concrete strengths are not obtained and shall be performed by the contractor at an approved testing laboratory at his cost.

If the work cubes do not give the stipulated strengths the engineer reserves the right to ask contractor to dismantle such portions of the work which in his opinion are unacceptable and redo the work to standard stipulated at contractor's cost. The contract price for concrete shall be all inclusive, including making preliminary mix design and test cubes, works cubes, testing them as per specification, slump tests, optional tests etc., complete.

1.20 Jointing with Adjacent Works :

The contractor shall bond new work to adjacent completed work , as shown in the drawing or as directed, by chipping, cutting or drilling of old concrete, by embedding new dowels in old concrete, or by exposing and cleaning the reinforcement of the old structure and lapping, welding new reinforcement to obtain continuity. All precautions as specified for preparing construction joints, shall also be taken for this work.

1.21 Form Work :

- 1.21.1 All form work shall be made of steel or plywood & mortar proof and sufficiently strong and well anchored to withstand the loads they have to bear without any distortion.

1.21.2 Before constructing forms, the contractor, if required, shall submit detailed drawings and design, wherever necessary in critical areas of proposed form work for examination by the engineer. Safety against buckling of any member shall be investigated in all cases. If such drawings are not satisfactory to the engineer, the contractor shall make such change as may be required prior to start of the work. The engineer's approval of the drawings as submitted or as corrected shall in no way relieve the contractor of his responsibility for adequately designing, constructing and maintaining forms and the safety of form work so that they will function properly under applicable conditions of work.

1.21.3 Form work shall be built with great care. All forms not found skilfully and perfectly made or lacking in rigidity will be rejected.

Supports shall be of the required dimensions for the work concerned and of first class materials.

False work shall be so constructed that vertical adjustments can be made to compensate for take up and settlement. Wedges may be used at the top or bottom of shores to facilitate vertical adjustment or dismantling of the form work. To permit easy removal the maximum load per wedge shall be 15 tonnes when located at the top and 20 tonnes when located at the bottom.

1.21.6 When wire is used to position the forms and reinforcement and if it remains embedded in the concrete, it shall be cut once the form work is dismantled to a depth of 10 mm from the concrete surface, then the hole shall be sealed in 1:1 cement mortar. When reused form work is employed, it shall be perfectly cleaned, straightened and oiled.

1.21.7 The vertical loads assumed shall consist of the dead load plus allowance for live load. The weight of form work together with weight of freshly placed concrete is considered dead load. The live load consists of the weight of workmen, equipment, runways and impact and will be taken as not less than 500 kg/sq.M of horizontal projection.

1.21.8 Forms, ties, bracing and shores must be designed to resist all forcible lateral loads such as wind, cable tensions, inclined supports, dumping of concrete and starting and stopping of equipment.

1.21.9 The form work must be designed for any special conditions of construction likely to occur, such as unsymmetrical placement of concrete, impact of machine delivered concrete, uplift and concentrated load. Imposition of construction load on partially completed structure shall not be allowed except with the written approval of the engineer.

1.21.10 A design analysis will not be required for form work for structures less than 5 meters in height if all loads are transmitted directly to the ground by vertical supports. However, safety against buckling of any member shall be investigated in all cases. For heavy construction and for all other cases, design analysis shall be made and got approved by the engineer. The form work system shall be designed to transfer all lateral loads to the ground in such a manner to ensure safety at all times. Diagonal bracing shall be provided in vertical and horizontal planes where required to provide stiffness and to prevent buckling of individual members.

- 1.21.11 The internal dimensions of the forms shall conform precisely to the structure to be built, they shall have smooth surfaces and their corners shall be rounded with 20 mm side triangular wooden struts unless otherwise specified on drawings. Forms shall be sufficiently rigid to hold without distortion of the fresh concrete, with a minimum factor of safety of 2.0.
- 1.21.12 Beam forms shall be provided with ties to avoid horizontal distortion, form work for columns shall be reinforced with square braces and those of considerable cross section or height shall be bound with spirals of twisted wire.
- 1.21.13 All forms shall be generously nailed, boards for slab work shall have at least two (2) nails on such supporting tie rod. Boards shall be of uniform thickness, edges shall be at right angles and smooth for easy jointing.
- 1.21.14 The number of supports shall be such as to safely support the loads specified, the engineer may demand that their number be increased whenever it is considered necessary. A load spreading plate shall be placed on the top of the supports, their base shall rest on a dual wooden wedge arrangement.
- 1.21.15 Prior to the concreting and after concreting, the exposed surfaces of the shuttering or moulds shall be cleaned of all adhering concrete before depositing of fresh concrete. Details of construction joints shall be arranged so that a 'Starter' is provided to which the forms for the next pour can be tightly clamped and suitable caulking shall be used to prevent leakage of grout from the concrete.
- 1.21.16 Wherever concreting of narrow members is required to be carried out within forms of considerable depth temporary openings in the sides of the forms shall, if so directed by the engineer, be provided to facilitate the pouring and consolidation of concrete.
- 1.21.17 Small temporary opening shall be provided at the bottom of forms for columns, wall and deep beams to permit the expulsion of rubbish etc., shuttering must be used for all slopes exceeding 15 degrees to the horizontal to enable the concrete to be properly rammed.
- 1.21.18 No load shall be put or any weight suspended for slabs, for one month after casting and temporary props shall be left in for the support of the underside of slabs, beams etc., for as long as is reasonably practicable after stripping shuttering.
- 1.21.19 No shuttering or temporary props shall be removed without permission being obtained from the engineer and being recorded in the contractor's log books under the engineers signatures.
- 1.21.20 Form stripping shall be performed slowly and gradually. No shuttering or temporary props shall be removed without permission being obtained from the engineer and being recorded in the contractor's log book under the engineer's signatures.
- 1.21.21 The form work in contact with concrete shall be clean and well coated with mould oil. Mould oil used shall be insoluble in water, non-staining and not injurious to concrete. It shall not become flaky or be removed by water.
- 1.21.22 The minimum period for striking form work shall be as per IS:456.

1.22 Bending, Binding and Fixing of Reinforcing Steel :

1.22.1 All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawings/ bar bending schedules and shall be as per IS:2502. They shall be bent gradually by machine or other approved means. Reinforcing bar shall not be straightened and rebent in a manner that will injure the material, bars containing cracks or splits shall be rejected. They shall be bent cold except bars of over 25mm in diameter which may be bent hot if specially approved by the engineer. Bars which depend for their strength on cold working shall not be bent hot. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 845 degree centigrade) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and rebending be such as shall not, in the opinion of the engineer, injure the materials. No reinforcement shall be bent when in position in the work without removing whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required design shall not be used.

1.22.2 Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be staggered and the locations of all splices, except those specified on the drawings shall be approved by the engineer. The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

1.22.3 Reinforcement shall be accurately fixed by any approved means and maintained in the correct position as shown on the drawings by the use of blocks, spacers and chairs as per IS:2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be securely bound together at all such points with number 18 gauge annealed soft iron wire. The vertical distances required between successive layers of bars in beams of similar members shall be maintained by the provision of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

1.22.4 Cover :

Unless indicated otherwise on the drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be as per the IS 456.

1.23 Inspection :

Erected and secured reinforcement shall be inspected and approved by the engineer prior to placement of concrete.

1.23.1 Finish for Concrete Surface :

1.23.1.1 Exposed concrete, other than floors or slabs which are exposed to view upon completion of the job shall have a smooth finish.

1.23.1.2 A smooth finish shall be obtained with the use of lined or ply wood forms having smooth and even surfaces and edges. Panels and form linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms, the joint marks shall be smoothed off and all blemishes, projections etc., removed leaving the surfaces reasonably smooth and unmarked.

1.23.1.3 Concrete surface shall not normally be patched or otherwise treated after the removal of forms. Where the surface exposed on stripping is not of a satisfactory nature, owing to the contractor's failure to take necessary precaution before, during or after the concrete placing, such surfaces shall be worked and finished in accordance with the instructions of the

engineer, at the cost of the contractor. The pores may be filled in with a weak solution of cement and water applied by brush and when dry the surface rubbed down with carborundum stone. The cost of the above treatment shall be deemed to be included in the rates entered by the contractor, in the bill of quantities. The top surfaces of the RCC slabs are to be screened off unless otherwise specified, to the required levels. There must be no surface grouting or treating up which might draw the 'fines' to the top. All shuttered surfaces shall be left as they strip without removing boards or panel markings. Any serious honeycombing will render the concrete work liable to rejection and cutting out and re-concreting wholly or partly as the engineer directs. All costs involved in repairing defects shall be borne by the contractor.

1.23.1.4 Concrete surfaces shall be finished as follows:

1.23.1.5 The exposed faces of all concrete work shall be made true to line, fair and smooth without rendering and should any part of the face work present a round, uneven honey combed or imperfect appearance when shuttering is removed shall be picked out to such a depth and refilled and properly refaced with such class of concrete as the engineer will direct, all at the contractor's expenses. Particular care must be taken on all exposed work that no irregularities or roughness occurs between the successive sections of the shuttering and the finished faces must be perfectly smooth and to such shapes as shown on the drawings.

1.23.1.6 Horizontal construction joints shall be true and regular as specified herein before.

1.24. **SAMPLING AND TESTING IN THE FIELD.**

1.24.1. Samples of concrete shall be taken at the direction of the Engineer in-charge in the field in accordance with IS:1199 & IS 456 "Methods of sampling and analysis of concrete". The contractor shall arrange for testing of concrete cubes from the reputed laboratories/Engineering colleges as approved and directed by Engineer-in-charge.. The cost of all testing shall be borne by the contractor.

1.24.2 These samples shall be tested for strength and consistency in accordance with I.S.516. The moulds and material for cubes and cylinders shall be supplied by the contractor who shall also arrange to transport the cubes/cylinders to laboratory at his cost

1.24.3. The acceptance criteria for the compressive strength shall be as per I.S. 456 or as given in subsequent paras. Only the slump indicated in the approved design mix shall be adopted. However large slumps than those indicated in the approved design mix of concrete of specified grade (strength) may be necessary to get a workable consistency for concrete in the case of beams. Walls, columns and other heavily reinforced members. No extra payment shall be made for extra cement that may have to be added in such cases to get the concrete of the same specified grade (strength) with larger slumps. The decision of Engineer in-charge regarding the degree of consistency or the amount of slump shall be final.

Samples shall be cured under laboratory conditions, except when in the opinion of the Engineer extreme weather condition may prevail at which time the Engineer in-charge may require curing under job conditions.

1.24.5. If the "test strength" of the laboratory controlled cubes/cylinders for any portion of the concrete work fall below the compressive strength specified, the Engineer in-charge shall have the right to order a change in the proportions or the water content for the remaining portion of the structure.

- 1.24.6. If the test strength of the job cured cubes/cylinders fell below the specified strength, the Engineer in-charge shall have the right to require provisions for temperature and moisture control during curing as necessary to secure the required strength and may require retests in accordance with "standard methods of securing, preparing and testing specimens from hardened concrete for compressive and flexural strengths" or order load tests to be made on the portion of the building so affected. All such tests shall be made at contractor's expenses.
- 1.24.7. When the cubes tested reveal a strength lower than those specified, the acceptance criteria for such concrete shall be decided as stipulated in IS: 456 (latest edition). The Engineer in-charge shall also reserve the right to reject whole or any part of the work. In case of acceptance of such works the standard deviations shall be worked out, and examined by the Engineer in-charge.

2.0. **CONCRETE FOR EQUIPMENT OR STEEL STRUCTURES FOUNDATIONS.**

- 2.1 Concrete for equipment foundation, whether principal or auxiliary, shall be poured continuously so that the structure becomes monolithic, particular care being exercised to see that the base slabs, if any, are of compact and impervious construction. Tunnels, passages, apertures and so forth shall be provided in accordance with the drawings for the installation of mechanical and electrical equipment, pipes or cables. The top elevation of the equipment foundations or parts shall be accurately cast to 20/50mm (or more as may be specification the drawings) above the level required for grouting and if shall be pneumatically chiselled off and well roughened just prior to the erection of the equipment concerned. All embedded anchor bolts or bolt selves shall be accurately and firmly set with the aid of approved templated, steel supports and/or other necessities. For holding the embedded bolts or sleeves in the correct position during concreting, template shall have to be of steel of suitable section approved by the Engineer. Two (2) sets of templates shall have to be provided, one to hold the bottom and the other the top of the bolts or sleeves. The bottom template shall be securely and rigidly fixed by providing anchorage arrangement and by welding to the lowest part of the steel reinforcement and other structural supports. The top templates shall be securely fixed by typing with guy wires and turn buckle arrangements to firm and rigid adjoining structures and stagings. The bottom template that is embedded in concrete will be measured and paid for as embedded steel.

Bolt pockets, where required, shall be cast with wooden taper wedges. These shall be withdrawn at an appropriate time when the concrete has set, the pockets cleaned roughened and then covered or blocked thoroughly to prevent debris getting into these. The exposed portions of bolts and embedded parts shall be kept well greased and adequately protected from damage throughout construction. Any damages found shall have to be corrected at the Contractor's cost. The AP Transco shall have the right to use the foundations, pads, piers, slabs, floors and all concrete work as needed for other works or equipment erected prior to its "Taking Over".

2.2. **JOINTING WITH ADJACENT WORKS:**

The Contractor shall bond new work to adjacent completed work, as shown in the drawing or as directed by chipping, cutting or drilling of old concrete, by embedding new dowels in old concrete, or by exposing and cleaning the reinforcement of the old structure and lap welding new reinforcement to obtain continuity. All precautions as specified for preparing construction joints, shall also be taken for this work.

2.3. **CONCRETING IN HOT WEATHER:**

Concrete shall not normally be placed when the atmospheric temperature exceeds 40 degrees centigrade in the open. If, in spite of programming concrete work in the cool hours of early morning, evening or night placement is necessary in too hot weather, then the Contractor shall take the following other precautions:

- Stock-pile aggregates in shade.
- Do not use fresh factory hot cement.
- Use cold water.
- Cool formwork by sprinkling water without collecting water inside.
- Reduce to minimum the time interval between mixing and placing.
- Place, vibrate and finish as quickly as possible.
- Initiate curing as soon as concrete hardens.

2.4. **CONCRETING IN COLD WEATHER:**

Special precautions specified in IS:456 shall be taken, should concreting be necessary when atmospheric temperature in the open is below four (4) degrees centigrade.

2.5. **CONCRETING UNDER WATER:**

The mix and method of concrete to be placed under water shall be approved by the Engineer.

Pumping of water shall not be permitted for twenty four (24) hours after completion of placement. No flow of water, natural or artificial shall be permitted during placement and upto twenty four (24) hours after completion of placement.

3.0 CONSTRUCTION OF PILES :

3.1 **GENERAL:-** Installation of piles shall be carried out in accordance with the pile construction drawings and as directed by the Engineer-in-charge.

3.2 **TECHNICAL SUPERVISION :** The contractor's site staff shall include a person of adequate experience in the field of Geology who shall be in full time attendance during piling operation. He shall be responsible for the positive and accurate identification of the rock horizon.

3.3 **PILING PROGRAMME :** The Contractor shall inform the Engineer in-charge each day of the programme of piling for the following day and shall give adequate notice of his intention to work outside normal hours and/or at week ends.

3.4 **SEQUENCE OF INSTALLATION:-** The sequence of installation of piles shall be subject to the approval of the Engineer-in-charge. In particular the sequence shall be selected to avoid piles being bored close to other recently constructed pile.

MATERIALS:- Drilling Fluid (Bentonite) shall be in accordance with clause A3.1 of IS:2911 Part-I: Section.II.

EQUIPMENT AND ACCESSORIES:- The equipment and accessories required for construction of bored piles shall be of a standard type and approved by the Engineer-in-charge.

DRILLING WITH FLUID:- The drilling fluid where required should be used at least from the level of sub-soil water and the hole should then be always kept almost full with the fluid which should preferably be kept in motion. The density and composition of fluid shall be such as to suit the requirements of the ground conditions and to maintain the fine materials from the boring in suspension.

SPILLAGE AND DISPOSAL OF DRILLING FLUID:- All reasonable steps be taken to prevent the spillage of bentonite suspension on the site in areas outside the immediate vicinity of boring. Discarded bentonite shall be removed from the site without delay. Any disposal of bentonite shall comply with the regulation of the local controlling authority.

PUMPING FROM BORE HOLES:- Pumping from a borehole shall not generally be permitted. However, small quantities of accumulated water may be pumped from 'dry' bores for cleaning out purposes prior to concreting.

3.10 INSTALLATION CRITERIA:

- a) The Contractor while boring the pile bores shall continuously collect the bore spoils and these shall be compared with the layer wise soil classifications reported in the bore-log details of the location reported in the soil investigation report. Should there be any variation between the two soil classifications, these shall be immediately reported to the Engineer in-charge.
- b) Whenever if the rock strata is encountered in the pile bore, the Contractor shall immediately report the matter to the purchaser and shall take up the work of rock chiselling only after the certification /approval of the Engineer in-charge. Since the piles are required to be terminated in the firm/hard strata the contractor shall demonstrate such founding strata and seek approval of the Engineer in-charge before terminating the piles.
- c) In order to verify the terminating depth, where rock strata is met with, the rock samples obtained from the bore spoils obtained from the chiseling of pile bores shall be tested for point load strength index and these shall then be compared/ correlated to the values of uni-axial compression strength test shown in the soil investigation report. Accordingly, the termination of piles in the socketing horizon shall be done with prior approval of the Engineer in-charge .
- d) Approval of foundation level by the Engineer in-charge shall in no way absolve the Contractor of his responsibility to guarantee the sound installation of piles conforming to the requirement of the specification.

3.11 **Control of Position and Alignment :**

- a) Piles shall be installed as accurately vertical as possible. The permissible limits with respect to position and inclination/alignment shall conform to IS-2911 Part I/Sec.2, which is reproduced below for ready reference.

The maximum deviation of vertical piles shall not exceed 1.5 percent in alignment.

Piles shall not deviate more than 75mm or D/10 whichever is more from their designed position at cut off level.

3.12 Boring :

a) Boring operations shall be done by rotary/percussion type drilling rigs using direct or reverse mud circulation (DMC or RMC) methods or grab method. In soft clays and loose sands, bailer method, if used, shall be used with caution to avoid the effect of suction. In cohesive soils, use of water for boring shall be restricted to a minimum, while boring in cohesion less deposits, water level in the bore hole shall be maintained at or slightly above the standing water table. Boring operations by any of the above methods shall be done using drilling mud.

The Contractor shall satisfy himself about the suitability of the method to be adopted as per conditions prevalent at site. If DMC or RMC is used, bentonite slurry shall be pumped through drill rods by means of high-pressure pumps. The cutting tools shall have suitable pores for the bentonite slurry to flow out at high pressure. If Contractor fails to make proper bore for any reason, the Contractor has to modify the boring technique and switchover to other boring methods as approved by the Engineer in-charge at no extra cost to the TS Transco. The boring operations using hydraulic piling rig are self-contained with power unit and complete accessories including shifting from one bore location to another, bentonite pump, light crane for lowering reinforcement cage. Pile driving rigs including vibratory hammers are assumed to be self contained with power units and necessary accessories required for driving. When Hard rock is encountered, Rotary core drilling equipment capable of drilling with speed and accuracy in rock strata shall be deployed to carryout drilling in Hard rock up to required depth, to avoid delay in progress of work, as directed by Engineer-in-charge of work at no extra cost to TSTRANSCO.

- c) Working level shall be above the pile cut off level. After the initial boring of about 1.0 to 2.0m, temporary guide casing shall be lowered in the pile bore. The diameter of guide casing shall be of such diameter to give the necessary finished diameter of the concrete pile. The center line of guide casing shall be checked before continuing further boring. Guide casing shall be minimum 2.0m length. Additional length of casing may be used depending on the conditions of the strata, ground water level etc.
- d) The bentonite slurry and the cuttings, which are carried to the surface by the rising flow of the slurry, shall pass through settling tanks of adequate size to remove the sand and spoils from the slurry before the slurry is re-circulated back to the boring. The bentonite slurry mixing and re-circulation plant shall be suitably designed and installed.

3.13. Cleaning of pile bore:

- a) After completion the pile bore up to the required depth, the bottom of the pile bore shall be thoroughly cleaned. Cleaning shall ensure that the pile bore is completely free from sludge/bored material, debris of rock/boulder etc,. Necessary checks shall be made as applicable to check for pile bore to conform the thorough cleaning of the pile bore.
- b) Pile bore shall be cleaned by fresh drilling mud through tremie pipe before start of concreting and after placing reinforcement.
- c) Pile bore spoil along with used drilling mud shall be disposed off as directed by the Engineer in-charge.

3.14. Concreting :

- a) The time between the completion of boring and placing of concrete shall not exceed 6 hrs. In case the time intervals exceed 6 hrs the pile bore shall be abandoned. However, the Engineer in-charge may allow concreting provided the contractor extends the pile bore by 0.5m beyond the proposed depth, and clean the pile bore. The entire cost of all operation and materials for this extra length shall be borne by the contractor.
- b) Concreting operations shall not proceed if the contaminated drilling mud at the bottom of the pile bore possesses density more than 1.25 T/Cu.m. or sand content more than 7%. The drilling mud sample shall be collected from the bottom of pile bore as applicable to the procedure under “check for pile bore” this shall be checked at regular intervals, as decided by the Engineer in-charge.
- c) It shall be ensured that volume of concrete poured is at least equal to the theoretically computed volume of pile shaft being cast.
- d) The temporary guide casing shall be entirely withdrawn cautiously, after concreting is done upto the required level. While withdrawing the casing concrete shall not be disturbed.

3.15. Cut Off Level (COL):

- a) The top of concrete in pile shall be brought about the COL to remove all laitance and weak concrete and to ensure good concrete at COL for proper embedment into pile cap.
- b) When the pile cutoff level is less than 1.0 metre below the working level, concrete shall be cast upto the piling platform level to permit overflow, of concrete for visual inspection. In case COL of pile is more than 1.0 metre below working level than concrete shall be cast to minimum of one metre above COL.

3.16. Building up of Piles:

If any pile, already cast as per construction drawing, requires any extra casting due to any change in cut off level or the cast pile top level is less than the specified level or for any other reason, then the pile shall be built up by using M30 grade concrete, ensuring proper continuity with the existing concrete to the satisfaction of the purchaser. Necessary reinforcement as per design requirement and suitable shuttering shall be provided before casting the concrete. Surrounding soil shall also be built up to the required level by proper compaction to ensure lateral capacity of the pile.

3.17. Breaking off of Piles:

If any pile already cast requires breaking down due to lowering in cut off level or for any other reason, then the same shall be carried out, (not before seven days of castings of concrete

in the piles) without affecting the quality of existing pile such as loosening, cracking etc. to the satisfaction of the Engineer in-charge.

3.18. Preparation of Pile head :

- a) The projected reinforcement above COL shall be properly cleaned and bent to the required shape and level to be anchored into the pile cap.
- b) The pile top shall be embedded into the pile cap by minimum 50mm or clear cover to reinforcement, whichever is higher.
- c) All loose material on the top of pile head after chipping to the desired level shall be removed and disposed off as directed by the Engineer in-charge.

Recording of Piling Data :

The Contractor shall keep records as indicated by Table 1.1 given here in after of the installation of each piles and shall submit three signed copies of these records to the Engineer-in-charge not later than noon of the next working day after the pile was installed. The signed records will form a record of the work.

Table 1.1 - Piling Records :

- a) Contract
- b) Pile location and type reference.
- c) Specified cut-off level
- d) Ground level at commencement of pile installation.
- e) Working level (if difference from ground level)
- f) As constructed dia meter.
- g) Date and time of boring and size of bore shall be 150mm dia.
- h) Levels at which geopages encountered.
- i) Bottom level and dia meter of temporary casing.
- j) Level of top of rock together with details of sampling (level, length, type, description).
- k) Pile toe level.
- l) Date and time of concreting.
- m) Top of finished concrete level.
- n) Level of water or drilling fluid at commencement of placing concrete.
- o) Details of drilling fluid including specific gravity measurement as directed.
- p) Details of pile base cleaning operations.
- q) Full details of permanent casing.
- r) Length and details of reinforcement placed.

- s) Volume of concrete installed in pile.
- t) Concrete mix and control test results.
- u) Method of placing concrete.
- v) All information regarding obstructions, delays and other interruptions to the sequence of work.

3.20. BORING:- While boring in cohesion less deposits below the water table care shall be taken to avoid the inflow of water and soil into the borehole by adding water and maintaining a level potentially above the standing water level. If the hole is unstable during boring either temporary casing or substitution of drilling fluid for the water shall be used to ensure stability. The method of stabilizing the hole shall be approved by the Engineer in-charge. In cohesive soils water shall not be added for boring purposes.

3.21 CASED PILES:- In the case of boring with casing, the casing should be at least from the level of sub-soil water, the casing shall be kept ahead of boring where there is danger of caving in, due to sub-soil water entering into the bore hole or where the soil is loose. While boring below sub-soil water level, precautions should be taken so that on boiling of the bottom of hole occurs due to difference in hydrostatic head.

3.22. CONTINUITY OF CONSTRUCTION:- Boring of any pile shall not be commenced unless it can be completed and concreted within the same working day.

3.23. REINFORCEMENT OF PILE:- The main longitudinal reinforcing bars in piles shall be in one continuous length unless otherwise approved. In long piles, joints will be permitted in main longitudinal bars but these shall be kept to a minimum. Joints in adjacent bars shall be staggered at least 1m apart along the length of the pile or joints shall be staggered at least 1.3 times the lap length which ever is more. Joints in reinforcement shall be such that the full strength of the bar is effective across the joint and the reinforcement cage is of sound construction for installation in the pile bore.

Longitudinal reinforcement shall be provided for the full length of the pile and shall extend above pile cut-off level as shown on drawings. Longitudinal reinforcement shall be formed into a rigid cage to resist deformation during handling and installation if necessary by the use of additional reinforcement subject to the approval of the Engineer-in-charge.

Lap or splice joints shall be provided with sufficient link bars to resist eccentric forces.

3.24. COVER:- Minimum cover to main reinforcement in the pile shaft shall be 75mm and should be subject to approval of Engineer-in-charge.

3.25. CONCRETING GENERAL:- The method of placing and the work ability of the concrete shall be such that a continuous monolithic concrete shaft of the full cross section is formed. Mechanical vibrators shall not be used to compact concrete.

3.26. CONCRETING MIX PARAMETERS:- Concrete in piles shall be of design mix grade M-30, generally in accordance with clause of this specification except that its consistency shall be compatible with the particular method of pile installation proposed. The slump of the concrete shall range between 100 and 180mm depending on the manner of concreting in accordance with Clause 6.3.2. of IS:2911: Part-I, Section.2.

- 3.27. CONCRETING PLACING:-** The placing of concrete, which shall not commence until the Engineer-in-charge has approved the bore hole, shall be completed as soon as possible.

The concrete shall be placed in such a manner that segregation does not occur. Concrete to be placed below water or drilling fluid shall be placed by tremie or other approved method and shall not be discharged freely into water or drilling mud. Where tremie placing is to be used it shall be in accordance with Clause 7.5 of IS:2911, Part-I, Section-2. Where concrete is placed through drilling mud, the specific gravity of the mud at the bottom of the boring shall not exceed 1.2, immediately prior to placing concrete. The amount of mud to be sampled should be adequate to suit the test apparatus (generally 1/2 to 1 litre is adequate).

- 3.28. EXTRACTION OF CASING:-** The method of extracting the temporary casing shall be to the approval of the Engineer in-charge and shall be used so that the concrete in the casing does not lift and maintains its workability so that it flows freely against the pile bore. Utmost care shall be exercised in maintaining an adequate head of concrete above the bottom of the casing until concreting is completed so as to prevent the inflow of soil and/or water into the bore. Care shall be taken to avoid necking or shearing of concrete in the pile shaft.

- 3.29. REPLACEMENT OF DEFECTIVE PILES:-** The Engineer-in-charge reserves the right to reject any pile which is defective in any way. Defective piles shall be treated as directed by the Engineer-in-charge. One or more additional piles to substitute the defective pile shall be installed at the contractor's cost as directed by the Engineer-in-charge.

- 3.30. METHOD OF MEASUREMENT:-** Forming concrete pile shaft shall be measured in running meters from the approved toe level to cut-off level for each diameter of pile.

Empty boring shall be measured in running meters from working ground level to approved toe level for each diameter of pile.

Reinforcement including projection about cut-off level is measured by weight in Tonnes. The weight shall be arrived at by multiplying the length, shown on the drawings or otherwise directed by the Engineer-in-charge by the sectional weights.

4.0. GALVANISED FOUNDATION BOLTS AND BASE PLATES :

The Tenderer shall erect the galvanised foundation bolts as shown in the drawing to facilitate erection of tower by welding the tower legs with suitable cleats. Each foundation bolt is fitted with two numbers of nuts and washers. The non-embedded portion of the foundation bolt which is above the pile cap shall be galvanised. All embedded anchor bolts shall be accurately and firmly set with the aid of approved templates. Steel supports and/or other accessories. For holding the embedded bolts or sleeve in the correct position during concreting, template arrangement shall be got approved by the Engineer in-charge. Two (2) sets of templates shall have to be provided one to hold the bottom and other at top of the bolts or sleeves. The bottom template shall be securely and rigidly fixed by providing anchorage arrangement and by welding to the lowest part of the steel reinforcement and other structural supports. The top templates shall be securely fixed by suitable arrangements. All the joints should be welded as per the directions of Engineer in-charge. Tower erecting agency will supply the galvanized foundation bolts.

For grouting of pockets C.M. (1:2) mix shall be used.

5.0. **HAND RAILING:**

Hand railing shall be provided on top of pile caps and beams using galvanized angles and GI pipe. The vertical hand railing posts (angles) shall be fixed in concrete as per the direction of Engineer in-charge. All the connections between the vertical and horizontal angles and fittings and fixtures should be welded as per the direction of Engineer in-charge. Hand Railing shall be on both sides of pile cap and beams. The top rails shall be GI pipe 50mm. The height of hand railing shall be 900mm.

SECTION - VI

1.0. Sampling, Testing and Quality Assurance

- (a) Facilities required for sampling and testing materials, concrete, etc. in field and in laboratory should be provided by the Contractor. The Contractor shall carry out all sampling and testing in accordance with relevant Indian Standards and this specification. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Engineer in-charge. In case the Engineer in-charge requires additional test, the Contractor shall arrange to get these done and submit to the Engineer in-charge the test result in triplicate within three days after completion of any test.
- (b) The Contractor shall maintain records of all inspection and testing, which shall be made available to the Engineer in-charge. The Engineer in-charge at his discretion may waive some of the stipulations for small and unimportant concreting operations and other works.

Quality Assurance Programme (Enclosed a standard proforma for guidance And acceptance).

- (d) The Contractor shall submit a detailed Full Quality Assurance Programme within 15 days from the date of award of the contract, according to the requirements of this specification. This shall include setting up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of field quality plan, etc. On finalized field quality plan, the Owner shall identify, customer hold points, beyond which work shall not proceed without written approval from the purchaser. The testing apparatus/equipment installed in the filed laboratory shall be calibrated/corrected by the qualified person as frequently as possible to give accurate testing results.

Frequency of sampling and testing etc. and acceptance criteria shall be as per relevant Indian Standard Codes. Type of tests to be conducted, sampling plan, reference document and acceptance norm, testing laboratory (i.e.,) manufacturer or contractor's field laboratory or AP Transco's approved laboratory will be finalized in Quality Assurance Plan approval. However, the testing frequencies set forth are the desirable minimum as per relevant IS codes and the Engineer in-charge shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials on works comply with the appropriate specifications. The materials shall be tested to meet all the specified requirements before acceptance, at manufacturers premises or at independent government approved laboratory.

SECTION – VII

1.0 Applicable Codes and Specifications:

The following specifications, standards and codes of practice are made a part of this specification. All standard codes of practice referred to herein shall be the latest edition including all applicable official amendments and revisions as applicable on the date of opening of the tenders.

In case of discrepancy between this specification and codes/ standards referred to herein, this specification shall govern.

1.1 Materials :

1. IS : 269 : Specification for ordinary, rapid hardening and low heat portland cement.
2. IS : 8112: Specification for ordinary, rapid hardening and low heat portland cement of 43 grade.
3. IS : 455 : Specification for portland blast furnace slag cement.
4. IS : 650 : Specification for standard sand for testing of cement.
5. IS : 383 : Methods of test for aggregate for concrete.
6. IS : 2386 : Method of test for strength of (parts I to VIII) concrete.
7. IS : 516 : Method of sampling and analysis of concrete.
8. IS : 1199 : Method of test for strength of concrete.
9. IS:3025 : Methods of sampling and test (physical and chemical) for water used in industry.
10. IS : 432 : Specification for mild steel and (parts I&II) medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
11. IS : 1139 : Specification for hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement.
12. IS : 1566 : Specification for plain hard drawn steel and medium tensile steel deformed bars for concrete reinforcement.
13. IS : 1785 : Specification for plain hard drawn steel wire for prestressed concrete.
14. IS : 1786 : Specification for cold twisted steel bars for concrete reinforcement.

- 15. IS : 2090 : Specification for high tensile steel bars used in prestressed concrete.
- 16. IS : 4090 : Specification for ply wood for concrete shuttering work.
- 17. IS : 2645 : Specification for integral cement water proofing compounds.
- 18. IS : 4461 : Cold worked steel bars for the reinforcement of concrete.

1. 2.Equipment

- 1. IS : 1791 : Specification for batch type concrete mixers.
- 2. IS : 2438 : Specification for roller pan mixer.
- 3. IS : 2505 : Specification for concrete vibrators (immersion type)
- 4. IS : 2514 : Specification for concrete vibrating cables.
- 5. IS : 3366 : Specification for pan vibrators.
- 6. IS : 4656 : Specification for from vibrators for concrete.
- 7. IS : 2722 : Specification for portable weigh batches for concrete (single and double bucket type).
- 8. IS : 2750 : Specification for steel scaffolding.

1.3 Codes of Practice :

- 1. IS : 456 : Code of practice for plain and reinforced concrete.
- 2. IS : 1343 : Code of practice for prestressed concrete.
- 3. IS : 457 : Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
- 4. IS : 3370 : Code of practice for concrete structures for storage of liquids.
(parts I to V)
- 5. IS : 3935 : Code of practice for composite construction.
- 6. IS : 2751 : Code of practice for welding of mild steel bars used for reinforced concrete construction.
- 7. IS : 2502 : Code of practice for bending andfixing of bars for concrete reinforcement.
- 8. IS : 3558 : Code of practice for immersion vibrators for consolidating concrete.
- 9. IS : 3414 : Code of practice for design and installation of joints in buildings.

- 10. IS : 4014 : Code of practice for laying in situ cement concrete flooring.
- 11. IS : 2911 : Code of practice for design construction and testing (Part IV) of pile foundation.
- 12. IS : 2720 : Code of practice for soil exploration.
- 13. IS : 2131 : Standard penetration test for soils.
- 14. IS : 4091-07: Code of practice for design and construction of foundations for transmission line towers and poles.
- 15. IS : 2911 : Code of practice for Design and construction of pile(Part I/Set 2) foundations bored cast in-situ piles.

1.4. Construction Safety :

- 1. IS : 3696 : Safe code for scaffolds and ladders.
(parts I & II)

1.5 Measurement :

- 1. IS : 1200 : Method of measurement of works.
- 2. IS : 3385 : Code of practice for of civil engineering works.

1.6 1. IS : 2062 :

- 2. IS : 6929 :

- 3. IS : 10262 :

- 4. IS : 5121 :

Ministry of surface transport (MOST) specification for Road and Bridge works –Section 1100 – Pile foundations 1997.

SECTION - VIII

1.0. **SPECIAL NOTES:**

The contractor shall be responsible for any delay and damage except due to "Force majeure" reasons which are genuinely beyond their control and for this full justification elaborating such circumstances will be furnished by them.

The contractor shall be under no liability whatsoever for damage or destruction to the work or temporary work or materials and equipment or to property or life which is due to acts of God, unprecedented floods and volcanic eruption, earthquake, lightning, gale typhon, storms, hurricane or act of any Government or strikes or lockouts or concerted action of workmen or Civil War (whether declared or not) or sabotage explosion, civil commotion, police action, revolution, epidemics, distraction artesian conditions, nuclear fusion or radio active disturbances and other like causes coming under the category of unexpected risks over which they have no control and directly or indirectly affecting the operation of the contract.

Suitable extension of time will be allowed for delays caused on account of force majeure reasons and other delays which are fully justified, at the request of the contractor, for the fulfillment of the contract at no additional financial implication.

SPECIAL NOTE :

- 1.1. The TS Transco shall not provide any bore log details along with the bid document.
- 1.2. The contractor shall make his own arrangements, at his own cost for locating the co ordinates and position of piles as per approved drawings and for determining the reduced level of three locations with respect of bench mark indicated by the Engineer in-charge under the supervision of Engineer-in –charge.
- 1.3. All HBG metal 40mm, 20mm and below size should be crushed metal only.
- 1.4. The rates quoted by the contractor are for finished items only. Cement and steel and other materials required for the work are to be procured by the contractor. The contractor should produce necessary test certificates for the quality of materials. Copies of purchase challans in case of cement and steel should be given. A field account of cement received at site. Daily usage, balance in the go-down situated in the working area has to be maintained. All the registers should be made available for the inspecting officers whenever demanded. The usage of cement and steel has to be in accordance with the theoretical requirements calculated and any short usage will be suitably discounted from the work bill as prescribed in the SSR for the corresponding period.
- 1.5. The plans attached to tender schedules are only tentative and for tender purpose only. Construction drawings will be released during execution. No extra rates are admissible due to any deviation in the construction drawings from the tendered drawings.
- 1.6. Only the technical specification mentioned herein which are relevant to the items of work under schedule 'A' will be followed. The other specifications not connected with any item of work under the scope of this work may be treated as not applicable.

- 1.7. The contractor is expected to turn out best quality of work with regard to the strength and finishing of the work. Failure on the part of the contractor to comply with the above instructions shall be liable for termination of the contract without assigning any reasons.
- 1.8. The contractor is expected to do perfect curing of the structure wherever it is necessary by engaging sufficient labour. If the contractor fails to engage sufficient labour for curing, the department will engage the required labour for curing and the cost of the same will be recovered from the contractor.
- 1.9 The Contractor shall furnish five copies of “As built” drawings after completion of work.

SECTION -1

**GENERAL TECHNICAL
REQUIREMENTS**

SECTION - 1**GENERAL TECHNICAL REQUIREMENTS****1.0 INTRODUCTION:****1.1 Specification for 400 Kv Transmission lines****2.0 SCOPE:**

The scope of the works envisaged in this specification for the 400kV Transmission lines are specified as follows: -

- 2.1 Tower fabrication including supply of steel, galvanising, supply of tower accessories, bolts, nuts, washers, proto type assembly and correction of shop drawings and approval of BOMs at works before dispatch, packing, supply and delivery FADS (free at destination site/stores) of 400kV Quad Moose Double circuit transmission line towers. The scope also covers detailed survey (if and where required), check survey, designing of specific towers/extensions/strengthening if required in the project, developing stringing charts, design of pile foundation, laying of conventional/pile foundations, erection, testing and commissioning of the 400kV D/C transmission lines employing Quad moose bundled ACSR conductor per phase and one number 7/3.66mm GSS earth wires and 1 No.OPGW. Redrawing of existing structural and shop drawings of all the towers being used in the project using Auto CAD with scale duly certifying their correctness and to be handed over to TSTRANSCO in hard and soft copies before clearing the material for mass fabrication. All the relevant drawings in AUTO CAD to the scale with reproducible tracings in such cases shall also be supplied to the purchaser by the contractor at free of cost. The new tower designs developed shall be got approved by CPRI, Bangalore. The scope also includes procurement of design soft wares and Other Accessories including training and related Hardware as per Specification.
- 2.2 Supply of GSS earth wire of size 7/3.66 mm, 95 Kg.f/sq.mm quality, OPGW cable along with Hardware & terminal equipment, ACSR Moose conductor 54/7/3.53mm, 120kN and 160kN Antifog Zinc Sleeve disc Insulators, Hardware fittings & Accessories for Conductor & Earth wire.
- 2.3 Detailed survey for the above line is being carried out by TSTRANSCO. The profiles and tower schedules to the extent detailed surveys are completed shall be made available to the contractor. The detailed surveys for left over portion of the line shall be carried out by the contractor(s) at the quoted rate.
- 2.4 The Bidder shall note that the lines to be erected are covered by industrial area and the bidder shall be responsible for the quality of the equipment/ material/services offered which shall withstand the environmental conditions in the area in respect of heavy pollution.

Also the contract is on TURN KEY basis and hence any other items not specifically mentioned in the specification but which are required for erection, testing and commissioning and satisfactory operation of this line are deemed to be included in the scope of the contract and same shall be arranged by the contractor unconditionally.

2.5 DELIVERY / COMPLETION PERIOD:

Refer Schedule-D

2.6 Photographs shall be taken by the contractor for each tower location of EHT lines in the following stages

1. After excavation is over in normal soils.
2. Before and after blasting in Hard rock soils.
3. During dewatering.
4. During concreting.
5. Shoring & shuttering.

The photographs should be clear. Bidder/contractor shall submit both hard copy and soft copy (2 sets) to the Engineer in charge immediately.

3.0 The relevant technical specifications are given in the following Sections: -

Section-2	:	Tower and Tower accessories
Section-3	:	ACSR Moose Conductor
Section-4	:	120kN and 160kN Antifog Zinc Sleeve disc Insulators and Long rod Insulators
Section-5 (a)	:	Galvanised Stranded steel Earth wire
Section-5 (b)	:	OPGW cable along with Hardware &Accessories
Section- 6	:	Accessories for Conductor & Earth wire and Hardware fittings
Section - 7	:	Detailed survey, Optimisation of Tower Locations & Check Survey
Section-8	:	Erection, Testing and Commissioning.
Section-9	:	Specific Technical Requirements
Section-10	:	Detailed procedure for Geo-Technical investigation
Section-11	:	Special Towers & Anchor Towers
Section-12	:	Guaranteed Technical Particulars to be furnished during sub-vendor approval
Section-13	:	Drawings
Section-14	:	Pile Foundations.

The scope of this specification also provides for fabrication of proto type tower its assembly and proto inspection and redrawing of existing structural drawings using AutoCAD and the same are to be supplied in soft and hardcopies for all towers with extensions, along with shop drawings.

4.0 The reproducible tracings of the structural drawings of towers, shop drawings, bill of materials and foundation drawings required by the successful bidder to complete the contract shall be supplied by the Purchaser. The successful bidder shall take the copies of the above and return the same to Purchaser. The successful bidder shall have to supply 10 sets of the copies of the above drawings.

However, where design of a particular tower extension is not available with the Purchaser or where any modification in the design is required, the bidder shall have to design and shall carryout detailing for the same without any additional financial commitment to the Purchaser. All the relevant drawings in such cases shall also be supplied to the Purchaser by the successful bidder.

5.0 QUALITY ASSURANCE PLAN:

5.1 The Contractor shall invariably furnish Quality Assurance Plan giving the following information along with his offer, failing which the offer shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

- i) Statement giving list of important raw materials, names of sub suppliers for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material, copies of test certificates.
- ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- iii) List of manufacturing facilities available.
- iv) Level of automation achieved and list of areas where manual processing exists.
- v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

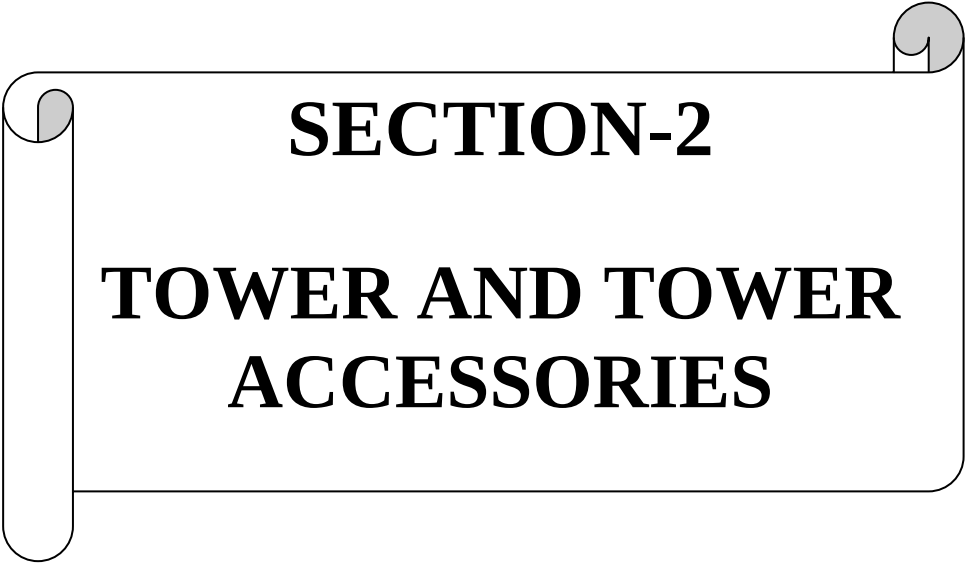
5.2 The material shall conform in all respects to high standards at engineering, design, workmanship latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material which in his judgement is not in full accordance therewith.

6.0 Sub vendor items:

For all the sub vendor items the following are to be furnished at the time of sub vendor approval after the award of contract.

- i. Quality Assurance Plan
- ii. Drawings.
- iii. Type Test reports conducted not earlier than five years.
- iv. Guaranteed Technical Particulars.

The above are to be approved by the purchaser before commencing of production.



SECTION-2

TOWER AND TOWER ACCESSORIES

SECTION – 2(A) TOWERS AND TOWER ACCESSORIES

1.0 SCOPE:

Following is the scope of work envisaged in this section.

Tower fabrication including supply of steel, galvanising, tower accessories, other necessary fittings like hanger rods, D-shackles etc., including bolts, nuts & washers, approval of proto assembly at works before despatch, packing, supply and delivery FADS (Free at Destination Site/stores).

- 1.1 The 400kV D/C Transmission Lines TM/QM shall be strung employing twin moose/quad moose bundled ACSR conductor per phase, and one number 7/3.66mm GSS earth wires and 1 No. OPGW.
- 1.2 Supply of GSS earth wire of size 7/3.66 m m, 95 Kg.f/sq.mm quality, OPGW along with Hardware & terminal equipment, ACSR Moose conductor 54/7/3.53mm, 120kN and 160kN Antifog Zinc Sleeve disc Insulators, Hardware fittings & Accessories for Conductor & Earth wire are included in the scope of contractor. The guaranteed technical parameters of all the materials are included in the tender specification.

2.0 STANDARDS:

The Indian Standard specification (IS) mentioned below or International Standards as amended upto date shall be applicable to the material and process used in the manufacture of towers and tower accessories and a copy of all IS codes mentioned shall be supplied by the successful bidder.

S. No	Indian Standards (IS)	Title	International & Internationally recognised Standard
1	IS:2-1960	Rules for rounding off numerical values.	
2	IS:209-1992	Specification for Zinc	ISO/ R/ 752 ASTM B 6 BS: 3436- 1986
3	IS:278-1991	Specification for Galvanised Steel Barbed wire	ASTM A131
4	IS:432-1982	Mild steel & medium tensile steel bars & hard drawn steel wire for concrete reinforcement.	
5	IS:456-1978	Code of practice for plain & reinforced concrete	
6	IS 2911-2010	CODE OF PRACTICE FOR DESIGN AND CONSTRUCTION OF PILE FOUNDATIONS	
7	IS:802(Part I/ Sec-I)-1995 Sec-II)-1992	Code of practice for use of structural steel in overhead transmission line towers: Materials and loads Permissible stresses Section – I : Materials and Loads Section – II : Permissible stresses	ASCE 52 IEC 826 BS 8100

8	IS:802 (Part-2)-1990	Code of practice for use of structural steel in overhead transmission line: Fabrication, galvanising, inspection and packing.	ASCE 52
9	IS:802 (Part-3) –1990	Code of practice for use of structural steel in overhead transmission line: Tower Testing.	ASCE 52 IEC 652
10	IS:808-1991 Part-V Part-VI	Dimensions for hot rolled steel beams, column channels & Angle sections. Equal leg angles Unequal leg angles	
11	IS:1367(Part-1)- 1992	Technical supply conditions for threaded steel fasteners	
12	IS:1573-1991	Specification for Electroplated coatings for zinc on iron and steel.	
13	IS:1893-1991	Criteria for earthquake resistant design of structures	
14	IS:2016-1992	Specification for Plain washers	ISO/R887-1968
15	IS:2062-1992	Specification for Structural general purposes	
16	IS:2551-1990	<i>Danger notice plates</i>	
17	IS : 800 – 1991	<i>Code of Practice for general building construction in steel</i>	CSA 6.1
18	IS:2629-1990	Recommended practice for hot dip galvanising of iron and steel	
19	IS:2633-1992	Method of testing uniformity of coating on zinc coated articles	ASTM A123 CSA G164
20	IS:3063-1994	Specification for single coil rectangular section spring washers for bolts, nuts and screws	DIN-127 1970
21	IS:3757-1992	High strength structural bolts	
22	IS:4091-1979	Code of practice for design and construction of foundations for transmission line towers and poles	
23	IS:4759-1990	Specification for Hot dip zinc coatings on structural steel and other allied products	
24	IS:5358-1969	Specification for Hot dip galvanised coating on fasteners	
25	IS:5613-1993 (Part-2/) Section.1 Section.2	Code of practice for design, installation and maintenance of overhead power lines: (<u>upto 220kV</u>) Design, Installation and maintenance	
26	IS:5613-1989 (Part-3/ Sect-1 Section-2	Code of practice for design, installation and maintenance of overhead power lines: (400kV lines) Design, Installation and maintenance	
27	IS:6610-1991	Specification for Heavy washers for steel structures	
28	IS :875 –1992	<i>Code of practice for design loads/ other than earthquakes for Buildings & Structures</i>	
29	IS :1852 1993	<i>Rolling & Cutting tolerances of Hot Rolled steel products</i>	
30	IS :3043 –1991	<i>Code of Practise for earthing</i>	
31	IS : 6623-1992	<i>High Strength structural nuts</i>	

32	IS:6639-1990	Specification for Hexagonal bolts for steel structures	
33	IS:6745-1990	Specification for Methods for determination of the weight of zinc coating on zinc coated iron and steel articles	
34	IS:7215-1991	Specification for Tolerance for Fabrication of steel structures	
35	IS:8500-1992	Specification for weldable structural steel (Medium and High Strength Quality)	
36	IS:10238-1989	Step bolts for steel structures	
37	IS:12427-1988	Transmission tower bolts	
38	IS : 12427- 1988	Indian Electricity Rules	
39	Publication No. 19 (N)/ 700	Regulation for Power Line crossings for Railway tracks – 1987	
40	C B I& P Publication No 268	Transmission line Manual	
41		ASCE Manual-72	

The standards mentioned above are available from :

Abbreviation	Name and address
BS	British Standards, British Standards Institution, 101, Pentonville Road, N1 9ND United Kingdom,
IEC/CISPR	International Electro-technical Commission. Bureau Central de la Commission, Electro Technique International, 1 Rue de Verembe, Geneva, Switzerland.
BIS	Bureau of Indian Standards, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi – 110 001, India
ISO	International Organisation for Standardisation, Danish Board of Standardisation, Danish Standardising Sraat, Aurehoegvej-12 DK-2900, Heelstrup, DENMARK.
NEMA	National Electric Manufacture Associate, 115, East 44th Street, New York NY 10017, U.S.A.
JIS	Japanese Standards Association 1-24 Akasaka 4-Chome, Minato-ku, Tokyo, Japan
DIN	<i>Deutsches Institute flir Normung Burggrafen Strance 4-10 Post Farh 1107 D-1000, Berlin 30 (GERMANY)</i>
ASTM	<i>American Society for Testing & Material 1916, Lase Street Philadelphia, PA 1903 1187 USA</i>

3.0 MATERIALS AND WORKMANSHIP:

All materials used in the manufacture of the tower and tower accessories shall be conforming to relevant standards given in Clause 2.0 *along with latest standards applicable.*

4.0 Types of Towers : 400kV

The towers shall be of the types fully described below:-

Type of tower	Designation	Type of stringing	Typical use of towers
Tangent (0 to 2 deg.)	A	Suspension	To be used for straight run and upto 2 deg. line deviation
Small Angle tower (0-15 deg)	B	Tension	To be used for angle of line deviation from 0 to 15deg and in line cut point.
Medium Angle tower (15 –30 deg)	C	Tension	To be used for angle of line deviation from 15 to 30 deg
Large Angle tower (30-60 deg. & Dead End)	D	Tension	To be used for angle of line deviation from 30 to 60deg. or for dead end

* The towers which are required to be strengthened as per site specific requirements shall be done by the successful bidder without any extra charges to TSTRANSCO.

Note :- The angles of line deviation specified above are for the design span. The span may, however, be increased up to an optimum limit with reduced angle of line deviation, if adequate ground and phase clearances are available. The limit of spans for each type of above-mentioned towers with reducing angle of deviation given in the tower capacity chart furnished by the Purchaser.

4.1 BODY EXTENSIONS:

The towers have been designed so as to be suitable for adding 3M, 6M, 9M, 12M, 18M, 25M & 30M body extensions for maintaining adequate ground clearance without reducing the specified factor of safety in any manner. The strength of tower members for all loading cases is adequate with and without extensions.

Wherever 12M, 18 M, 25M & 30M extensions are required, the spans and angles have been reduced suitably and tower spotting approvals for such extensions are to be obtained from Designs wing of TSTRANSCO.

4.2 LEG EXTENSIONS:

To spot the tower in the hilly terrain the bidder shall have to provide leg extensions/Hill side extensions for all types of towers ranging from 1.5M to 9.0M suitable to be fitted to basic towers, normal towers to plus six metres towers as well as with other extensions.

The quantities of hillside extensions shall be finalised only after completion of check survey. The quoted unit rates per metric tonne shall be applicable on the above body, leg and hillside extensions also.

- 4.3.1 For any requirement of special type towers as per field condition the design for the same has to be provided by bidder without any extra cost. Any new design required during the execution of line shall be arranged by the bidder without any extra cost.

4.4 CONFIGURATION AND TYPE OF CONNECTIONS:

- 4.4.1 The towers are of vertical configuration. (The tower out line drawing is enclosed with the bidding documents).
- 4.4.2 All member connections used in the tower and extensions shall be of bolted type.

5.0 TOWER ACCESSORIES:

5.1 STEP BOLTS & LADDERS:

- 5.1.1 Each tower has been provided with step bolts conforming to IS:10238 of not less than 16mm diameter and 175mm long, spaced not more than 450mm apart and extending from above the ACD to the tower. For double circuit tower the step bolt shall be fixed on two diagonally opposite legs upto top of the towers. For single circuit tower the step bolt shall be fixed on one leg upto waist level and on two diagonally opposite legs above waist level upto top of the towers. Each step bolt shall be provided with two nuts on one end to fasten the bolt securely to the tower and button head at the other end to prevent the feet from slipping away. The step bolts shall be capable of withstanding a vertical load not less than 1.5 KN. For special towers, where the height of the super structures exceeds 50 meters, ladders along with protection rings as per the Purchaser approved design shall be provided in continuation of the step bolts on one face of the tower from 30 meters above ground level to the top of the special structure. From 3.5 m to 30 m height of super structure step bolts shall be provided. Suitable platform using 6 mm thick perforated chequered plates along with suitable railing for access from step bolts to the ladder and from the ladder to each cross-arm tip and the ground wire support shall also to be provided. The platform shall be fixed on tower by using counter-sunk bolts.

5.2 NUMBER, DANGER, CIRCUIT AND PHASE PLATES:

- 5.2.1 Each tower shall be fitted with a danger plate, number plate & 2 sets of phase plates for double circuit tower. The transposition towers should have provision of fixing phase plates on both the transverse phase. Circuit plates (*set of 2*) shall be provided on all the Double Circuit Towers.
- 5.2.2 Bidder shall supply number plates, danger plates, circuit plates and phase plates for all towers as shown in drawings.
- 5.2.3 Danger plates shall conform to IS:2551-1990 in all respects, except that the plate shall be of vitreous enameled Red with letters, figures and the conventional skull and bones in white.
- 5.2.4 The number, circuit and phase plates shall conform to IS:5613 (Part 3/section-1)-1989.
- 5.2.5 The corner edges of the danger, number & circuit plates shall be rounded off to avoid sharp edges.

- 5.2.6 The letters of number & circuit plates shall be red enameled with white enameled back ground.

5.3 ANTI-CLIMBING DEVICE:

- 5.3.1 Towers are to be provided with anti-climbing devices as per drawing and conform to IS:5613 (Part 3/section-1) -1989.
- 5.3.2 Necessary holes, as shown on the fabrication drawings, are to be provided on the tower members for installation of the anti-climbing device.
- 5.3.3 The bidder shall quote unit rate for anti climbing device inclusive of structural members and barbed wire.
- 5.3.4 The barbed wire used shall be of TYPE - A and SIZE -1 as per IS-278, 1991 (latest).
- 5.3.5 The barbed wires shall be given chromating dip as per procedure laid down in IS : 1340.

5.4 BIRD GUARDS:

- 5.4.1 The bird guards for suspension towers shall be made of galvanised iron sheet and shall be as per drawing enclosed and shall conform to IS:5613 (Part-3/Section-1)-1989.
- 5.4.2 The unit rate for bird-guards shall be inclusive of all bolts, washers etc.

6.0 STATUTORY REQUIREMENTS:

Statutory requirements as laid down in the 'Indian Electricity Rules 1956' or by any other statutory body applicable to such structures shall be satisfied/observed.

7.0 CLEARANCES:

7.1 GROUND CLEARANCE:

The minimum ground clearance from the lowest conductor shall be considered as given in Section -9. The provisions made for considering the ground undulations, errors in stringing and creep on conductor is 150 mm towards ground undulation and errors in stringing.

7.2 CLEARANCES OF LIVE PARTS TO TOWER MEMBERS:

The minimum clearances between the live parts, tower and cross-arm members have been given in Section - 9.

7.3 INSULATOR STRINGS AND EARTH WIRE CLAMP ATTACHMENTS:

- a) For the attachment of suspension insulator strings a suitable hanger on the tower has been provided so as to obtain required clearance under extreme swinging conditions and free swinging of the string. The hanger has been designed to withstand the highest possible load that may be imposed on it. A typical out line *drawing of the hanger* is enclosed with this specification.

- b) Earth wire peak/ cross arms have been suitably designed to accommodate the shackle of the suspension clamp.
- c) At tension towers, strain plates of suitable dimension on each cross arm tip and top of the earth wire peak, has been provided for taking the D-Shackles of the tension insulator strings or earth wire tension clamps as the case may be.

7.4 SHIELD ANGLE:

The angle of shielding is defined as the angle formed by the line joining the center lines of the earthwire and power conductor/outer power conductor, in still air, at tower, to the vertical line through the center line of the earthwire. The angle of shielding to be maintained for the design of transmission lines under the project has been specified in **Section - 9**. The drop of 150 mm on account of earthwire suspension assembly has been considered while calculating the minimum angle of shielding.

8.0 GROUNDING OF TOWERS:

- 8.1 The Contractor shall measure the tower footing resistance (TFR) of each tower after it has been erected and before the stringing of the earthwire during dry weather. Each tower shall be earthed and the tower footing resistance shall not exceed 10 ohms. Pipe type earthing and counter poise type earthing wherever required shall be done in accordance with the latest additions and revision of

IS : 3043	Code of practice of Earthing
IS:5613	Code of practice for Design, Installation and maintenance (Part-III/section 2) of overhead power lines

- 8.2 The provision of holes on stubs shall be made as per approved earthing drawings.
- 8.3 The earthing will vary depending on soil resistivity. For soil resistivity less than 1500 Ohm-meter, earthing shall be established by providing 4 length of 30 meter counterpoise wire (Total 120m length wire). Otherwise for soil resistivity greater than 1500 Ohm-meter, earthing shall be established by providing 4 length of 70m counterpoise wire (Total 280 m length wire)
- 8.4 The Bidder shall quote for the supply of pipe type grounding materials complete with heavy duty galvanised pipe, galvanised mild steel strip, necessary bolts, nuts and washers required for connecting the strip to pipe and the tower.
- 8.5 The galvanised mild steel strip / flat shall be of 50 x 6 mm and invariably of 6 mtrs. length.
- 8.6 Counterpoise earthing, where necessary shall be provided by the contractor, in accordance with IS:5613 (Part-3/Section-2) - 1989. The ends of the earthwire shall be connected to an electrode of 20mm dia and 600mm long, which shall be buried as per the drawing enclosed.

9.0 FOUNDATION:

9.1 SCOPE:

The detailed drawings of foundations for different soil classification will be furnished by TSTRANSCO.

10.0 FABRICATION:

10.1 The fabrication of towers shall be in accordance with the provisions made in the following sub-clauses.

10.1.1 Except where hereinafter modified, details of fabrication shall conform to the relevant clauses of IS : 802 (part-II) - 1978 and CBIP publication No.268.

10.1.2 The steel angles used for fabrication of the towers shall be procured from SAIL or VSP or TISCO or ISCO. The angles which are not rerolled by the above agencies, the contractor can procure the rerolled angles from any other agencies to be approved by TSTRANSCO. The raw materials procured by these re-rollers shall be from reputed steel manufacturers i.e. VSP/SAIL, TISCO, ISCO, PGCIL approved agencies. If the contractor proposes to procure the steel angles from agencies other than SAIL, VSP, TISCO, ISCO, they have to obtain prior approval from TSTRANSCO.

All expenses against third party inspection and tests in reputed labs shall be borne by the contractor.

10.1.3 The contractor during fabrication of tower members shall ensure that mild steel and high tensile steel do not get mixed up during fabrication and as such identification mark shall be embossed on each and every H.T. Steel section. The bidder in his tender shall clearly bring out the means adopted to identify the mild steel and high tensile steel sections during fabrication. The structural drawing for all types of towers, body and leg extensions etc. together with the Bill of Material shall be provided by the Purchaser.

10.1.4 All parts of the towers shall be cut to correct lengths and fabricated in accordance with the shop drawings approved by the purchaser. Welding of two or more pieces to obtain the length of member specified shall not be allowed. Members shall be straight to the permissible tolerances to ensure proper fit before being laid off or worked and after galvanizing.

10.1.5 The tower members shall be accurately fabricated to bolt together easily at site without any undue strain on them or the bolts.

10.1.6 The diameter of the hole shall be equal to the diameter of bolt plus 1.5 mm.

10.1.7 No angle member shall have the two leg flanges brought together by closing the angle.

10.1.8 All parts of the towers shall be accessible for inspection and cleaning. Drain holes shall be provided at all points where pockets or depressions are likely to hold water.

10.1.9 All similar parts shall be made strictly inter changeable. All steel sections before any work is done on them, shall be carefully levelled, straightened and made true to detailed drawings by methods which will not injure the materials so that when assembled the adjacent matching surfaces are in close contact throughout. No rough edges shall be permitted in the entire structure.

10.2 OPERATIONS IN FABRICATION:

10.2.1 STRAIGHTENING:

Straightening shall be so done that it does not injure the material. Hammering shall not be permitted for straightening/or flattening of members. Sharp bends shall be a cause for

rejection. Straightening for members up to 110x110x10mm can be done using a “roller straightening” machine. Larger angles shall be straightened using a beam bending machine or hydraulic press.

10.2.2 CUTTING:

The cut surfaces shall be clean, smooth, reasonably square and free from any distortion.

10.2.3 BENDING:

Mild steel angle sections up to 75x75 mm (thickness up to and including 6 mm) shall be bent cold up to and including bend angles of 10 deg. Mild steel angle sections above 75x75 mm (thickness up to and including 6 mm) and up to and including 100x100 mm (thickness up to 8mm) may also be bent cold up to bend angles of 5 deg. All other angle sections and bend angles not covered above shall be bent hot. All plates up to 12 mm thickness shall be cold worked up to a maximum bend angle of 15 deg. Hot bending shall be employed for greater bend angles and thicker plates. All hot bent material shall be air-cooled. The bends shall be of even profile and free from any surface damages. Bends on all high tensile steel sections shall be done hot.

10.2.4 HOLING:

Holes in the members shall either be drilled or punched to jig and shall not be formed by flame cutting process. All blurr left by punching or drilling shall be completely removed. Punching may be adopted for MS sections with thickness upto 16 mm. For thicker sections, drilling shall be done. The holes near the bend line of a bent member on both sides of bend line should be punched/drilled after bending and relative positions of those holes shall be maintained with the use of proper templates/jigs and fixtures. The limit of punching for HT steel section may be indicated in the bid. In determining gauge lines IS 1852:1985 should be followed.

10.3 FASTENERS: BOLTS, NUTS AND WASHERS:

10.3.1 All tower members shall be joined together with Bolts and nuts. The redundants of first two (2) panels from ground level shall be connected with Anti-thefts bolts and nuts along with spring washers whereas the balance joints shall be connected with hexagonal bolts & nuts. All hexagonal bolts and nuts shall conform to IS –12427. They shall have hexagonal head and nuts, the heads being forged out of the solid, truly concentric, and square with the shank, which must be perfectly straight.

Anti-theft bolts and nuts shall have round tapered heads with hexagonal shear nuts. They shall conform to IS : 12427 and IS : 1367 for property class 5.6/5 except for dimensions which shall be as per enclosed drawing no. TL/400kV/ ATB.

10.3.2 The bolt shall be of 16/24 mm diameter and of property class 5.6 as specified in IS: 1367 (Part-III) and matching nut of property class 5.0 as specified in IS : 1367 (Part-VI).

10.3.3 Bolts upto M16 and having length upto 10 times the diameter if the bolt should be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical properties and effective dimensional control. The shear strength of bolts for 5.6 grade should be 310 Mpa minimum as per IS: 12427. Bolts should be provided with washer face in accordance with IS: 1363 (part-I) to ensure proper bearing.

- 10.3.4** Nuts for hexagonal bolts should be double chamfered as per the requirement of IS: 1363 Part-III. It should be ensured by the manufacturer that nuts should be overtapped beyond 0.4mm oversize on effective diameter for size upto M16.

Nuts for Anti-theft bolts should be round tapered with hexagonal shear nuts. The hexagonal portion of shear nuts shall break away at specified torque recommended by the supplier to ensure proper tightening of members and the fasteners shall not be opened subsequently with tools. The tightening torque and shearing of anti-theft nuts shall be verified during proto-assembly.

- 10.3.5** Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion will not extend into the plane of contact of the member.
- 10.3.6** All bolts shall be threaded to take the full depth of the nut and threaded for enough to permit firm gripping of the members, but not further. It shall be ensured that the threaded portion of each bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit and tight to the point where the shank of the bolt connects to the head.
- 10.3.7** Flat and tapered washers shall be provided wherever necessary. Spring washers shall be provided for insertion under all nuts. These washers shall be steel electro galvanised, positive lock type and 3.5mm in thickness for 16mm dia bolt and 4.5 mm for 24mm bolt.
- 10.3.8** To avoid bending stress in bolts or to reduce it to minimum, no bolt shall connect aggregate thickness of members more than three (3) times its diameter.
- 10.3.9** The bolt positions in assembled towers shall be as per structural drawing.
- 10.3.10** Bolts at the joints, shall be so staggered that nuts shall be tightened with spanners without failing.
- 10.3.11** To ensure effective in process- Quality control it is essential that the manufacturer should have in house testing facility for all tests like weight of zinc coating, shear strength and other tests etc. The manufacturer should also have proper Quality Assurance System which should be in line with the requirement of this specification and IS : 14000 series Quality system standard.

10.3.12 SPACING OF BOLTS AND EDGE DISTANCE:

The minimum spacing of bolts and edge distances shall be as given below:

Bolt diameter (mm)	Hole diameter (mm)	Minimum bolt Spacing (mm)	Minimum edge Distance	
			Hole center to rolled or sawn edge	Hole center to sheared cut edge
16	17.5	40	20	23
20	21.5	48	25	28
24	25.5	60	33	38

Not more than two diameters of bolt shall be used on any one tower. Step bolts are excluded from this requirement.

10.3.6 LOCKING DEVICES:

Spring washers designated as B-16-IS-3063 Electro galvanised/hot dip galvanised shall be provided for insertion under all nuts. These washers shall be of steel and electro-galvanised, conforming to IS:1573-1986 or hot dip galvanised as per IS:2629-1966 and positive lock bolt as per IS:3063-1972 Electro-galvanised/hot dip galvanised spring washers of type B. Washers of the following thickness shall be provided under all nuts.

Bolt Diameter (mm)	Thickness of spring washers (mm)
16	3.5
20	4.0
24	4.5

10.4 TOLERANCES:

The fabrication tolerances in general shall conform to IS:7215-1974 unless otherwise specified here under.

- a) The maximum allowable differences in diameter of the holes on the two sides of the plate or angle shall be 0.8mm i.e., the allowable taper in a punched hole shall not exceed 0.8mm on diameter.
- b) Tolerance cumulative and between consecutive holes shall be within ± 1.6 mm.
- c) Tolerance cumulative and between consecutive holes shall be within ± 0.5 mm.

10.5 ERECTION MARK:

- a) Each individual member shall have erection mark conforming to the component number given to it in the fabrication drawings. This mark shall be punched with marking dies of 16mm size before galvanising and shall be legible after galvanising.
- b) Erection Mark shall be AA-BB-CC-DD

AA-Purchaser's code assigned to the contractors (Alphabet).

BB-Contractor's mark-numerical.

CC-Tower type (Alphabet) (To be taken from the supplied fabrication drawings).

DD- Number mark (To be taken from the supplied fabrication drawings).

Erection mark for high tensile steel members shall be followed by the letter “H”

10.6 CHECK ASSEMBLY OF TOWERS:

Before proceeding with the mass fabrication of any type of tower, the contractor shall fabricate and assemble in his works for inspection by the purchaser or his authorised representative, one tower of each type as finally approved by the purchaser for checking the fabrication accuracy and workmanship. The check assembly shall be conducted in a horizontal position. The prototype assembly made on the ground in the horizontal position shall be adequately supported to prevent distortion and over-stressing of members. Proper fit shall be accomplished without extraordinary effort to align bolt holes or to force pieces into position. For the check assembly, bolts and nuts shall be not more than finger tight.

10.7 GALVANISING

All tower members shall be fully galvanised. Galvanising of the member of the towers shall conform to IS:2629-1990 and IS:4759-1990. All galvanised members shall withstand tests as per IS:2633-1994. For fasteners, the galvanising shall confirm to IS:5358-1969. The galvanising shall be done after all fabrication work is completed, except that the nuts may be tapped or re-run after galvanising. Threads of bolts and nuts shall have a neat fit and shall be such that they can be turned with finger throughout the length of the threads of bolts and they shall be capable of developing full strength of the bolts. Spring washers shall be electro-galvanised as per service grade 3 of IS:1573-1991 or hot dip galvanized as per service grade 4 of IS-4759-1990.

Deleted.

The zinc coating shall be adherent, reasonably uniform, smooth, continuous and free from imperfections such as black/ bare spots, ash rust strains, bulky white deposits/ wet storage strains and blisters.

10.8 STUBS:

10.8.1 The stubs shall mean a set of four fully galvanised stub angles and shall include cleats, bolts and nuts, etc.

10.8.2 The finished materials shall be dipped into the solution of dichromate after galvanising or treated with approved inhibitor (the details of which shall be given in the tender) for protection against “white storage stain” formation during transportation and storage.

10.9 STUB SETTING TEMPLATES:

Stub templates shall be fabricated and supplied by the contractor for all types of towers with or without extensions and also for leg extension. Stub templates suitable for standard towers and tower with extension of 3 metre, 6 metre, 9 meter and 12 metre shall be of adjustable type. The stub templates shall be painted. The number of templates of each type of tower is to be arranged by the Contractor to the satisfaction of the purchaser for timely completion of line at their cost. The drawings of the stub templates shall be provided by the purchaser to the contractor within 30 days. New set of templates for all types of towers & extensions shall be supplied to the purchaser after completion of erection work.

However, if purchaser feels that more templates are required for timely completion of a particular line due to any urgency, the contractor shall deploy the same within one week of making such request without any extra cost to the purchaser.

10.10 DRAWINGS AND BILL OF MATERIALS:

10.10.1 The following technical drawings and documentation are to be submitted along with the tender without which the tender is liable to be rejected:

- i) Drawings and / or catalogues of bidder's equipment.
- ii) Full description of the proposed method of tension stringing.

10.10.2 The Purchaser will furnish the below mentioned drawings to the successful bidder within thirty (30) days from the date of LOI.

- i) Fully dimensioned drawing for each standard type of tower complete with cross arms showing sizes of all steel sections, fittings, bolts, attachments etc.
- ii) Dimensioned drawings for extensions with sizes of steel sections employed.
- iii) Dimensioned drawings for stubs.
- iv) Dimensioned drawings for stub setting templates.
- v) Dimensioned drawings for anti-climbing device etc.
- vi) The existing capacity charts tower spotting requirements for all types of towers to be used for smaller angles and longer spans.
- vii) The Purchaser's existing shop drawings for each tower, body extensions.
- viii) Bills of materials for each tower, body extension and leg extension type
- ix) Fully dimensioned drawings of all types of foundations for standard towers, extensions etc.,
- x) Bill of material for foundations.
- xi) Drawing of sag template.

11.0 PACKING:

11.1 The material shall be boxed or bundled for transport in the following manner:

11.1.1 Angles shall be packed in bundles securely wrapped four times around at each end and at every metre with No.9 gauge galvanised steel wire with ends twisted tightly. Gross weight of any bundle shall not exceed approximately 450 kg.

11.1.2 Cleat angles, brackets, fillet plates and similar small loose pieces shall be nested and bolted together in multiples, and securely wired together through holes, wrapped round at least four times with no.9 gauge galvanised steel wire and ends twisted tightly. Gross weight of each bundle shall not exceed approximately 70 kg.

11.1.3 The correct number of bolts, nuts and washers to be packed in heavy gunny bags accurately tagged in accordance with the contents and a number of bags packed in a solid box of 22mm thick lumber with panelled ends to be securely nailed and further reinforced with 22mm x No.18 gauge iron band stretched entirely around the buttons with ends over lapping at least 150 mm. Gross weight of each box shall not exceed approximately 70 kg.

- 11.1.4 All packing shall be subject to the approval of the purchaser, or his appointed representatives.
- 11.1.5 The packing shall be carried out with caution to protect the material from moisture, salt or any impurities that may cause rust or harmful effects.
- 11.1.6 The packages shall be new and sufficiently sturdy in construction to withstand normal service incident to shipping and field handling.
- 11.1.7 The packing shall be made part-wise in a bundle for a maximum of 5 Nos. towers for dispatch limiting the weight of each package as indicated in the above paras. Immediately after every dispatch, the contractor shall furnish soft copy as well as hard copies indicating the dispatches offered (weight-wise and numbers), cumulative dispatch and balance tower parts yet to be dispatched to Chief Engineer / Construction, 400 kV.

11.2 MARKING OF PACKINGS:

Each bundle or package shall have the following marks:

- 11.2.1 The contract/purchase order no. and date, the name or designation of the consignee (to be furnished by the Purchaser).
- 11.2.2 Ultimate destination (as required by the Purchaser).
Detailed despatch instructions shall be asked for by the contractor, from the Purchaser at least 2 weeks ahead of the scheduled date of despatch.
All packages shall be marked with the standard packing mark as desired by the Purchaser.

12.0 PLACE OF MANUFACTURE AND MANPOWER:

The Bidder must have established steel fabrication facilities at his works. The galvanising of both plant & equipment available for fabrication, galvanising, testing facilities available in their works and other institutions which they intend to make use of shall be stated in the appropriate schedule and shall not be changed without prior approval of the purchaser. The bidder shall also submit the details of manpower available with his organisation indicating clearly the number of personnel engaged in the design, fabrication of towers and for erection /construction of the transmission lines. The bidder shall give a brief profile of his organisation and plant layout.

13.0 GUARANTEED TECHNICAL PARTICULARS:

The bidder shall fill in the guaranteed technical particulars in the appropriate schedule enclosed with the bidding documents and submit the same with the bid.

14.0 SCHEDULE OF REQUIREMENTS AND DESIRED DELIVERIES/COMPLETION

As per Volume-I of specification.

15.0 PERFORMANCE SCHEDULE:

The bidder shall furnish the details of his performance in respect of the major EHV transmission line works carried out by him in the performance schedule contained in Volume-I of this specification. These lines involving the supply of materials for and/or

erection of such EHV lines including 400kV lines which have been in service, at least for the last seven years.

16.0 SCHEDULE OF DEVIATION (to be enclosed in Bidding documents)

- 16.1** If the bidder has any exceptions to any of the clauses laid down in this specification, then these should be clearly stated on the schedule of deviations, (technical or commercial) and enclosed the same with bid.
- 16.2** If the bidder has no exceptions to any of the clauses laid down in this specification, then NIL shall be clearly stated on the schedule of deviations, (technical or commercial) and enclosed the same with bid.

A decorative graphic of a scroll with a black outline and a light gray fill. The scroll is oriented horizontally, with its ends curled up. The text is centered within the scroll.

SECTION - 3

**TECHNICAL SPECIFICATION
FOR
ACSR "MOOSE" CONDUCTOR**

SECTION - 3

TECHNICAL SPECIFICATION FOR ACSR "MOOSE" CONDUCTOR

1.0 SCOPE

This Specification provides for design, manufacture, engineering, inspection, stage testing and testing before despatch, packing, delivery and unloading at site/stores of **ACSR "Moose" Conductor of size 54/7/3.53 mm(IS 398 Part V)** to be used on 400 kV overhead transmission lines.

The Bidder shall be responsible for quality of material offered which shall withstand the environmental conditions in the area in respect of heavy pollution / Cyclone wind conditions and humidity.

2.0 STANDARDS

The Power conductor shall conform to the following Indian/ International Standards, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise specified herein before. International and Internationally recognized standards to which these standards generally correspond are also listed below: -

S.No.	Indian Standard	Title	International Standards
1	IS:209-1992	Specification for Zinc	BS-3436
2	IS:398 Part V-1992	Specification for Aluminum conductors for overhead transmission purposes Aluminum conductors galvanised steel reinforced	IEC-601089-1991 IEC - 601232
3	IS:1521-1972	Method of Tensile Testing of Steel wire	ISO/R89
4	IS:1778-1980	Reels and Drums for Bare conductors	BS-1559
5	IS:1841-1978	E.C Grade Aluminum rod produced by rolling	
6	IS:2629-1985/1990	Recommended practice for Hot Dip Galvanising of iron and steel	
7	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles	
8	IS:4826-1979	Galvanised coatings on round steel wires	ASTM A472-729 BS-443
9	IS:5484-1978	E.C. Grade Aluminum rod produced by continuous casting and rolling	
10	IS:6745-1972	Methods of determination of weight zinc-coating of zinc coated iron and steel articles	BS-443
11	IS : 8263-1976	Method of radio-interference tests on high voltage installations.	IEC:437-1973 NEMA:107

The standards mentioned above are available from: -

Reference Abbreviation		Name and Address
BS		British Standards, British Standards Institution, 101, Pentonville Road, N-19-ND United Kingdom
IEC / CISPR		International Electro-technical Commission. Bureau Central de la Commission, Electro Technique International, 1 Rue de verembe, Geneva, Switzerland
BIS		Bureau of Indian Standards, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi - 110 001, INDIA
ISO		International Organisation for Standardisation, Danish Board of Standardisation, Danish Standardising Sraat, Aurehoegvej-12 DK-2900, Heelstrup, DENMARK
NEMA		National Electric Manufacture Associate, 115, East 44th Street, New York NY 10017, U.S.A.
JIS		Japan Standards Association 1-24 Akasaka 4-chome, Minato-ku, Tokyo, Japan

However, in an event where the Supplier offers ACSR conductor conforming to International standards, including JIS, other than the above, then the salient points of comparison between the standards adopted and the standards quoted herein and in support of the guaranteed technical particulars to be furnished in the Proforma enclosed to this Technical specification shall be detailed in relevant schedule with an authenticated English version of such standards referred to.

ACRONYMS USED : -

1)	UTS	Ultimate tensile strength	2)	Kg	Kilogram
3)	kV	Kilo Volts	4)	kN	Kilo Newtons
5)	Max	Maximum	6)	Min	Minimum
7)	%	Percentage	8)	mm	Millimetre
9)	Deg	Degrees	10)	C	Celcius

3.0 PRINCIPAL PARAMETERS :**3.1 ACSR "MOOSE" CONDUCTOR**

1	Conductor		ACSR "Moose"		
2	IS applicable		IS-398 (Part-V)- 1992 1992 Latest version acceptable to International Standards.		
3	No. of Wires/ diameter /Aluminum (mm) Steel (mm)		54/3.53 7/3.53		
4	Number of strands:				
	Steel center		1		
	1 st steel layer		6		
	1 st Aluminum layer		12		
	2 nd Aluminum layer		18		
	3 rd Aluminum layer		24		
5	Sectional area of Aluminum (Sq.mm)		528.50		
6	Total Sectional Area (Sq.mm)		597.00		
7	Overall diameter (mm)		31.77		
8	Approximate weight (Kg./kM)		2004		
9	Calculated D.C resistances at 20 deg C max. (Ohm/kM)		0.05552		
10	Ultimate tensile strength, (kN)		161.2		
11	Final modulus of elasticity (Kg/Cm.)		0.703×10^6		
12	Coefficient of linear expansion per deg. C		19.30×10^6		
13	Lay-Ratio		Maximum	Minimum	
	Steel core 6 wire layer		18	16	
	Aluminum, 1 st layer (12 wire)		14	12	
	2 nd layer (18 wire)		13	11	
	3 rd layer (24 wire)		12	10	
14	Technical particulars of steel and aluminum strands		Aluminum	Steel (galvanised)	
a)	Diameter				
	Standard		3.53	3.53	
	Maximum mm		3.55	3.60	
	Minimum mm		3.51	3.46	
b)	Cross-sectional area of nominal diameter wire (Sq.mm)		9.787	9.787	
c)	Weight, (Kg/kM)		26.45	76.34	
d)	Minimum breaking load before stranding, (kN) :		1.57	12.86	
	After stranding		1.49	12.22	
15	D.C Resistance at 20 degrees C. (Ohm/kM)		2.921		

16	Zinc coating of steel core			
a)	Number of 1 minute dips	3		
b)	Coating (gms/Sq.m)	260		
c)	Process of Galvanising	Hot dip Galvanising		
d)	Quality of Zinc	IS-209/1979 or latest addition		
17	Joints in strands			
a)	Steel	Not permitted		
b)	aluminum	No joint shall be permitted in the aluminum strands in the outer most layer of the conductor. But permitted in the inner layers such that no two such joints are within 15 meters of each other in the complete stranded conductor		
c)	Ultimate tensile strength of joint Kg.	15.20		
18	Chemical composition of high carbon wire			
	<u>Element</u>	<u>% Composition</u>		
i)	Carbon	0.5 to 0.85		
ii)	Manganese	0.5 to 1.10		
iii)	Phosphorus	Not more than 0.035		
iv)	Sulphur	Not more than 0.045		
v)	Silicon	0.10 to 0.35		

4.0 GENERAL TECHNICAL REQUIREMENTS:

- 4.1 The ACSR conductor shall be suitable for being installed directly in air supported on suspension insulator strings or anchored through tension insulator strings at the power cross arms of Double circuit Transmission line towers.

The conductor shall be suitable for satisfactory operation under the tropical climatic conditions in which the Lines are passing. The applicable design particulars of the conductor to be used on the lines is furnished in clause-10 "System Particulars".

4.2 Physical constants of materials :

4.2.1 Physical constants for Hard-drawn Aluminum wire

4.2.1.1 Physical constants for Hard-drawn Aluminum are taken as per IS-398 Part -V,1992.

4.2.1.2 Resistivity:

The resistivity of aluminum depends upon its purity and its physical condition. For the purpose of this specification the maximum value permitted is 0.028264 at 20 Deg.C for "Moose" conductor. This value has been used for calculation of the maximum permissible value of resistance.

NOTE : It is not intended to check the resistivity from the measured values of resistance.

4.2.1.3 Density :

At a temperature of 20 Deg.C the density of Hard-drawn aluminium has been taken as 2.703 g/cu.cm.

4.2.1.4 Constant - Mass Temperature Co-efficient of Resistance at a temperature of 20 Deg C :

The Constant-mass temperature co-efficient of resistance of Hard drawn aluminium measured between two potential points rigidly fixed to the wire when the metal being allowed to expand freely has been taken as 0.004 per degree Celsius.

4.2.1.5 Co-efficient of Linear Expansion :

The Co-efficient of linear expansion of hard-drawn aluminium at 20 Deg C has been taken as 23.0×10^{-6} per deg C. This value holds good for all practical purposes over the range of temperatures from 20 Deg.C to highest safe operating temperature.

4.2.2 Physical constants for Galvanized steel wire:

4.2.2.1 Density :

At a temperature of 20 Deg. C, the density of galvanized steel wire is to be taken as 7.80 g / cm^3 .

4.2.2.2 Co-efficient of Linear Expansion:

The co-efficient of linear expansion of galvanised steel wire at 20 Deg C has been taken as 11.5×10^{-6} per deg C. This value holds good for all practical purposes over the range of temperatures from 20 Deg. C to highest safe operating temperature.

4.3 MATERIALS AND WORKMANSHIP

Important technical particulars are given hereunder:

- 4.3.1 The material offered shall be of best quality and workmanship. The ACSR Aluminum conductor strands shall consist of hard drawn aluminum wire manufactured from not less than 99.5% pure electrolytic aluminum rods of E.C. grade and copper content not exceeding 0.04%. The steel wire for both ACSR shall be made from material produced either by the acid or basic open hearth process or by electric furnace process or basic oxygen process. Steel wire drawn from Bessemer process shall not be used.
- 4.3.2 The galvanised steel wires shall be evenly and uniformly coated with electrolytic high grade, 99.95% purity zinc complying with the latest issue of IS-209 for zinc. The uniformity of zinc coating and the weight of coating shall be in accordance with clause 3.0 of this Section and shall be tested and determined according to the latest IS-2633 or any other authoritative standard. The steel strands shall be hot dip galvanised and shall have a minimum zinc coating of 260 gm/Sq.m after stranding. The coating shall be smooth, continuous, and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding in standard preece test. The steel strands shall be pre-formed and post-formed in order to prevent spreading of strands in the event of cutting of composite core wire.

4.4 CONDUCTOR PARAMETERS :

- 4.4.1 The Parameters of individual strands and ACSR conductor, shall be in accordance with the values given in Clause 3.0 in this Section.
- 4.4.2 Creep in a conductor is attributed partly due to settlement of strands and partly due to non-elastic elongation of metal when subjected to load. The manufacturer of conductor shall furnish the amount of creep which will take place in 10, 20, 30, 40 and 50 years along with the supporting calculations which are to be approved to arrive at creep compensation while initial stringing of the line. The calculations should be based on everyday temperature of 32 degree C and everyday tension of 22% of UTS of conductor of 400kV Lines .

4.5 TOLERANCES:

The following tolerances shall be permitted on standard diameter of aluminum steel wires.

- 4.5.1 A tolerance of plus or minus 0.5 percent for ACSR conductor shall be permitted on standard diameter of aluminum wires.
- 4.5.2 A tolerance of plus or minus 2.0 percent for ACSR conductor shall be permitted on the standard diameter of the galvanised steel wires.
- 4.5.3 The cross-section of any wire shall not depart from circularity by more than an amount corresponding to the tolerance on the standard diameter.
- 4.5.4 The details of diameters, lay ratios of Aluminum and steel wires shall be in accordance with the Clause 3.0 of this Section.

4.6 SURFACE CONDITIONS:

- 4.6.1 All aluminium and steel strands shall be smooth, and free from all imperfections, spills/and splits. The finished conductor shall be smooth, compact, uniform and free from all imperfections including spills and splits, die marks, scratches, abrasions, scuff marks, kinks (protrusion of wires), dents press marks, cut marks, wire cross-over, over-riding looseness, pressure and/or unusual bangle noise on tapping, material inclusions, white rust, powder formation or black spots (on account of reaction with trapped rain water etc.), dirt, grit, etc. The surface of conductor shall be free from points, sharp edges, abrasions or other departures from smoothness or uniformity of surface contour that would increase radio interference and corona losses. When subject to tension upto 50% of the ultimate strength of the conductor, the surface shall not depart from the cylindrical form nor any part of the component parts or strands move relative to each other in such a way as to get out of place and disturb the longitudinal smoothness of the conductor.

4.7 JOINTS IN WIRES

4.7.1 ALUMINIUM WIRES:

No Joint shall be permitted in the outermost layer of aluminum wires of the ACSR Moose conductor. Joints in the individual aluminium wires in the inner layers (12 wire & 18 wire layers) are permitted, but no two such joints are within 15 meters of each other in the complete stranded conductor. Such joints shall be made by the cold pressure butt-welding.

4.7.2 STEEL WIRES:

There shall be no joints in steel wires forming the core of the ACSR conductor.

4.8 STRANDING:

- 4.8.1 The wires used in construction of the stranded conductor, shall before stranding, satisfy all requirements of IS-398 Part-V,1992 .
- 4.8.2 In all constructions, the successive layers shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outermost layer of wires shall have a right hand lay. The lay ratio of the different layers shall be within the limits given in Clause-3.0 of this section.

4.9 LENGTHS:

- 4.9.1 The conductor shall be supplied in the standard lengths of 1800 mts. A tolerance of plus or minus 5% on the standard length offered by the Sub-vendor shall be permitted. All lengths shorter than the min permissible length shall be treated as random lengths. Not less than 90% of the total quantity of the conductor shall be supplied in standard lengths.

Thus the quantity of the conductor in random lengths shorter than standard ones shall not exceed 10% of the total quantity to be supplied. Further no single conductor length in respect of such 10% (maximum) supply in random lengths, shall be shorter than 70% of the standard length. Only one standard length or random length of conductor shall be wound on each drum.

The conductor in lengths in excess of the standard length with 5% tolerance shall not be accepted unless specifically indented by the Purchaser. All short lengths should be supplied in a batch of six or twelve to the declared destination. They shall also be distributed uniformly to the declared dispatching stations depending upon the quantity of conductor allocated for each station.

The contractor shall keep records of all the lengths of conductor manufactured from metal of the same heat and store the conductor by heat/batch at his works before dispatch. The dispatch of the conductor shall be done in multiples of 12 drums ensuring all drums of the same length are grouped by heat/batch. Each drum shall be marked to easily identify the heat/batch of the conductor thereon. This marking shall be agreed with the Purchaser.

- 4.9.2 The Contractor shall also indicate the maximum single length above the standard length that his sub vendor can manufacture with principal parameters specified in clause 3.0 of this section. This is required for special stretches like river crossing etc. The purchaser reserves the right to place order for the above and below lengths on the same terms and conditions applicable for the standard lengths during contract period. The drums used for the conductor over and above the standard lengths shall be strong enough to withstand rough handling during loading, transit and unloading.

5.0 TESTS:

- 5.1 The Type, Acceptance and Routine tests and tests during manufacture, shall be carried out on the conductor.
- 5.1.1 Type tests shall mean those tests, which are to be carried out to prove the process of manufacture and general conformity of the material to this specification. These tests shall be carried out on samples prior to commencement of commercial production against the order. The Sub-vendor shall indicate his schedule for carrying out these tests in the activity schedule. The Sub-vendors who have not carried out type tests will not be considered. The successful Bidder shall furnish the latest type test reports of the type tests conducted by his Sub vendor not later than 5 years subject to no alteration in the design at the time of Sub Vendor approval.

- 5.1.2 Acceptance Tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-despatch inspection, for the purposes of acceptance of that lot.
- 5.1.3 Routine Tests shall mean those tests which are to be carried out on each strand/spool/length of the conductor to check requirements which are likely to vary during production.
- 5.1.4 Tests during manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the Sub-vendor to ensure the desired quality of the end product to be supplied by him.
- 5.1.5 Samples for individual wires for tests shall be taken before stranding from not less than ten percent of the spools in the case of aluminium wires and ten percent of the coils in the case of steel wires. If samples are taken after stranding, they shall be obtained by cutting 1.2 mts. from the outer end of the finished conductor from not more than ten percent of the finished reels.
- 5.1.6 The standards and norms to which these tests will be carried out are listed against them. Where a particular test is a specific requirement of this specification, the norms and procedures of the test shall be as specified in **Test Procedures** or as mutually agreed to between the Bidder and the Purchaser in the Quality Assurance Programme.
- 5.1.7 For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Supplier in the proforma for "Guaranteed Technical Particulars", furnished in this specification and accepted by the Purchaser or acceptance value specified in this specification, whichever is more stringent for that particular test.
- 5.1.8 The Bidder shall provide the names and addresses of his test facilities together with all outside recognised agencies/ laboratories where he proposes to have tests conducted. He shall also list which tests he proposes to have conducted at each facility.

5.2 TESTS

The following tests shall be carried out as per detailed procedures of IS:398(Part-V) -1992 .

5.2.1 Tests on individual strands.

5.2.1.1 TYPE TESTS

- a) Visual examination including check for joints.
- b) Measurement of diameters of individual aluminium and steel wires
- c) Breaking load test
- d) Elongation test
- e) Wrapping test
- f) Torsion test
- g) Resistance test
- h) Galvanising test
- i) Chemical analysis of aluminium and steel
- j) Procedure qualification test on welded joints of individual Aluminium strands.

5.2.1.2 ROUTINE TESTS

- a) Visual examination including a check of joints
- b) Measurement of diameters of individual aluminium and steel wires
- c) Breaking load test
- d) Elongation test
- e) Wrapping test
- f) Torsion test
- g) Resistance test
- h) Galvanising test

5.2.2 TESTS ON COMPLETE CONDUCTOR

- a) Ultimate tensile strength Test
- b). Corona extinction voltage Test
- c). Radio interference voltage Test
- d). Resistance Test
- e) Stress - Strain Test on conductor and steel core.

5.2.2.1 ACCEPTANCE TESTS

- a) Visual check for joints, scratches etc., and length measurement of conductor by rewinding
- b) Check on lay ratio of various layers
- c) Procedure qualification tests on welded joints of individual aluminium strands

5.2.3 Tests on wooden drums - to be produced for verification by the inspecting officer at the time of inspection of finished conductor.

5.2.3.1 TYPE TESTS

- a) Visual check
- b) Dimensional check
- c) Drum material check
- d) Barrel batten strength check

5.2.3.2 ACCEPTANCE TESTS

- a) Visual check
- b) Dimensional check
- c) Drum material check
- d) Barrel batten strength check
- e) Drum marking check

5.2.3.3 ROUTINE TESTS

- a) Visual check
- b) Dimensional check
- c) Drum marking check

5.2.4 TESTS DURING MANUFACTURE

- a) Chemical analysis of the zinc used for Galvanising.
- b) Chemical analysis of the aluminum used to manufacture the aluminium strands
- c) Chemical analysis of the steel used to manufacture the steel strands
- d) Procedure qualification test on welded joints of individual Aluminium strands.

5.3 TESTING EXPENSES:

5.3.1. The entire cost of testing for the acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of conductor. The Purchaser feels if it is necessary to conduct the type tests for his satisfaction then it should be

done free of cost

- 5.3.2 In the event that type, acceptance or routine tests have to be repeated due to initial failure, all costs including time, travel and subsistence costs incurred by the Purchaser's representative in attending the repeat tests shall be paid by supplier. In the event that the Purchaser's representative incurs additional costs due to unreasonable delay or cancellation of tests at short notice, these additional costs shall also be paid in full by the *contractor*.

In case of failure in any type test, repeat type tests are required to be conducted, then all the expenses for deputation of Inspector/Purchaser's representative shall be borne by the *contractor*.

Also if on receipt of the Contract's to be ready for testing, the expenses incurred by the Purchaser for redeputation shall be deducted from the contract price.

The Purchaser reserves the right to repeat any or all type / acceptance tests on samples selected from lot supplied to purchaser wherever deemed necessary at free of cost.

5.4 **REJECTION AND RETEST:**

- 5.4.1 Each coil or spool selected for testing shall be tested for compliance with the requirements of IS: 398 Part -V or any other equivalent authoritative standard. Should any selected coil or spool not fulfill any of the test requirements, that particular coil or spool shall be withdrawn. In respect of each failure, two test pieces shall be selected from two different coils in the lot and subjected to the test under which the failure occurred. If either of the two retest pieces fails to pass that test, the lot concerned shall be rejected.

- 5.4.2 If samples are taken for test after stranding and if any selected reel fails in the retest, the manufacturer may test each and every reel and submit them for further inspection. All rejected material shall be suitably marked and segregated.

5.5 Sample Batch for type testing :-

- 5.5.1 The Sub-vendor shall offer at least three (3) drums for selection of samples required for conducting all the type tests.
- 5.5.2 The Sub-vendor is required to carry out all the acceptance tests successfully in the presence of Purchaser's representative before despatch.

5.6 **TEST REPORTS:**

- 5.6.1 Copies of type/acceptance test reports shall be furnished in three (3) copies along with one original. One copy shall be returned duly certified by the Purchaser only after which the material will be dispatched.
- 5.6.2 Record of routine test reports shall be maintained by the Sub-vendor at his works for periodic inspection by the Purchaser's representative.
- 5.6.3 Test Certificates of tests conducted during manufacture shall be maintained by the Sub-vendor. These shall be produced for verification as and when desired by the Purchaser.

5.7 **TEST FACILITIES:**

- 5.7.1 The test facilities available at the Sub-vendors works shall be listed and furnished by the successful Bidder at the time of approval of Sub Vendor. They shall include but not be limited to the following.

- a) Various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer, torsion test equipment, elongation test equipment, wrapping test equipment etc.
- b) Standard resistance for calibration of resistance bridges and equipment for calibrating other testing equipment. All equipment, or equipment for calibrating other equipment must have a valid certificate of calibration from a recognised calibration laboratory.
- c) The rewinding facilities with clutch system and reduced speed variable from 8 to 16 m/ min and free from vibrations, jerks etc., with transverse layering facilities shall be available to verify declared length and surface finish of the conductor.

6.0 INSPECTION:

- 6.1 The Purchaser's representative shall, at all times, be entitled to have access to the works and all places of manufacture where conductor shall be manufactured and the representative shall have full facilities for unrestricted inspection of the Sub-vendor's works, raw materials and process of manufacture and conducting necessary tests as detailed herein.
- 6.2 The Contractor shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of conductor in various stages so that arrangements can be made for inspection.
- 6.3 The Contractor will intimate the purchaser about carrying out of the tests at least 15 days in advance of the scheduled date of tests during which the purchaser will arrange to depute his representative/s to be present at the time of carrying out of the tests. Three (3) copies of the test reports shall be submitted.
- 6.4 No material shall be despatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Purchaser in writing. In the later case also, the conductor shall be despatched only after satisfactory testing for all tests specified herein has been completed and approved by the Purchaser.
- 6.5 Arrangements should be made available in the works of the manufacturer for transferring the conductor from one reel to another at the same time measuring the length of the conductor so transferred by means of a meter. At least 5% of the total number of drums subject to minimum of two in any lot put up for inspection, shall be selected at random to ascertain the length of conductor by the following method. The difference in the average length thus obtained and as declared by the Sub-vendor in the packing list shall be applied to all the drums if the conductor is found short during checking.
- 6.6 The acceptance of any quantity of material shall in no way relieve the Bidder of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective.

7.0 QUALITY ASSURANCE PLAN:

A Quality Assurance Plan including customer hold points covering the manufacturing activities of the material shall be required to be submitted by the successful Bidder to the Purchaser at the time of Sub Vendor approval.. The Quality Assurance Plan after the same is found acceptable, will be approved by the Purchaser. The Contractor shall follow the

approved Quality Assurance Plan in true spirit. If desired by the Purchaser, he shall give access to all the documents and materials to satisfy the Purchaser that the Quality Assurance Plan is being properly followed

Approval of drawing/work by Purchaser shall not relieve the Contractor of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The material shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material which in his judgement is not in full accordance therewith.

8.0. PACKING

WOODEN DRUMS:

- 8.1 The conductor shall be supplied in non-returnable strong wooden drums provided with lagging of adequate strength constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS:1778-1980 and latest version except as otherwise specified hereinafter.

The conductor drums shall be adequate to wind one standard length of 1800 meters of ACSR Moose conductor.

- 8.2 The drums shall be suitable for wheel mounting and for letting off the conductor under controlled tension. The conductor drums shall be provided with necessary clamping arrangements so as to be suitable for tension stringing of conductor.
- 8.3 The successful Bidder should submit the drawings of the conductor drums at the time of Sub Vendor approval after getting approval from the Purchaser, the Supplier shall submit 10 more copies of the approved drawings for further distribution and field use at TSTRANSCO end.
- 8.4 All wooden components shall be manufactured out of seasoned softwood free from defects which may materially weaken the component parts of the drums. Preservative treatment for anti-termite/anti-fungus shall be applied to the entire drum with preservatives of a quality which is not harmful to the conductor.
- 8.5 All flanges shall be 2-ply construction with 64 mm thickness. Each ply shall be nailed and clenched together at approximately 90 degrees. Nails shall be driven from the inside face of the flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2mm. There shall not be less than 2 nails per board in each circle.
- 8.6 The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least three nails with maximum nail spacing of 75 mm. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.
- 8.7 Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the spacing. Barrel studs should be tack welded with the nuts after tightening.

- 8.8 Normally, the nuts on the studs shall stand proud of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of the barrel shall generally be flushed with the top of the nuts.
- 8.9 Inner check of the flanges and drum barrel surface shall be painted with bitumen based paint.
- 8.10 Before reeling, card board or double corrugated or thick bituminised waterproof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper should be dried before use. Medium grade craft paper shall be used in between the layers of the conductor.
- After reeling the conductor the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.
- 8.11 A minimum space of 75 mm shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/galvanised steel wire. Each protective lagging shall have two recesses to accommodate the binders.
- 8.12 Each batten shall be securely nailed across grain as far as possible to the flange edges with atleast 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.
- 8.13 The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges. The end securing shall be done by taking out at least 500 mm of length of steel core on either ends by U-nails. The composite conductor shall be bound by use of galvanised steel wire/aluminium wire at three locations at least 75 mm apart or more covered with PVC adhesive tape so as to avoid loosening of conductor layers in transit and handling.
- 8.14 Only one standard length of conductor shall be wound on each drum. The method of lagging to be employed shall be clearly stated in the tender.

STEEL DRUMS:

The steel drums offered for longer lengths of conductor shall be suitable to withstand rough handling during transit and for rolling on the uneven ground without displacement / damage to the conductor. The barrel of the drum shall comprise of cross arms (Mild steel channel) provided with a drive bush/ pipe, tie rods (MS rod) with holders, inner rings (Mild steel flat) and reinforced channels to provide adequate support for fixing of hot rolled sheet. The drum flanges shall comprise of hot rolled sheet provided with corrugations of suitable dimension to give durable and strong side supports arising out of winding of the conductor on the drum and handling of the drum during transit. The external wooden laggings suitably treated against termites, warping etc., fixed in the outer ring shall be used on the drum to protect the conductor from external damage during transit. The drums shall be provided with the center pipe / plate and center bush / support pipe of suitable dimensions for facilitating mounting of the drum on the conductor let-off reel stand for tension stringing. The drum shall be provided with name plates of suitable dimensions to accommodate the drum marking stipulated in the specification.

The drawing of the drum indicating bill of material, dimension and quality of each component and overall dimension of the drum shall be submitted by the contractor at the time of Sub

Vendor approval by the Purchaser. The protective wrapping on the barrel and over the external layer of conductor and pasted on the inner side/ checks of flanges and paint & painting of drum shall also be got approved from the Purchaser while seeking approval of the drum drawing.

9.0 LABELLING AND MARKING:

The drum number shall be branded or gauged or stenciled into the flange. An arrow shall be marked on the sides of the drum, together with the words "Roll this way". Each drum shall have the following information provided on the outside of the flange stenciled with indelible ink.

- a) Manufacturer's name and address.
- b) Contract/Specification number.
- c) Size and type of conductor.
- d) Net weight of the conductor.
- e) Gross weight of the conductor and drum.
- f) Length of the conductor.
- g) Position of the conductor end.
- h) Drum and lot number.
- i) Name and address of the consignee.
- j) Month and year of manufacture.

The drum may also be marked with standard specification as per which the conductor is manufactured.

10.0 SYSTEM PARTICULARS

I. Technical Information :-

1. Electrical system data:

- a) System Voltage kV : 400
- b) Maximum Voltage kV : 420
- c) BIL (impulse) kV (peak) : 1550
- d) Power frequency withstand : 680
(wet) kV (Rms.)
- e) Switching surge withstand : 1050
voltage (wet) KV (peak)
- f) Minimum corona extinction
voltage at 50 Hz. AC. system
Dry condition : Not less than 320 kV (Rms.)
(Phase to Earth)
- g) Radio interference voltage : 1000mV.
at one MHz for phase to
earth voltage 305 kV (Rms.)
dry condition.
- h) Short circuit Level : 50 kA/ 1 Second

II. For 400kV AC Double circuit lines: Conductor and configuration

- a) Name : MOOSE

- b) Conductor per phase : 4 Nos.
- c) Sub - conductor spacing : 450 mm.

11.0 TEST PROCEDURES:

1.0 VISUAL EXAMINATION (including Check for joints)

The conductor shall be examined visually for good workmanship, joints and general surface finish of the conductor. The conductor drums shall be rewound in the presence of TSTRANSCO Inspecting Officer. The Inspector will initially check for scratches, joints etc., and that the conductor shall generally conform to the requirements of the specifications.

2.0 MEASUREMENT OF DIAMETERS

Measurement of diameters of individual aluminium and steel wires. The diameters of individual aluminium and steel wires shall be checked to ensure that they conform to the requirements of this specification.

3.0 MEASUREMENT OF LAY RATIOS

The lay-ratios of each layer of the conductor shall be measured and checked to ensure that they conform to the requirements of the specification.

4.0 BREAKING LOAD TEST :

Complete conductor

A sample of complete conductor having a minimum lengths of 5 meters with compression type dead end clamps of suitable capacity compressed at both ends, so as to permit the sample to take its applied gradually and held for about 10 seconds at a load of 5000 Kg. less than the specified breaking load. The load shall then be raised in steps of 500 Kg. and held for about 10 seconds at each step until fracture occurs. The fracture shall not be below the acceptable breaking load.

Breaking load test on individual Aluminum and Galvanized Steel wires.

This test shall be conducted on both aluminium and galvanized steel wires. The breaking load of one specimen cut from each of the samples taken shall be determined by means of suitable tensile testing machine. The load shall be applied gradually and the rate of separation of the jaws of the testing machine shall be not less than 25 mm/min. and not greater than 100 mm./min. The ultimate breaking load of the specimens shall be not less than the values specified in the clause 3.0 of this section.

5.0 DUCTILITY TEST :

For the purpose of this test both torsion and elongation tests shall be carried out on galvanized steel wires only.

5.1 TORSION TEST:

One specimen cut from each of the samples taken under IS-398, Part-V for galvanised steel wires shall be gripped at its ends in two vices. One of the vices shall be made to revolve at a speed not exceeding one revolution per second and the other shall be capable of moving longitudinally to allow for contraction or expansion during testing. A small tensile load not

exceeding 2 (two) percent of the breaking load of the wire shall be applied to the samples during testing. The test shall be continued until fracture occurs and the fracture shall show a smooth surface at right angles to the axis of the wire.

After fracture, the specimen shall be free from helical splits. The sample shall withstand a number of twists equivalent to not less than 18 on length equal to 100 times the diameter. When twisted after stranding the number of complete twists before fracture occurs shall be not less than 16 on a length equal to 100 times the diameter of the wire. The fracture shall show a smooth surface at right angles to the axis of the wire.

5.2 ELONGATION TEST:

The elongation of one specimen cut from each of the samples taken shall be determined. The specimen shall be straightened by hand and an original gauge length of 200 mm. shall be marked on the wire. A tensile load shall be applied as described in breaking load test and the elongation shall be measured after the fractured ends have been fitted together. If the fracture occurs outside the gauge marks, or within 25 mm. of either mark and the required elongation is not obtained, the test shall be disregarded and another test conducted. When tested before stranding, the elongation shall be not less than 4 percent. When tested after stranding, the elongation shall be not less than 3.5 percent.

6.0 WRAPPING TEST:

This test shall be conducted on both Aluminium and Galvanised steel wires.

Aluminium wires : One specimen cut from each of the samples of aluminium wires shall be wrapped round a wire of its own diameter to form a close helix of 8 turns. Six turns shall then be unwrapped and closely wrapped in the same direction as before. The wire shall not break or show any crack.

Galvanized steel wires :

One specimen cut from each of the samples of galvanized steel wire taken shall be wrapped round a mandrel of diameter equal to 4 times the wire diameter to form a close helix of 8 turns. Six turns shall then be unwrapped and again closely wrapped in the same direction as before. The wire shall not break.

7.0 RESISTANCE TEST :

This test shall be conducted on aluminium wires only. The electrical resistance of one specimen of aluminium wire cut from each of the samples taken shall be measured at ambient temperature. The measured resistance shall be corrected to the value corresponding to 20 degrees C. by means of following formula.

$$R_{20} = R_T \frac{1}{1 + (\alpha) * (T-20)}$$

Where

R_{20} = Resistance corrected at 20 degrees C.

R_T = Resistance measured at T degrees C.

(α) = Constant mass temperature coefficient of resistance 0.004×10^{-6}

T = Ambient temperature during measurement (Deg. C)

This resistance calculated to 20 degrees C. shall be not more than the maximum value specified in clause 3.0 of this section.

8.0 GALVANIZING TEST :

This test shall be conducted on galvanized steel wires only. The uniformity of Zinc coating and the weight of coating shall be in accordance with IS 4826-1979/ IEC 60888.

9.0 CORONA TEST :

Two 5.0 metre long samples of the conductor shall be arranged as twin horizontal bundle with a sub-conductor spacing of 450 mm at a height not exceeding 8.84 metres above ground. The sample is subjected to a corona extinction voltage of not less than 320 kV (rms) line to ground under dry conditions. There shall be no evidence of corona on the samples. The test shall be conducted without corona rings on the insulator fittings. Small corona rings may be fitted to the end fittings. The voltage shall be corrected for standard atmospheric pressure.

10.0 RADIO INTERFERENCE VOLTAGE TEST :

Under the conditions, as specified in clause 9.0 above the conductor samples shall have a radio interference voltage level below 1000 micro volts at one MHz when subjected to 50Hz AC voltage of 305kV to ground under dry conditions. This test may be carried out with corona rings and arcing horns.

11.0 STRESS-STRAIN TEST :

The test is contemplated only to collect the creep data of the conductor from the manufacturer. A sample of conductor of minimum 10 metres length shall be suitably compressed with dead end clamps.

Test Set-up

The test sample shall be supported in a trough over its full length and the trough adjusted so that the conductor will not be lifted by more than 10mm under tension. This shall be ascertained by actual measurement.

The distance between the clamp and the sleeve mouth shall be monitored with callipers during the test to ensure that, after the test, it does not change by more than $1\text{mm} + 0.1\text{mm}$ from the value before the test.

The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which lock the steel and aluminium wires together. Targets plates may be used with dial gauges or displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting the conductor, lifting it and moving it from side-to-side by the maximum amounts expected during the test should introduce not more than 0.3mm error in the reading.

Test Loads for Complete Conductor

The loading conditions for repeated stress-strain tests for complete conductor shall be as follows:

1 kN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then the strain gauges are to be set at zero tension.

For non-continuous stress-strain data, the strain readings at 1 kN intervals at lower tensions and 5 kN intervals above 30% of UTS shall be recorded.

The sample shall be reloaded to 30% of UTS and hold for 0.5 hour readings are to be noted after 5, 10, 15, 30 minutes during the hold period. The load shall be released then after the hold period.

The sample shall be reloaded to 50% of UTS and hold for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.

Reloading upto 70% of UTS shall be done and hold for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes. The load shall be released.

Reloading upto 85% of UTS shall be done and hold for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes and then the load shall be released then. Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongation shall be recorded upto 90% of UTS at the intervals described above.

Test Loads for Steel (Galvanised) Core only :

The loading conditions for repeated stress-strain tests for the steel core of ACSR shall be as follows:

The test shall consist of successive applications of load applied in a manner similar to that for the complete conductor at 30%, 50%, 70% and 85% of UTS.

The steel core shall be loaded until the elongation at the beginning of each hold period corresponds to that obtained on the complete conductor at 30%, 50%, 70% and 85% of UTS respectively.

Stress-strain curves: The design stress-strain curve shall be obtained by drawing a smooth curve through the 0.5 and 1 hour points at, 30% 50% and 70% of UTS loadings. The presence of any aluminium slack that can be related to any observed extrusion entering the span from the compression dead ends shall be removed from the lower ends of the design curves. Both the laboratory and standard stress-strain curves shall be submitted to the purchaser along with test results. The stress-strain data obtained during the test shall be corrected to the standard temperature i.e. 20 deg.C.

12.0 DC RESISTANCE TEST ON COMPOSITE CONDUCTOR

On a conductor sample of minimum 5m length, two contact clamps shall be fixed with a pre-determined bolt torque. The resistance of the sample shall be measured by a Kelvin double bridge by placing the clamps initially zero metre and subsequently one metre apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20 deg.C as per clause no. 10 of IS:398 (Part: V). The corrected resistance value at 20 deg.C shall conform to the requirements of this specification.

13.0 UTS TEST ON COMPOSITE CONDUCTOR:

Circles perpendiculars to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5m length between fixing arrangement suitable fixed on a tensile testing machine. The load shall be increased at a steady rate up to 50% of minimum specified UTS and held for one minute. Relative movement of the strands shall not distort the circles drawn. Thereafter the load shall be increased at a steady rate to minimum UTS and for one minute. The conductor sample shall not fail during this period. The applied load shall then be increased until failing load is reached and the value recorded.

14.0 VISUAL AND DIMENSIONAL CHECK OF DRUMS:

The drums shall be visually inspected and measured to ensure the requirements of the specification are met.

15.0 CHEMICAL ANALYSIS OF ALUMINIUM AND STEEL:

Samples taken from aluminum and steel ingots / coils / strands shall be chemically / spectrographically analysed. The same shall be in conformity to the requirements stated in the specification.

16.0 CHECKING OF DECLARED LENGTH, JOINTS AND SCRATCHES:

Conductor drums shall be rewound in the presence of the Purchaser. The purchaser shall visually check for scratches, joints etc and that the conductor generally conforms to the requirements of the specification. The length of conductor shall be measured. A maximum of 10 percent (10%) of drums from each lot shall be rewound in the presence of the purchaser.

17.0 CHECK ON BARREL BATTEN STRENGTH:

The details of the Barrel strength test shall be agreed between the purchaser and the contractor.

18.0 PROCEDURE QUALIFICATION TEST ON WELDED ALUMINIUM STRANDS:-

Two aluminum wires shall be welded as per the approved procedures and subjected to tensile load. The breaking strength of the welded sample shall not be less than the guaranteed strength of the individual strand.

SECTION - 4

TECHNICAL SPECIFICATION FOR 120 KN & 160 KN ANTIFOG ZINC SLEEVE DISC INSULATORS/PORCELAIN LONG ROD INSULATORS

SECTION - 4

TECHNICAL SPECIFICATION FOR 120 KN & 160 KN ANTIFOG ZINC SLEEVE DISC INSULATORS

1.0 SCOPE

- 1.1 The scope of Sub-vendors covers design, manufacture, stage testing, inspection and testing before despatch, packing, supply, delivery, unloading and stacking at site/stores of insulators, specified herein and for their satisfactory operation on 400kV Transmission Lines.

The Contractor shall be responsible for quality of material offered by the Sub-vendor and shall withstand the environmental conditions in the area in respect of pollution conditions and humidity.

- 1.2 The following are the materials covered in this bid.

PORCELAIN ANTIFOG ZINC SLEEVE DISC INSULATORS

- a) 120kN EM strength Discs (Suspension) type of size 305x145 mm, 120 kN with creepage distance of 460 mm.
- b) 160kN EM strength Discs (Tension) type of size 305x170 mm, 160 kN with creepage distance of 470 mm.

The quantity required for this project are as mentioned in the Price schedule.

- 1.3 The Purchaser may vary the quantities and his decision shall be final.

2.0 STANDARDS:

The insulators shall conform to the following Indian/ International Standards, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise specified herein. International and Internationally recognised standards to which these standards generally correspond are also listed below: -

S.No.	Indian Standard	Title	International Standards
1	IS:731-1971	Porcelain insulators for overhead power line with a nominal Voltage greater than 1000 V	BS-137 (I & II) IEC : 60383- (Part-I)-1993 (Part-II) 1992
2	IS:209-1992	Specification for zinc	BS : 3436
3	IS:406	Method of chemical Analysis of slab zinc	
4	IS: 2071 Part (I) - 1993 Part (II) - 1974 Part (III) - 1976	Methods of High Voltage Testing	

S.No.	Indian Standard	Title	International Standards
5	IS: 2629-1985/1990	Recommended practice for Hot Dip Galvanisation for iron and steel	
6	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles.	
7	IS:3188-1980	Characteristics of string insulator units	IEC : 60305
8	IS:6745-1972	Methods of determination of weight of zinc coating on zinc coated iron and steel articles	
9	IS: 7814	Specification for Phosphor Bronze rods and bars sheet strip and wire	BS : 2870
10	IS: 1570 (Part-I)	Specification for wrought steels for general engineering purposes. Steel specified by tensile and / or yield properties	
11	IS : 2004-1978	Carbon Steel forgings for general engineering purposes	
12	IS : 6603-1972	Stainless steel bars and flats	
13	IS : 8263-1976	Methods of RI test of HV Insulators	IEC : 60437-1973 NEMA PUBLICATION NO. 107/1964 / CISPR
14	IS : 8269-1976	Methods for switching Impulse test on HV insulators	IEC : 60506-1975
15		Thermal Mechanical performance test and Mechanical performance test on Insulator units.	IEC : 60575-1977
16	IS : 2486	Specification for insulators fittings for overhead power lines with a nominal voltage greater than 1000 Volts.	
	Part-I-1971	General requirements & Tests	BS : 328-1973
	Part-II-1974	Dimensional requirements	IEC : 60120-1984
	Part-III-1966	Locking devices	IEC : 60372 - 1984
17	IS : 1367 - 1980	Technical supply conditions for threaded steel fasteners	
18	IS : 2071 (Part-II) - 1974	Method of Impulse Voltage testing	
19	IS : 2107 - 1977	Specification for white heart malleable iron castings	
20	IS : 2108 - 1977	Specification for black heart malleable iron castings	
21	IS : 13134 – 1992	Guide for selection of insulators in respect of pollution conditions	IEC : 60815 – 1986 & IEC : 60273 - 1990
22	IS : 8704	Artificial Pollution tests on HV Insulators to be used on AC systems	IEC : 60507 - 1991

Reference Abbreviation	Name and Address
BS	British Standards Institution, 389, Chiswick High Road, London, W4 4AL, United Kingdom
IEC / CISPR	International Electro-technical Commission. Bureau Central de la Commission, Electro Technique International, 1 Rue de verembe, Geneva, Switzerland
BIS	Bureau of Indian Standards, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi - 110 001, INDIA
ISO	International Organisation for Standardisation, Danish Board of Standardisation, Danish Standardising Sraat, Aurehoegvej-12 DK-2900, Heelstrup, DENMARK
NEMA	National Electric Manufacture Associate, 115, East 44th Street, New York NY 10017, U.S.A.
JIS	Japan Standards Association 1-24 Akasaka 4-chome, Minato-ku, Tokyo, Japan

However, in an event where the Supplier offers material conforming to JIS or other International standards, then the salient points of comparison between the standards adopted and the standards quoted herein and in support of the guaranteed technical particulars to be furnished in the proforma enclosed to this Technical specification shall be detailed in relevant schedule with an authenticated English version of such standards referred to.

ACRONYMS USED:

1)	UTS	Ultimate tensile strength	2)	Kg	Kilogram
3)	kV	Kilo Volts	4)	kN	Kilo Newton's
5)	Max	Maximum	6)	Min	Minimum
7)	%	Percentage	8)	mm	Millimeter
9)	Deg	Degrees	10)	C	Celsius
11)	EMS	Electro Mechanical Strength			

3.0 CLIMATIC CONDITIONS

The insulators shall be suitable for being installed directly in air with 400 kV Moose ACSR conductor as detailed below:

They shall be therefore suitable for satisfactory operation under the tropical climatic conditions listed below.

I		Location			Andhra Pradesh
II		Temperature			
	1	Maximum ambient temperature (Degree C)			50 / 45
	2	Minimum ambient temperature (Degree C)			7.5
	3	Daily average ambient temperature (Degree C)			35
	4	Maximum temperature (Degree C)			
			a)	Conductor	75
			b)	Earthwire	53
III		Relative humidity			
			1)	Maximum	100%
			2)	Minimum	10%
IV	i)	Annual rainfall (max) mm			925
	ii)	Average rainfall (mm)			1200
V		Average number of rainy days per annum			90
VI		Average number of thunderstorm days per annum			50
VII		Number of months of tropical monsoon conditions (Months)			4
VIII		Maximum wind pressure			150 kG / Sq.m
IX		Maximum altitude above mean sea level (meters)			Up to 1000
X		Seismic level (Horizontal Acceleration) (Vertical Acceleration)			0.030 G 0.015 G

4.0 PRINCIPAL PARAMETERS

4.1 DETAILS OF DISC INSULATORS

Porcelain Disc Insulators

The disc Insulators offered shall be suitable for operation on 3phase, 50Hz, effectively earthed 400 kV Transmission system and be of the Anti-Fog Zinc sleeve disc Porcelain insulator type.

4.2 DRAWINGS TO BE SUBMITTED

4.2.1 The Sub-vendor through the contractor shall furnish full description and illustration of the material offered.

4.2.2 The contractor shall furnish the outline drawing (6 copies) of each type of disc insulator unit including a cross sectional view of the insulator shell at the time of Sub-vendor approval. The drawing shall include but not be limited to the following information:

- Diameter and spacing with manufacturing tolerances.
- Ball and socket coupling designation.
- Minimum creepage distance with positive tolerance
- Eccentricity of the disc

- i) Axial run out
 - ii) Radial run out
- e) Unit mechanical and electrical characteristics
- f) Size and weight of ball and socket parts of insulators discs.
- g) Weight of unit insulator disc.
- h) Materials for the shell, cap and pin of the insulator disc and standard to which they conform.
- i) Identification mark
- j) Manufacturer's catalogue number
- k) Brief installation instructions
- l) Relevant technical details
- m) Galvanisation Process, weight of zinc and no. and duration of dips.

4.2.3 Drawings for complete Insulator strings may be furnished with following information.

- a) Dimensional drawings for different insulator strings.
- b) EMS
- c) No. of Porcelain insulator discs
- d) Minimum air gap between the arcing horn and grading/ corona rings.
- e) Weight of porcelain insulator discs, Hardware sets and total weight of tension and suspension insulator strings (Porcelain).
- f) Tolerance if any.

4.2.4 List of specification drawings in respect of the disc insulators indicated above is given in this specification(for information only). These specification drawings are attached herewith for information and guidance of the Sub-vendor only. The drawings to be furnished by the Sub-vendor, shall be as per his design and manufacture and shall be distinct and separate from the specification drawings. However the overall length of the string and length of insulator portion shall conform to the values given on the drawing.

4.3 After getting approval from Purchaser and successful completion of all the type tests, the Contractor shall submit 10 more copies of the same drawing to the Purchaser for further distribution and field use at Purchaser's end.

5.0 GENERAL TECHNICAL REQUIREMENTS

5.1.1 PORCELAIN

The porcelain used shall be ivory white, nonporous of high dielectric, mechanical and thermal strength, free from internal stresses, blisters, laminations, voids, foreign matter, imperfections or other defects which might render it in any way unsuitable for insulator shells. Porcelain shall remain unaffected by climatic conditions, ozone, acid, alkalis, zinc or dust. The manufacturing shall be by the wet slip process and an impervious character obtained by thorough verification.

5.1.2 PORCELAIN GLAZE:

Surfaces to come in contact with cement shall be made rough by sanding. All other exposed surfaces shall be glazed with ceramic materials having the same temperature coefficient of expansion as that of the insulator shell. The thickness of the glaze shall be uniform throughout and the colour of the glaze shall preferably be brown. The glaze shall have a good visible lustre, smooth on surface and be subject to satisfactory performance under extreme tropical climatic weather conditions and prevent ageing of the porcelain. The glaze shall remain under compression on the porcelain body throughout the working temperature range.

5.1.3 CAP AND BALL PINS

Ball pins shall be made with drop forged steel and caps with malleable cast iron. They shall be in one single piece and duly hot dip galvanised. They shall not contain parts or pieces joined together, welded, shrink fitted or by any other process from more than one piece of material. The pins shall be of high tensile steel, drop forged and heat-treated. The caps shall be cast with good quality black heart malleable, cast iron/ spheroidal graphite iron/drop forged steel and annealed. Galvanising shall be by the hot dip process with a heavy coating of zinc of very high purity. The Sub-vendor shall specify the grade, composition and mechanical properties of steel used for caps and pins.

5.1.4 ZINC SLEEVE

For Anti-fog type disc insulators, Zinc sleeves shall be provided on the shank of the ball pins. The zinc to be used for making sleeve shall be 99.99% pure or as per latest acceptable standards. The Zinc sleeves shall be fixed at the top position of the neck of the shank of the ball pin. The length of the shank of the ball pin shall be suitably chosen to ensure easy fixing into the socket of the next disc insulator. The zinc sleeve shall cover the top neck portion of the shank of the ball pin to a minimum extent of 20 mm and embedded into the cemented portion up to an extent of 10mm.

The thickness of the sleeve shall be 5mm. The Zinc sleeve shall be clamped and fused together with the pin without forming any gap between the sleeve and the pin. Any gap will cause corona discharge due to the moisture and the insulators with this defect will be rejected outright.

5.1.5 SECURITY CLIPS:

The security clips shall be made of stainless steel.

5.1.6 CEMENT:

Cement to be used as a fixing material shall be quick setting, fast curing Portland cement. It shall not cause fracture by expansion or loosening by contraction. Cement shall not react chemically with metal parts in contact with it and its thickness shall be as small and as uniform as possible. Proper care shall be taken to correctly center and to locate individual parts during cementing.

5.2 MATERIAL DESIGN AND WORKMANSHIP:

5.2.1 GENERAL:

- (i) All raw materials to be used in the manufacture of the insulators shall be subject to strict raw material quality control and to stage testing/quality control during manufacturing stage to ensure the quality of the final end product. Manufacturing shall conform to the best engineering practices adopted in the field of extra high voltage transmission. Sub-vendors shall therefore offer insulators as are guaranteed by them and accepted by the Purchaser for satisfactory performance on 400kV Transmission Lines.
- (ii) The design, manufacturing, process and material control at various stages be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish, elimination of sharp edges and corners to limit corona and radio interference voltages.
- (iii) The Sub-vendor of insulator discs shall guarantee the minimum overall creepage distance and protected creepage distance. No negative tolerance shall be permitted on the creepage distances of the insulators.

5.2.2 INSULATOR SHELL:

The design of the Porcelain insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

5.2.3 METAL PARTS:

- (i) The pin and cap for disc insulators shall be designed to transmit the mechanical stresses to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric and of such design that it will not yield or distort under loaded conditions. The head portion of the pinball shall be suitably designed so that when the insulator is under tension the stresses are uniformly distributed over the pinhole portion of the shell. The pinball shall move freely in the cap socket either during assembly of a string or during erection of a string or when a string is placed in position.
- (ii) Metal caps of disc insulators shall be free from cracks, seams, shrinks, air holes, blow holes and rough edges. All metal surfaces shall be perfectly smooth with no projecting parts or irregularities that may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly. Pins shall not show any microscopically visible cracks, inclusions and voids.

5.2.4 GALVANISING :

All ferrous parts shall be hot dip galvanised in accordance with the latest edition of IS: 2629 and zinc conforming to IS: 209. The zinc coating shall be uniform, smoothly adherent, reasonably bright, continuous and free from impurities such as flux, ash, rust stains, bulky white deposits and blisters. Before ball pins are galvanised, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements. The galvanised metal parts shall be guaranteed to withstand at least six successive dips each lasting one-minute duration under the standard preece test. The minimum weight of zinc shall be 610 gm/sq.m.

5.2.5 CEMENTING :

The porcelain insulator design shall be such that the insulating medium shall not directly engage with hard metal. The surfaces of porcelain and the metal parts shall be coated with resilient paint to offset the effect of difference in thermal expansions of these materials. There shall be no growth of cement to avoid failure of the shell in tension by cracking. The cement used shall be subjected to autoclave testing to measure the expansion of the cement.

5.2.6 SECURITY CLIPS (LOCKING DEVICES) :

5.2.6.1 Socket fitting shall be provided with security clip in accordance with IS: 2486 (Parts III & IV) to provide positive locking against unintentional disengagement of socket from the ball of the insulator. The security clip shall be humped to maintain the clip in the locked position and shall have both prongs spread to prevent complete withdrawal from the socket. The clip end shall not project outside the recess of socket when the clip is in locked position. The locking device should be resilient, corrosion resistant and of suitable mechanical strength. There shall be no risk of the locking device being displaced accidentally or being rotated when in position. Under no circumstances shall the locking device allow separation of insulator units of strings.

5.2.6.2 The hole for the security clip shall be on the side of the socket opposite to the socket opening. The hole for the clip shall be countersunk. The clip eye shall be of such design that the same may be engaged by a hotline clip puller to provide for disengagement under energised conditions.

5.2.6.3 The force required to pull the clip to its unlocked position shall not be less than 50 N or more than 500N.

5.2.6.4 The security clip shall be "R" type made of stainless steel of type AISI 302 or 304.

5.2.6.5 2.5 % additional security clips shall be provided.

5.3 BALL AND SOCKET DESIGNATION:

The dimensions of the balls and sockets for 120 KN & 160 KN discs shall be of 20mm designation in accordance with the standard dimensions stated in IS: 2486 (Part II).

5.4 DIMENSIONAL TOLERANCE OF INSULATOR DISCS :

It shall be ensured that the dimensions of the disc insulators are within the limits specified below

a)	TYPE	RATING	DIAMETER OF DISC (mm)		
			STD	MAX	MIN
	Anti fog Zinc sleeved disc Insulators	120 kN	305	320	291
		160kN	305	320	291
b)	TYPE	RATING	BALL TO BALL SPACING OF DISC (mm)		
			STD	MAX	MIN

	Anti fog	120 kN	145	149	141
	Zinc sleeved disc Insulators	160kN	170	175	165

5.5 INTERCHANGEABILITY:

The insulators inclusive of the ball and socket fittings shall be of standard design suitable for use with hardware fittings of any make conforming to relevant Indian Standards.

5.6 CORONA AND RI PERFORMANCE :

All surfaces shall be clean, even, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localised pressure. The metal parts and porcelain shall not produce any noise generating corona under all operating conditions.

5.7 SUITABILITY FOR LIVE LINE MAINTENANCE :

The insulators shall be compatible for use with hot line or live line maintenance techniques so that usual hot line operations can be carried out with ease, speed and safety.

5.8 METHODS AND PERIODICITY OF MAINTENANCE :

Sub-vendors shall indicate the methods generally adopted in routine hot and cold line maintenance of EHV lines for similar disc insulators supplied by them. Sub-vendors shall also indicate the recommended periodicity of such maintenance.

5.9 FREEDOM FROM DEFECTS:

Insulators shall have none of the following defects:

- i) Ball pin shackle
- ii) Cementing defects near the pin like small blow holes, small hair cracks, lumps, etc.,
- iii) Sand fall defects on the surface of the insulator.

5.10 TYPE AND RATING OF INSULATOR STRINGS:

5.10.1 PARTICULARS OF DISC INSULATORS AND INSULATOR STRINGS OF PORCELAIN ANTI FOG WITH ZINC SLEEVE OF 120kN & 160kN RATING FOR 400kV SYSTEM

SL NO	PARTICULARS	DOUBLE SUSPENSION STRING	SINGLE SUSPENSION AND PILOT STRING	SINGLE "V" SUSPENSION STRING	DOUBLE TENSION STRING FOR ANGLE TOWERS	DOUBLE TENSION STRING FOR ROAD, RAIL CROSSINGS AND T.TS
1.	No. of Standard discs	2x23	1x23	2x23	2x23	2x24
2.	Size of Porcelain Disc Insulators	305 x 145	305 x 145	305 x 145	305 x 170	305 x 170

3.	E & M strength each string (kN)	2x120	120	2x120	2 x160	2x160
4.	Ball and Socket Designation (mm)	20	20	20	20	20
5.	Creepage distance of each porcelain Insulator Disc (mm)	460	460	460	470	470

NOTE: AT MAJOR CROSSINGS

Supension Towers : 120 kN 2X24 Discs.

Angle Towers : 160 kN 2X24 Discs.

5.10.2 STRING CHARACTERISTICS:

The Characteristics of complete porcelain string shall be as follows:

S.No.	Details	Single / Pilot / Single "V" Suspension	Double Tension
1	Lighting impulse withstand voltage (dry) kV peak	1550	1550
2	Power Frequency withstand voltage (wet) kV rms	680	680
3	Switching impulse withstand kV (peak)	1050	1050
4	RIV at 1 MHz at 305kV (rms) MV	1000	1000
5	Corona extinction voltage kV	320	320
6	Voltage distribution across the string	9%	10%
7	Mechanical failing load kN	1 x 120	2 x 160
8	No deformation load kN	1 x 96	2 x 120

Insulator units after assembly shall be concentric and coaxial within limits as permitted by Indian/ International Standards.

5.10.3 The string design shall be such that when units are coupled together there should not be contact between the shell of one unit and metal of the next adjacent unit.

6.0 TESTS:

The following tests shall be carried out on the Zinc sleeved disc insulator string and disc insulators.

6.1 TYPE TESTS:

These shall mean those tests that are to be carried out to prove the design, process of manufacture and general conformity of the material and product with the intents of this bid. These tests shall be conducted on a representative number of samples from a test lot of 2000 discs for each type of insulator prior to commencement of commercial production. The Supplier shall indicate his schedule for carrying out these tests.

The copies of the type tests, particularly switching flashover, lightning flashover and power frequency flashover shall also indicate the path of flash over. If during the testing the flash over

occurs other than between live and earthed metal then the test result shall be reviewed by the Purchaser together with suppliers of the insulators and fittings.

6.2 ACCEPTANCE TESTS:

These shall mean those tests which are to be carried out on samples taken from each lot offered for pre-despatch inspection for the purpose of acceptance of the lot.

6.3 ROUTINE TESTS:

These shall mean those tests, which are to be carried out on each insulator to check the requirements that are likely to vary during production, as per IS : 731/IEC 60383.

6.4 STAGE TESTS DURING MANUFACTURE:

Stage tests during manufacture shall mean those tests which are to be carried out during the process of manufacture and end final inspection before dispatch to ensure quality control such that the end product is of the designed quality conforming to the intent of this bid.

6.5 TEST VALUES:

For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Sub-vendor in the guaranteed technical particulars or the acceptance value specified in this bid or the relevant standard whichever is more stringent for that particular test.

6.6 TEST PROCEDURES AND SAMPLING NORMS:

The norms and procedure of sampling for the above tests shall be as per the relevant Indian Standard or other Internationally accepted standards. The standards and norms according to which these tests are to be carried out are listed against each test. Where a particular test is a specific requirement of this bid, the norms and procedure for the same shall be as per **Test Procedures** or as mutually agreed to between the supplier and the Purchaser in the Quality Assurance Program.

6.7 TYPE TESTS ON DISC OR INDIVIDUAL UNITS

S.No.	Type of Insulators	Tests		Standards
1	Antifog sleeved Zinc Disc Insulators	1	Visual examination	IS : 731-1971
		2	Verification of dimensions	IEC : 60383-1993
		3	Visible discharge test (dry)	IS : 731-1971
		4	Impulse Voltage withstand and Flashover test (dry)	IS : 731-1971
		5	Power Frequency voltage withstand and flashover test i) Dry ii) wet	IEC : 60383-1993
		6	Temperature cycle test	IS : 731-1971
		7	Electromechanical failing load test	IS : 731-1971 IEC : 60383-1, 1993
		8	Thermal Mechanical performance	IEC : 60383-1993

S.No.	Type of Insulators	Tests		Standards
		9	RIV test (dry)	IS: 8263-1976 IEC: 60437-1973
		10	Verification of displacements	IEC: 60383-1,1973
		11	Verification of locking system	IEC: 60383-1,1973
		12	Puncture withstand test	IS: 731-1971
		13	Porosity test	IS: 731-1971
		14	Steep wave front test	As per Test procedures
		15	Galvanising test	IS : 731-1971
		16	Metallurgical test	IS: 21088 & 2004
		17	Residual strength test	IEC : 60797
		18	Salt fog pollution test for Antifog insulators	IS: 8704-1995 IEC: 60507-1991
		19	Chemical analysis of zinc sleeve	As per Test procedures

6.8 TYPE TESTS ON COMPLETE STRINGS

S.No.	Type of Insulators	Tests		Standards
1	Complete Porcelain disc insulator strings with Hardware and fittings	1	Power Frequency Voltage withstand test with corona control rings / grading ring and arcing horns under wet & dry conditions	IEC: 60383-1993
		2	Switching surge Voltage withstand test under wet condition	IEC : 60383-1993
		3	Impulse Voltage withstand test under dry condition.	IEC : 60383-1993
		4	Impulse Voltage flashover test under dry condition	IEC : 60383-1993
		5	Voltage Distribution Test	As per Test Procedures of this specification
		6	Corona and RIV test under dry condition	As per Test Procedures of this specification
		7	Mechanical strength test	As per Test Procedures of this specification
		8	Vibration test	As per Test Procedures of this specification
		9	Visual examination	As per Test Procedures of this specification
		10	Salt fog pollution test	IEC : 60507-1991
		11	Verification of dimensions	IS : 731

NOTE : All the Type Tests given for complete insulator strings above shall be conducted on all different types of Insulator strings.

6.9 ACCEPTANCE TESTS

S.No.	Type of Insulators	Tests		Standards
1	Antifog Zinc sleeved Disc Insulators	1	Visual examination	IS : 731-1971
		2	Verification of dimensions	IEC : 60383-1993
		3	Temperature cycle test	IS : 731-1971
		4	Electromechanical failing load test	IS : 731-1971 IEC : 60383-1, 1993
		5	Mechanical performance	IEC : 60383-1993
		6	Porosity test	IS : 731-1971
		7	Galvanising test	IS : 731-1971
		8	Residual strength test	IEC : 60797
		9	Test on locking device for Ball and socket coupling	IEC : 60373-1976
		10	Eccentricity Test	IEC : 60383, 1993
		11	Puncture Test	IEC : 60383, 1993

6.10 ROUTINE TESTS

S.No.	Type of Insulators	Tests		Standards
1	Antifog Zinc sleeved Porcelain Disc Insulators	1	Visual inspection	IS : 731-1971
		2	Mechanical Routine Test	IS : 731-1971
		3	Electrical Routine Test	IS : 731-1971

6.11 TESTS DURING MANUFACTURE (STAGE TESTS)

S.No.	Type of Insulators	Tests		Standards
1	On all components as applicable	1	Chemical analysis of Zinc used for galvanising	As per Test Procedures of this specification
		2	Chemical analysis, mechanical and metallographic test and magnetic particle inspection for malleable castings	As per Test Procedures of this specification
		3	Chemical analysis, hardness test and magnetic particle inspection for forgings	As per Test Procedures of this specification
		4	Hydraulic internal pressure tests on shell	As per Test Procedures of this specification

S.No.	Type of Insulators	Tests		Standards
		5	Crack detection test for metal parts	As per Test Procedures of this specification
		6	Autoclave test on cement	As per Test Procedures of this specification

6.12 TEST CHARGES AND TEST SCHEDULE:

6.12.1 TYPE TESTS:

All the materials offered shall be fully type tested as per this specification and the contractor shall furnish four sets of type test reports at the time of sub-vendor approval. These tests must have been conducted within 5 years from the date of submission of bid. The Purchaser reserves the right to demand repetition of some or all type tests in the presence of Purchaser's representative at free of cost. For any change in the design/type already type tested and the design/type offered against this specification, Purchaser reserves the right to demand repetition of tests.

6.12.2 In case of any failure during testing on complete insulator string; the test shall be repeated at the Contractor/ manufacturer's cost. In case of any dispute as to which component of the string has failed during testing on the complete insulator string the assessment of the Purchaser as to which item caused the failure in a particular type test shall be final and binding on part of the Insulator/ Hardware manufacturer.

6.12.3 In case of failure of any type test the Supplier whose material has failed is either required to modify the design of the material and successfully carryout all the type tests as has been detailed out in clauses 6.7 & 6.8 of this specification or to repeat that particular type test at least three times successfully at his own expenses. The decision of the Purchaser in this regard shall be final and binding. The Supplier whose material has not failed in the test shall be required to supply the requisite quantity of material (that is insulators or hardware fitting as the

case may be) required for repeat testing at the place of testing and the additional cost of supply shall be borne by the Supplier whose material has failed in the testing. The Supplier whose material failed on test shall also pay all costs incurred by the Purchaser's representative in witnessing the repeat tests, including time, travel and subsistence.

6.12.4 For type testing which involve the tests on the complete insulator string with hardware fittings the manufacturer of hardware fittings shall supply the necessary number of sets of hardware fittings at the place of the testing free of cost. The Purchaser reserves the right to get the disc insulators of each type tested along with hardware fittings of more than one manufacturer but not more than three hardware manufacturers.

6.12.5 All acceptance tests as stipulated herein shall be carried out by the supplier in the presence of purchaser's representative. The record of routine tests and tests performed during manufacture, as and when desired by the Purchaser shall be furnished by the Contractor. In the event that acceptance or routine tests have to be repeated due to initial failure, all costs, including time, travel and subsistence costs incurred by the Purchaser's representative in attending the repeat tests shall be paid by the Contractor.

6.12.6 Immediately after finalisation of the programme of type/ acceptance testing, the Supplier shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

6.12.7 The purchaser reserves the right to repeat any or all type or acceptance test on samples selected from lots supplied to purchaser wherever deemed necessary at free of cost.

7.0 INSPECTION:

- 7.1 i) Purchaser and his representatives shall at all times be entitled to have access to the works and to all places of manufacturer where insulators are manufactured and the Supplier shall afford all facilities to them for unrestricted inspection of the works, inspection of materials, inspection of manufacturing process of insulators and for conducting necessary tests as specified herein.
- ii) The Supplier shall keep the Purchaser informed in advance of the time of starting and of progress of manufacture of insulators in its various stages so that arrangements could be made for inspection.
- iii) No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected and tested and despatch instructions issued by the Purchaser.
- iv) The acceptance of any quantity of insulators shall in no way relieve the sub-vendor and the Contractor of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection, if such disc are later found to be defective.

7.2 IDENTIFICATION MARKING:

7.2.1 Each disc insulator unit shall be legibly and indelibly marked with the trade mark of the manufacturer, the month and year of manufacture, the guaranteed combined mechanical and electrical strength in kilo Newtons abbreviated by 'kN' to facilitate easy identification and proper use.

7.2.2 The marking on the insulator shell shall be printed and not impressed and the same shall be applied before firing.

7.2.3 One 10mm thick ring of a suitable quality of paint shall be marked on the cap of each insulator to enable the easy identification of the insulators strength. The paint shall have no detrimental effect on the insulators performance. The following colours shall be used for identification.

120kN disc insulators	Red
160kN disc insulators	Yellow

8.0 CO-ORDINATION FOR TESTING

The disc insulators supplier shall have to co-ordinate testing of the disc insulators/ Porcelain Long Rod Insulators with hardware fittings to be supplied by hardware fittings supplier to the purchaser and shall have to also guarantee overall satisfactory performance of disc insulators/ Porcelain Long Rod Insulators with hardware fittings.

In case of electrical tests on strings complete with hardware, the responsibility of testing and guarantee of the values of RIV, corona and voltage distribution test shall rest with the hardware supplier and for all the other tests with the insulator discs supplier.

- 8.1 Sub-vendors who have already performed the tests on the offered insulators, with hardware manufactured by a hardware supplier, shall submit the test reports specifically pointing out the name and address of the hardware manufacturer and the name of the contact person of a power utility who has witnessed such tests.

9.0 PACKING & FORWARDING:

- i) All insulators shall be packed in strong seasoned wooden crates. The gross weight of the crates along with insulators shall not normally exceed 100 kg. to avoid handling problem.
- ii) The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
- iii) Suitable cushioning, protective padding, or dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.
- iv) All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink. All galvanised components shall be given a protective coating against formation of white rust during sea transportation.
- v) The drawing of the packing crate shall require approval of the Purchaser.

10.0 SYSTEM PARTICULARS

ELECTRICAL SYSTEM DATA:

1	Nominal system voltage kV rms	400
2	Highest system voltage kV rms	420
3	Power frequency withstand voltage (wet) kV rms	680
4	Switching surge withstand voltage (wet condition) kV peak	1050
5	Lightning impulse withstand Voltage (dry) kV	1550
6	Corona extinction voltage kV rms	320
7	Short Circuit level kA	50
8	System neutral Earthing	Effectively earthed
9	Voltage distribution limit	
	Suspension string	9 %
	Tension string	10 %
10	Conductor	
	Name	Moose
	Conductors / Phase	4 Nos.
	Sub conductor spacing	450 mm
11	Conductor Configuration	Horizontal configuration for S/C towers Vertical configuration for D/C towers - 3 conductors vertically one above the other on either side of tower body

12	No. of Ground wires	One No., 7/3.66 mm, GSS E/W & One No. OPGW
13	Insulator string Configuration I-Suspension (Single / Double) and Pilot string, V-Suspension Tension (Double Tension) - Horizontal	

11.0 TEST PROCEDURES

1. MECHANICAL STRENGTH TEST:

The complete Zinc sleeved insulator string along with its hardware fitting excluding arcing horn, and suspension assembly/dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand. Small hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

2. CHEMICAL ANALYSIS OF ZINC USED FOR GALVANIZING:

Samples taken from the zinc ingot shall be chemically analysed as per IS:209. The purity of zinc shall not be less than 99.95%.

3. TESTS FOR FORGINGS:

The chemical analysis hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognised procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Supplier and Purchaser in Quality Assurance Programme.

4. TEST ON CASTINGS:

The chemical analysis, mechanical and metallographic tests and magnetic particle inspection for castings will be as per the internationally recognised procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Supplier and Purchaser in Quality Assurance Programme.

5. ECCENTRICITY TEST (Axial and Radial run out)

The insulator shall be vertically mounted on a fixture using dummy pin and socket. A vertical scale with horizontal slider shall be used for the axial run out. The pointer shall be positioned in contact with the bottom of the outermost petticoat of the disc. The disc insulators shall be rotated with reference to the fixture and the slider shall be allowed to move up and down on the scale but always maintaining contact with the bottom of the outer most petticoat. After one full

rotation of the disc the maximum and minimum position the slider has reached on the scale can be found out. Difference between the above two readings shall satisfy the guaranteed value for axial run out.

Similarly using a horizontal scale with vertical slider the radial run out shall be measured. The slider shall be positioned on the scale to establish contact with the circumference of the disc insulator and disc insulator rotated on its fixture always maintaining the contact. After one full rotation the maximum and minimum position of the slider reached on the scale are found out. The difference between the above readings shall satisfy the guaranteed value for radial run out.

6. CRACK DETECTION TEST:

Crack detection test shall be carried out on each ball pin before assembly of disc unit. The manufacturer shall maintain complete record of having conducted such tests on each and every piece of ball pin. The Sub-vendor shall furnish full details of the equipment available with him for crack test and also indicate the test procedure in detail.

7. VOLTAGE DISTRIBUTION TEST

The voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted into percentage. The voltage across any disc shall not exceed the values given in **System Particulars**, expressed as a percentage of the total voltage across the string.

8. VIBRATION TEST

The suspension string shall be tested in suspension mode and tension string in tension mode itself in laboratory with a span of minimum 30 metres. In the case of suspension string a load equal to 600 kg shall be applied along the axis of the suspension string by means of turn buckle. The insulator string along with hardware fittings and two sub conductors (each tensioned at 4500 Kg.) shall be secured with clamps. The system shall be suitable to maintain constant tension on each sub conductor throughout the duration of the test. Vibration dampers shall not be used on the test span. Both the sub conductors shall be vertically vibrated simultaneously at one of the resonance frequencies of the insulator string (more than 10 Hz) by means of vibration inducing equipment. The peak to peak displacement in mm of vibration at the antinode point nearest to the string shall be measured and the same shall not be less than $(1000/f^{1.8})$ where f is the frequency of vibration in cycles/sec. The insulator string shall be vibrated for not less than 10 million cycles without any failure. After the test the disc insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware for looseness shall be examined for fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and disc insulators after the vibration test.

The disc insulators shall be subjected to the following tests as per relevant standards: -

	Tests	Percentage of Insulator units to be tested
a)	Temperature cycle test followed by mechanical performance test	60
b)	Puncture test	40

9. TIME LOAD TEST:

The insulator string shall first be subjected to 5minute power frequency routine test. After successful completion of this test, the insulator string shall be mounted vertically/ horizontally and subjected to a load equal to 67% of the specified mechanical strength for a duration of 24 hours.

After the completion of above period if the string is found to be intact on visual examination, it shall again be subjected to 5 minutes power frequency routine test. The string shall be deemed to have passed the time load test if it successfully withstands 5 minute power frequency routine test.

10. POLLUTION WITHSTAND VOLTAGE TEST

The test shall be carried out in accordance with the clean fog test method (solid layer method) prescribed in Section 4 of IEC: 507-1991. Test procedure is as follows :-

First the test object is contaminated by dipping in contaminant solution, which is composed of salt (NaCl), Insoluble material (Kaolin) and water. Insoluble deposit density (NSDD) of 0.1 mg/ sq.cm and salt deposit density of 0.30 mg/sq.cm are required. After having been contaminated and dried, the test object is installed in the fog chamber.

The specified constant test voltage as per IEC-507 is applied to the test object and then artificial steam fog is generated. The applied voltage is maintained for 60 minutes or until flashover occurred within 60 minutes. The above procedure is repeated at least three (3) times on freshly contaminated test object.

11 STEEP WAVE FRONT TEST

The test shall be performed on disc insulator units selected at random from the lot offered for selection of samples for type tests.

- a) Each insulator unit shall be subjected to five (5) successive positive and negative impulse flashovers with a wave having minimum effective rate of rise of 2500kV per Microsecond.
- b) Each unit shall then be subjected to three (3) dry power frequency voltage flashovers.

An insulator shall be deemed to have met the requirements of this test if having been subjected to the ten impulse flashovers, the arithmetic mean of the three subsequent dry power frequency voltage flashover values equals or exceeds 95% of the rated dry power frequency voltage.

An insulator shall be deemed to have failed to meet the requirement of the above test if,

- a) It has not flashed over when the oscilloscope or peak voltage indicator shows a marked reduction in voltage. or
 - b) Any one of the subsequent dry power frequency voltage flashover values is less than 80% of the value specified.
-

Failure of any one unit in either the steep wave front or subsequent low frequency voltage test shall be cause for testing on double the number of units.

12 THERMAL RUNAWAY TEST

The sample shall be placed in an oven at a temperature of 80 degrees C (+/- 2 degree C) for at least 3 hours so as to ensure uniform heating of all discs. At that temperature each disc shall be subjected to 50 kV (rms) power frequency voltage. The voltage shall be applied for one hour and no puncture shall occur.

13 AUTOCLAVE TEST

The autoclave tests shall be conducted in accordance with ASTM C151-84.

PORCELAIN ANTIFOG LONG ROD INSULATORS

PORCELAIN ANTIFOG LONG ROD INSULATORS

Details of Long Rod Insulators

PORCELAIN LONG ROD INSULATORS

- a) 120kN EM strength PORCELAIN ANTIFOG LONG ROD Insulators with creepage distance of 3500 mm of each unit.
- b) 160kN EM strength PORCELAIN ANTIFOG LONG ROD Insulators with creepage distance of 3645 mm of each unit.

1.0 The insulators of the strings shall consist of standard long rod insulators with normal sheds for a three phase, 50 Hz, effectively earthed 400 kV transmission system in a heavy polluted atmosphere. Insulators shall be long rod type with Ball and socket connections.

- 1.1 Insulators shall have normal sheds/alternate sheds with good self-cleaning properties. Insulator shed profile, spacing projection etc. shall be strictly in accordance with the recommendation of IEC-815.
- 1.2 Supplier quoting for long rod insulators made of electro porcelain shall also supply intermediate ball pins and intermediate arcing horns along with long rod insulators in complete shape as type tested.
- 1.3 The price of these items shall be considered as including in the price of long rod insulators. The size of long rod insulator, minimum creepage distance, the number to be used in different type of strings, their electromechanical strength and mechanical strength of insulator string along with hardware fittings shall be as follows:

Sl. No	Type of String	Size of long rod insulators (mm)	Minimum creepage distance of each unit (mm)	No. of individual units per string	Electro-mechanical strength of insulator disc (KN)	Mechanical strength of insulator string along with hardware fittings (KN)
1	Double 'I' suspension	60-75	3500	2 x 3	120	240
2	Single 'I' suspension on Pilot	60-75	3500	1 x 3	120	120
3	Single Tension	60-75	3500	1 x 3	120	120
4	Double Tension	75-85	3645	2 x 3	160	320

- Note :
- (i) Bidders may quote for the relevant strings.
 - (ii) Length of long rod insulator strings shall be matching with the corresponding disc insulator strings.
 - (iii) The cost of intermediate Ball pin and intermediate arcing horn shall be considered as including in the price of long rod insulators.

2.0 Pin and Cap

- 2.1 Pin and cap shall be designed to transmit the mechanical stresses to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric, of such design that it will not yield or distort under load conditions.
- 2.2 The pin ball shall move freely in the cap socket but without danger of accidental uncoupling during erection or in position. The design of the long rod should be such that stresses due to expansion or contraction in any part of the insulator shall not lead to deterioration.

3.0 Ball and Socket Designation

The dimensions of the balls and socket shall be of 20 mm designation for 120 & 160 KN for long rod insulators in accordance with the standard dimensions stated in IS 2486-(Part-II)/IEC:120.

4.0 Dimensional Tolerance

The tolerance on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows :

$\pm (0.04 d + 1.5)$ mm when $d < 300$ mm.

$\pm (0.025d + 6)$ mm when $d > 300$ mm

Where d being the dimensions in millimeters for diameter, length or creepage distance as the case may be.

However, no negative tolerance shall be applicable to creepage distance.

5.0 Intermediate Ball Pin Designation

The dimensions of the intermediate ball pin shall be in accordance with the standard dimension stated in IEC:471.

6.0 Intermediate Arcing Horn

6.1 For Insulator strings with long rod insulators besides the arcing horn on tower side of hardware fittings, intermediate arcing horns along with fixtures and fasteners as shown in the specification shall also be provided.

6.2 The total effective arcing distance shall be 3050 mm under nominal dimensions of insulator.

6.3 The spark gap shall be so adjusted to ensure effective operation under actual field coordination.

7.0 Inter Changeability

The long rod insulators with ball and socket connection shall be of standard design suitable for use with the hardware fittings of any make conforming to relevant IEC standards

8.0 Corona and RI Performance

All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localised pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating conditions.

9.0 Maintenance

9.1 The long rod insulators offered shall be suitable for employment of hot line maintenance techniques so that usual hot line operations can be carried out with ease, speed and safety.

9.2 All insulators shall be designed to facilitate cleaning and insulators shall have the minimum practical number of sheds and grooves. All grooves shall be so proportioned that any dust deposit can be removed without difficulty either by wiping with a cloth or by remote washing under live line condition.

10.0 Materials**10.1 Porcelain**

The porcelain used in the manufacture of long rods shall be alumina type. It shall be sound, free from defects and thoroughly vitrified and smoothly glazed.

10.2 Glaze

The finished porcelain shall be glazed in brown colour. The glaze shall cover all exposed parts of the insulator and shall have a good luster, smooth surface and good performance under the extreme weather conditions of a tropical climate. It shall not be

cracked or chipped by aging under the normal service conditions. The glaze shall have the same co-efficient of expansion as of the porcelain body throughout the working temperature range.

10.3 **Insulator Cap**

The caps of long rod insulator units shall be of malleable cast iron or other suitable material, duly hot dip galvanised and shall not be made by jointing, welding, shrink fitting or any other process from more than one piece of material. The design of the unit shall be such that stresses due to expansion and contraction of any part of the insulator shall not lead to deterioration.

10.4 **Intermediate Ball Pin**

The intermediate ball pin shall be made of drop forged steel, duly hot dip galvanised and shall not be made by jointly welding, shrink filling or any other process from more than one piece of material.

10.5 **Intermediate Arcing horn**

Intermediate Arcing horn shall be mild steel tube.

10.6 **Cement**

Cement used in the manufacture of the insulator shall not cause fracture by expansion or loosening by contraction. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as small and uniform as possible. Proper care shall be taken to correctly centre and locate individual parts during cementing.

11.0 **Workmanship**

11.1 All the materials shall be of latest design and conform to the best modern practices adopted in the extra high voltage field. Bidders shall offer only such insulators as are guaranteed by him to be satisfactory and suitable for 400 kV transmission lines and will give continued good service.

11.2 The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners to limit corona and radio interference.

11.3 The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

11.4 Metal caps shall be free from cracks, seams, shrinks, air holes and rough edges. All surfaces of the metal parts shall be perfectly smooth with the projecting points or irregularities, which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.

11.5 All ferrous parts shall be hot dip galvanised to give a minimum average coating of zinc equivalent to 610 gm/sq. mm. and shall be in accordance with the requirement of IS: 2629 and shall satisfy the tests mentioned in IS : 2633. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. the galvanised metal parts shall be guaranteed to withstand at least six successive dips each lasting for one (1) minute duration under the standard preece test. The galvanising shall be carried out only after any machining.

11.6 The design of the insulators shall be such that the porcelain shall not engage with hard metal.

- 11.7 Insulator units after assembly shall be concentric and co-axial within limits as permitted by the relevant international standard.
- 11.8 The manufacturer of the insulators shall guarantee an insulator failure rate not exceeding one per 1500 porcelain long rod units. In case the annual failure rate during the first ten years of operation exceeds the above figure under normal operating conditions, as will be determined by check to be conducted as per mutually agreed procedure and conditions upto ten years (as permitted by the operating situation). The manufacturer shall supply to the owner free of cost spare insulators (Porcelain long rod) equal to 10 times the excess failure.
- 11.9 The manufacturer shall guarantee that there shall not be any decapping and breakage of insulators or line under normal operating conditions. In event of any decapping or breakage resulting in line drop during the first ten years of service the manufacturer shall have to pay Rs. 100000/- (Rs. One Lakh) per dropped string towards expenditure to be incurred by TSTRANSCO for this line repair.

12.0 Standard Technical Particulars for Porcelain Long Rod Insulators each unit:

Sl. No	Description	Unit	Standard Technical Particular value	
			120 KN Insulator for 400 kV	160 KN Insulator for 400 kV
1.0	General			
a)	Size and Designation of ball & Socket assembly	mm	20 as per IS 2468/ IEC 120	20 as per IS 2468/ IEC 120
2.0	Dimensions			
a)	Core diameter	mm	60 to 85	75 to 85
b)	Tolerance on core diameter	$\pm$ mm	0.04d+1.5	0.04d+1.5
c)	Minimum nominal creepage distance of single unit	mm	3500	3645
3.0	Materials			
a)	Colour of glaze of finished porcelain insulator		Brown	Brown
4.0	Mechanical Strength of disc	kN	120	160
5.0	Minimum electrical values			
a)	Power frequency Flashover voltage DRY / WET	kV (rms)	270 / 240	290 / 250
b)	Power frequency Withstand voltage DRY / WET	kV (rms)	250 / 230	270/ 230
c)	Impulse Flashover test voltage 1.2 x 50 μ s (Dry) POSITIVE / NEGATIVE	kV (peak)	550 / 570	550 / 570
d)	Impulse Withstand test voltage 1.2 x 50 μ s (Dry) POSITIVE / NEGATIVE	kV (peak)	500 / 510	500 / 510
6.0	Eccentricity of disc			
a)	Max. axial/radial run out		1.2 % of insulator length	1.2 % of insulator length
b)	Max. angular displacement	deg	15	15
7.0	Galvanising			

Sl. No	Description	Unit	Standard Technical Particular value	
			120 KN Insulator for 400 kV	160 KN Insulator for 400 kV
a)	Minimum mass of zinc coating	Gm/sq.m.	610	610
b)	Minimum no. of one minute dips in the standard preece test	Nos.	6 dips	6 dips
c)	Minimum purity of zinc used for galvanising	%	99.95	99.95

STRING CHARACTERISTICS:

The Characteristics of complete porcelain string shall be as follows:

S.No.	Details	Single Suspension / Pilot	Double Tension
1	Lighting impulse withstand voltage (dry) kV peak	1550	1550
2	Power Frequency withstand voltage (wet) kV rms	680	680
3	Switching impulse withstand kV (peak)	1050	1050
4	RIV at 1 MHz at 305kV (rms) MV	1000	1000
5	Corona extinction voltage kV	320	320
6	Voltage distribution across the string	9%	10%
7	Mechanical failing load kN	1 x 120	2 x 160
8	No deformation load kN	1 x 96	2 x 120

13.0 Tests and Standards**13.1 Type Tests**

The following type tests shall be conducted on a suitable number of individual long rod units, components, materials or complete strings:

13.2 On unit Long rod insulators

a)	Verification of dimensions	As per IEC :60383
b)	Power frequency voltage withstand and flashover test under (i) dry (ii) wet condition	As per IEC : 60383
c)	Impulse voltage withstand and flashover test (dry)	As per IEC : 60383
d)	Visible Discharge test (dry)	As per IS:731, Cl. 10.2
e)	RIV test (dry)	As per IEC:60437
f)	Thermal mechanical performance test	As per IEC:60575
g)	Bending Test (for Long Rod insulator)	As per IS/IEC

13.3 On the complete Insulator String with Hardware Fittings

Sl	Tests	Ref	Strings on which test to be conducted*.		
400kV With Twin MOOSE Conductor					
a)	Power frequency voltage withstand test with corona control rings/grading ring and arcing horns under wet condition	As per IEC:60383	SIS(T), SISP (T), ST(T), DT		
b)	Switching surge voltage withstand test under wet condition	As per IEC:60383			
c)	Impulse voltage withstand test under dry condition	As per IEC:60383			
e)	Corona and RIV test under dry condition	As per IS/IEC			
f)	Mechanical Strength test	As per IS/IEC			
g)	Vibration test	As per IS/IEC	SIS, DT		
h)	Power Arc Test (for 400 kV only)	As per IS/IEC	SIS, DT		
String with 400 kV Twin MOOSE Conductor		SIS: Single I Suspension, SISP: Single I Suspension PILOT, ST: Single Tension, DT: Double Tension			

13.4 Type tests specified under Clause 6.1.1 (a) to (e) and 6.1.2 shall not be required to be carried out if a valid test certificate is available for a similar design. The test certificate shall be considered valid if,

- i) Tests conducted earlier is either conducted in accredited laboratory (accredited based on ISO/IEC vide 25/17025 or EN 45001 by the National accreditation body of the country where laboratory is located or witnessed by the representative(s) of TSTRANSCO or utility and
- ii) Tests mentioned at 6.1.2 (e) to (g) and have been conducted within 5(five) years prior to the date of bid opening.

In case the test have been conducted earlier than the above stipulated period or in the event of any discrepancy in the test report (i.e., any test not applicable due to any design/manufacturing change including substitution of components or due to non-compliance with the requirement stipulated in the Technical Specifications), the tests shall be conducted by the Supplier at no extra cost to the Purchaser.

13.5 Acceptance Tests

6.2.4	Visual examination	As per IEC : 60383
b)	Verification of dimensions	As per IEC : 60383
c)	Temperature cycle test	As per IEC : 60383
d)	Galvanising test	As per IEC : 60383
e)	Mechanical performance test	As per IEC:60575 Clause 4.0

f)	Test on locking device for ball and socket coupling	As per IEC:60372
g)	Eccentricity test	As per IEC : 60383-1
h)	Mechanical failing load test	As per IEC : 60383-1
i)	Porosity test	As per IEC : 60383
j)	Metallurgical Test (For metal fittings only in black condition)	As per IS/IEC
	i) Grain size	
	ii) Inclusion rating	
	iii) Chemical analysis	
	iv) Microstructure	
k)	Thermal Mechanical performance test#	As per IS/IEC
l)	Bending Test#	As per IS/IEC

Note : ‘Thermal Mechanical performance test’ and ‘Bending Test’ shall be performed as acceptance test once for supply of every 6520 nos. long rod insulator units of a particular rating.

13.6 Routine Tests

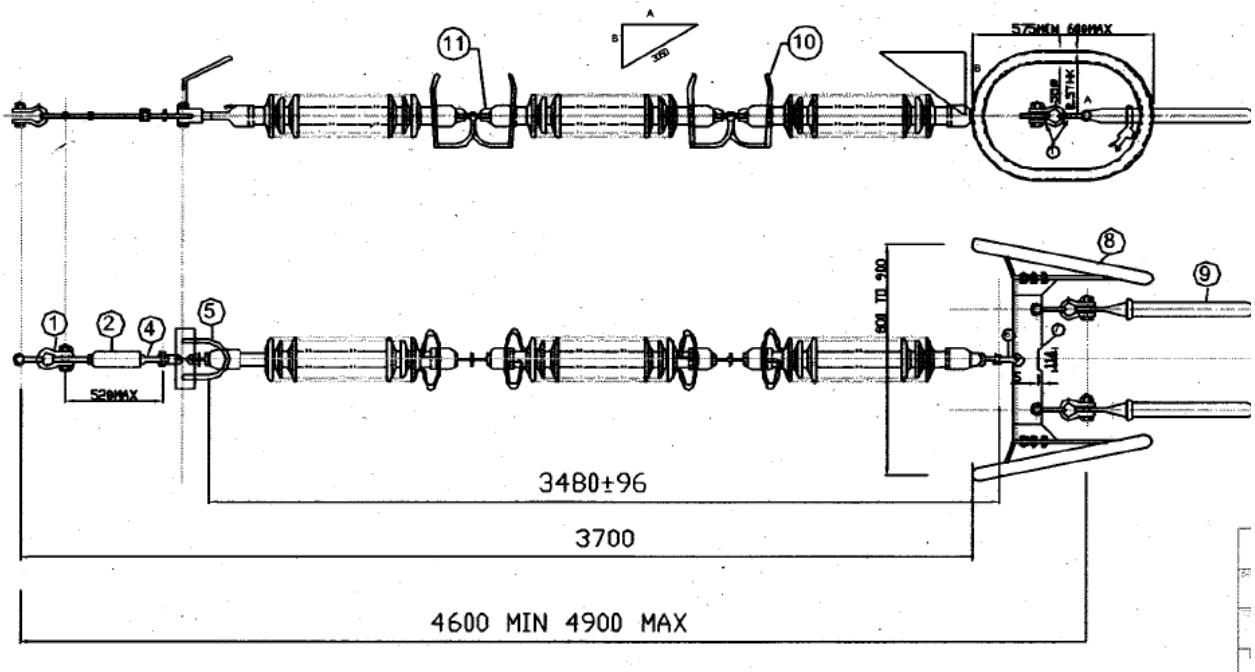
For Porcelain Long Rod Insulator Units

a)	Visual Inspection	As per IEC:60383
b)	Mechanical routine test	As per IEC:60383

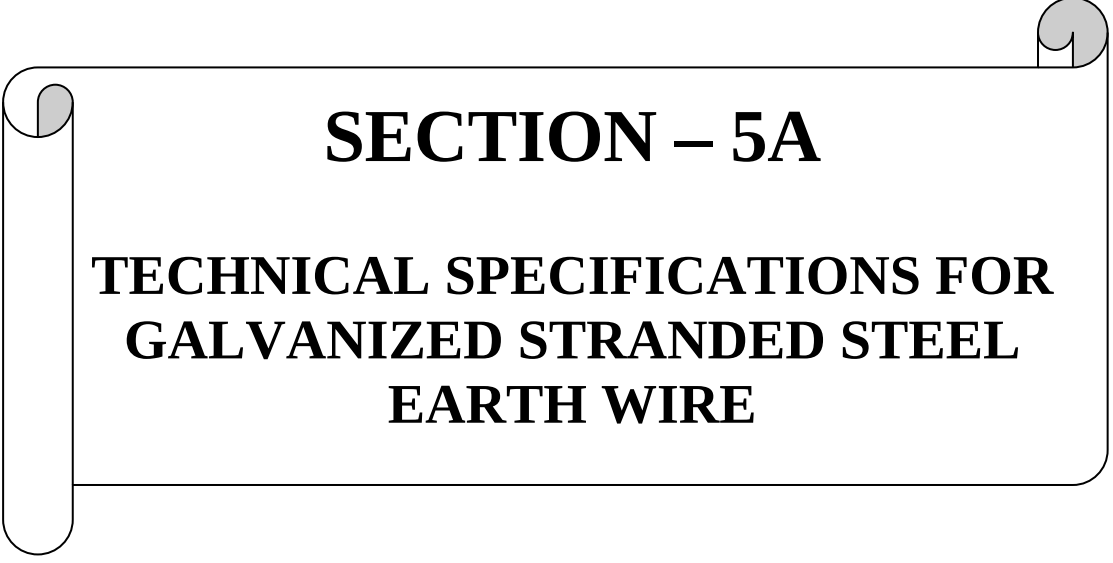
13.7 Tests During Manufacture

On all components as applicable

a)	Chemical analysis of zinc used for galvanising	As per IS/IEC
b)	Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.	As per IS/IEC
c)	Chemical analysis hardness tests and magnetic particle inspection for forgings	As per IS/IEC
d)	Hydraulic Internal Pressure tests on disc insulator shells	As per IS/IEC
e)	Autoclave Test on Cement	As per IS/IEC



Tender purpose only
TSTRANSCO

A decorative border resembling a scroll, with a vertical strip on the left and a horizontal strip at the top, both featuring rounded ends and a slight shadow effect.

SECTION – 5A

TECHNICAL SPECIFICATIONS FOR GALVANIZED STRANDED STEEL EARTH WIRE

SECTION – 5A

TECHNICAL SPECIFICATIONS FOR GALVANIZED STRANDED STEEL EARTH WIRE

1.0 Technical Description of Galvanized Steel Earth wire

1.1 Details of Earthwire

1.1.1 The galvanized steel earthwire shall generally conform to the specification of ACSR core wire as mentioned in IS:398 (Part-II) except where otherwise specified herein.

1.1.2 The details of the earthwire for are tabulated below: -

a)		Stranding and wire diameter	7/3.66 mm steel
b)		Number of strands	
	i)	Steel core	1
	ii)	Outer steel layer	6
c)		Total sectional area	73.65 Sq mm.
d)		Over all diameter	10.98 mm
e)		Approximate weight	583 kg / kM
f)		Calculated D.C resistance at 20 deg centigrade	2.5 Ohms.kM
g)		Minimum ultimate tensile strength	68.4 kN
h)		Direction of lay of outer layer	Right hand

1.2 Workmanship

1.2.1 All steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasions and kinks after drawing and also after stranding.

1.2.2 The finished material shall have minimum brittleness as it will be subjected to appreciable vibration while in use.

1.2.3 The steel strands shall be hot dip galvanized and shall have minimum, Zinc coating of 275 gms/sqm after stranding. The zinc coating shall be smooth, continuous, of uniform thickness, free from imperfections and shall withstand three and a half dips after stranding in standard Preece test. The steel wire rod shall be of such quality and purity that, when shall be of uniform quality and have the same properties and characteristics as prescribed in ASTM designation B498 – M.

1.2.4 The steel strands shall be preformed and post formed in order to prevent spreading of strands while cutting of composite earthwire. Care shall be taken to avoid damage to galvanization during performing and post forming operation.

1.2.5 To avoid susceptibility towards wet storage stains (white rust), the finished material shall be provided with a protective coating of boiled linseed oil.

1.3 Joints in Wires

There shall be no joint of any kind in the finished steel wire strand entering into the manufacture of the earthwire. There shall be no strand joints or strand splices in any length of the completed stranded earthwire.

1.4 Tolerances

The manufacturing tolerance to the extent of the following limits only shall be permitted in the diameter of the individual steel strands and lay length of the earthwire:

For 7/3.66 mm size Earth wire

	Standard	Maximum	Minimum
Diameter	3.66 mm	3.75 mm	3.57 mm
Lay length	181 mm	198 mm	165 mm

1.5 Materials

1.5.1 Steel:

The steel wire strands shall be drawn from high carbon steel rods and shall conform to the following requirements as to the chemical composition:

Element	% Composition
Carbon	Not more than 0.55
Manganese	0.4 to 0.9
Phosphorous	Not more than 0.04
Sulphur	Not more than 0.04
Silicon	0.15 to 0.35

1.5.2 Zinc

The zinc used for galvanizing shall be electrolytic High Grade Zinc of 99.95% purity It shall conform to and satisfy all the requirements of IS:209.

1.6 Standard Length

1.6.1 The standard length of the earthwire shall be 2000 meters. The tolerance on length shall be $\pm 5\%$ on the standard length.

1.6.2 Random length will be accepted provided no length is less than 70% of standard length and the total quantity of random lengths is not more than ten (10) percent of the total quantity each shipment.

2.0 Tests and Standards

2.1 Type Tests on Earthwire:

The following tests shall be conducted once on a sample / samples of earthwire for every 500 Kms of production from each manufacturing facility:

a)	UTS test	: As Per Test Procedures
b)	DC resistance test	: As Per Test Procedures

2.2 Acceptance Tests on Earthwire

- a) Visual and dimensional check on drum: **As Per Test Procedures**
- b) Visual check for joints scratches etc. : **As Per Test Procedures**
and lengths of earthwire
- c) Dimensional check : **As Per Test Procedures**
- d) Lay length check : **As Per Test Procedures**
- e) Galvanising test : **As Per Test Procedures**
- f) Torsion test : **As Per Test Procedures**
- g) Elongation test : **As Per IS : 398 (Part-II)**
- h) Wrap test : **As Per IS : 398 (Part-II)**
- i) DC resistance test : **As Per IS : 398 (Part-II)**
- j) Breaking load test : **As Per IS : 398 (Part-II)**
- k) Chemical Analysis of steel : **As Per Test Procedures**

2.3 Routine Tests on Earthwire

- a) Check for correctness of stranding : **As Per Test Procedures**
- b) Check that there are no cuts, fins etc. : **As Per Test Procedures**
on the strands.
- c) Check that drums are as per
Specification : **As Per Test Procedures**

2.4 Test During Manufacture of Earthwire

- a) Chemical analysis of zinc used for
Galvanising : **As Per Test Procedures**
- b) Chemical analysis of steel : **As Per Test Procedures**

2.5 Testing Expenses

- 2.5.1 The entire cost of testing for the acceptance and routine tests during manufacture specified herein shall be treated as included in the quoted unit price except for the expenses of the inspector/Purchaser's representative.
- 2.5.2 The purchaser reserves the right to repeat any or all type or acceptance tests on samples selected from lots supplied to purchaser wherever deemed necessary at free of cost.

2.6 Sample Batch For Type Testing

- 2.6.1 The Contractor shall offer material for selection of samples for type testing only after getting Quality Assurance Plan approved from Purchaser's Quality Assurance Department. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by Purchaser.
- 2.6.2 The Contractor shall offer at least three drums for selection of sample required for conducting all the type test.
- 2.6.3 The Contractor is required to carry out all the Acceptance tests successfully in presence of Purchaser's representative before sample selection.

2.7 Test Reports

- 2.7.1 Copies of type test reports shall be furnished in at least three (3) copies along with one original. One copy will be returned duly certified by the Purchaser only after which the commercial production of the material shall start.
- 2.7.2 Record of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Purchaser's representative.
- 2.7.3 Test Certificates of tests during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Purchaser.

2.8 Inspection

- 2.8.1 The Purchaser's representative shall at all times be entitled to have access to the works and all places of manufacture, where earthwire shall be manufactured and representative shall have full facilities for unrestricted inspection of the Contractor's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.
- 2.8.2 The Contractor shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of earthwire in its various stages so that arrangements can be made for inspection.
- 2.8.3 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Purchaser in writing. In the latter case also the earthwire shall be dispatched only after satisfactory testing for all tests specified herein have been completed.
- 2.8.4 The acceptance of any quantity of material shall in no way relieve the Contractor of any of his responsibilities for meeting all requirements of Specification, and shall not prevent subsequent rejection if such material is later found to be defective.

2.9 Test Facilities

- 2.9.1 The following additional test facilities shall be available at the Contractor's works:
 - a) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.
 - b) Standard resistance for calibration of resistance bridges.
 - c) Finished Earthwire shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 meters per minute). The rewinding facilities shall have appropriate clutch system and free of vibration, jerks etc., with traverse laying facilities.

2.10 Packing for Earthwire

- 2.10.1 The Earthwire shall be supplied in non-returnable, strong, wooden drums and provided with lagging of adequate strength, constructed to protect the Earthwire against all damage and displacement in the field. The Contractor shall be responsible for any loss or damage during transportation handling and storage due to improper packing. The drums shall generally conform to IS:1778-1980, except as otherwise specified hereinafter.
- 2.10.2 The drums shall be suitable for wheel mounting and for letting off the earthwire under a minimum controlled tension of the order of 5 kN.
- 2.10.3 The general outline of the drum for Earthwire shall be as per annexed drawing. The Contractor should submit drum drawings at the time of sub-vendor approval.
- 2.10.4 For Earthwire, two standard length shall be wound on each drum.
- 2.10.5 For Earthwire, each strand shall be individually welded to prevent parting of two lengths at a tension less than 15 kN. The two ends where the first length finishes and the second length starts, shall be clearly marked with adhesive tape and no weld should be present outside these marks. The length between the two marks shall be treated as scrap and will not be taken into account for measurement purposes.
- 2.10.6 All wooden components shall be manufactured out of seasoned softwood free from defects that may materially weaken the component parts of the drums. Preservative treatment shall be applied to the entire drum with preservatives of a quality which is not harmful to the earthwire.
- 2.10.7 The flanges shall be of two ply construction with each ply at right angles to the adjacent ply and nailed together. The nails shall be driven from the inside face flange, punched and then clenched on the outer face. The thickness of each ply shall not vary by more than 3 mm from that indicated in the figure. There shall be atleast 3 nails per plank of ply with maximum nail spacing of 75 mm. Where a slot is cut in the flange to receive the inner end of the earthwire the entrance shall be in line with the periphery of the barrel.
- 2.10.8 The wooden battens used for making the barrel of the earthwire shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the earthwire.
- 2.10.9 Barrel studs shall be used for the construction of drums. The flanges shall be holed and the barrel studs shaft be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.
- 2.10.10 Normally, the nuts on the studs shall stand protruded of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be counter sunk. The ends of barrel shall generally be flushed with the top of the nuts.
- 2.10.11 The inner cheek of the flanges and drum surface shall be painted with a bitumen based paint.
- 2.10.12 Before reeling, cardboard or double corrugated or thick bituminized waterproof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. After reeling the earthwire, the exposed surface of

- the outer layer of earthwire shall be wrapped with water proof thick bituminized bamboo paper to preserve the earthwire from dirt, grit and damage during transport and handling.
- 2.10.13 A minimum space of 50 mm for earthwire shall be provided between the inner surface of the external protective lagging and outer layer of the earthwire.
- 2.10.14 Each batten shall be securely nailed across grains as far as possible to the flange, edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nails shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.
- 2.10.15 The nuts on the barrel studs shall be tack welded on the one side in order to fully secure them. On the second end, a spring washer shall be used.
- 2.10.16 Outside the protective lagging there shall be minimum of two binder consisting of hoop iron/galvanised steel wire. Each protective lagging shall have two recesses to accommodate the binders.
- 2.10.17 The earthwire ends shall be properly sealed and secured on the side of one of the flanges to avoid loosening of the earthwire layers during transit and handling.

2.11. **Marking**

Each drum shall have the following information stenciled on it in indelible ink along with other essential data

- (a) Contract/Award letter number.
- (b) Name and address of consignee
- (c) Manufacturer's name and address
- (d) Drum number
- (e) Size of earthwire
- (f) Length of earthwire in meters
- (g) Gross weight of drum with lagging
- (h) Weight of empty drum with lagging
- (i) Arrow marking for unwinding
- (j) Position of the earthwire ends
- (k) Distance between outer most layer of Earthwire and the inner surface of lagging.
- (l) Barrel diameter at three locations and an arrow marking at the location of measurement.

2.12 **Verification of Earthwire Length**

The Purchaser reserves the right to verify the length of earthwire after unreeling at least ten (10) percent of the drums in a lot offered for inspection.

2.13 **Standards**

The earthwire shall conform to the following Indian/International Standards, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise in the Specification.

In the event of the supply of earthwire conforming to standards other than specified, the Contractor shall confirm in his bid that these standards are equivalent to those specified. In case of award salient features of comparison between the standards proposed by the Contractor and those specified in this documents will be provided by the Contractor to establish their equivalence.

Sl. No.	Indian Standard	Title	International Standard
1.	IS: 209 - 1992	Specification for Zinc	BS: 3436 – 1986
2.	IS: 398 - 1990	Specification for Aluminium Conductors For Overhead Transmission Purposes	IEC: 1089 – 1991 BS: 215 – 1970
3.	IS: 398 -1998 Part – II	Aluminium Conductor Galvanised Steel Reinforced	BS: 215 – 1970 IEC: 1089 1991
4.	IS: 398 – 1992 Part – IV	Aluminum Alloy stranded conductor	B-3242 – 1970 ASTM-8399 M86 IEC:1089 – 1991
5.	IS: 398 – 1992 Part – V	Aluminum Conductor Galvanised Steel-Reinforced For Extra High Voltage (400 KV) and above	IE:1089-1991 BS:215-1970
6.	IS:1778-1997	Reels and Drums for Bare Conductors	BS:1559-1949
7.	IS:1521-1991	Method of Tensile Testing of Steel Wire	
8.	IS:2629-1990	Recommended Practice for Hot Dip Galvanising of Iron and Steel	
9.	IS:2633-1992	Method of Testing Uniformity of Coating on Zinc Coated Articles	
10.	IS: 4826-1992	Galvanised Coating on Round Steel Wires	IEC:888-1987 BS:443-1969
11.	IS: 6745-1991	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles	BSC:433-1969 ISO 1460-1973
12	IS: 8263-1991	Method of Radio Interference Testes on High Voltage Insulators	IEC:437-1973 NEMA:107-1964 CISPR
13	IS: 9997-1991	Aluminium Alloy Redraw Roads	IEC 104-1987
14		Zinc Coated steel wires for stranded Conductors	IEC: 888-1987
15		Hard drawn Aluminum wire for overhead line conductors	IEC: 889-1987

3.0 TEST PROCEDURES:

3.1 UTS Test

Circles perpendicular to the axis of the earthwire shall be marked at two places on a sample of earthwire of minimum 5 m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate upto 50% of UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at steady rate to 100% of UTS and held for one minute. The earthwire sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

3.2 D.C. Resistance Test

On a earthwire sample of minimum 5m length two contact clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by Kelvin double bridge by placing the clamps initially at zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be

corrected to the value at 20⁰ C. The resistance corrected at 20⁰ C shall conform to the requirements of this Specification.

3.3 Chemical Analysis of Zinc

Samples taken from the zinc ingots shall be chemically/spectrographically analysed. The same shall be in conformity to the requirements stated in the Specification.

3.4 Chemical Analysis of Steel

Samples taken from the steel ingots/coils/strands shall be chemically/spectrographically analysed. The same shall be in conformity to the requirements stated in this Specification.

3.5 Visual and Dimensional Check on Drums and its barrel strength test.

The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this Specification. The details regarding barrel strength test will be discussed and mutually agreed to by Contractor and Purchaser in the quality assurance programme.

3.6 Visual Check for Joints, Scratches etc. and Length of Earthwire

Ten percent drums from each lot shall be rewound in the presence of the Purchaser. The Purchaser shall visually check for scratches, joints etc. and see that the earthwire generally conforms to the requirements of this Specification. The length of earthwire wound on the drum shall be measured with the help of counter meter during rewinding.

3.7 Dimensional Check

The individual strands shall be dimensionally checked to ensure that they conform to the requirement of this Specification.

3.8 Lay Length Check

The lay length shall be checked to ensure that they conform to the requirements of this Specification.

3.9 Galvanising Test

The test procedure shall be as specified in IS:4826-1979. The material shall conform to the requirements of this Specification. The adherence of zinc shall be checked by wrapping around a mandrel four times the diameter of steel wire.

3.10 Torsion Test

The minimum number of twists which a single steel strand shall withstand during torsion test shall be eighteen for a length equal to 100 times the standard diameter of the strand. In case test sample length is less or more than 100 times the stranded diameter of the strand the minimum number of twists will be proportioned to the length and if number comes in the fraction then it will be rounded off to next higher whole number.

4.0 REJECTION AND RETEST

Should any one of the test pieces first selected fail to pass the tests, three further samples from the same batch shall be selected, one of which shall be from the length from which the original test sample was taken, unless that length has been withdrawn by the supplier.

- 4.1 Should all the three test pieces from these additional samples satisfy the requirements of the tests, the batch represented by these samples shall be deemed to comply with the standard. Should the test pieces from any of the three additional samples fail, the batch represented shall be deemed not to comply with the standard.
- 4.2 If the test pieces for tests on strands taken from finished wire on a drum selected for such tests fail in the retest, the manufacturer shall test each and every drum and submit them for re-inspection.
- 4.3 All rejected material shall be suitably marked and segregated.
- 4.4 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Purchaser in writing. In the later case also, the wire shall be dispatched only after satisfactory testing for all tests specified herein has been completed and approved by the Purchaser.
- 4.5 The acceptance of any quantity of material shall in no way relieve the Supplier of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective.
- 4.6 The Tenderer shall indicate the name(s) of reputed inspection agencies. The inspection charges will be borne by the Tenderer. However, the purchaser reserves the right to appoint at its cost any inspection agency to carry out the inspection & the expenditure incurred therein is to be borne by the Purchaser.

Technical Specification of OPGW cable and associated hardware & fittings

This section describes the functional & technical specifications of OPGW cabling and associated hardware & fittings.

1.1 Fibre Optic Cabling

This section defines the requirements for G.652D & G655 Dual-window Single mode (DWSM) telecommunication grade fibre optic. Bidders shall furnish with their bids, detailed descriptions of the fibres & cable (s) proposed.

All optical fibre cabling including fibre itself and all associated installation hardware shall have a minimum guaranteed design life span of 25 years. Documentary evidence in support of guaranteed life span of cable & fibre shall be submitted by the Contractor during detailed engineering.

1.1.1 Required Optical Fibre Characteristics

This section describes the characteristics of optical fibre to be provided under this specification.

1.1.1.1 Physical Characteristics

Dual-Window Single mode (DWSM), G.652D optical fibres shall be provided in the fibre optic cables. DWSM optical fibres shall meet the requirements defined in Table 2-1 (a).

1.1.1.2 Attenuation

The attenuation coefficient for wavelengths between 1525 nm and 1575 nm shall not exceed the attenuation coefficient at 1550 nm by more than 0.05 dB. The attenuation coefficient between 1285 nm and 1330 nm shall not exceed the attenuation coefficient at 1310 nm by more than 0.05 dB. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.10 dB. The fibre attenuation characteristics specified in table 2-1 (a) shall be “guaranteed” fibre attenuation of any & every fibre reel.

The overall optical fibre path attenuation shall not be more than calculated below:

Maximum attenuation @ 1550nm: $0.21 \text{ dB/km} \times \text{total km} + 0.05\text{dB/splice} \times \text{no. of splices} + 0.5 \text{ dB/connector} \times \text{no. of connectors}$.

Maximum attenuation @ 1310nm: $0.35\text{dB/km} \times \text{total km} + 0.05 \text{ dB/splice} \times \text{no. of splices} + 0.5 \text{ dB/connector} \times \text{no. of connectors}$.

Table 1-1 (a)
DWSM OPTICAL Fibre Characteristics

Fibre Description:	Dual-Window Single-Mode
Mode Field Diameter:	8.6 to 9.5 μm ($\pm 0.6 \mu\text{m}$)
Cladding Diameter:	125.0 $\mu\text{m} \pm 1 \mu\text{m}$
Model field concentricity error	$\leq 0.6 \mu\text{m}$
Cladding non-circularity	$\leq 1\%$
Cable Cut-off Wavelength λ_{cc}	$\leq 1260 \text{ nm}$
1550 nm loss performance	As per G.652 D
Proof Test Level	$\geq 0.69 \text{ Gpa}$
Attenuation Coefficient:	@ 1310 nm $\leq 0.35 \text{ dB/km}$ @ 1550 nm $\leq 0.21 \text{ dB/km}$
Chromatic Dispersion; Maximum:	18ps/(nm x km) @ 1550 nm 3.5 ps/(nm x km) 1288-1339 nm 5.3 ps/(nm x km) 1271-1360 nm
Zero Dispersion Wavelength:	1300 to 1324 nm
Zero Dispersion Slope:	0.092 ps/(nm ² xkm) maximum

Polarization mode dispersion coefficient	$\leq 0.2 \text{ ps/km}^{1/2}$
Temperature Dependence:	Induced attenuation $\leq 0.05 \text{ dB}$ (-60°C - +85°C)
Bend Performance:	@ 1310 nm (75±2 mm dia Mandrel), 100 turns; Attenuation Rise $\leq 0.05 \text{ dB}$ @1550 nm (30±1 mm radius Mandrel), 100 turns; Attenuation Rise $\leq 0.05 \text{ dB}$ @ 1550 nm 32±0.5 mm dia Mandrel, 1 turn; Attenuation Rise $\leq 0.50 \text{ dB}$

1.1.2 Fibre Optic Cable Construction

Overhead Fibre Optic Cables shall be OPGW (Optical Ground Wire). The OPGW cable is proposed to be installed on transmission lines. The design of cable shall account for the varying operating and environmental conditions that the cable shall experience while in service.

1.1.2.1 Transmission Line Details

Typical details of transmission lines are indicated in the Appendices. Any other details, as required for cable design etc, shall be collected by the Contractor during survey.

1.1.2.2 Optical Fibre Cable Link Lengths

The Contractor shall supply & install the optical fibre cable as required based on detailed site survey to be carried out by the Contractor during the project execution. The Contract price shall be adjusted accordingly.

For the purpose of payment, the optical fibre link lengths are defined as transmission line route lengths from Gantry at one terminating station to the Gantry in the other terminating station. The actual cable lengths to be delivered shall take into account various factors such as sag, service loops, splicing, working lengths & wastage etc, and no additional payment shall be payable in this regard. The unit rate for FO cable quoted in the Bid price Schedules shall take into account all such factors.

1.1.2.3 Optical Fibre Identification

Individual optical fibres within a fibre unit and fibre units shall be identifiable in accordance with EIA/TIA 598 OR IEC 60304 or Bellcore GR-20 colour-coding scheme.

Colouring utilized for colour coding optical fibres shall be integrated into the fibre coating and shall be homogenous. The colour shall not bleed from one fibre to another and shall not fade during fibre preparation for termination or splicing.

Each cable shall have traceability of each fibre back to the original fibre manufacturer’s fibre number and parameters of the fibre. If more than the specified number of fibres are included in any cable, the spare fibres shall be tested by the cable manufacturer and any defective fibres shall be suitably bundled, tagged and identified at the factory by the vendor.

1.1.2.4 Buffer Tube

Loose tube construction shall be implemented. The individually coated optical fibre(s) shall be surrounded by a buffer for protection from physical damage during fabrication, installation and operation of the cable. The fibre coating and buffer shall be strippable for splicing and termination. Each fibre unit shall be individually identifiable utilizing colour coding. Buffer tubes shall be filled with a water-blocking gel.

1.1.2.5 Optical Fibre Strain & Sag-tension chart

The fibre optic cable shall be designed and installed such that the optical fibres experience no strain under all loading conditions defined in IS 802. Zero fibre strain condition shall apply even after a 25 year cable creep.

For the purpose of this specification, the following definitions shall apply;

- Maximum Working Tension (MWT) is defined as the maximum cable tension at which there is no fibre strain.
- The no fibre strain condition is defined as fibre strain of less than or equal to 0.05%, as determined by direct measurements through IEC/ETSI(FOTP) specified optical reflectometry techniques.
- The Cable strain margin is defined as the maximum cable strain at which there is no fibre strain.
- The cable Maximum Allowable Tension (MAT) is defined as the maximum tension experienced by the Cable under the worst case loading condition.
- The cable max strain is defined as the maximum strain experienced by the Cable under the worst case loading condition
- The cable Every Day Tension (EDT) is defined as the maximum cable tension on any span under normal conditions.
- The Ultimate / Rated Tensile Strength (UTS/RTS/breaking strength) is defined as the maximum tensile load applied and held constant for one minute at which the specimen shall not break.

While preparing the Sag-tension charts for the OPGW cable the following conditions shall be met:

- The Max Allowable Tension (MAT) / max strain shall be less than or equal to the MWT/Strain margin of the cable
- The Sag shall not exceed the earth wire sag in all conditions.
- The Max Allowable Tension shall also be less than or equal to 0.4 times the UTS.
- The 25 years creep at 25% of UTS (creep test as per IEEE 1138) shall be such that the 25 years creep plus the cable strain at Max Allowable Tension (MAT) is less than or equal to the cable strain margin.
- The everyday tension (EDT) shall not exceed 20% of the UTS for the OPGW cable.

The Sag-tension chart of OPGW cable indicating the maximum tension, cable strain and sag shall be calculated and submitted along with the bid under various conditions mentioned below:

1. 53°C, no wind and no ice
2. 32°C, no wind and no ice
3. 0°C, no wind and no ice
4. 32°C, full wind and no ice
5. 32°C, 75% full wind and no ice
6. 0°C, 2/3rd / 36% of full wind (IS 802:1977/1995)

The above cases shall be considered for the spans from 100 m to 600 m or higher span length in the range of 50 m spans. Max. vertical sag, max. tension and max sag at 0° C & no wind shall be considered for in line with the design parameter of transmission line. The typical details are indicated in the appendices. The full wind load shall be considered as the design wind load for all the specified transmission lines as per relevant IS 802 version and the sag-tension chart shall be submitted considering the transmission lines. The contractor shall submit the stringing chart for review of Employer.

1.1.2.6 Cable Materials

The materials used for optical fibre cable construction, shall meet the following requirements:

1.1.2.6.1 Filling Materials

The interstices of the fibre optic unit and cable shall be filled with a suitable compound to prohibit any moisture ingress or any water longitudinal migration within the fibre optic unit or along the fibre optic cable. The water tightness of the cable shall meet or exceed the test performance criteria as per IEC-794-1-F-5.

The filling compound used shall be a non-toxic homogenous waterproofing compound that is free of dirt and foreign matter, nonhygroscopic, electrically nonconductive and non-nutritive to fungus. The compound shall also be fully compatible with all cable components it may come in contact with and shall inhibit the generation of hydrogen within the cable.

The waterproofing filling materials shall not affect fibre coating, colour coding, or encapsulant commonly used in splice enclosures, shall be dermatologically safe, non-staining and easily removable with a non-toxic cleaning solvent.

1.1.2.6.2 Metallic Members

When the fibre optic cable design incorporates metallic elements in its construction, all metallic elements shall be electrically continuous.

1.1.2.6.3 Marking, Packaging and Shipping

This section describes the requirements for marking, packaging and shipping the overhead fibre optic cable.

- (a) Drum Markings: Each side of every reel of cable shall be permanently marked in white lettering with the vendors' address, the Purchaser's destination address, cable part number and specification as to the type of cable, length, number of fibres, a unique drum number including the name of the transmission line & segment no., factory inspection stamp and date.
- (b) Cable Drums: All optical fibre cabling shall be supplied on strong drums provided with lagging of adequate strength, constructed to protect the cabling against all damage and displacement during transit, storage and subsequent handling during installation. Both ends of the cable shall be sealed as to prevent the escape of filling compounds and dust & moisture ingress during shipment and handling. Spare cable caps shall be provided with each drum as required.

The spare cable shall be supplied on sturdy, corrosion resistant, steel drums suitable for long periods of storage and re-transport & handling.

There shall be no factory splices allowed within a continuous length of cable. Only one continuous cable length shall be provided on each drum. The lengths of cable to be supplied on each drum shall be determined by a "schedule" prepared by the Contractor.

1.1.2.6. OPGW cable Installation requirements

OPGW cables shall be installed in off-line conditions. The tentative bill of quantities for both live- line as well as off-line OPGW cable system installations have been specified in the appendices and the actual quantities for both types shall be finalized during project execution after detailed survey.

Supervision of Installation – The Contractor shall supervise the stringing at site as per the approved stringing procedure. Site visit for supervision shall be carried out as per instruction of Employer. However, the contract price shall be adjusted as per the actual requirement. The Supervision/Inspection work in Contractor's scope shall mainly include inspection as per stringing procedure, proper location of drum site, installation of stringing blocks/pulleys, proper sagging, proper installation of hardware, proper tension as per Sag-Tension chart, provision of service loops of OPGW in jointing locations etc.

1.1.2.7 Optical Ground Wire (OPGW)

OPGW cable construction shall comply with IEEE-1138, 1994. The cable provided shall meet both the construction and performance requirements such that the ground wire function, the optical fibre integrity and optical transmission characteristics are suitable for the intended purpose. The cable shall consist of optical fibre units as defined in this specification. There shall be no factory splices within the cable structure of a continuous cable length.

The composite fibre optic overhead ground wire shall be made up of buffered optical fibre units (fibres in the buffer tube) embedded in a water tight aluminium / aluminium alloy / stainless steel protective central fibre optic unit surrounded by concentric-lay stranded metallic wires in single or multiple layers. The dual purpose of the composite cable is to provide the electrical and physical characteristics of conventional overhead ground wire while providing the optical transmission properties of optical fibre.

1.1.2.7.1 Central Fibre Optic Unit

The central fibre optic unit shall be designed to house and protect multiple buffered optical fibres units from damage due to forces such as crushing, bending, twisting, tensile stress and moisture. The central fibre optic unit and the outer stranded metallic conductors shall serve together as an integral unit to protect the optical fibres from degradation due to vibration and galloping, wind and ice loadings, wide temperature variations, lightning an fault current, as well as environmental effects which may produce hydrogen.

Central fibre optic unit may be of aluminium or stainless steel tube with aluminium protective coating. In case of aluminium protective coating, the coating must completely cover the tubes leaving no exposed areas of tubing that can make electrical contact either directly or indirectly through moisture, contamination, protrusions, etc with the surrounding stranded wires. The tube may be fabricated as a seamless tube, seam welded, or a tube without a welded seam.

1.1.2.7.2 Breaking Strength

The rated breaking strength of the completed OPGW shall be taken as no more than 90 percent of the sum of the rated breaking strengths of the individual wires, calculated from their nominal diameter and the specified minimum tensile strength.

The rated breaking strength shall not include the strength of the optical unit. The fibre optic unit shall not be considered a load bearing tension member when determining the total rated breaking strength of the composite conductor.

1.1.2.7.3 Electrical and Mechanical Requirements

Table 2-2(a) provides OPGW Electrical and Mechanical Requirements for the minimum performance characteristics. Additionally, the OPGW mechanical & electrical characteristics shall be similar to that of the earthwire being replaced such that there is no or minimal consequential increase in stresses on towers. For the purpose of determining the appropriate Max Working Tension limit for the OPGW cable IS 802:1995 and IS 875:1987 shall be applied. However the OPGW installation sag & tension charts shall be based on IS 802 version to which the line is originally designed. For the OPGW cable design selection and preparation of sag tension charts, the limits specified in this section shall also be satisfied. The Bidder shall submit sag-tension charts for the above cases with their bids.

Table 1.2(a)
OPGW Electrical and Mechanical Requirements

(1)	Everyday Tension	≤ 20% of UTS of OPGW
(2)	D.C. Resistance at 20°C:	< 1.0 ohm/Km
(3)	Short Circuit Current:	≥ 6.32 kA for 1.0 second

1.1.2.7.4 Operating conditions

Since OPGW shall be located at the top of the EHV transmission line support structure, it will be subjected to Aeolian vibration, Galloping and Lightning strikes. It will also carry ground fault currents. Therefore, its electrical and mechanical properties shall be same as those required of conventional ground conductors.

1.1.2.7.5 Installation

OPGW installed under off line condition, shall be generally in accordance with the IEEE Guide to the Installation of Overhead Transmission Line Conductors (IEEE STD. 524 with latest revisions), with additional instructions and precautions for fibre optic cable handling. The stringing procedure shall be submitted by the Contractor prior to stringing for Employer's approval.

The OPGW cable sections shall normally be terminated & spliced only on tension towers. In exceptional circumstances, and on Employer specific approval, cable may be terminated on Suspension towers, but in this case tower strength shall be examined to ensure that tower loads are within safe limits and if required, necessary tower strengthening shall be carried out by the Contractor.

1.1.2.7.6 Installation Hardware

The scope of supply of the optical cable includes the assessment, supply and installation of all required fittings and hardware such as Tension assembly, Suspension assembly, Vibration dampers, Reinforcing rods, Earthing clamps, Downlead clamps, splice enclosure etc. The Bidder shall provide documentation justifying the adequacy and suitability of the hardware supplied. The Contractor shall determine the exact requirements of all accessories required to install and secure the OPGW.

The OPGW hardware fittings and accessories shall follow the general requirements regarding design, materials, dimensions & tolerances, protection against corrosion and markings as specified in clause 4.0 of EN 61284:1997 (IEC 61284). The shear strength of all bolts shall be at least 1.5 times the maximum installation torque. The OPGW hardware & accessories drawing & Data Requirement Sheets (DRS) document shall consist of three parts: (1) A technical particulars sheet (2) An assembly drawing i.e. level 1 drawing and (3) Component level drawings i.e. level 2 & lower drawings. All component reference numbers, dimensions and tolerances, bolt tightening torques & shear strength and ratings such as UTS, slip strength etc shall be marked on the drawings.

The fittings and accessories described herein are indicative of installation hardware typically used for OPGW installations and shall not necessarily be limited to the following:

- (a) Suspension Assemblies: Preformed armour grid suspension clamps and aluminium alloy armour rods/reinforcing rods shall be used. The suspension clamps shall be designed to carry a vertical load of not less than 25 kN. The suspension clamps slippage shall occur between 12kN and 17kN as measured in accordance with type test procedures.

The Contractor shall supply all the components of the suspension assembly including shackles, bolts, nuts, washers, split pins, etc. The total drop of the suspension assembly shall not exceed 150 mm (measured from the center point of attachment to the center point of the OPGW). The design of the assembly shall be such that the direction of run of the OPGW shall be the same as that of the conductor.

- (b) Dead End Clamp Assemblies: All dead end clamp assemblies shall preferably be of preformed armoured grip type and shall include all necessary hardware for attaching the assembly to the tower strain plates. Dead end clamps shall allow the OPGW to pass through continuously without cable cutting. The slip strength shall be rated not less than 95% of the rated tensile strength of the OPGW.
- (c) Clamp Assembly Earthing Wire: Earthing wire consisting of a 1500 mm length of aluminium or aluminium alloy conductor equivalent in size to the OPGW shall be used to earth suspension and dead end clamp assemblies to the tower structure.

- The earthing wire shall be permanently fitted with lugs at each end. The lugs shall be attached to the clamp assembly at one end and the tower structure at the other.
- (d) Structure Attachment Clamp Assemblies: Clamp assemblies used to attach the OPGW to the structures, shall have two parallel grooves for the OPGW, one on either side of the connecting bolt. The clamps shall be such that clamping characteristics do not alter adversely when only one OPGW is installed. The tower attachment plates shall locate the OPGW on the inside of the tower and shall be attached directly to the tower legs/cross – members without drilling or any other structural modifications.
 - (e) Vibration Dampers: Vibration dampers type 4R Stockbridge or equivalent, having four (4) different frequencies spread within the Aeolian frequency bandwidth, shall be used for suspension and tension points in each span. The Contractor shall determine the exact numbers and placement(s) of vibration dampers through a detailed vibration analysis as specified in technical specifications. Vibration damper clamps shall be made of aluminium or aluminium alloy, shall support the dampers during installation and shall maintain the dampers in position without damage to the OPGW and without causing fatigue. Armour or patch rods made of aluminium or aluminium alloy shall be provided as required to reduce clamping stress on the OPGW. The vibration damper body shall be hot-dip galvanized mild steel/cast iron or shall be permanent mould cast zinc alloy.

1.1.3 Fibre Optic Splice Enclosures (Joint Box)

All splices shall be encased in Fibre Optic Splice Enclosures. Suitable splice enclosures shall be provided to encase the optical cable splices in protective, moisture and dust free environment. Splice enclosures shall comply to ingress protection class IP 66 or better. The splice enclosures shall be designed for the storage and protection of required number of optical fibre splices and equipped with sufficient number of splice trays for splicing all fibres in the cable. No more than 6 fibres shall be terminated in a single splice tray. They shall be filled with suitable encapsulate that is easily removable should re-entry be required into the enclosures. Splice enclosures shall be suitable for outdoor use with each of the cable types provided under this contract. Splice enclosures shall be appropriate for mounting on transmission line towers above anti-climb guard levels at about 10 metres from top of the tower and shall accommodate pass-through splicing. The actual mounting height and location shall be finalized after Survey. Contractor shall be responsible for splicing of fibres and installation of splice enclosures.

1.1.3.1 Optical Fibre Splices

Splicing of the optical fibre cabling shall be minimized through careful contractor planning. There shall be no mid-span splices allowed. All required splices shall be planned to occur on tower structures. All optical fibre splicing shall comply with the following:

- (a) All fibre splices shall be accomplished through fusion splicing.
- (b) Each fibre splice shall be fitted with a splice protection sheath fitted over the final splice.
- (c) All splices and bare fibre shall be neatly installed in covered splice trays. No more than six (6) fibres shall be installed in each splice tray.
- (d) For each link, bi-directional attenuation of single mode fusion splices, shall not average more than 0.05 dB and no single splice loss shall exceed 0.1 dB when measured at 1550 nm.
- (e) For splicing, fibre optic cable service loops of adequate length shall be provided so that all splices occurring at tower structures can be performed at ground level.

1.1.4 Fibre Optic Approach Cables

For purposes of this specification, a fibre optic approach cable is defined as the Armoured underground fibre optic cable required to connect Overhead Fibre Optic Cable (OPGW) between the final in line splice enclosure on the gantry / tower forming the termination of the fibre cable on the power line and the Fibre Optic Distribution Panel (FODP) installed within the building. The estimated fibre optic approach cabling length requirements are indicated in the appendices. However, the Contractor shall supply & install the optical fibre approach cable as required based on detailed site survey to be carried out by the Contractor during the project execution and the Contract price shall be adjusted accordingly.

1.1.4.1 Basic Construction

The cable shall be suitable for direct burial, laying in trenches & PVC/Hume ducts, laying under false flooring and on indoor or outdoor cable raceways.

1.1.4.2 Jacket Construction & Material

The approach cable shall be a UV resistant, rodent proof, armoured cable with metallic type of armoring. The outer cable jacket for approach cable shall consist of carbon black polyethylene resin to prevent damage from exposure to ultra-violet light, weathering and high levels of pollution. The jacket shall confirm to ASTM D1248 for density.

1.1.4.3 Optical, Electrical and Mechanical Requirements

Approach cable shall contain fibres with identical optical/physical characteristics a those in the OPGW cables. The cable core shall comprise of tensile strength member(s), fibre support/bedding structure, core wrap/bedding, and an overall impervious jacket.

1.1.5 Installation of Approach cable

The existing cable trenches/cable raceways proposed to be used shall be identified in the survey report. The Contractor shall make its best effort to route the cable through the existing available cable trenches. Where suitable existing cable trenches are not available, suitable alternatives shall be provided after Employer approval. However, the approach cable shall be laid in the HDPE pipe in all condition.

Suitable provisions shall be made by the contractor to ensure adequate safety earthing and insulated protection for the approach cable.

All required fittings, supports, accessories, ducts, inner ducts, conduits, risers and any item not specially mentioned but required for laying and installtion of approach cables shall be supplied and installed by the Contractor.

1.1.6 Optical Fibre Termination and Splicing

Optical fibre terminations shall be installed in Fibre Optical Distribution Panels (FODP) designed to provide protection for fibre splicing of preconnectorized pigtails and to accommodate connectorized termination and coupling of the fibre cables. The contractor shall provide rack/wall mounted fibre optic distribution panels (FODPs) sized as indicated in the appendices and shall terminate the fibre optic cabling up to the FODPs. The location of FODP rack shall be fixed by the Contractor, with the Employer's approval.

1.1.6.1 Fibre Optic Distribution Panel

At each location requiring the termination of at least one fibre within a cable, all fibres within that cable shall be connectorized and terminated in Fibre Optic Distribution Panels in a manner consistent with the following:

- a) All fibre optic terminations shall be housed using FODPs provisioned with splice organizers and splice trays. All fibres within a cable shall be fusion spliced to preconnectorized pigtails and fitted to the "Back – side" of the provided fibre optic couplings.
- b) FODPs shall be suitable for use with each of the cable types provided as part of this contract. FODPs shall accommodate pass-through splicing and fibre terminations.
- c) FODPs for indoor use shall be supplied in suitable cabinets/racks with locking arrangement.
- d) ALL FODPs shall be of corrosion resistant, robust construction and shall allow both top or bottom entry for access to the splice trays, Ground lugs shall be provided on all

FODPs and the Contractor shall ensure that all FODPs are properly grounded. The FODP shall meet or exceed ingress protection class IP55 specifications.

- e) Flexible protection shall be provided to the patch cord bunches going out from FODP to other equipment.

1.1.6.2 Optical Fibre Connectors

Optical fibres shall be connectorised with FC-PC type connectors preferably. Alternatively connector with matching patch cord shall also be acceptable. Fibre optic couplings supplied with FODPs shall be appropriate for the fibre connectors to be supported. There shall be no adapters.

1.1.7 Service Loops

For purposes of this specification, cable and fibre service loops are defined as slack (extra) cable and fibre provided for facilitating the installation, maintenance and repair of the optical fibre cable plant.

- (a) Outdoor Cable Service Loops: In – line splice enclosures installed outdoors and mounted on the utility towers, shall be installed with sufficient fibre optic cable service loops such that the recommended minimum bend radius is maintained while allowing for installation or maintenance of the cable to be performed in a controlled environment at ground level.
- (b) Indoor Cable Service Loops: FODPs shall provide at least three (3) metres of cable service loop. Service loops shall be neatly secured and stored, coiled such that the minimum recommended bend radius' are maintained.
- (c) Fibre Units Service Loops: For all fibre optic cable splicing, the cable shall be stripped back a sufficient length such that the fan-out of fibre units shall provide for at least one (1) metre of fibre unit service loop between the stripped cable and the bare fibre fan-out.
- (d) Pigtail Service Loops: Connectorised pigtails spliced to bare fibres shall provide at least 1 metre of service loop installed in the FODP fibre organizer and at least one (1) metre of service loop to the couplings neatly stored behind the FODP coupling panels.
- (e) Fibre Service Loops: At least 0.5 metre of bare fibre service loop shall be provided on each side of all fibre splices. The bare fibre service loops shall be neatly and safely installed inside covered splice trays.

1.1.8 Methodology for Installation and Termination

All optical fibre cable termination, installation, stringing and handling plans, guides and procedures, and engineering analysis (e.g. tension, sag, vibration etc.) shall be submitted to the Employer for review and approval in the engineering/design phase of the project, prior to establishing the final cable lengths for manufacture. Installation procedures including details of personnel and time required shall be documented in detail and submitted to Employer for approval. All installation practices shall be field proven and ISO accredited.

All cable segments shall include service loops as specified in this specification. The maximum allowable stringing tension, maximum allowable torsional shear stress, crush strength and other physical parameters of the cable shall not be exceeded. The preventative measures to be taken shall be documented in details and submitted to Employer in advance of installation.

Optical fibre attenuation shall be measured after installation and before splicing. Any increase in attenuation or step discontinuity in attenuation shall not be acceptable and shall constitute a cable segment failure. In the event of cable damage or any fibre damage, the complete section (tension location to tension location) shall be replaced as mid-span joints are not acceptable.

Any or all additional steel work or modifications require to attach the fibre cabling to the overhead transmission/distribution line towers shall also be carried out by the contractor. It shall be the Contractors responsibility to provide adequate communications among all crew members and support staff to ensure safe and successful installations.

1.1.9 Cable Raceways

To the extent possible, existing cable raceways shall be utilized. The Contractor is required to provide and install any additional indoor cable raceways which maybe required for proper implementation of and communication system. This requirement shall be finalized during survey. The cable raceways shall conform to the following:

- (a) All cable raceways shall be sized to support full loading requirements plus at least a 200% safety loading factor
- (b) Indoor cable raceways shall be fabricated from construction grade aluminium, galvanized iron or anodized sheet metal or any other suitable material approved by the Employer. Suitable anticorrosion measures shall be provided. Steel fabricated raceways shall be finished inside and out, treated to resist rust and to form a metal-to-paint bond.
- (c) Mechanical construction drawings of the cable raceways shall be submitted for Employer's information & review.

2.0 Type Testing

"Type Tests" shall be defined as those tests which are to be carried out to prove the design, process of manufacture and general conformity of the materials to this specification. Type testing shall comply with the following:

- a) All cable being supplied shall conform to type tests as per technical specification.
- b) The test reports submitted shall be of the tests conducted within last seven (7) years for OPGW cable prior to the date of bid opening. In case the test reports are older than seven (7) years for OPGW cable on the date of bid opening, the contractor shall repeat these tests at no extra to the purchaser.
- c) The contractor shall submit, within 30 days of contract award, copies of test reports for all of the type tests that are specified in the specifications and that have previously (before contract award) been performed. These reports may be accepted by the employer only if they apply to materials and equipment that are essentially identical to those due to be delivered under the contract and only if test procedures and parameter values are identical to those specified in this specifications carried out at accredited labs and witnessed by third party / customer's representatives.

In the event of any discrepancy in the test reports or any type tests not carried out, same shall be carried out by contractor without any additional cost implication to the employer.

- d) Type tests shall be certified or performed by reputed laboratories using material and equipment data sheets and test procedures that have been approved by the employer. The test procedures shall be formatted as defined in the technical specifications and shall include a complete list of the applicable reference standards and submitted for employer approval at least four (4) weeks before commencement of test(s). The contractor shall provide the employer at least 30 days written notice of the planned commencement of each type test.
- e) The contractor shall provide a detailed schedule for performing all specified type tests. These tests shall be performed in the presence of a representative of the employer, if required.
- f) The contractor shall ensure that all type tests can be completed within the time schedule offered in his technical proposal.

- g) In case of failure during any type test, the supplier is either required to manufacture a fresh sample lot and repeat all type tests successfully or repeat that particular type test(s) at least three times successfully on the samples selected from the already manufactured lot at his own expenses. In case a fresh lot is manufactured for testing then the lot already manufactured shall be rejected.

2.1 Type Test Samples

The contractor shall supply equipment/material for sample selection only after the quality assurance plan has been approved by the employer. The sample material shall be manufactured strictly in accordance with the approved quality assurance plan. The contractor shall submit for employer approval, the type test sample selection procedure. The selection process for conducting the type tests shall ensure that samples are selected at random. At least three samples of each of the proposed equipment / item / cable drum except FO cable installation hardware & fittings shall be offered for selection. For FO cable installation hardware & fittings at least ten (10) samples shall be offered for selection.

2.1.2 List of Type Tests

The type testing shall be conducted on the following equipment/items

- (a) Optical fibres
- (b) OPGW Cable
- (c) OPGW Cable fittings
- (d) Vibration Damper
- (e) Splice Enclosure (Joint Box)

2.3 Type Tests for Optical Fibres

The type tests listed below in table 2.1 shall be conducted on DWSM fibres to be supplied as part of overhead cables. The tests specific to the cable type are listed in subsequent sections.

Table 2.1

Type Tests for Optical Fibres

S.No.	Test Name	Acceptance Criteria	Test procedure
1	Attenuation	As per section-02 of TS	IEC 60793-1-40 Or EIA/TIA 455-78A
2	Attenuation Variation with Wavelength	As per section-02 of TS	IEC 60793-1-40 Or EIA/TIA 455-78A
3	Attenuation at Water Peak	As per section-02 of TS	IEC 60793-1-40 Or EIA/TIA 455-78A
4	Temp. Cycling (Temp dependence of Attenuation)		IEC 60793-1-52 Or EIA/TIA 455-3A cycles
5	Attenuation with bending (bend performance)		IEC 60793-1-47 Or EIA/TIA 455-62A

6	Mode Field dia		IEC 60793-1-45 Or EIA/TIA 455- 164A/167A/174
7	Chromatic Dispersion		IEC 60793-1-42 Or EIA/TIA 455- 168A/169A/175A
8	Cladding Diameter		IEC 60793-1-20 Or EIA/TIA 455-176
9	Point Discontinuities of attenuation		IEC 60793-1-40 Or EIA/TIA 455-59
10	Core-Clad concentricity error		IEC 60793-1-20 Or EIA/TIA 455-176
11	Fibre Tensile proof testing		IEC 60793-1-30 Or EIA/TIA 455-31B
- End of table -			

2.4 Type Test for OPGW cables

The type tests to be conducted on the OPGW cable are listed in Table 2.2 Type Tests for OPGW Cables. Unless specified otherwise in the technical specifications or the referenced standards, the optical attenuation of the specimen, measured during or after the test as applicable, shall not increase by more than 0.05 dB/Km.

Table 2.2

Type tests for OPGW Cable

S.No.	Test Name	Test Description	Test Procedure	
1	Water Ingress Test	IEEE 1138-2009	IEEE 1138-2009 (IEC 60794-1-2 Method F5 or EIA/TIA 455-82B): Test duration: 24 hours	
2	Seepage of filling compound	IEEE 1138-2009	IEEE 1138-2009 EIA/TIA 455-81B	Preconditioning period: 72 hours. Test duration: 24 hours

3	Short Circuit Test	IEEE 1138-2009	IEEE 1138-2009	Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. A suitable temperature sensor such as thermocouple shall be used to monitor and record the temperature inside the OPGW tube in addition to monitoring & recording the temperatures between the strands and between optical tube and the strand as required by IEEE 1138. Test shall be conducted with the tension clamps proposed to be supplied. The cable and the clamps shall be visually inspected for mechanical damage and photographed after the test.
		Or IEC60794-4-10/IEC 60794-1-2 (2003) Method H1		Initial temperature during the test shall be greater than or equal to ambient field temperature.
4	Aeolian Vibration Test	IEEE 1138-2009 Or IEC 60794-4-10/IEC 60794-1-2, Method E19	IEEE 1138-2009	Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. The vibration frequency and amplitude shall be monitored and recorded continuously. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring. Test shall be conducted with the tension/suspension clamps proposed to be supplied. The cable and the clamps shall be visually inspected for mechanical damage and photographed after the test.

5	Galloping test	IEEE 1138-2009	IEEE 1138-2009	Test shall be conducted with the tension/suspension clamps proposed to be supplied. The cable and clamps shall be visually inspected for mechanical damage and photographed after the test. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring.
6	Cable Bend Test	Procedure 2 in IEC 60794-1-2 Method E11		The short-term and long term bend tests shall be conducted in accordance with procedure 2 in IEC 60794-1-2 E11 to determine the minimum acceptable radius of bending without any increase in attenuation or any other damage to the fibre optic cable core such as bird caging, deformation, kinking and crimping.
7	Sheave Test	IEEE 1138-2009 OR IEC 60794-1-2 (2003) Method E1B	IEEE 1138-2009	Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. The Sheave dia. Shall be based on the pulling angle and the minimum pulley dia employed during installation. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring.
8	Crush Test	IEEE 1138-2009	IEEE 1138-2009 (IEC 60794-1-2, Method E3/EIA/TIA 455-41B)	The crush test shall be carried out on a sample of approximately one (1) metre long in accordance with IEC 60794-1-2 E3. A load equal to 1.3 times the weight of a 400 – metre length of fibre optic cable shall be applied for a period of 10 minutes. A permanent or temporarily increase in optical attenuation value greater than 0.1 dB change in sample shall constitute failure. The load shall be further increased in small increments until the measured attenuation of the optical waveguide fibres increases and the failure load recorded along with results.

9	Impact Test	IEEE 1138-2009	IEEE 1138-2009, (IEC 60794-1-2 E4/EIA/TIA 455-25B)	The impact test shall be carried out in accordance with IEC 60794-1-2 E4. Five separate impacts of 0.1-0.3kgm shall be applied. The radius of the intermediate piece shall be the reel drum radius $\pm 10\%$. A permanent or temporary increase in optical attenuation value greater than 0.1 dB/km change in sample shall constitute failure.
10	Creep Test	IEEE 1138-2009	IEEE 1138-2009	As per Aluminium Association Method, the best-fit straight line shall be fitted to the recorded creep data and shall be extrapolated to 25 years. The strain margin of the cable at the end of 25 years shall be calculated. The time when the creep shall achieve the strain margin limits shall also be calculated.
11	Fibre Strain Test	IEEE 1138-2009	IEEE 11-38-1994	
12	Strain Margin Test	IEEE 1138-2009	IEEE 1138-2009	
13	Stress strain test	IEEE 1138-2009	IEEE 1138-2009	
14	Cable Cut-off wavelength test	IEEE 1138-1994	IEEE 1138-1994	
15	Temperature Cycling Test	IEEE 1138-2009	IEEE 1138-2009 Or IEC 60794-1-2, Method F1	
16	Corrosion (Salt Spary) test	EIA/TIA 455-16A		
17	Tensile performance test	IEC 60794-1-2 E1/EIA/TIA 455-33B		The test shall be conducted on a sample of sufficient length in accordance with IEC 60794-1-2 EI. The attenuation variation shall not exceed 0.05 dB/Km up to 90% of RTS of fibre optic cable. The load shall be increased at a steady rate up to rated tensile strength and held for one (1) minute. The fibre optic cable sample shall not fail during the period. The applied load shall then be increased until the failing load is reached and the value recorded.

18	Fault current/ lightning test	IEC 60794-4-10/IEC 60794-1-2 (2003)	The OPGW cable construction shall be tested in accordance with IEC 60794-1-2, Method H2 for Class 1.
19	DC Resistance Test (IEC 60228)	On a fibre optic cable sample of minimum 1 metre length, two contact clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially zero metre and subsequently one metre apart. The tests shall be repeated at least five times and the average value recorded after correcting at 20°C.	
- End of table -			

2.5 Type Test on OPGW cable fittings

The type tests to be conducted on the OPGW cable fittings and accessories are listed below:

(i) Mechanical Strength Test for suspension/tension assembly

Applicable Standards: IEC 61284, 1997

Suspension Assembly

The armour rods/reinforcement rods are assembled on to the approved OPGW using the Installation Instructions to check that the assembly is correctly fitted and is the same that will be carried out during installations.

Part 1:

The suspension assembly shall be increased at a constant rate up to a load equal to 50% of the specified minimum failure load increased and held for one minute for the test rig to stabilize. The load shall then be increased at a steady rate to 67% of the minimum failure load and held for five minutes. The angle between the cable, the suspension assembly and the horizontal shall not exceed 16°. This load shall then be removed in a controlled manner and the protection splice disassembled. Examination of all the components shall be made and any evidence of visual deformation shall be documented.

Part 2:

The suspension clamp shall then be placed in the testing machine. The tensile load shall gradually be increased up to 50% of the specified Minimum failure load of the suspension assembly and held for one minute for the test rig to stabilize and the load shall be further increased at a steady rate until the specified minimum failure load is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value shall be documented.

Tension Assembly

The Tension Assembly is correctly fitted and is the same that will be carried out during installations.

Part 1:

The tension assembly (excluding tension clamp) shall be increased at a constant rate up to a load equal to 50% of the specified of the specified minimum failure load increased at a constant rate and held for one minute for the test rig to stabilize. The load shall then be increased at a steady rate to 67% of the minimum failure load and held of five minutes. This load shall then remove in a controlled manner and the tension assembly disassembled. Examination of the tension dead-end and associated components shall be made and any evidence of visual deformation shall be documented.

Part 2:

The Tension Dead-End and associated components shall then be reassembled and bolts tightened as before. The tensile load shall gradually be increased up shall gradually be increased up to 50% of the specified minimum failure load of the tension assembly and held for one minute for the test rig to stabilize and the load shall be further increased at a steady rate until the specified minimum failure load is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value shall be documented.

Acceptance Criteria for Tension/Suspension assembly:

- No evidence of binding of the Nuts or Deformation of components at end of Part 1 of test.
- No evidence of fracture at the end of one minute at the minimum failure load during Part 2 of the test.

Any result outside these parameters shall constitute a failure.

(ii) Clamp slip strength test for suspension assembly

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length fibre optical cable shall be fixed in the clamps. Once the suspension clamp has been assembled, the test rig is tensioned to 1 KN and the position scale on the recorder 'zeroed'. The test rig is then tensioned to 2.5 KN and the relative positions of the Reinforcing Rods, Armour Rods and suspension clamp shall be marked by a suitable means to confirm any slippage after the test has been completed. The relative positions of the helical Armour Rods and associated Reinforcing Rods at each end shall be marked and also 2 mm relative position between clamp body and Armour Rods shall be marked on one side. The load shall be increased to 12KN at a loading rate of 3 KN/min and held for one minute. At the end of this one minute period, the relative displacement between clamp body and the armour rods shall be observed. If the slippage is 2mm or above, the test shall be terminated. Otherwise, at the end of the one minute the position of the clamp body and 2mm. relative positions between clamp body and armour rods shall be marked on the other side. After the one minute pause, the load shall be further increased at a loading rate of 3 KN/min, and recording of load and displacement shall continue until either the relative position displacement between clamp body and armour rods reaches more than 2 mm or the load reaches the maximum slip load of 17 KN. On reaching either of the above values the test is terminated. Visual examination of all paint marks shall be recorded, and a measurement of any displacement recorded in the table of results.

Acceptance Criteria:

The suspension clamp has passed the slip test if the following conditions are met:

- No slippage* shall occur at or below the specified minimum slip load.
 - * Definition of no slippage in accordance with IEC 61284, 1997:- Any relative movement less than 2 mm is accepted. The possible couplings or elongations produced by the cable as a result of the test itself are not regarded as slippage.
- Slippage shall occur between the specified maximum and minimum slip load of 12-17KN.
- There shall be no slippage of the Reinforcing Rods over the cable, and no slippage of the Armour Rods over the Reinforcing Rods.
- The relative movement (i.e. more than 2 mm between Armour Rods & Clamp body) between minimum 12KN and maximum slip 17KN, shall be considered as slip.
- The Armour Rods shall not be displaced from their original lay or damaged**.

** Definition of no damage in accordance with convention expressed in IEC 61284: 1997 no damage, other than surface flattening of the strands shall occur.

Any result outside these parameters is a failure.

(iii) Slip strength test of tension clamp

Tension clamps shall be fitted on a 8 m length of fibre optic cable on both ends. The assembly shall be mounted on a tensile testing machine and anchored in a manner similar to the arrangement to be used in service. A tensile load shall gradually be applied up to 20% of the RTS of OPGW. Displacement transducers shall be installed to measure the relative movement between the OPGW relative to the Reinforcing Rods and Tension Dead – End relative to Reinforcing Rods. In addition, suitable marking shall be made on the OPGW and Dead – End to confirm grip. The load shall be gradually increased at a constant rate up to 50% of the UTS and the position scale of the recorder is zeroed. The load shall then gradually increased up to 95% of the UTS and maintained for one minute. After one minute pause, the load shall be slowly released to zero and the marking examined and measured for any relative movement.

Acceptance Criteria:

- No movement* shall occur between the OPGW and the Reinforcing Rods, or between the Reinforcing Rods and the Dead-End assembly.
- No failure or damage or disturbance to the lay of the Tension Dead – End, Reinforcing Rods or OPGW.

*Definition of no movement as defined in IEC 61284: Any relative movement less than 2 mm is accepted. The possible couplings or elongations produced by the conductor as a result of the test itself are not regarded as slippage.

Any result outside these parameters shall constitute a failure.

(iv) Grounding Clamp and Structure Mounting Clamp Fit Test

For structure mounting clamp, one series of test shall be conducted with two fibre optic cables installed, one series of tests with one fibre optic cable installed in one groove, and one series of tests with one fibre optic cable in the other groove. Each clamp shall be installed including clamping compound as required on the fibre optic cable. The nut shall be tightened on to the bolt by using torque wrench with a torque of 5.5 kgm or supplier's recommended torque and the tightened clamps shall be held for 10 minutes. After the test remove the fibre optic cable and examine all its components for distortion, crushing or breaking. Also the fibre optic cable shall be checked to ensure free movement within the core using dial callipers to measure the diameter of the core tube. The material shall be defined as failed if any visible distortion, crushing, cracking or breaking of the core tube is observed or the fibre optic cable within the core tube is not free to move, or when the diameter of the core tube as measured at any location in the clamped area is more than 0.5 mm larger or smaller of the core diameter as measured outside the clamped area.

(v) Structure Mounting Clamp Strength Test

The clamp and mounting assembly shall be assembled on a vertical 200 mm x 200 mm angle and a short length of fibre optic cable installed. A vertical load of 200 kg shall be applied at the end of the mounting clamp and held for 5 minutes. Subsequently, the load shall be increased to 400 kg and held for 30 seconds. Any visible distortion, slipping or breaking of any component of the mounting clamp or assembly shall constitute failure.

2.6 Type Test on Vibration Damper

(a) Dynamic Characteristic Test

The damper shall be mounted with its clamp tightened with torque recommended by the manufacturer on shaker table capable of simulating sinusoidal vibrations for Critical Aeolian Vibration frequency band ranging from $0.18/d$ to $1.4/d$ – Where d is the OPGW cable diameter in meters. The damper assembly shall be vibrated vertically with a ± 1 mm amplitude from 5 to 15

Hz frequency and beyond 15 Hz at 0.5 mm to determine following characteristics with the help of suitable recording instruments.

- (i) Force Vs frequency
- (ii) Phase angle Vs frequency
- (iii) Power dissipation Vs frequency

The force Vs frequency curve shall not show steep peaks at resonance frequencies and deep troughs between the resonance frequencies. The resonance frequencies shall be suitably spread within the Aeolian vibration frequency-band between the lower and upper dangerous frequency limits determined by the vibration analysis of fibre optic cable without dampers.

Acceptance criteria for vibration damper:

- (i) The above dynamic characteristics test on five damper shall be conducted.
- (ii) The mean reactance and phase angle Vs frequency curves shall be drawn with the criteria of best fit method.
- (iii) The above mean reactance response curve should lie within following limits:
 $V.D. \text{ for OPGW} - 0.060 f \text{ to } 0.357 f \text{ kgf/mm}^*$
Where f is frequency in Hz.
- (iv) The above mean phase angle response curve shall be between 25° to 130° within the frequency range of interest.
- (v) If any above curve lies within the envelope, the damper design shall be considered to have successfully met the requirement.
- (vi) Visual resonance frequencies of each mass of damper is to be recorded and to be compared with the guaranteed values.

(b) Vibration Analysis

The vibration analysis of the fibre optic cable shall be done with and without damper installed on the span. The vibration analysis shall be done on a digital computer using energy balance approach. The following parameters shall be taken into account for the purpose of analysis.

- (i) The analysis shall be done for single fibre optic cable without armour rods. The tension shall be taken as 25% of RTS of fibre optic cable for a span ranging from 100 m to 1100 m.
- (ii) The self damping factor and flexural stiffness (EI) for fibre optic cable shall be calculated on the basis of experimental results. The details to experimental analysis with these data shall be furnished.
- (iii) The power dissipation curve obtained from damper characteristics test shall be used for analysis with damper.
- (iv) Examine the Aeolian Vibration level of the fibre optic cable with and without vibration damper installed at the recommended location or wind velocity ranging from 0 to 30 Km per hour, predicting amplitude, frequency and vibration energy input.
- (v) From vibration analysis of fibre optic cable without damper, antinode vibration amplitude and dynamic strain levels at clamped span extremities as well as antinodes shall be examined and thus lower and upper dangerous frequency limits between which the Aeolian vibration levels exceed the specified limits shall be determined.
- (vi) From vibration analysis of fibre optic cable with damper(s) installed at the recommended location, the dynamic strain level at the clamped span extremities,

damper attachment point and the antinodes on the fibre optic cable shall be determined. In addition to above damper clamp vibration amplitude and antinodes vibration amplitudes shall also be examined.

The dynamic strain levels at damper attachment point, clamped span extremities and antinodes shall not exceed the specified limits. The damper clamp vibration amplitude shall not be more than that of the specified fatigue limits.

(c) Fatigue Tests

(i) Test Set Up

The fatigue tests shall be conducted on a laboratory set up with a minimum effective span length of 30m. The fibre optic cable shall be tensioned at 25% of RTS of fibre optic cable and shall not be equipped with protective armour rods at any point.

Constant tension shall be maintained within the span by means of level arm arrangement. After the fibre optic cable has been tensioned, clamps shall be installed to support the fibre optic cable at both ends and thus influence of connecting hardware fittings are eliminated from the free span. The clamps shall not be used for holding the tension on the fibre optic cable. There shall be no loose parts, such as suspension clamps, U bolts, on the test span supported between clamps mentioned above. The span shall be equipped with vibration inducing equipment suitable for producing steady standing vibration. The inducing equipment shall have facilities for step less speed control as well as step less amplitude arrangement. Equipment shall be available for measuring the frequency, cumulative number of cycles and amplitude of vibration at any point along the span.

(ii) Fatigue Test

The vibration damper shall be installed on the test span with the manufacturer's specified tightening torque. It shall be ensured that the damper shall be kept minimum three loops away from the shaker to eliminate stray signals influencing damper movement.

The damper shall be vibrated at the highest resonant frequency of each damper mass. For dampers involving torsional resonant frequencies, tests shall be done at torsional modes also in addition to the highest resonant frequencies at vertical modes. The resonance frequency shall be identified as the frequency at which each damper mass vibrates with the maximum amplitude on itself. The amplitude of vibration of the damper clamp shall be maintained not less than $\pm 25/f$ mm where f is the frequency in Hz.

The test shall be conducted for minimum ten million cycles at each resonant frequency mentioned above. During the test, if resonance shift is observed, the test frequency shall be tuned to the new resonant frequency.

The clamp slip test as mentioned herein shall be repeated after fatigue tests without retorquing or adjusting the damper clamp, and the clamp shall withstand a minimum load equal to 80% of the slip strength for a minimum duration of one minute.

After the above tests, the damper shall be removed from fibre optic cable and subjected to dynamic characteristics test. There shall not be any major deterioration in the characteristics of the damper. The damper then shall be cut open and inspected. There shall not be any broken, loose, or damaged part. There shall not be significant deterioration or wear of the damper. The fibre optic cable under clamp shall also be free from any damage.

For purpose of acceptance, the following criteria shall be applied:

- (1) There shall not be any resonant frequency shift before and after the test by more than $\pm 20\%$
- (2) The power dissipation of the damper before and after test at the individual resonant frequencies do not differ by more than $\pm 20\%$

Beside above tests, the type tests listed below in the table shall also be conducted on vibration damper.

S.No.	Test Name	Test Procedure
1	Visual examination & Dimensional and material verification	IEC 61897 Clause 7.1 & 7.2
2	Clamp Slip test	IEC 61897 Clause 7.5
3	Clamp bolt tightening test	IEC 61897 Clause 7.7
4	Attachments of weights to messenger cable	IEC 61897 Clause 7.8
5	Attachment of clamps to messenger cable	IEC 61897 Clause 7.8
6	Damper effectiveness evaluation	IEC 61897 Clause 7.11.3.2

2.7 Type Tests for Splice Enclosures (Joint Box)

Following type tests shall be demonstrated on the splice enclosure(s) (Splice Enclosure/Box). For certain tests, lengths of the fibre optic cable shall be installed in the splice box, and the fibres must be spliced and looped in order to simulate conditions of use. The attenuation of the fibres shall be measured, during certain tests, by relevant fibre optic test procedures (EIA/TIA 455 or IEC 60794-1 procedures).

(i) Temperature Cycling Test

FO cable is installed in the splice enclosure and optical fibres spliced and looped. The box must be subjected to 5 cycles of temperature variations of -40°C to + 65 °C with a dwell time of at least 2 hours on each extreme.

Fibre loop attenuation shall be measured in accordance with EIA 455-20/IEC 60794-1-C10. The variation in attenuation shall be less than $\pm 0.05\text{dB}$. The final humidity level, inside the box, shall not exceed the initial level, at the closing of the box.

(ii) Humid Heat test

The sealed splice enclosure, with fibres spliced and looped inside, must be subjected to a temperature of $+55\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ with a relative humidity rate of between 90% and 95% for 5 days. The attenuation variation of the fibres during the duration of the test shall be less than $\pm 0.05\text{dB}$, and the internal humidity rate measured, less than 2%.

(iii) Rain Withstand Test/Water Immersion test

The splice enclosure with optical fibres cable installed and fibres spliced fixed, shall be subjected to 24 hours of simulated rain in accordance with IEC 60060 testing requirements. No water seepage or moisture shall be detected in the splice enclosure. The attenuation variation of the fibres after the test shall be less than $\pm 0.05\text{dB}$.

(iv) Vibration Test

The splice enclosure, with fibres united inside, shall be subjected to vibrations on two axes with a frequency scanning of 5 to 50 Hz. The amplitude of the vibrations shall be constant at 0.450mm, peak to peak, for 2 hours, for each of the vibrations' axes. The variation in attenuation, of the fibres, shall be less than $\pm 0.05\text{dB}$. The splice enclosure shall be examined for any defects or deformation. There shall be no loosening or visible damage of the FO cable at the entry point.

(v) Bending and Torsion test

The splice enclosure, with fibres spliced inside, shall be firmly held in place and be subjected to the following sequence of mechanical stresses on the cable:

- a) 3 torsion cycles of $\pm 180^\circ$ shall be exercised on the cable. Each cycle shall be less than one minute.
- b) 3 flexure cycles of the cable, of $\pm 180^\circ$ with one cycle less than one minute.

The variation in the attenuation, of the fibres, shall be less than $\pm 0.05\text{dB}$. The cables connection ring shall remain securely fixed to the box with the connection maintained firmly. No defects/fissures shall be noted on the joint ring or on the splice enclosure.

(vi) Tensile test

The splice enclosure with cable fixed to the boxes shall be subjected to a minimum tension of 448 N for a period of two minutes. No fissure shall be noted in the connections or on the box.

(vii) Drop test

With 2 lengths of 11 metres of cable fixed to the box, it shall be dropped five times from a height of 10 metres. There shall be no fissure, at all, of the box, and the connections shall remain tight. The test surface shall be carried out in accordance with IEC 60068-2-32.

2.8 Factory Acceptance Tests

Factory acceptance tests shall be conducted on randomly selected final assemblies of all equipment to be supplied. Factory acceptance testing shall be carried out on OPGW cable and associated hardware & fittings, Joint box.

Material shall not be shipped to the employer until required factory tests are completed satisfactorily, all variances are resolved, full test documentation has been delivered to the employer, and the employer has issued material inspection & clearance certificate (MICC). Successful completion of the factory tests and the employer approval to ship shall in no way constitute final acceptance of the system or any portion thereof. These tests shall be carried out in the presence of the employer's authorized representatives unless waiver for witnessing by employer's representatives is intimated to the contractor.

Factory acceptance tests shall not proceed without the prior delivery to and approval of all test documentation by the employer.

The factory acceptance test shall demonstrate the technical characteristics of the equipment in relation to this specifications and approved drawings and documents. List of factory acceptance tests for fibre optic transmission system. Termination equipment Sub-system, NMS are given in specified tables in this section. This list of factory acceptance tests shall be supplemented by the contractor's standard FAT testing program The factory acceptance tests for the other items shall be proposed by the contractor in accordance with technical specifications and contractor's (including Sub-Contractor's/supplier's) standard FAT testing program. In general the FAT for other items shall include at least: Physical verification, demonstration of technical characteristics, various operational modes, functional interfaces, alarms and diagnostics etc.

For Test equipment & clock, FAT shall include supply of proper calibration certificates, demonstration of satisfactory performance, evidence of correct equipment configuration and manufacturer's final inspection certificate/report.

2.9 Sampling for FAT

From each batch of equipment presented by the contractor for factory acceptance testing, the employer shall select random sample(s) to be tested for acceptance. Unless otherwise agreed, all required FAT tests in the approved FAT procedures, shall be performed on all samples. The sampling rate for the factory acceptance tests shall be minimum 10% of the batch size (minimum 1) for all items. The physical verification shall be carried out on 100% of the offered quantities as per the approved FAT procedure. In case any of the selected samples fail, the failed sample is rejected and additional 20% samples shall be selected randomly and tested. In case any sample from the additional 20% also fails the entire batch may be rejected. In case a number of equipments are required for demonstration of the performance of any equipment during FAT, the sample size shall be taken as that number of equipments which are necessary to demonstrate the performance, irrespective of the percentage.

For the OPGW cable hardware fittings & accessories, the minimum sampling rate, and batch acceptance criteria shall be as defined in IS 2486.

The sampling rate for the factory acceptance tests shall be 10% of the batch size (minimum2) for FO cable drums, FODPs Joint box and other similar items.

Since FAT testing provides a measure of assurance that the quality control objectives are being met during all phases of production, the employer reserves the right to require the contractor to investigate and report on the cause of FAT failures and to suspend further testing/approvals until such a report is made and remedial actions taken, as applicable.

Production testing shall mean those test which are to be carried out during the process of production by the contractor to ensure the desired quality of end product to be supplied by him. The production tests to be carried out at each stage of production shall be based on the contractor’s standard quality assurance procedures. The production tests to be carried out shall be listed in the Manufacturing Quality Plan (MQP), along with information such as sampling frequency, applicable standards, acceptance criteria etc.

The production tests would normally not be witnessed by the employer. However, the employer reserves the right to do so or inspect the production testing records in accordance with inspection rights specified for this contract.

3.0 Factory Acceptance Tests on Optical fibre to be supplied with OPGW

The factory acceptance tests listed in table below are applicable for the Optic fibres to be supplied. The listed tests follow testing requirements set forth in IEEE standard 1138, 1994 section 4.2.2.1 and section 5.2.2.1. The referenced sections specify the detailed test description. The acceptance norm shall be as specified in the above mentioned IEEE standards unless specified otherwise in the technical specifications.

Table 3.1 Factory Acceptance Tests for Optical Fibres: Optical Tests

Sl.No.	Test Name	Acceptance Criteria	Test procedure
1	Attenuation Coefficient	Table 1-1 (a)	EIA/TIA 455-78A
2	Point Discontinuities of attenuation	Section 1.1.1.2	EIA/TIA 455-59
3	Attenuation at Water Peak	Table 1-1 (a)	EIA/TIA 455-78A
4	Chromatic Dispersion		EIA/TIA 455-168A/169A/175A
5	Core-Clad Concentricity Error		EIA/TIA 455-176
6	Cladding diameter		EIA/TIA 455-176
7	Fibre Tensile proof testing		EIA/TIA 455-31B
- End of table -			

The test report for the above tests for the fibers carried out by the fiber manufacturer and used in the OPGW cables shall be shown to the inspector during OPGW cable FAT and shall be submitted along with the OPGW cable FAT report.

3.1 Factory Acceptance Test on OPGW cable

The factory acceptance tests for OPGW cable specified below in table follow the requirements set forth in IEEE standard 1138/IEC 60794. The FAT shall be carried out on 10% of offered drums in each lot as specified in technical specifications and the optical tests shall be carried out in all fibres of the selected sample drums. The Rated Tensile strength test shall be carried out on one sample in each lot.

Table 3.2

Factory Acceptance Tests on OPGW Applicable standard: IEEE 1138/IEC 60794

Sl.No.	Factory Acceptance Test on Manufactured OPGW
1	Attenuation Co-efficient at 1310 nm and 1550 nm
2	Point discontinuities of attenuation
3	Visual Material verification and dimensional checks as per approved DRS/Drawings
4	Rate Tensile Strength
5	Lay Length Measurements

2.2 Factory Acceptance Test on OPGW Fittings

The factory acceptance tests for OPGW fittings as specified below in Table 3.3. The sampling plan shall be as per relevant standard:

Table 3.3

Factory Acceptance Tests on OPGW Fittings

Sl.No.	Factory Acceptance Test
Suspension Assembly	
1	UTS/Mechanical Strength of the assembly
2	Clamp Slip Test
3	Visual Material verification and dimensional checks as per approved DRS/Drawings
4	Mechanical Strength of each component
5	Galvanising test
Tension Assembly	
6	Clamp Slip Strength Test
7	Visual Material verification and dimensional checks as per approved DRS/Drawings
8	Mechanical Strength of each component
9	Galvanising test
Vibration Damper	
10	Galvanising test on damper, masses and messenger wires
11	Damper response (resonant frequencies)
12	Clamp Slip test
13	Strength of messenger wires
14	Attachments of weights to messenger cable
15	Attachments of clamps to messenger cable

16	Clamp bolt tightening test
17	Clamp bolt torque test
18	Dynamic characteristic test
19	Visual Material verification and dimensional checks as per approved DRS/Drawings
Structure Mounting Clamp	
20	Clamp fit test
21	Clamp Strength Test
22	Visual Material verification and dimensional checks as per approved DRS/Drawings
- End of Table -	

2.3 Factory Acceptance Test on Splice Enclosure (Joint Box)/FODP

The factory acceptance tests for Splice Enclosures/FODP as specified below in Table:

Table 3.4

Factory Acceptance Tests on Splice Enclosures (Joint Box)/FODP

Sl.No.	Factory Acceptance Tests
1.	Visual check of quantities and specific component number for each component of splice enclosure/FODP and dimensional checks against the approved drawings

3.4 Factory Acceptance Tests on test equipment, Pigtail & other items

As per technical specification and approved DRS/Documents.

3.5 Site Acceptance Tests

The contractor shall be responsible for the submission of all equipment & test equipment supplied in this contract for site tests and inspection as required by the employer. All equipment shall be tested on site under the conditions in which it will normally operate.

The tests shall be exhaustive and shall demonstrate that the overall performance of the contract works satisfies every requirement specified. At a minimum Site Acceptance Testing requirement for FO cable is outlined in following section. This testing shall be supplemented by the contractor’s standard installation testing program, which shall be in accordance with his quality plan(s) for FO equipment installation.

During the course of installation, the Employer shall have full access for inspection and verification of the progress of the work and for checking workmanship and accuracy, as maybe required. On completion of the work prior to commissioning, all equipment shall be tested to the satisfaction of the employer to demonstrate that it is entirely suitable for commercial operation.

3.6 Minimum Site Acceptance Testing Requirement for FO Cabling

Prior to installation, every spooled fibre optic cable segment shall be tested for compliance with the pre-shipment data previously received from the manufacturer. This requirement will preclude the installation of out of specification cable segments that may have been damaged during shipment.

3.7 Phase of Site Acceptance Testing

SAT shall be carried out link from FODP to FODP. SAT may be performed in parts in case of long links.

The tests, checks, adjustments etc conducted by the contractor prior to offering the equipment for SAT shall be called Pre-SAT activities. The Pre-SAT activities shall be described in the installation manuals and field quality plan documents.

Sag and tension of OPGW shall generally be as per approved sag-tension chart and during installation, sag and tension of OPGW shall be documented. Upon completion of a continuous cable patch, all fibres within the cable patch shall be demonstrated for acceptance of the cable path. Fibre Optic cable site testing minimum requirements are provided in Table 3.5 through 3.6 below:

Table 3.5

Fibre Optic cable Pre-Installation Testing

Item	Description
1	Physical Inspection of the cable assembly for damage
2	Optical fibre continuity and fibre attenuation with OTDR at 1550 nm
3	Fibre optic cable length measurement using OTDR

Table 3.6

Fibre Optic Cable Splicing Testing

Item	Description
1	Pre splice bi-directional average attenuation with OTDR
2	Physical inspection of splice box/enclosure for proper fibre/cable routing techniques
3	Physical inspection of sealing techniques, weatherproofing, etc.

Table 3.7

Fibre Optic Cable Commissioning Testing

Item	Description
1	End to End (FODP to FODP) bi-directional average attenuation of each fibre at 1310 nm and 1550 nm by OTDR
2	End to End (FODP to FODP) bi-directional average attenuation of each fibre at 1310 nm and 1550 nm by Power meter.
3	Bi-directional average splice loss by OTDR of each splice as well as for all splices in the link (including at FODP also)
4	Proper termination and labeling of fibres & fibre optic cables at FODP as per approved labeling plan.
- End of Table -	

4. TECHNICAL PARAMETERS of OPGW

Sl.No.	Description	Tech. Particulars
1	Make & Model	
2	No. of Fibres in OPGW	24
3	Mode	DW-SM
4	Buffer type	Loose
5	Buffer tube diameter	2.2 mm
6	Buffer tube material	PBT
7	No. of buffer tubes	4
8	No. of fibres per tube	6
9	Identifiacion/numbering of individual tubes	Red, green blue and natural
10	No. of empty tubes(if any)	1
11	Filling material	moisture proof & Hydrozen adherent jelly
12	Strength members	1
13	Binding yarn/tape	Tapes
14	10%Aluminium clad steel wire(Daimeter & number)	2.55 +/- 0.03 mm & 12 Nos.
15	Aluminium tube diameter	5.4 mm
16	Approximate outside diameter	7.4 +/- 0.03 mm
17	Cable diameter	12.50 mm +/- 0.1 mm
18	Cable cross section area	113 mm ²
19	Min. Breaking load /Ultimate Tensile Strength	81.00 k N
20	Fibre Strain margin	0.6%
21	Weight	500 kgs / km
22	Crush strength	1000 kg with a 10 cm ² piste
23	Modulus of Elasticity	103.4 kN / mm ²
24	Minimum bending radius	300 mm
25	Maximum bending radius	Short term 300 mm long term 400 mm
26	Permissible CTS Tensile stress	0.669 k N / mm ²
27	Coeffieicnt of inner expansion	15.3 X 10 ⁻⁶ Per °C
28	Coefficient of expansion	6.3 X 10 ⁻⁶ Per °C
	Cladding	
	Core	
29	Nominal operating temperature range	- 10 °C to 70 °C
30	SC current transient peak temperature	41 KA
31	Maximum allowable temperature for lightning strike	200

32	Available length of cable per drum: Min	2500mtrs.
	Max	3500mtrs.
33	Splice loss(Max. & Min. allowable)	0.05 dB, 0.01dB
34	Operating Temperature range -	- 10 °C to 70 °C
35	Expected Cable Life	40years
36	Fibre production method	
37	Core diameter	9.2 +/- 0.5 µm
38	Core non circularity	
39	Cladding diameter	125 +/-0.5 µm
40	Core Clad Concentricity Error	< 1µm
41	Cladding noncircularity	< 2 %
42	Protective coating type & material Primary Secondary	Acrylate PBT
43	Coating concentricity	> 70%
44	Colour coding scheme compliant with EIA395A/IEC3047	Yes
45	Attenuation Coefficient @1310nm -	.36 d B /km
	@1550nm -	.22 d B /km
46	Attenuation variation With Wavelength(+/-5nm Temperature-	0.05 d B /km 0.05d B /km
47	Mode field non Circularity -	< 2%
48	Chromatic Dispersion	
	At 1310 nm	2.8 ps/ (nm.km)
	At 1550 nm	18 ps/ (nm.km)

Chief Engineer/Telecom

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SECTION – 6
TECHNICAL SPECIFICATION
FOR HARDWARE FITTINGS
AND
ACCESSORIES OF CONDUCTOR
& EARTHWIRE

SECTION-6
TECHNICAL SPECIFICATION FOR
HARDWARE FITTINGS
and
ACCESSORIES OF CONDUCTOR & EARTHWIRE

CONTENTS

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SECTION-6
TECHNICAL SPECIFICATION FOR HARDWARE FITTINGS
and
ACCESSORIES OF CONDUCTOR & EARTHWIRE

1.0 Technical Description of Hardware Fittings

1.1 Details of Hardware Fittings

1.1.1 The hardware fittings shall be suitable for use with Disc insulators having ball and socket fittings. The hardware fittings shall be as per the specification drawings enclosed with the section of drawing of the specification. Each hardware fitting shall be supplied complete in all respects and shall include the following hardware parts :

1.1.2 Suitable arcing horn as specified in clause 1.8 hereinafter.

1.1.3 Suitable yoke plates complying with the specifications given hereinafter.

1.1.4 Corona control rings/grading ring with fittings for attachment to line side yoke plate.

1.1.5 Sag adjustment plate for Quadruple tension hardware fittings and turn buckle for single tension hardware fittings.

1.1.6 Suspension and dead end assembly to suit conductor size as detailed in clause 1.13, 1.14 and 1.15 hereinafter.

1.1.7 Provisions for attaching balancing weights on the line side yoke plate of single suspension pilot hardware fittings.

1.1.8 Other necessary fittings viz D-shackles, eye links, extension links, ball clevis, socket clevis, clevis eye, U clevis and chain link etc. to make the hardware fittings complete.

1.1.9 2.5% extra fasteners .

1.2 Dimensions of Insulator String Along with Hardware Fitting

The various limiting dimensions of the insulator strings along with hardware fittings shall be as per the specification drawings enclosed in section of drawings of this specification.

1.2.1 For every set of quad-tension hardware fittings, one number 250mm rigid spacer suitable for twin ACSR MOOSE conductor shall also be provided to ensure that there is no fouling of conductors or any component of the fittings while bringing down top two conductor through bottom two conductors of quad bundle, at the jumper connection.

1.3 Interchangeability

1.3.1 The hardware for insulator strings with disc insulators together with ball and socket fittings shall be of standard design, so that these hardware are interchangeable with each other and suitable for use with insulators of any make conforming to relevant Indian/International Standard.

1.4 Corona and RI Performance

Sharp edges and scratches on all the hardware fittings shall be avoided. All surfaces must be clean, smooth, without cuts and abrasions or projections. The

Contractor must give suitable assurance about the satisfactory corona and radio interference performance of the materials offered by him.

1.5 Maintenance

1.5.1 The hardware fittings offered shall be suitable for employment of hot line maintenance technique so that usual hot line operations can be carried out with ease, speed and safety. The technique adopted for hot line maintenance shall be generally bare hand method & hot stick method. The Bidder should clearly establish in the bid, the suitability of his fittings for hot line maintenance.

1.5.2 The line side yoke plate shall have a notch & a working hole of suitable size. The design of corona control rings/grading ring shall be such that it can be easily replaced by employing hot line maintenance technique.

1.6 Designation

1.6.1 Ball and Socket Designation

The dimensions of the ball and socket are furnished in section-I of this Specification. The designation should be in accordance with the standard dimensions stated in IS:2486-(Part-II)/IEC:120. The dimensions shall be checked by the appropriate gauge after galvanizing only.

1.7 Security Clips and Split Pins

1.7.1 Security clips for use with ball and socket coupling shall be R-shaped, hump type which provides positive locking of the coupling as per IS:2486-(Part-III)/IEC : 372. The legs of the security clips shall be spread after assembly in the works to prevent complete withdrawal from the socket. The locking device should be resilient, corrosion resistant and of suitable mechanical strength. There shall be no risk of the locking device being displaced accidentally or being rotated when in position. Under no circumstances shall the locking devices allow, separation of fittings.

1.7.2 The hole for the security clip shall be countersunk and the clip should be of such design that the eye of clip may be engaged by a hot line clip puller to provide for disengagement under energised conditions. The force required to pull the security clip into its unlocked position shall not be less than 50 N (5 kg) or more than 500 N (50 kg).

1.7.3 Split pins shall be used with bolts & nuts.

1.8 Arcing Horn/Intermediate Arcing Horn

1.8.1 The arcing horn / Intermediate Arcing Horn shall be either ball ended rod type or tubular type.

- 1.8.2 The arcing horn shall be provided as shown on the drawing of the hardware fittings, in this specification.
- 1.8.3 The air gap shall be so adjusted to ensure effective operation under actual field conditions.

1.9 Yoke Plates

The strength of yoke plates shall be adequate to withstand the minimum ultimate tensile strength as specified in the bid drawings.

The plates shall be either triangular or rectangular in shape as may be necessary. The design of yoke plate shall take into account the most unfavorable loading conditions likely to be experienced as a result of dimensional tolerances for disc insulators as well as components of hardware fittings within the specified range. The plates shall have suitable holes for fixing corona control rings/grading ring/arcing horn. All the corners and edges should be rounded off with a radius of at least 3 mm. Design calculations i.e. for bearing & tensile strength, for deciding the dimensions of yoke plate shall be furnished by the bidder. The holes provided for bolts in the yoke plate should satisfy shear edge condition as per Clause No. 8.10 of IS:800-1984.

1.10 Corona Control Rings/Grading Ring

- 1.10.1 The Corona control rings/grading ring shall be provided with hardware fittings and shall be of such design that it should cover at least one disc insulator in disc insulator strings so that they will reduce the voltage across the insulator units. It shall also improve corona and radio interference performance of the complete insulator string along with hardware fittings.
- 1.10.2 The corona control rings/grading ring shall be made of high strength heat treated aluminium alloy tube of minimum 2.5 mm wall thickness. If mild steel brackets are used then the brackets shall not be welded to the pipe but shall be fixed by means of bolts and nuts on a small aluminium plate attachment welded to the pipe. The welded center of the corona control ring/grading ring shall be grinded before buffing. Alternately, Aluminium tube/flats of suitable dimensions welded to the corona control rings/grading rings may be used for connection to yoke plate.
- 1.10.3 The Corona control rings/grading ring should have a brushed satin finish and not a bright glossy surface. No blemish should be seen or felt when rubbing a hand over the metal.
- 1.10.4 The limiting dimensions of corona control ring shall be as per the specification drawings.
- 1.10.5 Bidder may quote for grading ring with armour grip suspension assembly. The grading ring shall be of open type design with a gap of 125 mm. The open ends shall be suitably terminated. The outside diameter of the tube shall be 60 mm. The ends of grading ring tube shall be sealed with welded aluminium cap duly buffed.

1.11 Sag Adjustment Plate

- 1.11.1 The sag-adjustment plate to be provided with the Double Tension / Quad tension hardware fitting shall be of three plate type. The sag adjustment plate shall be provided with a safety locking arrangement. The device shall be of such design that the adjustment is done with ease, speed and safety.
- 1.11.2 The maximum length of the sag adjustment plate from the connecting part of the rest of the hardware fittings shall be 520 mm. The details of the minimum and maximum adjustment possible and the steps of adjustment shall be clearly indicated in the drawing. An adjustment of 150 mm minimum at the interval of 6 mm shall be possible with the sag adjustment plate.
- 1.11.3 Design calculations for deciding the dimensions of sag adjustment plate shall be furnished by bidder. The hole provided for bolts should satisfy shear edge condition as per Clause No.8.10 of IS:800-1984.

1.12 Turn Buckle

- 1.12.1 The turn buckle is to be provided with single tension hardware fitting. The threads shall be of sufficient strength to remain unaffected under the specified tensile load.
- 1.12.2 The maximum length of the turn buckle from the connecting part of the rest of the hardware fittings shall be 520 mm. The details of the minimum and maximum adjustment possible shall be clearly indicated in the drawing. An adjustment of 150 mm minimum shall be possible with turn buckle.

1.13 Suspension Assembly

- 1.13.1 The suspension assembly shall be suitable for the specific conductor as per Specification.
- 1.13.2 The suspension assembly shall include free center type suspension clamp along with standard preformed armour rods or armour grip suspension clamp; except for Pilot insulator string for which only suitable Envelope type suspension clamp shall be used.
- 1.13.3 The suspension clamp along with standard preformed armour rods set shall be designed to have maximum mobility in any direction and minimum moment of inertia so as to have minimum stress on the conductor in the case of oscillation of the same.
- 1.13.4 The suspension clamp along with standard preformed armour rods/armour grip suspension clamp set shall have the slip strength not less than that specified in the Standard Technical Particulars.
- 1.13.5 The suspension assembly shall be designed, manufactured and finished to give it a suitable shape, so as to avoid any possibility of hammering between suspension assembly and conductor due to vibration. The suspension assembly shall be smooth without any cuts, grooves, abrasions, projections, ridges or excrescence, which might damage the conductor.

- 1.13.6 The suspension assembly/clamp shall be designed so that it shall minimise the static & dynamic stress developed in the conductor under various loading conditions as well as during wind induced conductor vibrations. It shall also withstand power arcs & have required level of Corona/RIV performance.
- 1.13.7 The magnetic power loss shall not be more than that stipulated in the Standard Technical Particulars.
- 1.13.8 **Free Center Type Suspension Clamp**
- For the Free Center Suspension Clamp seat shall be smoothly rounded and curved into a bell mouth at the ends. The lip edges shall have rounded bead. There shall be at least two U-bolts for tightening of clamp body and keeper pieces together.
- 1.13.10 **Standard Preformed Armour Rod Set**
- 1.13.10.1 The Preformed Armour Rods Set, suitable for specific Conductor, shall be used to minimise the stress developed in the sub-conductor due to different static and dynamic loads because of vibration due to wind, slipping of conductor from the suspension clamp as a result of unbalanced conductor tension in adjacent spans and broken wire condition. It shall also withstand power arcs, chafing and abrasion from suspension clamp and localised heating effect due to magnetic power losses from suspension clamps as well as resistance losses of the conductor.
- 1.13.10.2 The preformed armour rods set shall have right hand lay and the inside diameter of the helics shall be less than the outside diameter of the conductor to have gentle but permanent grip on the conductor. The surface of the armour rod when fitted on the conductor shall be smooth and free from projections, cuts and abrasions etc.
- 1.13.10.3 The pitch length of the rods shall be determined by the Bidder but shall be less than that of the outer layer of conductor and the same shall be accurately controlled to maintain uniformity and consistently reproducible characteristic wholly independent of the skill of linemen.
- 1.13.10.4 The length of each rod along with permissible tolerances shall be as stipulated in the Standard Technical Particulars. The end of armour rod shall be parrot billed.
- 1.13.10.5 The number of armour rods in each set shall as stipulated in the Standard Technical Particulars. Each rod shall be marked in the middle with paint for easy application on the line.
- 1.13.10.6 The armour rod shall not loose their resilience even after five applications.
- 1.13.10.7 The conductivity of each rod of the set shall not be less than 40% of the conductivity of the International Annealed Copper Standard (IACS).
- 1.13.11 **Armour Grip Suspension Clamp**
- 1.13.11.1 The armour grip suspension clamp shall comprise of retaining strap, support housing, elastomer inserts with aluminium reinforcements and AGS preformed rod set.

- 1.13.11.2 Elastomer insert shall be resistant to the effects of temperature up to 95°C, Ozone, ultraviolet radiations and other atmospheric contaminants likely to be encountered in service. The physical properties of the elastomer shall be of approved standard. It shall be electrically shielded by a cage of AGS performed rod set. The elastomer insert shall be so designed that the curvature of the AGS rod shall follow the contour of the neoprene insert.
- 1.13.11.3 The AGS preformed rod set shall be as detailed in clause 1.13.10.4 to 1.13.10.7 in general except for the following.
- 1.13.11.4 The length of the AGS preformed rods shall be such that it shall ensure sufficient slipping strength as detailed under clause 1.13.4 and shall not introduce unfavorable stress on the conductor under all operating conditions. However the length of AGS preformed rods shall not be less than that stipulated in the Standard Technical Particulars.
- 1.14 **Envelope Type Suspension Clamp**
 - 1.14.1 The seat of the envelope type suspension clamp shall be smoothly rounded & suitably curved at the ends. The lip edges shall have rounded bead. There shall be at least two U-bolts for tightening of clamp body and keeper pieces together. Hexagonal bolts and nuts with split-pins shall be used for attachment of the clamp.
- 1.15 **Dead end Assembly**
 - 1.15.1 The dead end assembly shall be suitable for specific Conductor.
 - 1.15.2 The dead end assembly shall be compression type with provision for comprising jumper terminal at one end. The angle of jumper terminal to be mounted should be 30° with respect to the vertical line. The area of bearing surface on all the connections shall be sufficient to ensure positive electrical and mechanical contact and avoid local heating due to I^2R losses. The resistance of the clamp when compressed on Conductor shall not be more than 75% of the resistance of equivalent length of Conductor.
 - 1.15.3 Die compression areas shall be clearly marked on each dead-end assembly designed for continuous die compressions and shall bear the words 'COM PRESS FIRST' suitably inscribed near the point on each assembly where the compression begins. If the dead end assembly is designed for intermittent die compressions it shall bear identification marks 'COMPRESSION ZONE' AND 'NON-COMPRESSION ZONE' distinctly with arrow marks showing the direction of compressions and knurling marks showing the end of the zones. The letters, number and other markings on the finished clamp shall be distinct and legible. The dimensional tolerances of the cross section of aluminium and steel dead end; for dead end assembly for the specific conductor shall be as stipulated in the Standard Technical Particulars.
 - 1.15.4 The assembly shall not permit slipping of, damage to, or failure of the complete conductor or any part thereof at a load less than 95% of the ultimate tensile strength of the conductor.

1.16 **Balancing Weights**

For holding the single suspension pilot insulator string used for jumper connections at the transposition towers from excessive deflection, suitable balancing weights, weighing 200 kg. are to be suspended through the line side yoke plate. It shall consist of four weights, each weighing 50 Kgs. and shall be connected to the yoke plate by means of eye bolt and shackle arrangement. The bottom weight shall be provided with recess to shield the ends of eye bolts. The same shall be suitable for use on specific transmission lines.

1.17 **Fasteners : Bolts, Nuts and Washers**

- 1.17.1 All bolts and nuts shall conform to IS:6639. All bolts and nuts shall be galvanised as per IS-1367 - (Part 13)/IS-2629. All bolts and nuts shall have hexagonal heads, the heads being forged out of solid truly concentric, and square with the shank, which must be perfectly straight.
- 1.17.2 Bolts up to M16 and having length up to 10 times the diameter of the bolt should be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical properties and effective dimensional control. The shear strength of bolt for 5.6 grade should be 310 MPa minimum as per IS - 12427. Bolts should be provided with washer face in accordance with IS:1363 Part-1 to ensure proper bearing.
- 1.17.3 Nuts should be double chamfered as per the requirement of IS:1363 Part-III. It should be ensured by the manufacturer that nuts should not be over tapped beyond 0.4 mm oversize on effective diameter for size up to M16.
- 1.17.4 Fully threaded bolts shall not be used. The length of the bolt shall be such that the threaded portion shall not extend into the place of contact of the component parts.
- 1.17.5 All bolts shall be threaded to take the full depth of the nuts and threaded enough to permit the firm gripping of the component parts but no further. It shall be ensured that the threaded portion of the bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit and tight to the point where shank of the bolt connects to the head.
- 1.17.6 Flat washers and spring washers shall be provided wherever necessary and shall be of positive lock type. Spring washers shall be electro-galvanised. The thickness of washers shall conform to IS:2016-1967.
- 1.17.7 The Bidder shall furnish bolt schedules giving thickness of components connected, the nut and the washer, the length of shank and the threaded portion of bolts and size of holes and any other special details of this nature.
- 1.17.8 To obviate bending stress in bolt, it shall not connect aggregate thickness more than three time its diameter.
- 1.17.9 Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.

1.17.10 To ensure effective in-process Quality control it is essential that the manufacturer should have all the testing facilities for tests like weight of zinc coating, shear strength, other testing facilities etc, in-house. The manufacturer should also have proper Quality Assurance system, which should be in line with the requirement of this specification and IS-14000 services Quality System standard.

1.17.11 Fasteners of grade higher than 8.8 are not to be used.

1.18 Materials

The materials of the various components shall be as specified hereunder. The Bidder shall indicate the material proposed to be used for each and every component of hardware fittings stating clearly the class, grade or alloy designation of the material, manufacturing process & heat treatment details and the reference standards.

1.18.1 The details of materials for different component are listed as in Table-I

TABLE-1 : (Details of Materials)

Sl. No.	Name of item	Material treatment	Process of Standard	Reference	Remarks
1.	Security Clips	Stainless Steel/ Phosphor Bronze	-	AISI 302 or 304-L/ IS-1385	
2.	Arcing Horn	Mild Steel Rod/ Tube Type	Hot dip galvanised	As per IS-226 or IS-2062	
3.	Ball Fittings, Socket, all shackles links cleves	Class-IV Steel	Drop forged & normalized Hot dip galvanised	As per IS: 2004	
4.	Yoke Plate	Mild Steel	Hot dip galvanized	As per IS-226 or IS-2062	
5.	Sag Adjustment plate	Mild Steel	Hot dip galvanized	As per IS-226 or IS-2062	
6(a).	Corona Control ring/ Grading ring	High Strength Al. Alloy tube (6061/ 6063/1100 type or 65032/ 63400 Type)	Heat treated Hot dip galvanized	ASTM-B429 or as per IS	Mechanical strength of welded joint shall not be less than 20 KN
6(b).	Supporting Brackets & Mounting Bolts	High Strentgth Al Alloy 7061/ 6063/ 65032/ 63400 Type) or Mild Steel	Heat treated Hot dip galvanized	ASTM-B429 or as per IS:226 or IS:2062	
7.	Turn Buckle	Class-II Steel	Forged hot dip galvanized	IS:2004	
8(a).	Free centre type clamp/ Envelope type Clamp: Clamp Body, Keeper Piece	High Strength Al. Alloy 4600/ LM-6 or 6061/ 65032	Casted or forged & Heat treated	IS:617 or ASTM-B429	

8(b)	Envelope type Clamp: Cotter bolts/ Hangers, Shackles, Brackets	Mild Steel	Hot dip galvanised	As per IS-226 or IS-2062	
8(c)	Envelope type Clamp: U Bolts	Stainless Steel or High Strength Al alloy 6061/ 6063 or 65032/ 63400	Forged & Heat treated	AISI 302 or 304-L ASTM-B429	
9.	P. A. rod	High strength Al alloy type 6061 or equivalent	Heat treatment during manufacturing	ASTM:B429	Min. tensile strength of 35 kg/mm ²
10.	AGS clamp	High strength corrosion resistant Al. alloy LM6, 4600 or equivalent 6061	Cast/forged heat treated.	IS:617 or equivalent	
	(a) Supporting house				
	(b) Al insert and retaining strap	High strength Al alloy type 6061 or equivalent	Forged and Heat treated	ASTM:B429	
	(c) Elastomer cushion	Moulded on Al reinforcement			
11(a).	Dead End Assembly: Outer Sleeve	EC grade Al of purity not less than 99.50%			
11(b).	Steel Sleeve	Mild Steel	Hot Dip Galvanised	IS:226/IS-2062	
12.	Balancing weights	Cast iron MCI/ machined Mild Steel	Hot dip galvanised	IS:226/2062 or equivalent	

Note : Alternate materials conforming to other national standards of other countries also may be offered provided the properties and compositions of these are close to the properties and compositions of material specified. Bidder should furnish the details of comparison of material offered vis a vis specified in the bid or else the bids are liable to be rejected.

1.19 Workmanship

- 1.19.1 All the equipment shall be of the latest design and conform to the best modern practices adopted in the Extra High Voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for the rated transmission lines and will give continued good performance.
- 1.19.2 The design, manufacturing process and quality control of all the materials shall be such as to give the specified mechanical rating, highest mobility, elimination of sharp edges and corners to limit corona and radio-interference, best resistance to corrosion and a good finish.

- 1.19.3 All ferrous parts including fasteners shall be hot dip galvanised, after all machining has been completed. Nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electro galvanised. The bolt threads shall be undercut to take care of the increase in diameter due to galvanising. Galvanising shall be done in accordance with IS 2629 :1985/ IS 1367 (Part 13) and shall satisfy the tests mentioned in IS 2633: 1986.
- 1.19.4 Before ball fittings are galvanised all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the dimensions below the design requirements.
- 1.19.5 The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash rust, stains, bulky white deposits and blisters. The zinc used for galvanising shall be Zinc of any grade in IS 209:1992 ingot (fourth revision) or IS 13229:1991.
- 1.19.6 Pin balls shall be checked with the applicable "GO" gauges in at least two directions. one of which shall be across the line of die flashing, and the other 90° to this line. "NO GO" gauges shall not pass in any direction.
- 1.19.7 Socket ends, before galvanising, shall be of uniform contour. The bearing surface of socket ends shall be uniform about the entire circumference without depressions or high spots. The internal contours of socket ends shall be concentric with the axis of the fittings as per IS:2486/IEC : 120.
- The axis of the bearing surfaces of socket ends shall be coaxial with the axis of the fittings. There shall be no noticeable tilting of the bearing surfaces with the axis of the fittings.
- 1.19.8 In case of casting, the same shall be free from all internal defects like shrinkage, inclusion, blow holes, cracks etc. Pressure die casting shall not be used for casting of components with thickness more than 5 mm.
- 1.19.9 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum.
- 1.19.10 No equipment shall have sharp ends or edges, abrasions or projections and cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under service conditions.
- 1.19.11 All the holes shall be cylindrical, clean cut and perpendicular to the plane of the material. The periphery of the holes shall be free from burrs.
- 1.19.12 All fasteners shall have suitable corona free locking arrangement to guard against vibration loosening.

- 1.19.13 Welding of aluminium shall be by inert gas shielded tungsten arc or inert gas shielded metal arc process. Welds shall be clean, sound, smooth, uniform without overlaps, properly fused and completely sealed. There shall be no cracks, voids incomplete penetration, incomplete fusion, under-cutting or inclusions. Porosity shall be minimised so that mechanical properties of the aluminium alloys are not affected. All welds shall be properly finished as per good engineering practices.

1.20 Bid Drawings:

- 1.20.1 The Bidder shall furnish full description and illustrations of materials offered.

- 1.20.2 Fully dimensioned drawings of the complete insulator string hardware and their component parts showing clearly the following arrangements shall be furnished along with the bid. Weight, material and fabrication details of all the components should be included in the drawings.

- (i) Attachment of the hanger or strain plate.
- (ii) Suspension or dead end assembly.
- (iii) Arcing horn attachment to the string as specified in clause 1.8 of this technical Specification.
- (iv) Yoke plates
- (v) Hardware fittings of ball and socket type for inter connecting units to the top and bottom Yoke plates.
- (vi) Corona control rings/grading ring attachment to conductor and other small accessories.
- (vii) Links with suitable fittings.
- (viii) Details of balancing weights and arrangements for their attachment in the single suspension pilot insulator string.

- 1.20.3 All drawings shall be identified by a drawing number and contract number. All drawings shall be neatly arranged. All drafting & lettering shall be legible. The minimum size of lettering shall be 3 mm. All dimensions & dimensional tolerances shall be mentioned in mm.

The drawings shall include :

- (i) Dimensions and dimensional tolerance.
- (ii) Material, fabrication details including any weld details & any specified finishes & coatings. Regarding material designation & reference of standards are to be indicated.
- (iii) Catalogue No.
- (iv) Marking
- (v) Weight of assembly
- (vi) Installation instructions
- (vii) Design installation torque for the bolt or cap screw.

- (viii) Withstand torque that may be applied to the bolt or cap screw without failure of component parts.
- (ix) The compression die number with recommended compression pressure.
- (x) All other relevant terminal details.

1.20.4 After placement of award, the Contractor shall submit fully dimensioned drawing including all the components in four (4) copies to the Owner for approval. After getting approval from the Owner and successful completion of all the type tests, the Contractor shall submit thirty (30) more copies of the same drawings to the Owner for further distribution and field use at Owner's end.

2.0 Accessories for ACSR Moose Conductor

2.1 General

2.1.1 This portion (under clause 2.0) details the technical particulars of the accessories for Conductor.

2.1.2 2.5% extra fasteners and retaining rods shall be provided.

2.2 Mid Span Compression Joint

2.2.1 Mid Span Compression Joint shall be used for joining two lengths of conductor. The joint shall have a resistivity less than 75% of the resistivity of equivalent length of conductor. The joint shall not permit slipping off, damage to or failure of the complete conductor or any part thereof at a load less than 95% of the ultimate tensile strength of the conductor.

2.2.2 The joint shall be made of steel and aluminium sleeves for jointing the steel core and aluminium wires respectively. The steel sleeve should not crack or fail during compression. The steel sleeve shall be hot dip galvanised. The aluminium sleeve shall have aluminium of purity not less than 99.5%. The dimensions and dimensional tolerances of mid span compression joint shall be as per Standard Technical Particulars.

2.3 T-Connector

T-Connector of compression type shall be used for jumper connection at transposition tower. It shall be manufactured out of 99.5% pure aluminium and shall be strong enough to withstand normal working loads. The T-connector shall have a resistivity across jumper less than 75% resistivity of equivalent length of conductor. The T-connector shall not permit slipping off, damage to or failure of complete conductor. The welded portions shall be designed for 30 kN axial tensile load. Leg sleeve of T-connector should be kept at an angle of 15 deg. from vertical and horizontal plane of the conductor in order to minimise jumper pull at the welded portion. The dimensions and dimensional tolerances of T-connector shall be as per Standard Technical Particulars.

2.4 Repair Sleeve

Repair Sleeve of compression type shall be used to repair conductor with not more than two strands broken in the outer layer. The sleeve shall be manufactured from 99.5% pure aluminium and shall have a smooth surface. The repair sleeve shall comprise of two pieces with a provision of seat for sliding of the keeper piece. The edges of the seat as well as the keeper piece shall be so rounded that the conductor strands are not damaged during installation. The dimensions and dimensional tolerances of repair sleeve shall be as per Standard Technical Particulars.

2.5 Spacer Damper

2.5.1 Suitable spacer dampers for four bundle ACSR MOOSE conductor for 400 kV (Quad) line shall be offered. The spacer damper covered by this specification shall be designed to maintain the bundle spacing of 457 mm under all normal operating conditions and to effectively control Aeolian vibrations as well as sub span oscillation and to restore conductor spacing after release of any external extraordinary load. The nominal sub conductor spacing shall be maintained within ± 5 mm.

2.5.2 The spacer damper shall restore the normal sub-conductor spacing due to displacement by wind, electromagnetic and electrostatic forces including the specified short circuit level without permanent deformation or damage either to bundle conductors or to spacer damper itself.

2.5.3 The design offered shall be presented as a system consisting of spacer dampers and their staggering scheme for spans ranging from 100 m to 1100 m. A vibration performance test shall be carried out on an experimental test line. The systems tested should be those specified by the Supplier for the 400 kV line conditions. Only systems satisfying the performance criteria under Annexure-A shall be submitted by Bidder along with bid.

The test line selected for the performance evaluation shall have been designed for that purpose, be adequately exposed to wind and properly instrumented.

Sl.	Description	Technical Particulars
1.	Configuration	Double circuit for 400 kV line: Four ACSR MOOSE Quad conductor bundle per phase and all three phases in vertical configuration. Refer section-I for mechanical properties of conductor
2.	Span length in metres i) Ruling design span ii) Maximum span iii) Minimum Span	400 metres 1100 metres 100 metres
3.	Tensile load in each sub-conductor	As per sag tension calculations.
4.	Armour rods used	Yes
5.	Maximum permissible dynamic strains	± 150 micro strains

- 2.5.4 The operating conditions specified, the spacer damper system shall adequately control Aeolian vibrations throughout the life of the transmission line with wind velocity ranging from 0 to 30 km per hour in order to prevent damage to conductor at suspension clamps, dead end clamps and spacer damper clamps.
- 2.5.5 The spacer damper system shall also control the sub-span oscillations in order to prevent conductor damage due to chaffing and severe bending stresses at the spacer damper clamps as well as suspension and dead end clamps and to avoid wear to spacer damper components.
- 2.5.6 The spacer damper shall consist of a rigid central body called the frame linked to the conductor by four articulated arms terminated by suitable clamping system. The articulation shall be designed to provide elastic and damping forces under angular movement of the arms. The dynamic characteristics of the articulations shall be maintained for the whole life of the transmission line.
- 2.5.7 The clamping system shall be designed to provide firm but gentle and permanent grip while protecting the conductor against local static or dynamic stresses expected during normal operating conditions. The clamping system shall be designed to compensate for any reduction of conductor diameter due to creep.
- 2.5.8 Bolted type clamps shall allow installation without removal of the bolts or the clamps from clamp body. Locking mechanism shall be suitable to prevent bolt loosening. Clamp locking devices with small loose components shall not be accepted. Nut cracker, hinged open or boltless type clamps are acceptable provided adequate grip can be maintained on the conductor.
- 2.5.9 Bolts and nuts shall be of mild steel, stainless steel, or high strength steel in accordance with the design of the spacer damper.
- 2.5.10 Where elastomer surfaced clamps are used, the elastomer elements shall be firmly fixed to the clamp. The insert should be forged from aluminium alloy of type 6061 or equivalent aluminium alloy having minimum tensile strength of 25 kg/mm². The insert shall be moulded on the insert surface. The insert shall be duly heat treated and aged to retain its consistent characteristics during service. The grain flow of the forged insert shall be in the direction of the maximum tension and compression loads experienced.
- 2.5.11 If clamps involving preformed rods are used, these rods shall be designed for specific conductor size. They shall be made of high strength aluminium alloy of type 6061 or equivalent aluminium alloy having a minimum tensile strength of 35 kg/mm³. The rods shall be ball ended. The rods shall be heat treated and aged to achieve specified mechanical properties and to retain the same during service. The length of the rods shall be such that the ends fall inside the imaginary square whose sides are vertical and horizontal outer tangents to the conductor sections.

- 2.5.12 The spacer damper body shall be cast/forged from suitable high strength corrosion resistant aluminum alloy. The aluminium alloy shall be chosen in relation with the process used.
- 2.5.13 The rubber components involved in the design such as damping elements shall be made with rubber compound selected specifically for that particular application. The Bidder shall submit a complete list of physical and mechanical properties of the elastomer used. This list shall make reference to all applicable ASTM standards.
- 2.6.4 The rubber components used shall have good resistance to the effects of temperature up to 95°C and to ultraviolet radiation, ozone and other atmospheric contaminants. The rubber shall have good wear and fatigue resistance and shall be electrically semi-conductive.
- 2.5.14 The spacer damper involving ferrous material shall not have magnetic power loss more than that stipulated in the Standard Technical Particulars at 600 A, 50 Hz alternating current per sub-conductor.
- 2.5.15 The spacer damper assembly shall have electrical continuity. The electrical resistance between the sub-conductors across the assembly in case of spacer damper involving elastomer surfaced clamps shall be suitably selected by the manufacturer to ensure satisfactory electrical performance and avoid deterioration of elastomer under service conditions.
- 2.5.16 The spacer damper assembly shall have complete ease of installation and shall be capable of removal/reinstallation without any damage.
- 2.5.17 The spacer damper assembly shall be capable of being installed and removed from the energized line by means of hot line techniques. The Bidder shall supply with the bid the complete description of the installation, removal and reinstallation procedure.
- 2.5.18 The Bidder shall recommend the staggering scheme for installation of spacer dampers on the line which shall ensure most satisfactory fatigue performance of the line as specified. The scheme shall indicate the number of spacer dampers per phase per span and the sub span lengths to be maintained between spacer dampers while installing on the four bundle conductors.
- 2.5.19 The staggering scheme shall be provided for spans ranging from 100 m to 1100 m. The number of spacer dampers for a nominal ruling span of 400 m shall not be less than six.
- 2.5.20 No sub span shall be greater than 70 m and no end sub span shall be longer than 40 m.
- 2.5.21 The staggering scheme shall be such that the spacer dampers be unequally distributed along the span to achieve sufficient detuning of adjacent sub spans for oscillations of sub span mode and to ensure bundle stability for wind speeds up to 60 km/hr.

- 2.5.22 The Bidder shall furnish all the relevant technical documents in supports of the staggering scheme recommended for the spacer damper.

2.6 Rigid Spacer for Jumper for Quad Conductor

- 2.6.1 Jumpers at tension points shall be fitted with spacers so as to limit the length of free conductor to 3.65 m and to maintain the sub conductor spacing of 457 mm. Bidder shall quote for rigid spacer for jumper. It shall meet all the requirements of spacer used in line except for its vibration performance. Spacers requiring retaining rods shall not be quoted for jumpers.
- 2.62 The spacer offered by the Bidder shall satisfy the following requirements.
- 2.6.2.1 Spacer shall restore normal spacing of the sub conductors after displacement by wind, electromagnetic and the electrostatic forces under all operating conditions including the specified short circuit level without permanent deformation damage either to conductor or to the assembly itself. They shall have uniform grip on the conductor
- 2.6.2.2 For spacer requiring retaining rods, the retaining rods shall be designed for the specified conductor size. The preformed rods shall be made of high strength, special aluminium alloy of type 6061/65032 and shall have minimum tensile strength of 35 kg/sq.mm. The ends of retaining rods should be ball ended. The rods shall be heat-treated to achieve specified mechanical properties and give proper resilience and retain the same during service.
- 2.6.2.3 Four number of rods shall be applied on each clamps to hold the clamp in position. The minimum diameter of the rods shall be 7.87 ± 0.1 mm and the length of the rods shall not be less than 1100 mm.
- 2.6.2.4 Where elastomer surfaced clamp grooves are used, the elastomer shall be firmly fixed to the clamp. The insert should be forged from aluminium alloy of type 6061/65032. The insert shall be duly heat treated and aged to retain its consistent characteristics during service.
- 2.6.2.5 Any nut used shall be locked in an approved manner to prevent vibration loosening. The ends of bolts and nuts shall be properly rounded for specified corona performance or suitably shielded.
- 2.6.2.6 Clamp with cap shall be designed to prevent its cap from slipping out of position when being tightened.
- 2.6.2.7 The clam grooves shall be in uniform contact with the conductor over the entire surface, except for rounded edges. The groove of the clamp body and clamp cap shall be smooth and free of projections, grit or other material. which cause damage to the conductor when the clamp is installed.
- 2.6.2.8 For the spacer involving bolted clamps, the manufacturer must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5 kN and 5 kN. The clamp when installed on the conductor shall not cause excessive stress concentration on the conductor leading to permanent deformation of the conductor strands and premature fatigue failure in operation.

- 2.6.2.9 Universal type bolted clamps, covering a range of conductor sizes, will not be permitted.
- 2.6.2.10 No rubbing, other than that of the conductor clamp hinges or clamp swing bolts, shall take place between any parts of the spacer. Joint incorporating a flexible medium shall be such that there is no relative slip between them.
- 2.6.2.11 The spacer shall be suitably designed to avoid distortion or damage to the conductor or to themselves during service.
- 2.6.2.12 Rigid spacers shall be acceptable only for jumpers.
- 2.6.2.13 The spacer shall not damage or chafe the conductor in any way which might affect its mechanical and fatigue strength or corona performance.
- 2.6.2.14 The clamping system shall be designed to compensate for any reduction in diameter of conductor due to creep.
- 2.6.2.15 The spacer assembly shall not have any projections, cuts, abrasions etc. or chattering parts which might cause corona or RIV.
- 2.6.2.16 The spacer tube shall be made of aluminium alloy of type 6061/65032. If fasteners of ferrous material are used, they shall conform to and be galvanised conforming to relevant Indian Standards. The spacer involving ferrous fasteners shall not have magnetic power loss more than one watt at 600 Amps 50 Hz alternating current per sub conductor.
- 2.6.2.17 Elastomer, if used, shall be resistant to the effects of temperature up to 95 deg.C, ultraviolet radiation and other atmospheric contaminants likely to be encountered in service. It shall have good fatigue characteristics. The physical properties of the elastomer shall be of approved standard.
- 2.6.2.18 The spacer assembly shall have electrical continuity. The electrical resistance between the sub-conductor across the assembly in case of spacer having elastomer clamp grooves shall be suitably selected by the manufacturers to ensure satisfactory electrical performance and to avoid deterioration of elastomer under all service conditions.
- 2.6.2.19 The spacer assembly shall have complete ease of installation and shall be capable of removal/reinstallation without any damage.
- 2.6.2.20 The spacer assembly shall be capable of being installed and removed from the energised line by means of hot line technique.

2.7 Material and Workmanship

- 2.7.1 All the equipment shall be of the latest proven design and conform to the best modern practice adopted in the extra high voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 400 kV transmission line application with bundle conductors and will give continued good performance.
- 2.7.2 The design, manufacturing process and quality control of all the materials shall be such as to achieve requisite factor of safety for maximum working load, highest mobility, elimination of sharp edges and corners, best resistance to corrosion and a good finish.

- 2.7.3 All ferrous parts shall be hot dip galvanised, after all machining has been completed. Nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electro galvanised as per grade 4 of IS-1573-1970. The bolt threads shall be undercut to take care of increase in diameter due to galvanising. Galvanising shall be done in accordance with IS:2629/IS-1367 (Part-13) and satisfy the tests mentioned in IS-2633. Fasteners shall withstand four dips while spring washers shall withstand three dips. Other galvanised materials shall have a minimum overall coating of Zinc equivalent to 900 gm/sq.m and shall be guaranteed to withstand at least six dips each lasting one minute under the standard Preece test for galvanising unless otherwise specified. The average thickness of zinc coating shall be 127 microns.
- 2.7.4 The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanising shall be of grade Zn.99.95 as per IS:209.
- 2.7.5 In case of castings, the same shall be free from all internal defects like shrinkage, inclusion, blow holes. cracks etc.
- 2.7.6 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum and localised heating phenomenon is averted.
- 2.7.7 No equipment shall have sharp ends or edges, abrasions or projections and shall not cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under all service conditions.
- 2.7.8 Particular care shall be taken during manufacture and subsequent handling to ensure smooth surface free from abrasion or cuts.
- 2.7.9 The fasteners shall conform to the requirements of IS:6639. All fasteners and clamps shall have corona free locking arrangement to guard against vibration loosening.

2.8 Compression Markings

Die compression areas shall be clearly marked on each equipment designed for continuous die compressions and shall bear the words 'COMPRESS FIRST' suitably inscribed on each equipment where the compression begins. If the equipment is designed for intermittent die compressions, it shall bear the identification marks 'COMPRESSION ZONE' and 'NON-COMPRESSION ZONE' distinctly with arrow marks showing the direction of compression and knurling marks showing the end of the zones. The letters, number and other markings on finished equipment shall be distinct and legible.

2.9 Bid Drawings

2.9.1 The Bidder shall furnish detailed dimensioned drawings of the equipments and all component parts. Each drawing shall be identified by a drawing number and Contract number. All drawings shall be neatly arranged. All drafting and lettering shall be legible. The minimum size of lettering shall be 3 mm. All dimensions and dimensional tolerances shall be mentioned in mm.

2.9.2 The drawings shall include

- (i) Dimensions and dimensional tolerances
- (ii) Material fabrication details including any weld details and any specified finishes and coatings. Regarding material, designations and reference of standards are to be indicated.
- (iii) Catalogue No.
- (iv) Marking
- (v) Weight of assembly
- (vi) Installation instructions
- (vii) Design installation torque for the bolt or cap screw
- viii) Withstand torque that may be applied to the bolt or cap screw without failure of component parts
- (ix) The compression die number with recommended compression pressure.
- (x) All other relevant technical details

2.9.3 Placement charts for spacer and damper

2.9.4 The above drawings shall be submitted with all the details as stated above along with the bid document. After the placement of award, the Contractor shall again submit the drawings in four copies to the Purchaser for approval. After Purchaser's approval and successful completion of all type tests, 10 (ten) more sets of drawings shall be submitted to Purchaser for further distribution and field use at Purchaser's end.

3.0 G.S.S.Earth wire Accessories

3.1 General

3.1.1 This portion Specify the details of the technical particulars of the accessories for Galvanised Steel Earth wire.

3.1.2 2.5% extra fasteners shall be supplied.

3.2 Mid Span Compression Joint

Mid Span Compression Joint shall be used for joining two lengths of earth wire. The joint shall be made of mild steel with aluminium encasing. The steel sleeve should not crack or fail during compression. The Brinell Hardness of steel should not exceed the value as stipulated in the Standard Technical Particulars. The steel sleeve shall be hot dip galvanised.

The aluminium sleeve shall have aluminium of purity not less than that stipulated in the Standard Technical Particulars. Filler aluminium sleeve shall also be provided at the both ends. The joints shall not permit slipping off, damage to or failure of the complete earth wire or any part thereof at a load not less than 95% of the ultimate tensile strength of the earth wire. The joint shall have resistivity less than 75% of resistivity of equivalent length of earth wire. The dimensions and the dimensional tolerances of the joint shall be as stipulated in the Standard Technical Particulars.

3.3 **Vibration Damper**

- 3.3.1 Vibration dampers of 4R-Stockbridge type with four (4) different frequencies spread within the specified aeolian frequency band-width corresponding to wind speed of 5m/s to 7 m/s shall be used for suspension and tension points on each earth wire in each span to damp out aeolian vibrations as mentioned herein after.
- 3.3.2 Alternate damping systems or “Dogbone” dampers offering equivalent or better performance also shall be acceptable provided the manufacturer meets the qualifying requirements stipulated in the Specifications. Relevant technical documents to establish the technical suitability of alternate systems shall be furnished by the Bidder along with the bid.
- 3.3.3 One damper minimum on each side per earth wire at suspension points and two dampers on each side per earth wire at tension points shall be used for ruling design span of 400 meters for 400 kV line.
- 3.3.4 The Bidder may offer damping system involving more number of dampers per ruling design span than the specified. However suitable price compensation shall be considered for evaluation. For the purpose of price compensation 80% of towers as suspension locations and 20% of the towers as tension locations and all the spans assumed to be ruling design spans.
- 3.3.5 The clamp of the vibration damper shall be made of aluminium alloy. It shall be capable of supporting the damper during installation and prevent damage or chaffing of the earth wire during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the earth wire without damaging the strands or causing premature fatigue failure of the earth wire under the clamp. The clamp groove shall be in uniform contact with the earth wire over the entire clamping surface except for the rounded edges. The groove of the clamp body and clamp cap shall be smooth, free from projections, grit or materials which could cause damage to the earth wire when the clamp is installed. Clamping bolts shall be provided with self locking nuts designed to prevent corrosion of the threads or loosening during service.
- 3.3.6 The messenger cable shall be made of high strength galvanised steel/stainless steel with a minimum strength of 135 Kg/sq.mm. It shall be of preformed and post formed quality in order to prevent subsequent droop of weights and to maintain consistent flexural stiffness of the cable in service. The number of standards in the messenger cable shall be 19. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion.

3.3.7 The damper mass shall be made of hot dip galvanised mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks, shrinkages, inclusions and blow holes etc. The inside and outside surfaces of the damper masses shall be smooth.

3.3.8 The vibration analysis of the system, with and without damper, dynamic characteristic of the damper as detailed under Annexure-A, shall have to be submitted by the Bidder along with his bid. The technical particulars for vibration analysis and damping design of the system are as follows:-

Sl. o.	Description	Technical particulars
1.	Configuration	One continuously steel earthwire 10.98 mm diameter in horizontal configuration. Refer to Section-I for mechanical properties of the earthwire.
2.	Span length in meters	
i)	Ruling design span	400 meters
ii)	Maximum span	1100 meters
iii)	Minimum span	100 meters
3.	Tensile load in Conductor at temperature of 0 deg. C and still air	As per sag tension calculations.
4.	Maximum permissible dynamic strain	+/- 150 micro strains

3.3.9 The damper placement chart for spans ranging from 100 m to 1100 m shall be submitted by the Bidder. All the placement charts should be duly supported by relevant technical documents.

3.3.10 The damper placement charts shall include the following :

- (1) Location of the dampers for various combinations of spans and line tensions clearly indicating number of dampers to be installed per earth wire per span.
- (2) Placement distances clearly identifying the extremities between which the distances are to be measured.
- (3) Placement recommendation depending upon type of suspension clamps (viz, free center type/trunion type etc.)
- (4) The influence of mid span compression joints in the placement of dampers.

3.4 Flexible Copper Bond

The flexible copper bond shall be circular in cross-section of minimum 34 sq.mm equivalent copper area and not less than 500 mm in length. It shall consist of 259 wires of 0.417 mm dia. tinned copper conductor. It shall be laid up as 7 stranded ropes, each of 37 bunched wires. The tinning shall be as per

relevant Indian Standard. Two tinned copper connecting lugs shall be press jointed to either ends of the flexible copper cable. One lug shall be suitable for 12 mm, dia. bolt and the other for 16 mm dia bolt. The complete assembly shall also include one 16 mm dia., 40 mm long HRH MS Bolt hot dip galvanised with nut and lock washer.

3.5 Suspension Clamp

- 3.5.1 Standard anchor shackle/twisted shackle for earth wire suspension clamp shall be supplied for attaching to the hanger plate of tower.
- 3.5.2 At all suspension towers, suitable suspension clamps shall be used to support the required earth wire. The clamps shall be of either free center type or trunion type and shall provide adequate area of support to the earth wire. The groove of the clamp shall be smooth, finished in an uniform circular or oval shape and shall slope downwards in a smooth curve to avoid edge support and hence to reduce the intensity of bending moment on earth wire.
- 3.5.3 There shall be no sharp point in the clamps coming in contact with earth wire. There shall not be any displacement in the configuration of the earth wire strands nor shall the strands be unduly stressed in final assembly during working conditions.
- 3.5.4 The clamping piece and the clamp body shall be clamped by at least two U-bolts of size not less than 10 mm diameter having one nut and one 3 mm thick lock nut with washer on each of its limbs. Suspension clamps shall be provided with inverted type U-bolts. One limb of the U-bolt shall be long enough to accommodate the lug of the flexible copper bond.
- 3.5.5 The Contractor shall supply all the components of the suspension assembly including shackles, bolts, nuts, washers, split pin etc. The total drop of the suspension assembly from the center point of the attachment to the center point of the earth wire shall not exceed 150 mm. The design of the assembly shall be such that the direction of run of the earth wire shall be same as that of the conductor.
- 3.5.6 The complete assembly shall be guaranteed for slip strength of not less than 12 kN and not more than 17 kN. The breaking strength of the assembly shall not be less than 25 kN.

3.6 Tension Clamp

- 3.6.1 At all tension towers suitable compression type tension clamps shall be used to hold the required galvanised steel earth wire. Anchor shackle shall be supplied which shall be suitable for attaching the tension clamp to strain plates.
- 3.6.2 The clamps shall have adequate area of bearing surface to ensure positive electrical and mechanical contact and shall not permit any slip to the earth wire under working tension and vibration conditions. The angle of jumper terminal to be mounted should be 30 deg. with respect to the vertical line.

- 3.6.3 The clamps shall be made of mild steel with aluminium encasing. The steel should not crack or fail during compression. The Brinell hardness of steel sleeve shall not exceed 200. The steel sleeve shall be hot dip galvanised. The aluminium encasing shall have aluminium of purity not less than 99.5%. Filler aluminium sleeve shall also be provided at the end.
- 3.6.4 The complete assembly shall be so designed as to avoid undue bending in any part of the clamp and shall not produce any hindrance to the movements of the clamps in horizontal or vertical directions.
- 3.6.5 The slip strength of the assembly shall not be less than 95% of the ultimate strength of the earth wire.
- 3.6.6 The clamps shall be complete with all the components including anchor shackle, bolts, nuts, washers, split pin, jumper arrangement etc.

3.7 Material and Workmanship

Same as Clause 2.7 of this section

3.8 Compression Marking

Same as Clause 2.8 of this section

3.9 Bid Drawings

Same as Clause 2.9 of this section

4.0 STANDARD TECHNICAL PARTICULARS

- 4.1 The Standard technical particulars to adhered by the contractor / manufacturer are furnished below:

Standardised Technical Particulars of Hardware Fittings and Accessories of Quad ACSR MOOSE conductor for 400 kV Transmission Line

1.	SUSPENSION HARDWARE FITTINGS FOR QUAD ACSR 'MOOSE' CONDUCTOR				
Sl.	Description	Unit	Particulars / Value		
			<u>Double 'T'</u>		<u>Single 'T' Pilot</u>
			AGS clamp	Free centre clamp	Envelope clamp
1.	Maximum magnetic power loss of suspension assembly at sub conductor current of 600 amperes, 50Hz AC	Watt	4		8
2.	Slipping strength of suspension assembly(clamp torque Vs slip curve shall be enclosed)	kN	20-29		
3.	Particulars of standard/AGS Standard / AGS preformed armour rod set for suspension assembly				
	a) No. of rods per set	No.	12		NA
	b) Direction of lay		Right Hand		NA
	c) Overall length after fitting on conductor	mm	2235	2540	NA

	d) Diameter of each rod	mm	9.27	NA
	e) Tolerance in			NA
	i) Diameter of each rod	±mm	0.10	NA
	ii) Length of each rod	±mm	25	NA
	iii) Difference of length between the longest and shortest rod in a set	±mm	13	NA
	g) Type of Aluminium alloy used for manufacture of PA rod set		6061/ 65032	NA
	h) UTS of each rod	Kg/mm ² (Min)	35	NA
4.	Particulars of Elastomer (For AGS Clamp only)			
	a) Type of elastomer		Chloroprene / Neoprene	NA NA
	b) Shore hardness of elastomer		65 - 80	NA NA
	c) Temperature range for which elastomer is designed	°C	Upto 95°C	NA NA
	d) Moulded on insert		Yes	NA NA
5.	Mechanical Strength of Suspension fitting (excluding suspension clamp)	KN	240	120
6.	Mechanical Strength of suspension clamp.		70 70	70
7.	Purity of Zinc used for galvanising	%	As per IS:209 / IS 13229	
8.	Min. No. of dips in standard preece test the ferrous parts can withstand	No	a) Fasteners : 4 dips of 1 min b) Spring washers : 3 dips of 1 min c) All others : 6 dips of 1 min	

2.	TENSION HARDWARE FITTINGS QUAD ACSR MOOSE CONDUCTOR			
Sl.	Description	Unit	Particulars / Value	
			Single Tension	Quad Tension
1.	Mechanical Strength of Tension fittings (excluding dead end clamp)	kN	120	640
2.	Type of Dead End assembly		Compression	
3.	Compression Pressure	MT	100	
4.	Maximum electrical resistance of dead end assembly as a percentage of equivalent length of Conductor	%	75	
5.	Slip strength of dead end assembly	kN	153.2	
6.	Purity of Zinc used for galvanising	%	As per IS:209 / IS 13229	
7.	Min. No. of dips in standard preece test the ferrous parts can withstand.	Nos	a) Fasteners : 4 dips of 1 min b) Spring washers : 3 dips of 1 min c) All others : 6 dips of 1 min	

Mid span compression Joint for ACSR MOOSE Conductor				
Sl.	Description	Unit	Particulars/ Value	
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>
1.	Material of Joint		Aluminium of purity 99.5%	Mild Steel(Fe-410, IS:2062)
2.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN	From 100 to 200	
3.	Weight of Zinc coating for steel sleeve	gm/m ²	610	
4.	Dimension of sleeve Before compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Inside diameter	mm	34.00 ± 0.5	11.10 ± 0.2
ii)	Outside diameter	mm	54.00 ± 1.0	21.00 ± 0.5
iii)	Length	mm	735 ± 5	250 ± 5
5.	Dimensions of Sleeve after compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Outside dimension(Corner to corner)	mm	53.00 ± 0.5	20.20 ± 0.5
ii)	Outside dimension (face to face)	mm	46.00 ± 0.5	17.50 ± 0.5
iii)	Length	mm	785 ± 5	286 ± 5
6.	Slip strength	KN	153.2	
7.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare conductor.	%	75	
8.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320	
9.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro Volts	1000	

Repair sleeve for ACSR MOOSE Conductor			
Sl.	Description	Unit	Particulars/ Value
1.	Material		Aluminium of minimum purity 99.5%
2.	Dimension of Aluminum sleeve Before compression		
i)	Inside diameter	mm	34.00 ± 0.5
ii)	Outside diameter	mm	54.00 ± 1.0
iii)	Length	mm	305 ± 5.0
3.	Dimensions of Aluminum Sleeve after compression		
i)	Outside dimension(Corner to corner)	mm	53.00 ± 0.5
ii)	Outside dimension (face to face)	mm	46.00 ± 0.5
iii)	Length	mm	330 ± 5
4.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
5.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro Volts	1000

QUAD SPACER DAMPER FOR QUAD ACSR MOOSE CONDUCTOR					
Sl.	Description	Unit	Particulars / Value		
1.	Type of Clamps		Bolted / Nut cracker / Hinged open / Boltless / Preformed rods.		
2.	Type of Damping element		Spring / Elastomer / EPDM		
3.	Material of				
	(a) Clamp		Al Alloy IS:4600 or Equivalent		
	(b) Body		Galvanised Steel / Al Alloy 4600 or Equivalent		
4.	Elastomer (<i>if used</i>)				
	(a) Shore hardness		50 - 80		
	(b) Temp. range for which designed	°C	Upto 95°C		
5.	Minimum ultimate tensile strength of spacer				
	(a) Compressive load	kN	14		
	(b) Tensile load	kN	7.0		
6.	Slipping strength of spacer clamp				
	(a) Before vibration test	kN	Clamp type	Longitudinal Load (kN)	Maxm Slip permitted (mm)
			Metal – Metal Bolted	6.5	1
			Rubber loaded	2.5	2.5
			Preformed rods	2.5	12
	(b) After vibration test	kN	80% of the above values		
7.	Maximum magnetic power loss of at sub conductor current of 600 amperes, 50Hz AC	Watt	Below 1 watt.		
8.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320		
9.	Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) Microvolts under dry condition	µV	Below 1000		

QUAD RIGID SPACER FOR QUAD ACSR MOOSE CONDUCTOR					
Sl.	Description	Unit	Particulars / Value		
1.	Material of				
	(a) Clamp		Al Alloy IS:4600 or Equivalent		
	(b) Body		Galvanised Steel / Al Alloy 4600 or Equivalent		
2.	Elastomer (<i>if used</i>)				
	(a) Shore hardness		65 - 80		
	(b) Temp. range for which designed	°C	Upto 95°C		
3.	Minimum ultimate tensile strength of spacer				
	(a) Compressive load	kN	14		
	(b) Tensile load	kN	7.0		
4.	Slipping strength of spacer clamp	kN	Clamp type	Longitudnal Load (kN)	Maxm Slip permitted (mm)
			Metal – Metal Bolted	6.5	1
			Rubber loaded	2.5	2.5
			Preformed rod	2.5	12
5.	Maximum magnetic power loss of at sub conductor current of 600 amperes, 50Hz AC	Watts	Below 1 watt.		
6.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320		
7.	Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) Microvolts under dry condition	µV	Below 1000		

T-connector for ACSR MOOSE Conductor			
Sl.	Description	Unit	Particulars/ Value
1.	Material		Aluminium of purity 99.5%
2.	Dimension of Aluminum sleeve Before compression		
	i) Inside diameter	mm	34.00 ± 0.5
	ii) Outside diameter	mm	54.00 ± 1.0
	iii) Length	mm	400.00 ± 5.0
3.	Dimensions of Aluminum Sleeve after compression		
	i) Outside dimension(Corner to corner)	mm	53.00 ± 0.5
	ii) Outside dimension (face to face)	mm	46.00 ± 0.5
4.	Axial tensile strength of welded portion of T-connector	KN	30
5.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare conductor.	%	75
6.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
7.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro Volts	1000

Standardised Technical Particulars of Accessories of 7/3.66mm GSS. Earthwire

1. MID SPAN COMPRESSION JOINT FOR 7/3.66 MM GSS EARTHWIRE

Sl.	Description	Unit	Particulars/ Value		
			<u>Aluminium / Filler Sleeve</u>		<u>Steel Sleeve</u>
1.	Material of Joint		Aluminium of minimum purity 99.5%	Mild Steel(Fe-410, IS:2062)	
2.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN	From 100 to 200		
3.	Dimension of sleeve Before compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	<u>Alu filler sleeve</u>
i)	Inside diameter	mm	22.00 ± 0.5	11.50 ± 0.2	11.50 ± 0.2
ii)	Outside diameter	mm	30.00 ± 0.5	21.00 ± 0.5	21.00 ± 0.5
iii)	Length	mm	400 ± 5	230 ± 5	60 ± 5
4.	Dimensions of Sleeve after compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	
i)	Outside dimension(Corner to Corner)	mm	29.40 ± 0.5	20.20 ± 0.5	
ii)	Outside dimension (face to face)	mm	25.00 ± 0.5	17.50 ± 0.5	
iii)	Length	mm	430 (approx)	265 (approx)	
5.	Slip strength	KN	65		
6.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare Earthwire	%	75		
7.	Galvanising				
a)	Minimum weight of Zinc coating for steel parts	gm/m2	600		
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5(IS 13229)		
c)	Min. No. of dips in standard preece test the ferrous parts can withstand.	Nos.	6 dips of 1 minute		

2. FLEXIBLE COPPER BOND FOR 7/3.66 MM GS EARTHWIRE

Sl.	Description	Unit	Particulars/ Value
1.	Stranding		37/7/0.417
2.	Cross sectional area	Sq.mm	35.4
3.	Minimum copper equivalent area	Sq.mm	34
4.	Length of copper cable	mm	500 + 5
5.	Material of lugs		Tinned copper
6.	Bolt Size		
	i) Diameter	mm	16
	ii) Length	mm	40
7.	Slip Strength	kN	3

3. VIBRATION DAMPER FOR 7/3.66 MM GS EARTHWIRE			
Sl.	Description	Unit	Particulars/ Value
1.	Type of Damper		4R-Stockbridge type
2.	Materials of components		
	a) Damper masses		Cast iron/mild steel/Zinc alloy duly hot dip galvanised
	b) Clamp		Aluminum alloy 4600
	c) Messenger cable		High tensile strength galvanized steel
3.	Number of strands in stranded messenger cable	Nos.	19
4.	Minimum ultimate tensile strength of stranded messenger cable	Kg/mm ²	135
5.	Slip strength of stranded messenger cable (mass pull off)	kN	2.5
6.	Slipping strength of damper clamp		
	(a) Before fatigue test	kN	2.5
	(b) After fatigue test	kN	2
7.	Resonance frequencies range	Hz	10 to 60
8.	Percentage variation in reactance after fatigue test in comparison with that . before fatigue test	%	+/-40 (Maximum)
9.	Percentage variation in power dissipation after fatigue test in comparison with that before fatigue test	%	+/-40 (Maximum)
10.	Galvanising		
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	600
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard prece test the ferrous parts can withstand.	Nos.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute

4. SUSPENSION CLAMP FOR 7/3.66 MM GS EARTHWIRE

Sl.	Description	Unit	Particulars/ Value
1.	Material of components		
	(a) Shackle		Forged Steel
	(b) Clamp Body & Keeper		Malleable cast iron / SGI / Al Alloy 4600
	(c) U- Bolt		Mild Steel
2.	Total Drop (Maximum)	mm	150
3.	Breaking Strength (Minimum)	kN	25
4.	Slipping Strength	kN	12 to 17
5.	Galvanising		
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	600
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard prece test the ferrous parts can withstand.	Nos.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute

5. TENSION CLAMP FOR 7/3.66 MM GSS EARTHWIRE

Sl.	Description	Unit	Particulars/ Value		
1.	Material of components				
	(i) Anchor Shackle		Forged Steel		
	(ii) Compression Clamp				
	a) Steel Sleeve		Mild Steel		
	b) Aluminium sleeve		Aluminium of purity 99.5%		
	c) Aluminium Filler sleeve		Aluminium of purity 99.5%		
3.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN	120-200		
4.	Dimension of sleeve Before compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	<u>Alu filler sleeve</u>
i)	Inside diameter	mm	22.00 ± 0.5	11.50 ± 0.2	11.50 ± 0.2
ii)	Outside diameter	mm	30.00 ± 0.5	21.00 ± 0.5	21.00 ± 0.5
iii)	Length	mm	245 ± 5	205 ± 5	25 .0
5.	Dimensions of Sleeve after compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	
i)	Outside dimension(Corner to Corner)	mm	29.40 ± 0.5	20.20 ± 0.5	
ii)	Outside dimension (face to face)	mm	25.00 ± 0.5	17.50 ± 0.5	
6.	Slip strength	KN	65		
7.	Minimum Breaking strength of assembly (excluding clamp)	KN	70		
8.	Compression Pressure	Ton	100		
9.	Galvanising				
a)	Minimum weight of Zinc coating for steel parts	gm/m2	600		
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5(IS 13229)		
c)	Min. No. of dips in standard preece test the ferrous parts can withstand.	Nos.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute		

5.0 Tests and Standards**5.1 Type Tests****5.1.1 On the complete Insulator String with Hardware Fittings****5.1.1.1 On the complete Disc Insulator String with Hardware Fittings**

- a) Power frequency voltage withstand test with : As per IEC:383
corona control rings/grading ring and arcing horns
under wet condition
- b) Switching surge voltage withstand test under wet : As per IEC:383
condition

- c) Impulse voltage withstand test under dry condition : As per IEC:383
- d) Impulse voltage flashover test under dry condition : As per IEC:383
- e) Voltage distribution test : As per Annexure-A
- f) Corona and RIV test under dry condition : As per Annexure-A
- g) Mechanical Strength test : As per Annexure-A
- h) Vibration test : As per Annexure-A
- i) Power Arc Test (for 400 kV only) : As per Annexure-A

5.1.2 On Suspension Hardware Fitting only

- a) Magnetic power loss test for suspension assembly : As per Annexure-A
- b) Clamp slip strength Vs torque test for suspension clamp : As per Annexure-A
- c) Mechanical strength Test : As per Annexure-A
- d) Ozone Test on elastomer : As per Annexure-A

5.1.3 On Tension Hardware Fitting only

- a) Electrical resistance test for dead end Assembly : As per IS:2486 (Part-I)
- b) Heating cycle test for for dead end Assembly : As per IS:2486 (Part-I)
- c) Slip strength test for dead end assembly : As per IS:2486 (Part-I)
- d) Mechanical strength test : As per Annexure-A

5.1.4 Mid Span Compression Joint for Conductor and Earthwire

- a) Chemical analysis of materials : As per Annexure-A
- b) Electrical resistance test :As per IS:2121 (Part-II)
- c) Heat cycle test :As per IS:2121 (Part-II)
- d) Slip strength test : As per Annexure-A
- e) Corona Extinction Voltage (Dry) : As per Annexure-A
- f) Radio Interference Voltage (dry) : As per Annexure-A

Note : Tests mentioned at (c), (e) & (f) are not applicable to mid span compression joints for earthwire

5.1.5 Repair Sleeve for Conductor

- a) Chemical analysis of materials : As per Annexure-A
- b) Corona extinction voltage test (dry) : As per Annexure-A
- c) Radio interference voltage test (dry) : As per Annexure-A

5.1.6 PG Clamps/T-Connector for Conductor

a)	Chemical analysis of materials	: As per Annexure-A
b)	Electrical resistance test	:As per IS:2121 (Part-II), Clause 6.5 & 6.6
c)	Heating cycle test	:As per IS:2121 (Part-II)
d)	Axial tensile load test on welded portion	: As per Annexure-A
e)	Corona extinction voltage test (dry)	: As per Annexure-A
f)	Radio interference voltage test (dry)	: As per Annexure-A

5.1.7 Flexible Copper Bond

a)	Slip strength test	: As per Annexure-A

5.1.8 Vibration Damper for Earthwire

a)	Chemical analysis of materials	: As per Annexure-A
b)	Dynamic characteristics test	: As per Annexure-A
c)	Vibration analysis	: As per Annexure-A
d)	Clamp slip test	: As per Annexure-A
e)	Fatigue tests	: As per Annexure-A
f)	Damper efficiency test	: As per IS:9708

5.1.9 Quad Spacer Damper for Conductor

a)	Chemical analysis of materials	: As per Annexure-A
b)	Clamp slip test	: As per Annexure-A
c)	Performance test	: As per Annexure-A
	i) Aeolian	
	ii) sub span oscillations	
d)	Magnetic power loss test (if applicable)	: As per Annexure-A
e)	Dynamic Characteristic test	
f)	Fatigue test	
g)	Tension-compression Test	: As per Annexure-A
h)	Corona extinction voltage test (dry)	: As per Annexure-A
i)	Radio interference voltage test (dry)	: As per Annexure-A
j)	Ozone test on elastomer	: As per Annexure-A

5.1.10 Rigid Spacer for jumper

- a) Chemical analysis of materials : As per Annexure-A
- b) Clamp slip test : As per Annexure-A
- c) Magnetic power loss test (if applicable) : As per Annexure-A
- d) Tension-compression Test : As per Annexure-A
- e) Corona extinction voltage test (dry) : As per Annexure-A
- f) Radio interference voltage test (dry) : As per Annexure-A

5.1.11 On Earthwire Suspension clamp Assembly

- a) Chemical analysis of materials : As per Annexure-A
- b) Clamp slip strength Vs torque test for suspension clamp : As per Annexure-A
- c) Mechanical strength Test : As per Annexure-A

5.1.12 On Earthwire Tension clamp Assembly

- a) Chemical analysis of materials : As per Annexure-A
- b) Mechanical strength test (excluding clamp) : As per Annexure-A
- c) Slip strength test for tension assembly : As per Annexure-A
- d) Electrical resistance test for tension clamp : As per Annexure-A

5.1.14 All the type tests given under clause no. 5.1.1 above shall be conducted on Double 'T' suspension and Quadruple tension insulator string along with hardware fittings for 400 kV lines with Quad ACSR Moose conductor.

5.1.15 The tests specified under Clause No. 5.1.1.1 (a) to (g)/5.1.1.2 (a) to (f) shall be conducted on Single 'T' suspension pilot & single tension insulator string along with hardware fittings for 400 kV lines with Quad ACSR MOOSE conductor.

5.1.16 Heating cycle test on dead end assembly, mid span compression joint for Conductor and T – connector and performance test for Quad spacer damper shall not be required to be carried out if a valid test certificate is available for a similar design, i.e., test conducted earlier should have been conducted in accredited laboratory (accredited based on ISO/IEC guide 25/17025 or EN 45001 by the National Accreditation body of the country where laboratory is located) or witnessed by the representative (s) of OWNER or Utility. The test reports submitted shall be for the tests conducted within the last 5 (five) years prior to the date of Bid opening.

In case the tests have been conducted earlier than the above stipulated period or in the event of any discrepancy in the test report (i.e., any test report not applicable due to any design / manufacturing change including substitution of components or due to non compliance with the requirement stipulated in the Technical Specification) the tests shall be conducted by the Contractor at no extra cost to the Owner.

- 5.1.17 Type tests specified under Clause 5.1.1.1 (a) to (d) /5.1.1.2 (a) to (d) shall not be required to be carried out if a valid test certificate is available for a similar design, i.e., tests conducted earlier should have been conducted in accredited laboratory (accredited based on ISO/IEC guide 25/17025 or EN 45001 by the National Accreditation body of the country where laboratory is located) or witnessed by the representative (s) of OWNER or Utility. The test reports submitted shall be for the tests conducted within the last 5 (five) years prior to the date of Bid opening.

In case the tests have been conducted earlier than the above stipulated period or in the event of any discrepancy in the test report (i.e., any test report not applicable due to any design / manufacturing change including substitution of components or due to non compliance with the requirement stipulated in the Technical Specification) the tests shall be conducted by the Contractor at no extra cost to the Owner.

5.2 **Acceptance Tests**

5.2.1 **On Both Suspension and Tension Hardware Fittings**

a)	Visual Examination	: As per IS:2486-(Part-I)
b)	Verification of dimensions	: As per IS:2486-(Part-I)
c)	Galvanising/Electroplating test	: As per IS:2486-(Part-I)
d)	Mechanical strength test of each component (excluding corona control rings grading ring and arcing horn)	: As per Annexure-A
e)	Mechanical Strength test of welded joint	: As per Annexure-A
f)	Mechanical strength test for corona control ring/ grading ring and arcing horn	BS:3288 - (Part-I)
g)	Test on locking device for ball and socket coupling	: As per IEC:372 (2)
h)	Chemical analysis, hardness tests, grain size, inclusion rating & magnetic particle inspection for forgings/castings	: As per Annexure-A

5.2.2 On Suspension Hardware Fittings only

- a) Clamp Slip strength Vs Torque test for suspension clamp : As per Annexure-A
- b) Shore hardness test of elastomer cushion for AG suspension clamp : As per Annexure-A
- c) Bend test for armour rod set : As per IS:2121(Part-I), Clause 7.5,7,10 & 7.11
- d) Resilience test for armour rod set : As per IS:2121(Part-I), Clause 7.5,7,10 & 7.11
- e) Conductivity test for armour rods set : As per IS:2121(Part-I), Clause 7.5,7,10 & 7.11

5.2.3 On Tension Hardware Fittings only

- a) Slip strength test for dead end assembly : As per IS:2486 (Part-I) Clause 5.4

5.2.4 On Mid Span Compression Joint for Conductor and Earthwire

- a) Visual examination and dimensional verification : As per IS:2121 (Part-II), Clause 6.2, 6.3 & 6.7
- b) Galvanising test : As per Annexure-B
- c) Hardness test : As per Annexure-B

5.2.5 PG Clamps/T-Connector for Conductor

- a) Visual examination and dimensional verification : As per IS:2121 (Part-II)
- b) Axial tensile load test for welded portion : As per Annexure-A

5.2.6 Repair Sleeve for Conductor

- a) Visual examination and dimensional verification : As per IS:2121(Part-II) Clause 6.2, 6.3

5.2.7 Flexible Copper Bond

- a) Visual examination and dimensional verification : As per IS:2121(Part-II) Clause 6.2, 6.3
- b) Slip strength test : As per annexure-A

5.2.8 Vibration Damper for Earthwire

a) Visual examination and dimensional verification	: As per IS:2121(Part-II) Clause 6.2, 6.3 7 6.7
b) Galvanising test	: As per Annexure-B
(i) On damper masses	: As per Annexure-B
ii) On messenger cable	: As per Annexure-B
c) Verification of resonance frequencies	: As per Annexure-B
d) Clamp slip test	: As per Annexure-B
e) Clamp bolt torque test	: As per Annexure-B
f) Strength of the messenger cable	: As per Annexure-B
g) Mass pull off test	: As per Annexure-B
h) Dynamic characteristics test	: As per Annexure-B

5.2.9 Quad Spacer Damper for line / Rigid spacer for Jumper

a) Visual examination and dimensional verification	: As per IS:2121(Part-II) Clause 6.2, 6.3 7 6.7
b) Galvanising test	: As per Annexure-B
c) Movement test (except for spacer jumpers)	: As per Annexure-B
d) Clamp slip test	: As per Annexure-B
e) Clamp bolt torque test	: As per Annexure-B
f) Compression-tension test	: As per Annexure-B
g) Assembly torque test	: As per Annexure-B
h) Hardness test for elastomer (if applicable)	: As per Annexure-B

5.2.10 Earthwire Tension Clamp Assembly

a) Visual examination and dimensional verification	: As per IS:2121(Part-II)
b) Galvanising test	: As per Annexure-A
c) Slip strength test for tension clamp	: As per Annexure-A
d) Mechanical strength test on each component (excluding clamp)	: As per Annexure-A
e) Hardness test	: As per Annexure-A

5.2.11 Earthwire Suspension Clamp Assembly

- a) Visual examination and dimensional verification : As per IS:2121(Part-II)
- b) Galvanising test : As per Annexure-A
- c) Clamp slip strength test : As per Annexure-A
- d) Mechanical strength test on each component (excluding clamp) : As per Annexure-A

5.3 Routine Tests**5.3.1 For Hardware Fittings**

- a) Visual examination IS:2486-(Part-I)
- b) Proof Load Test : As per Annexure-A

5.3.1 For conductor and earthwire accessories

- a) Visual examination and dimensional verification : As per IS:2121(Part-II) Clause 6.2, 6.3 7 6.7

5.4 Tests During Manufacture on all components as applicable

- a) Chemical analysis of Zinc used for galvanising IS:2486-(Part-I)
- b) Chemical analysis mechanical metallographic test and magnetic particle inspection for malleable castings : As per Annexure-A
- c) Chemical analysis, hardness tests and magnetic particle inspection for forging : As per Annexure-A

5.5 TEST CHARGES AND TEST SCHEDULE:**5.5.1 Type Tests:**

All the equipment offered shall be fully type tested as per the relevant standards. These tests must have been conducted five years earlier from the date of tender opening. The Purchaser reserves the right to demand repetition of some or all the type tests in the presence of Purchaser's representative.

For any change in the design/type already type tested and the design/type offered against this specification the Purchaser reserves the right to demand, repetition of tests without any extra cost and that the contractor shall pay all costs incurred by the purchaser representative in witnessing the repeat tests, including time charges travel and subsistence.

- 5.5.2 If the Purchaser feels it necessary to conduct the type tests for his satisfaction then it should done at free of cost.
- 5.5.3 For type tests which involve the tests on the complete insulator string with hardware fittings, the manufacturers of hardware fittings shall supply the necessary number of sets of hardware fittings at the place of testing free of cost.
- 5.5.4 In case of failure of the complete string in any type test, the manufacturer whose product has failed in the test shall get the test repeated at his cost. In case of any dispute, the assessment of the Purchaser as to what items caused the failure in the type tests shall be final and binding on the part of insulator/hardware manufacturers.
- 5.5.5 In case of a failure in any type test, the contractor whose material has failed is either required to modify the design of the material and successfully carryout all the type tests as has been detailed out in Clause 7.6 of this specification or to repeat that particular type test at least three times successfully at his own expenses. The decision of the Purchaser in this regard shall be final and binding. The contractor whose material has not failed in the test shall be required to supply the requisite quantity of material (that is, insulator discs or hardware fittings as the case may be) required for repeat testing at the place of testing and the cost of supply shall be borne by the sub-vendor whose material has failed in testing.
- 5.5.6 The entire cost of testing for acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of hardware fittings, except for the expenses of the Purchaser's representative. All acceptance tests shall be carried out by the supplier in the presence of purchaser's representative.
- 5.5.7 Immediately after finalisation of the programme of type/acceptance/routine testing, the bidder/ sub-vendor shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

5.6 Sample Batch For Type Testing

- 5.6.1 The Contractor shall offer material for sample selection for type testing only after getting Quality Assurance Programme approved by the Owner. The Contractor shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection. The sample for type testing will be manufactured strictly in accordance with the Quality Assurance Programme approved by the Owner.
- 5.6.2 Before sample selection for type testing the Contractor shall be required to conduct all the acceptance tests successfully in presence of Owner's representative.

5.7 Schedule of Testing and Additional Tests

- 5.7.1 The Bidder has to indicate the schedule of following activities in their bids
- (a) Submission of drawing for approval.
 - (b) Submission of Quality Assurance programme for approval.
 - (c) Offering of material for sample selection for type tests.
 - (d) Type testing.

- 5.7.2 The Owner reserves the right of having at his own expense any other test(s) of reasonable nature carried out at Contractor's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material comply with the specifications.
- 5.7.3 The Owner also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Contractor's premises or at any other test center. In case of evidence of non compliance, it shall be binding on the part of Contractor to prove the compliance of the items to the technical specifications by repeat tests, or correction of deficiencies, or replacement of defective items, all without any extra cost to the Owner.
- 5.8 **Co-ordination for testing**
- The Contractors shall have to co-ordinate testing of their hardware fittings with insulators to be supplied by other Supplier to the Owner and shall have to also guarantee overall satisfactory performance of the hardware fittings with the insulators.
- 5.9 **Test Reports**
- 5.9.1 Copies of type test reports shall be furnished in at least six copies along with one original. One copy shall be returned duly certified by the Owner, only after which the commercial production of the concerned material shall start.
- 5.9.2 Copies of acceptance test report shall be furnished in at least six copies. One copy shall be returned, duly certified by the Owner, only after which the materials will be dispatched.
- 5.9.3 Record of routine test report shall be maintained by the Contractor at his works for periodic inspection by the Owner's representative.
- 5.9.4 Test certificates of tests during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Owner.
- 5.10 **Inspection**
- 5.10.1 The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where the material and/or its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Contractor's, sub-Contractor's works raw materials. manufacturer's of all the material and for conducting necessary tests as detailed herein.
- 5.10.2 The material for final inspection shall be offered by the Contractor only under packed condition as detailed in clause 5.11 of this part of the Specification. The engineer shall select samples at random from the packed lot for carrying out acceptance tests.
- 5.10.3 The Contractor shall keep the Owner informed in advance of the time of starting and of the progress of manufacture of material in its various stages so that arrangements could be made for inspection.

5.10.4 Material shall not be despatched from its point of manufacture before it has been satisfactorily inspected and tested unless the inspection is waived off by the Owner in writing. In the latter case also the material shall be despatched only after all tests specified herein have been satisfactorily completed.

5.10.5 The acceptance of any quantity of material shall in no way relieve the Contractor of his responsibility for meeting all the requirements of the Specification, and shall not prevent subsequent rejection, if such material are later found to be defective.

5.11 Packing and Marking

5.11.1 All material shall be packed in strong and weather resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 200 Kg to avoid handling problems.

5.11.2 The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.

5.11.3 Suitable cushioning, protective padding, dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.

5.11.4 Bolts, nuts, washers, cotter pins, security clips and split pins etc. shall be packed duly installed and assembled with the respective parts and suitable measures shall be used to prevent their loss.

5.11.5 Each component part shall be legibly and indelibly marked with trade mark of the manufacturer.

5.11.6 All the packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly despatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink.

5.12 Standards

5.12.1 The Hardware fittings; conductor and earth wire accessories shall conform to the following Indian/International Standards which shall mean latest revisions, with amendments/ changes adopted and published, unless specifically stated otherwise in the Specification.

5.12.2 In the event of the supply of hardware fittings; conductor and earth wire accessories conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent to those specified. In case of award, salient features of comparison between the Standards proposed by the Contractor and those specified in this document will be provided by the Contractor to establish their equivalence.

Sl.	Indian Standard	Title	International Standard
1.	IS: 209-1992	Specification for zinc	BS:3436-1986
2.	IS:398-1992 Part-V	Aluminum Conductor Galvanised Steel-Reinforced For Extra High Voltage (400 KV) and above	IEC:1089-1991 BS:215-1970
3.	IS 1573	Electroplated Coating of Zinc on iron and Steel	
4.	IS : 2121 (Part-II)	Specification for Conductor and Earthwire Accessories for Overhead Power lines: Mid-span Joints and Repair Sleeves for Conductors	
5.	IS:2486 (Part-I)	Specification for Insulator Fittings for Overhead power Lines with Nominal Voltage greater than 1000 V: General Requirements and Tests	
6.	IS:2629	Recommended Practice for Hot Dip Galvanising of Iron and Steel	
7.	IS:2633	Method of Testing Uniformity of Coating on Zinc Coated Articles	
8.		Ozone test on Elastomer	ASTM- D1 171
9.		Tests on insulators of Ceramic material or glass for overhead lines with a nominal voltage greater than 1000V	IEC:383-1993
10.	IS:4826	Galvanised Coating on Round Steel Wires	ASTM A472-729 BS:443-1969
11.	IS:6745	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles	BS:433 ISO : 1460 (E)
12.	IS:8263	Method of Radio Interference Tests on High Voltage Insulators	IEC:437 NEMA:107 CISPR
13.	IS:6639	Hexagonal Bolts for Steel Structures	ISO/R-272
14.	IS:9708	Specification for Stock Bridge Vibration Dampers for Overhead Power Lines	
15.	IS:10162	Specification for Spacers Dampers for Twin Horizontal Bundle Conductors	

The standards mentioned above are available from:

Reference Abbreviation	Name and Address
BS	British Standards, British Standards Institution 101, Pentonville Road, N - 19-ND UK
IEC/CISPR	International Electro technical Commission, Bureau Central de la Commission, electro Technique international, 1 Rue de verembe, Geneva SWITZERLAND
BIS/IS	Beureau Of Indian Standards. Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi - 110001. INDIA
ISO	International Organisation for Standardization. Danish Board of Standardization Danish Standardizing Sraat, Aurehoegvej-12 DK-2900, Heeleprup, DENMARK.
NEMA	National Electric Manufacture Association, 155, East 44th Street. New York, NY 10017 U.S.A.

ANNEXURE - I**1.0 Tests on Complete Strings with Hardware Fittings****1.1 Voltage Distribution Test (For Insulator String with Disc Insulators)**

The voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted into percentage. The voltage across any disc shall not exceed 9% for suspension insulator strings and 10% for tension insulator strings for 400 kV line.

1.2 Corona Extinction Voltage Test (Dry)

The sample assembly when subjected to power frequency voltage shall have a corona Extinction voltage of not less than 320 kV (rms) line to ground for 400 kV lines under dry condition. There shall be no evidence of corona on any part of the sample. The atmospheric condition during testing shall be recorded and the test results; shall be accordingly corrected with suitable correction factor as stipulated in IEC:60383.

1.3 RIV Test (Dry)

Under the conditions as specified under (1.2) above, the insulator string along with complete hardware fittings shall have a radio interference voltage level below 1000 micro volts at one MHz when subjected to 50 Hz AC voltage of 305 kV line to ground under dry condition for 400 kV line. The test procedure shall be in accordance with IS:8263/IEC:437.

1.4 Mechanical Strength Test

The complete insulator string along with its hardware fitting excluding arcing horn, corona control ring, grading ring and suspension assembly/dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

1.5 Vibration Test

The suspension string shall be tested in suspension mode, and tension string in tension mode itself in laboratory span of minimum 30 meters. In the case of suspension string a load equal to 600 kg shall be applied along the axis of the suspension string by means of turn buckle. The insulator string along with hardware fittings and four sub conductors each tensioned at 43 KN shall be secured with clamps. The system shall be suitable to maintain constant tension on each sub-conductors throughout the duration of the test. Vibration dampers shall not be used on the test span. Both the sub-conductors shall be vertically vibrated simultaneously at one of the resonance

frequencies of the insulators string (more than 10 Hz) by means of vibration inducing equipment. The peak to peak displacement in mm of vibration at the antinode point nearest to the string shall be measured and the same shall not be less than $1000/f^{1.8}$ where f is the frequency of vibration in cycles/sec. The insulator string shall be vibrated for not less than 10 million cycles without any failure. After the test the disc insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware shall be examined for looseness, fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and disc insulators after the vibration test. The disc insulators shall be subjected to the following, tests as per relevant standards:

Sl.	Test	Percentage of Disc insulator units to be tested
a)	Temperature cycle test followed by mechanical performance test	60
b)	Puncture test/steep wave front test (Only for glass insulators)	40

1.6

Power Arc test

This test shall be performed on the complete string in accordance with IEC Technical Report IEC : 61467-1997 with the following test series :

Test circuit	Short circuit current	Number and duration of test
B	$I_n = I_{sys} = 40 \text{ KA}$	Two of $t_n = 0.2\text{s}$ and one of $t_n = 0.5\text{s}$

The acceptance criteria after the completion of test series shall be following.

- Insulator separation not permitted.
- Burning/melting of metal components, breaking of insulator sheds, glaze removal are permitted.
- The complete insulator string along with its hardware fittings including arcing horn, corona control ring/grading ring shall withstand 80% of UTS.

1.7

Assembly Test

This test shall be carried out to ensure that the cotter pins, bolts, clamps etc., fit freely and properly.

2.0 Tests on Hardware Fittings**2.1 Magnetic Power Loss Test for Suspension Assembly**

For 400 kV line with Quad ACSR MOOSE conductor, four hollow aluminium tubes of 32 mm diameter shall be placed 457 mm apart. An alternating current over the range of 400 to 800 Amps shall be passed through each tube. The reading of the wattmeter with and without two suspension assemblies along with line side yoke plate, clevis eye shall be recorded. Not less than three suspension assemblies shall be tested. The average power loss for suspension assembly shall be plotted for each value of current. The value of the loss corresponding to 600 amperes shall be read off from the graph.

2.2 Galvanising/Electroplating Test

The test shall be carried out as per Clause no. 5.9 of IS:2486-(Part-1) - 1972 except that both uniformity of zinc coating and standard pre-test shall be carried out and the results obtained shall satisfy the requirements of this specification.

2.3 Mechanical Strength Test of Each Component

Each component shall be subjected to a load equal to the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. The component shall then again be loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified UTS and held for one minute. No fracture should occur. The applied load shall then be increased until the failing load is reached and the value recorded.

2.4 Mechanical Strength Test of Welded Joint

The welded portion of the component shall be subjected to a Load of 2000 kgs for one minute. Thereafter, it shall be subjected to die-penetration/ultrasonic test. There shall not be any crack at the welded portion.

2.5 Clamp Slip Strength Vs Torque Test for Suspension Clamp

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length of ACSR conductor shall be fixed in the clamp. The clamp slip strength at various tightening torques shall be obtained by gradually applying the load at one end of the conductor. The Clamp slip strength vs. torque curve shall be drawn. The above procedure is applicable only for free center type suspension clamp. For AG suspension clamp only clamp slip strength after assembly shall be found out.

2.6 Shore Hardness Test for Elastomer Cushion for AG Suspension Assembly

The shore hardness at various points on the surface of the elastomer cushion shall be measured by a shore hardness meter and the shore hardness number shall be between 65 to 80.

2.7 Proof Load Test

Each component shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength which shall be increased at a steady rate to 67% of the UTS specified. The load shall be held for one minute and then removed. After removal of the load the component shall not show any visual deformation.

2.8 Tests for Forging Casting and Fabricated Hardware

The chemical analysis, hardness test, grain size, inclusion rating and magnetic particle inspection for forging, castings and chemical analysis and proof load test for fabricated hardware shall be as per the internationally recognised procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as in the Quality Assurance programme.

2.9 Mechanical Strength Test for Suspension/Tension Hardware Fittings

The complete string without insulators excluding arcing horn, corona control rings/grading ring and suspension assembly/dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. This load shall be held for five minutes and then removed. After removal of the load, the string component shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS is reached and held for the one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

2.10 Ozone Test for Elastomer

This test shall be performed in accordance with ASTM D-1171 by the Ozone chamber exposure method (method B). The test duration shall be 500 hours and the ozone concentration 50 PPHM. At the test completion, there shall be no visible crack under a 2 x magnification.

3.0 Tests on Conductor and Earth wire Accessories**3.1 Mid Span Compression Joint for Conductor and Earth wire****(a) Slip Strength Test**

The fitting compressed on conductor/earth wire shall not be less than one meter in length. The test shall be carried out as per IS:2121 (Part-II) clause 6.4 except that the load shall be steadily increased to 95% of minimum ultimate tensile strength of conductor/earth wire and retained for one minute at this load. There shall be no movement of the conductor/ earth wire relative to the fittings and no failure of the fittings during this one minute period.

3.2 T-Connector for Conductor

Axial Tensile Load Test for Welded Portion

The sleeve portion of the T-Connector shall be compressed on conductor. The compressed portion shall be held rigidly on some fixtures and axial load shall be applied along with the jumper terminal. The load shall be increased gradually till breaking of welded joint occurs. The breaking load should be above 30 kN.

3.3 Flexible Copper Bond

Slip Strength Test

On applying a load of 3 kN between the two ends, stranded flexible copper cable shall not come out of the connecting lugs and none of its strands shall be damaged. After the test, the lugs shall be cut open to ascertain that the gripping of cable has not been affected.

3.4 Vibration Damper for Earth wire

(a) Dynamic Characteristics, Test

The damper shall be mounted with its clamp tightened with torque recommended by the manufacturer on shaker table capable of simulating sinusoidal vibrations for aeolian vibration frequency band ranging from 10 to 60 Hz for damper for earth wire. The damper assembly shall be vibrated vertically with a ± 1 mm amplitude from 5 to 15 Hz frequency and beyond 15 Hz at ± 0.5 mm to determine following characteristics with the help of suitable recording instruments:

- (i) Force Vs frequency
- (ii) Phase angle Vs frequency
- (iii) Power dissipation Vs frequency

The Force Vs frequency curve shall not show steep peaks at resonance frequencies and deep troughs between the resonance frequencies. The resonance frequencies shall be suitably spread within the aeolian vibration frequency-band between the lower and upper dangerous frequency, limits determined by the vibration analysis of conductor/earth wire without dampers.

Acceptance criteria for vibration damper.

- (i) The above dynamic characteristics test on five damper shall be conducted.
- (ii) The mean reactance and phase angle Vs frequency curves shall be drawn with the criteria of best fit method.
- (iii) The above mean reactance response curve should lie within following limits :

V.D. for 7/3.66 Earth wire : $0.060 f$ to $0.357 f$ gf/mm

Where f is frequency in Hz.

- (iv) The above mean phase angle response curve shall be between 25° to 130° within the frequency range of interest.
- (v) If the above curve lies within the envelope, the damper design shall be considered to have successfully met the requirement.
- (vi) Visual resonance frequencies of each mass of damper is to be recorded and to be compared with the guaranteed values.

(b) Vibration Analysis

The vibration analysis of the earthwire shall be done with and without damper installed on the span. The vibration analysis shall be done on a digital computer using energy balance approach. The following parameters shall be taken into account for the purpose of analysis :

- (i) The analysis shall be borne for single earthwire without armour rods as per the parameters given under clause 3.3.8 of this part of the Specification. The tension shall be taken as 14 kN for 7/3.66 mm earth wire respectively for a span ranging from 100 m to 1100 m.
- (ii) The self damping factor and flexural stiffness (EI) for earthwire shall be calculated on the basis of experimental results. The details of experimental analysis with these data should be furnished.
- (iii) The power dissipation curve obtained from Dynamic Characteristics Test shall be used for analysis with damper.
- (iv) Examine the aeolian vibration level of the earthwire with and without vibration damper installed at the recommended location or wind velocity ranging from 0 to 30 Km per hour, predicting amplitude, frequency and vibration energy input.
- (v) From vibration analysis of earthwire without damper, antinode vibration amplitude and dynamic strain levels at clamped span extremities as well as antinodes shall be examined and thus lower and upper dangerous frequency limits between which the aeolian vibration levels exceed the specified limits shall be determined.
- (vi) From vibration analysis of earthwire with damper/dampers installed at the recommended location, the dynamic strain level, at the clamped span extremities, damper attachment point and the antinodes on the earthwire shall be determined. In addition to above damper clamp vibration amplitude and antinode vibration amplitudes shall also be examined.

The dynamic strain levels at damper attachment points, clamped span extremities and antinodes shall not exceed the specified limits. The damper vibration amplitude shall not be more than that of the specified fatigue limits.

c) Clamp Slip and Fatigue Tests

- (i) Test Set Up

The clamp slip and fatigue tests shall be conducted on a laboratory set up with a minimum effective span length of 30 m. The 7/3.66 mm earth wire at 14 and shall not be equipped with protective armour rods at any point. Constant tension shall be maintained within the span by means of lever arm arrangement. After the earthwire has been tensioned, clamps shall be installed to support the earthwire at both ends and thus influence of connecting hardware fittings are eliminated from the free span. The clamps shall not be used for holding the tension on the earthwire. There shall be no loose parts, such as suspension clamps, U bolts on the test span supported between clamps mentioned above. The span shall be equipped with vibration inducing equipment suitable for producing steady standing vibration. The inducing equipment shall have facilities for stepless speed control as well as stepless amplitude arrangement. Equipment shall be available for measuring the frequency, cumulative number of cycles and amplitude of vibration at any point along the span.

(ii) Clamp Slip test

The vibration damper shall be installed on the test span. The damper clamp, after lightning with the manufacturer's specified tightening torque, when subjected to a longitudinal pull of 2.5 kN parallel to the axis of earthwire for a minimum duration of one minute shall not slip i.e. the permanent displacement between earthwire and clamp measured after removal of the load shall not exceed 1.0 mm. The load shall be further increased till the clamp starts slipping. The load at which the clamp slips shall not be more than 5 kN.

(iii) Fatigue Test

The vibration damper shall be installed on the test span with the manufacturer's specified tightening torque. It shall be ensured that the damper shall be kept minimum three loops away from the shaker to eliminate stray signals influencing damper movement.

The damper shall then be vibrated at the highest resonant frequency of each damper mass. For dampers involving torsional resonant frequencies, tests shall be done at torsional modes also in addition to the highest resonant frequencies at vertical modes. The resonance frequency shall be identified as the frequency at which each damper mass vibrates with the maximum amplitude on itself. The amplitude of vibration of the damper clamp shall be maintained not less than $\pm 25/f$ mm, where f is the frequency in Hz.

The test shall be conducted for minimum ten million cycles at each resonant frequency mentioned above. During the, test if resonance shift is observed the test frequency shall be tuned to the new resonant frequency.

The clamp slip test as mentioned hereinabove shall be repeated after fatigue test without retorquing or adjusting the damper clamp, and the clamp shall withstand a minimum load equal to 80% of the slip strength for a minimum duration of one minute.

After the above tests, the damper shall be removed from conductor/earthwire and subjected to dynamic characteristics test. There shall not be any major deterioration in the characteristic of the damper. The damper then shall be cut open and inspected. There shall not be any broken, loose, or damaged part. There shall not be significant deterioration or wear of the damper. The conductor/earthwire under clamp shall also be free from any damage.

For the purpose of acceptance, the following criteria shall be applied.

- (1) There shall not be any frequency shift by more than ± 2 Hz for frequencies lower than 15 Hz and ± 3 Hz for frequencies higher than 15 Hz.
- (2) The force response curve shall generally lie within guaranteed % variation in reactance after fatigue test in comparison with that before fatigue test by the Contractor.
- (3) The power dissipation of the damper shall not be less than guaranteed % variation in power dissipation before fatigue test by the Contractor. However, it shall not be less than minimum power dissipation which shall be governed by lower limits of reactance and phase angle indicated in the envelope.

3.5 **Spacer Damper**

(a) Performance Test

One very important quality of a spacer damper is its ability to control Aeolian vibrations and sub-span oscillations within acceptable limits. Performance testing shall be carried out on an experimental test line, as described in Clause 2.5.3, Section-VI. After testing, there shall not be any slippage greater than 3mm on conductors, loosening of components or damage to conductors or spacer damper components.

i) Aeolian Vibrations

Under the specified operating conditions, the spacer damper shall control Aeolian vibrations in order to prevent damage to conductors either at suspensions clamp or at the spacer damper clamps.

For measurements and evaluation purpose, the following criteria shall apply:

- The peak to peak amplitude of any vibration cycle shall never exceed $1.5 Y_b$, where Y_b is the safe "Bending Amplitude".
- The RMS value of any vibration measurement sample shall be lower than $0.6 Y_b/2$, at 89mm from last point of contact with suspension or spacer clamp.

ii) Sub-span Oscillations

The spacer damper system shall control subspan oscillations in order to prevent conductor damage due to clashing or to severe bending stresses at the spacer damper clamp, and avoid wear of spacer dampers elements.

In order to achieve that performance level, subspan oscillation shall be controlled within the following limits, for any wind speed below 60 km/hr.

- In any individual subspan, the peak to peak amplitude of each subconductor shall never exceed 350mm.
- In any individual subspan, the RMS value (Y_{rms}) of each oscillation measurement sample shall be such that:

$$f.Y_{rms} < 80 \text{ mm/sec.}$$

Where

Y_{rms} = antinode amplitude (mm)

f = frequency of the oscillation (cycle/sec.)

$$f = (1/2L) \sqrt{T/m}$$

L = subspan length (m)

T = Conductor tension (N)

m = conductor mass (kg/m)

For any set of 10 or more measurement samples associated with a given wind sector and a given subspan, the Y_{rms} value shall be such that:

$$f.Y_{rms} < 70 \text{ mm/sec.}$$

The wind sector is defined as a combination of 5 km/hr wind speed range and 10° wind direction range.

Each measurement sample shall be at least one (1) minute long.

(b) Clamp Slip Test (for spacer for jumper also)

The spacer damper assembly shall be installed on a four conductors bundle string at a tension of 43 kN. In case of spacer for jumper, the clamp of sample shall be tightened with a specified tightening torque. One of the sample clamps, when subjected to a longitudinal pull parallel to the conductor axis for a minimum duration of one minute, shall not slip on the conductor, i.e. the permanent displacement between the conductor and the clamp of the sample measured after removal of the load shall not exceed specified values. The minimum slip under longitudinal pull varies with clamp type according to the following table.

CLAMP TYPE	LONGITUDINAL LOAD (kN)	MAXIMUM SLIP(mm)
Metal-Metal bolted	6.5	1
Rubber loaded Clamp using	2.5	2.5
Preformed rods	2.5	12

In order to determine the effect of conductor creep with the spacer dampers only, the conductor shall be retensioned to 68 kN without further tightening the spacer damper clamps and the clamp slip test shall be reperformed. The minimum slip under longitudinal loads shall not be less than 80% of the values given in the above table.

Similar testing shall be performed of the other clamps of the same sample. For spacer dampers only, such clamp slip tests shall also be conducted after each of the vibration tests mentioned in Clause 3.5 (a) but under longitudinal loading corresponding to 80% of the values given in the above table.

c) Dynamic Characteristic Test for Spacer Damper

The purpose of this test is to obtain quantitative information regarding the dynamic characteristic of the spacer damper. The values obtained during this test will serve as references to evaluate the behaviour of the same spacer damper under the fatigue test.

The test will consist in the application of sinusoidal movement to the spacer damper articulation and measurement of the force (F), displacement (X) and phase angle (ϕ) between these two. From these values, the stiffness (K) and damping fraction (n) shall be calculated as:

The test frequency shall not be higher than 3 Hz. The test shall be performed at five different displacement amplitudes. The amplitudes shall be selected to reproduce 10, 20, 40, 60 and 90 percent of the maximum displacement permitted by the spacer damper design.

The test shall be performed on three samples.

In case of spacer dampers with a single articulation for each arm, the central body shall be applied between two arms corresponding to a horizontal pair of conductors. In this case, one spacer clamp may be fixed and the other displaced in its direction, the central body being free to move.

a) Fatigue Test for Spacer Damper

The purpose of this test is to evaluate the capacity of the spacer damper to sustain without damage the cyclic movements which can be induced by vibrations.

The spacer damper articulation shall be subjected to cyclic motions for a total of 10 million cycles. The test frequency shall be between 2 and 3 Hz. The amplitude of motion shall be established on the following basis:

- the load applied on the spacer damper clamp shall not be less than 300N;
- The clamp displacement under the applied load shall not be less than 60% of the maximum displacement permitted by the design;
- If the 300 N load generates movement exceeding the maximum permitted displacement, the load can be reduced to limit the movement to 95% of the maximum displacement.

After the test, the sample shall be subjected to a second dynamic characteristic test. The test shall be performed at two amplitudes, 10% and 60% of the maximum displacement.

The spacer damper shall show no signs of cracks or deterioration, loosening of bolts or abnormal wear.

The dynamic characteristics (k and n) shall not be less than 75% of the values measured before the fatigue test. The test shall be performed on three samples which have been previously subjected to dynamic characteristics test. Motion shall be as described in Dynamic Characteristic Test.

b) Ozone Test

This test shall be performed on elastomer/rubber components in accordance with ASTM D-1171 by the ozone chamber exposure method (method B). The test durations shall be 500 hours and the ozone concentration 50 PPHM. At the test completion, there shall be no visible crack under a 2xmagnification.

c) Compression and Tensile Tests

Three samples of spacer dampers shall be subjected to a tension compression test. The load shall be applied between each pair of diagonally opposed conductors. Under the compressive load, the arms shall be allowed to rotate until they reach their mechanical stops. A compressive load of 15 kN shall first be applied and held for five minutes. Then a tensile load of 5 kN shall be applied on the same pair of arms. The test shall be repeated on the other pair of arms. After the test, the spacer damper must be dismantled and the components examined. There should not be any failure of components or damage impairing the reusability of the spacer damper such as permanent deformation. The spacer geometry shall be maintained within 5% of the original dimensions.

3.6 Magnetic Power Loss Test for Spacer Damper/Spacer for jumper

The sample involving ferrous parts shall be tested in a manner to simulate service conditions for 50 Hz pure sine-wave. The test should be carried out at various currents ranging from 400 amperes to 800 amperes for 400 kV line and the magnetic power loss at various currents should be specified in tabulated graphical form. The difference between the power losses without and with sample at room temperature shall be limited to 1 watt for 600 amperes current (rms) for ACSR MOOSE Conductor. The losses shall be determined by averaging the observations obtained from at least four samples.

3.7 Mechanical Strength Test for Earthwire Suspension/Tension Clamp

(a) The suspension assembly/tension assembly (excluding tension clamp) shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. This load shall be held for five minutes and then removed. After removal of the load, the components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to loosen the nuts initially. The assembly shall then be reassembled and loaded to 50% of

UTS and the load shall be further increased at a steady rate till the specified minimum UTS is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

(b) Clamp Slip Strength Vs Torque Test for Suspension Assembly

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length of Earthwire shall be fixed in the clamps. The clamp slip strength at various tightening torques shall be obtained by gradually applying the load at one end of the earthwire. The clamp slip strength Vs torque curve shall be drawn. The clamp slip strength at the recommended tightening torque shall be more than 12 kN but less than 17 kN for 7/3.66 mm earthwire.

(c) Slip Strength Test of Tension Clamp

Tension clamps shall be compressed on a 5 m length of earthwire on both ends. The assembly shall be mounted on a tensile testing machine and anchored in a manner similar to the arrangement to be used in service. A tensile load of 50% of the specified breaking load of the earthwire shall be applied & the sample shall be marked in such a way that movement relative to the fitting can easily be detected. Without any subsequent adjustment of the fitting, the load shall be steadily increased to 95% of the specified breaking load and maintained for one minute. There shall be no movement of the earthwire relative to the fitting during this one minute period and no failure of the fitting also.

(d) Electrical Resistance Test of Tension Clamp

The tension clamp and the jumper shall be compressed on two suitable lengths of earthwire. The electrical resistance shall be measured between points on earthwire near the clamp and near the jumper mouth keeping 25 mm clearance of the fitting and should not exceed 75% of the measured resistance of equivalent length of earthwire. The test shall be conducted with direct current. The current connections shall be at a distance not less than 50 times the diameter of earthwire from the fitting and shall be made so that effective contact is ensured with all those strands of the earth wire which would be taken into account in calculating its equivalent resistance. The test shall be repeated with the polarity reversed and the average of the two results considered as the measured value.

3.8 Corona Extinction Voltage Test (Dry)

The sample when subjected to power frequency voltage shall have a corona extinction voltage of not less than 320 kV (rms) line to ground for 400 kV lines under dry condition for 400 kV line. There shall be no evidence of corona on any part of the sample. The atmospheric condition during testing shall be recorded and the test results shall be accordingly corrected with suitable correction factor as stipulated in IS:731.

3.9 Radio Interference Voltage Test (Dry)

Under the conditions as specified under (3.8) above, the sample shall have a radio interference voltage level below 1000 micro volts at one MHz when subjected to 50 Hz AC voltage of 305 kV rms line to ground under dry condition for 400 kV line. The test procedure shall be in accordance with IS:8263.

3.10 Chemical Analysis Test

Chemical analysis of the material used for manufacture of items shall be conducted to check the conformity of the same with Technical Specification and approved drawing.

4.0 Tests on All components (As applicable)

4.1 Chemical Analysis of Zinc used for Galvanizing

Samples taken from the zinc ingot shall be chemically analysed as per IS-209-1979. The purity of zinc shall not be less than 99.95%.

4.2 Tests for Forgings

The chemical analysis hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognised procedures for these tests. The, sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Purchaser in Quality Assurance Programme.

4.3 Tests on Castings

The chemical analysis, mechanical and metallographic tests and magnetic particle inspection for castings will be as per the internationally recognised procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Purchaser in Quality Assurance Programme.

Acceptance Tests

1 Mid Span Compression Joint for Conductor and Earthwire

(a) Hardness Test

The Brinell hardness at various points on the steel sleeve of conductor core and of the earthwire compression joint and tension clamp shall be measured.

2. T-Connector for Conductor

(a) Axial Tensile Load Test for Welded Portion

Same as clause 3.2 of Annexure-A .

3. Flexible Copper Bond

(a) Slip Strength Test

Same as clause 3.3 of Annexure - A.

4. Vibration Damper for Earthwire

(a) Verification of Resonance Frequencies

The damper shall be mounted on a shaker table and vibrate at damper clamp displacement of ± 0.5 mm to determine the resonance frequencies. The resonance shall be visually identified as the frequency at which damper mass vibrates with maximum displacement on itself. The resonance frequency thus identified shall be compared with the guaranteed value. A tolerance of ± 1 Hz at a frequency lower than 15 Hz and ± 2 Hz at a frequency higher than 15 Hz only shall be allowed.

(b) Clamp Slip Test

Same as Clause 3.4 (c) (ii) of Annexure - A.

(c) Clamp Bolt Torque Test

The clamp shall be attached to a section of the earthwire. A torque of 150 percent of the manufacturer's specified torque shall be applied to the bolt. There shall be no failure of component parts. The test set up is as described in Clause 3.4 (c) (i), Annexure-A.

(d) Strength of the Messenger Cable

The messenger cable shall be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. Alternatively, each strand of message caste may be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. In such a case, the 95% of yield strength of each wire shall be added to get the total strength of the caste. The load shall be not less than the value guaranteed by the Contractor.

(e) Mass Pull off Test

Each mass shall be pulled off in turn by fixing the mass in one jaw and the clamp in the other of a suitable tensile testing machine. The longitudinal pull shall be applied gradually until the mass begins to pull out of the messenger cable. The pull off loads shall not be less than the value guaranteed by the Contractor.

(f) Dynamic Characteristics Test

The test will be performed as acceptance test with the procedure mentioned for type test with sampling mentioned below

Vibration Damper:

- 1 Sample for 1000 Nos. & below Conductor
- 3 Samples for lot above 1 000 & up to 5000 nos.
- Additional 1 sample for every additional 1500 pieces above 5000.

The acceptance criteria will be as follows

- (i) The above dynamic characteristics curve for reactance & phase angle will be done for frequency range of 10 Hz to 60 Hz for vibration damper for 7/3.66 mm earth wire.
- (ii) If all the individual curve for dampers are within the envelope as already mentioned for type test for reactance & phase angle, the lot passes the test.
- (iii) If individual results do not fall within the envelope, averaging of characteristics shall be done.
 - (a) Force of each damper corresponding to particular frequency shall be taken & average force of three dampers at the frequency calculated.
 - (b) Similar averaging shall be done for phase angle.
 - (c) Average force Vs frequency and average phase Vs frequency curves shall be plotted on graph paper. Curves of best fit shall be drawn for the entire frequency range.
 - (d) The above curves shall be within the envelope specified.

5. Spacer Damper/ Spacer for jumper

(a) Dynamic charactics Test

The test shall be carried out as per clause 3.5 (c) of Annexure-A.

(b) Movement Test

The spacer assembly shall be capable of the following movements without damaging the conductor, assuming one conductor is fixed and the other moving :

(i)	Longitudinal movement parallel to the conductor	± 50 mm
(ii)	Vertical movement in a vertical direction at right angle to the conductor	± 25 mm
(iii)	Torsional movement/angular movement in a vertical plane parallel to the conductor	± 5 deg.

(c) Compressive and Tensile Test

The spacer assembly shall withstand ultimate compressive load of 14 kN and tensile load of 7.0 kN applied between sub conductor bundle and held for one minute without failure. Line distance between clamps shall be recorded during each of the compression and tension test. Measurement shall be recorded at (i) no load (ii) with load (iii) after release of load. The center line distance under load shall be within ± 100 mm of the nominal design spacing. After release of load it shall be possible to retain the clamps at their original position using only slight hand pressure. There shall be no deformation or damage to the spacer assembly which would impair its function of maintaining the normal spacing.

(d) Clamp Slip Test

Same as clause 3.5(b) of Annexure-A.

(e) Clamp Bolt Torque Test

The spacer assembly shall be attached to conductor. A torque of 150 per cent of the manufacturer's specified tightening torque shall be applied to the clamp bolts or cap screws. There shall be no failure of the component parts.

(f) Assembly Torque Test

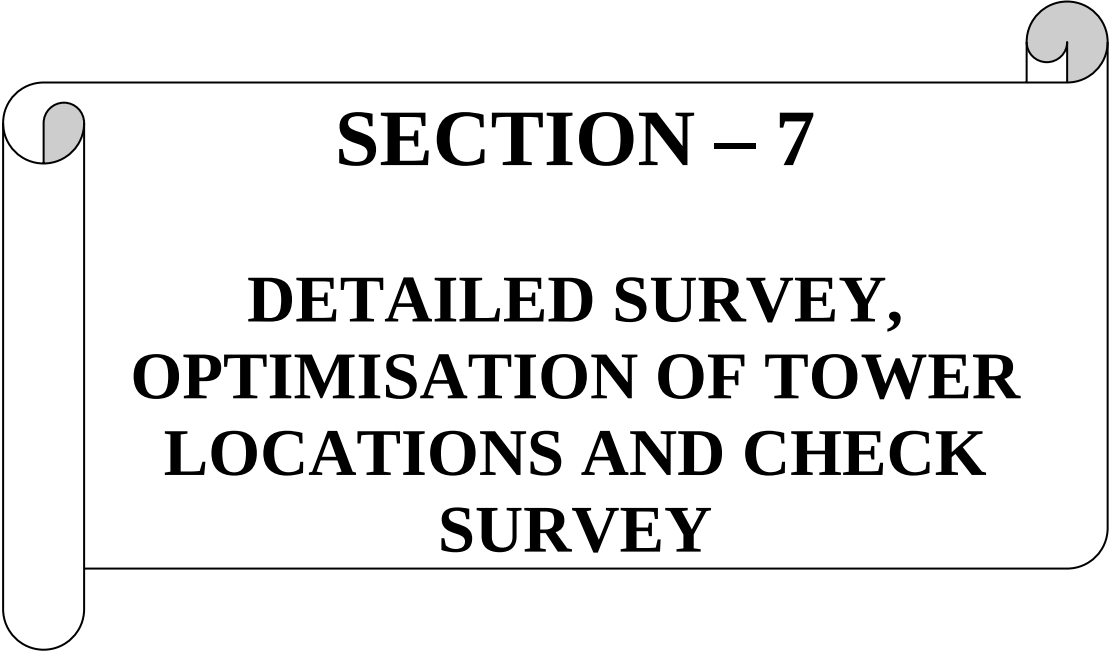
The spacer assembly shall be installed on conductor. The same shall not rotate on either clamp on applying a torque of 0.04 kN in clockwise or anti-clockwise direction.

(g) Hardness test for Elastomer

The shore hardness at different points on the elastomer surface of cushion grip clamp shall be measured by shore hardness meter. They shall lie between 65 to 80.

(h) UTS of Retaining Rods

The ultimate tensile strength of the retaining rods shall be measured. The value shall not be less than 35 kg/sq.mm.

A decorative border resembling a scroll, with a vertical strip on the left and a horizontal strip at the top, both featuring rounded ends and a slight 3D effect.

SECTION – 7

DETAILED SURVEY, OPTIMISATION OF TOWER LOCATIONS AND CHECK SURVEY

SECTION - 7

DETAILED SURVEY, OPTIMISATION OF TOWER LOCATIONS AND CHECK SURVEY

1.0 SCOPE:

The bidder shall be responsible for carrying out detailed survey (when requested by the Purchaser) along any or all sections of the route alignment shown in the route alignment map. This includes preparation of route profiles, tower spotting including river crossing location, optimisation of tower locations, measurement of soil resistivity and Geo-technical investigation at specified locations, assessment of quantities of different types of towers, body extensions, tower schedule, tower capacity chart, sag template etc.

The bidder shall also be responsible for undertaking check survey required for execution the line.

2.0 SURVEY PROGRAMME

The detailed survey and check survey shall be performed by the qualified and experienced personnel and supervised by the qualified surveyor. Not less than 30 days prior to the commencement of work, the contractor shall submit qualification of surveyor(s), work programme and list of surveying equipment for approval of Purchaser.

3.0 ROUTE ALIGNMENT

Before commencement of detailed survey, the contractor shall carry out a walk over survey along the route alignment drawing enclosed and identify the starting and end points. The altitude / level above MSL of starting a few intermediate location and enroute and end point shall be coordinated with the available GTs.

A route alignment map on a scale of 1:50000 shall be prepared showing all the topographical details including railway lines, rivers and important roads, power and telecom crossings etc upto 8km on either side of the route alignment for approval of the Purchaser. All other relevant features shall also be indicated in the route alignment map as per IS: 5613 (Part 3/Sec2)

4.0 DETAILED SURVEY

The detailed survey shall be carried out using GPS, total station, digital theodolites etc along the approved route alignment.

4.1 ROUTE MARKING

The route of the transmission line shall be recorded using GPS positional accuracy less than 3m.

The coordinates of all the angle points as well as other important crossings, landmarks etc shall be recorded using GPS for easy relocating.

At the starting point of the commencement of route survey of the coordinates shall be recorded. The coordinates of the location of the survey instrument shall also be recorded. Further, the coordinates at prominent position at intervals of not more than 750 meter along the transmission line to be surveyed upto the next angle point shall also be recorded. Wherever the alignment crosses the EHT line, Railway line P & T line or roads, the contractor shall record coordinates on the points of crossing. Wherever line route alignment passes over permanent land marks such as rock, boulders, culverts etc, suitable white paint marks with directional and TTRANSCO markings shall be made and co-ordinates recorded.

4.2 Profiling

The complete survey along the route shall be carried out using modern surveying equipments viz. total stations, GPS, digital theodolite, long range scanners etc. Reference levels at every 20 meters along the route are to be recorded. R/L at other undulations along the route as well as in the route plan and other Enroute details viz. crossings, buildings & structures, trees & other infrastructure Etc shall also be recorded. Areas along the route, which in the view of the contractor are not suitable for tower spotting, shall also be marked.

The complete profiling details shall be digitized and the data shall be prepared & stored in the format compatible to computer-aided tower spotting software.

A printed/plotted output of the digitized profiling shall be submitted by the contractor to Owner's site-in-charge for review before taking up computer-aided tower spotting.

4.3 Tower spotting

While profiling & spotting the towers, the following shall be considered:

a) Span :-

The number of consecutive spans between the section points shall not exceed 15 spans or 5 Km in plain terrain and 10 spans or 3 Km in hilly terrain. A section point shall comprise of tension point **with QB or QC or QD type.**

b) Extension / Truncation :-

Individual span shall be as near to the normal design span as possible. If during tower spotting it is found that, due to undulations of the ground profile, the ground clearance become insufficient when using normal height towers, these towers may be heightened by the use of standard body or leg extensions designed for this purpose. In case of locations where the ground clearance is available, truncated towers may be employed.

c) Loading :-

There shall not be any upward force on suspension towers under normal working conditions and the suspension towers shall support atleast the minimum weight span as provided in the designs. In case uplift is unavoidable, it shall be examined if the same can be overcome by adding standard body extensions to the towers failing which tension towers designed for the purpose shall be employed at such positions.

d) Road Crossing :-

At all important crossings, the tower shall be fitted with double suspension or tension insulator strings depending on the type of tower, but the ground clearance at the roads under maximum temperature and still air shall be such that with broken on adjacent span, ground clearance of the conductor from the road surface shall not be less than 8.84 mtrs for 400KV, 12.5m for $\pm$ 500KV HVDC and 15m for 765 KV SC. At all national highways, tension towers shall be used and crossing spans however will not be more than 250 metres.

e) Railway Crossings :-

Railway crossings shall be supported on Dead End Type Towers on either side depending on the merits of each case and shall be constructed in conformity with the specification laid down by the Railway Authorities. The following are the important features of the prevailing regulations.

- i) *The maximum crossing span shall be 300m or 80% of the design span, whichever is lesser.*
- ii) *The minimum distance of the crossing tower shall be atleast equal to the height of the tower plus 6 mtrs away from the centre of the nearest railway track*
- iii) *The minimum ground clearance above rail level of the lowest portion of any conductor under condition of maximum sag shall be maintained at 17.9 metres.*
- iv) *The minimum clearance between the jib of a railway crane and the bottom conductors shall be 6.0m.*
- v) *No crossing shall be located over a booster transformer, traction, switching station, traction sub-station or a track cabin location in an electrical area.*

f) River crossings :-

In case of major river crossing, towers shall be suspension type and the anchor towers on either side of the main river crossing shall be AN/ Special Anchor type tower. Clearance required by navigation authority shall be provided. For non navigable river, clearance shall be reckoned with respect to highest flood level (HFL).

g) Power Line crossings :-

Where this line is to cross over another line of the same voltage or lower voltage angle tower based on angle with suitable extensions shall be used. Provisions to prevent the possibility of its coming into contact with other overhead lines shall be made in accordance with the Indian Electricity Rules, 1956 as amended upto date. In order to reduce the height of the crossing towers, it may be advantageous to remove the ground-wire of the line to be crossed (if this is possible and permitted by the owner of the line to be crossed).

Minimum clearance in metres between lines when crossing each line :

S.No	Nominal System Voltage	110-132 kV	220 kV	400kV	800 kV
1	110-132 kV	3.05	4.58	5.49	7.94
2	220 kV	4.58	4.58	5.49	7.94
3	400kV	5.49	5.49	5.49	7.94
4	800 kV	7.94	7.49	7.94	7.94

For Power line crossings of voltage level of 132 kV and above, an angle tower shall be provided on either side of existing line duly examining the feasibility to divert the existing line Earthwire to avoid huge extensions which can be temporary dead end condition with proper guying.

h) Telecommunication line Crossings :-

The angle of crossing shall be as near to 90 degrees, the matter will be referred to the authority incharge of the telecommunication System. On a request from the contractor, the permission of the telecommunication authority may be obtained by the owner.

Also, in the crossing span, power line support will be as near the telecommunication line as possible, to obtain increased vertical clearance between the wires.

i) Details enroute :-

All topographical details, permanent features, such as trees, buildings etc., 26m for 400kV and 32 m for 765 kV on either side of the alignment shall be detailed on the profile plan.

4.4 Clearance from ground, Building, Trees etc.,

Clearance from ground, buildings, trees and telephone lines shall be provided in conformity with the Indian Electricity Rules, 1956 as amended upto date.

The contractor shall count, mark and put proper numbers with suitable quality of paint at his own cost on all the trees that are to be cut at the time of actual execution of the work as detailed below. Contractor may please note that Owner shall not pay any compensation for any loss or damage to the properties or for tree cutting due to contractor's work.

To evaluate and tabulate the trees and bushes coming within 26m for 400KV and 32m for 765 kV on either side of the central line alignment the trees will be numbered and marked and quality paint serially from angle point 1 (I) onwards and the corresponding number will be painted on the stem of trees at a height of 1 metre from ground level. The trees list should contain the following: -

- a) Girth (circumferences) measured at a height of 1 meter from ground level.
- b) Approximate height of the tree with an accuracy of + 2 metres.
- c) Name of the type of the species/ tree.
- d) The bushly and under growth encountered in the 46m for 400KV and 64m for 765 KV lines should also be evaluated with its type, height, girth and area in square meters, clearly indicating the growth in the tree/ bush statement.

4.5 Survey Report.

Complete BOQ of the transmission lines shall be furnished in the survey report.

Each angle point locations shall be shown with detailed sketches showing existing close by permanent land marks such as specific tree (s), cattle shade, homes, tube wells, temples, electric pole/ tower, telephone pole, canal, roads, railway lines etc. The relative distance of land marks from the angle points and their bearings shall be indicated in the sketch. These details shall be included in the survey report.

Information w.r.t. infrastructure details available enroute, identification and explanation of route constraints, etc shall also be furnished in the Survey report and shall inter-alia include the following.

Information regarding infrastructural facilities available along the final route alignment like access to roads, railway stations, construction material sources (like quarry points for stone, sand and availability of construction water) labour, existing transport facilities, fuel availability etc., shall be furnished in the survey report.

All observations which the contractor thinks would be useful to the construction of the transmission lines mentioned under scope of the work are to be reported.

Suggestions regarding the number of convenient zones (line segments/ portion) in which the entire alignment can be divided keeping in view the convenience of corporation are to be pointed.

Suggestions regarding location for setting up stores during line construction in consultation with Owner representatives shall also be provided by the contractor.

Working months available during various seasons along the final route alignment, with period, time of sowing & harvesting of different type of crops and the importance attached to the crops particularly in the context of way leave problems and compensation payable shall be stated by the contractor.

Availability of labour of various categories and contractors of civil works shall be reported.

Some portions of the line may require clearance from various authorities. The contractor shall indicate the portion of the line so affected, the nature of clearance required and the name of the concerned organizations such as local bodies, municipalities, P & T (name of circle), Inland navigation, Irrigation Department, Electricity Boards and Zonal Railways, Divisional Forest Authorities etc.

All the requisite data for processing the case of statutory clearances such as PTCC, Forest and Railway shall be provided along with the report.

The contractor shall also collect & details pertaining to pollution levels envisaged along the transmission line.

5.0 CHECK SURVEY FOR TOWER LOCATION

The check survey shall be conducted to locate and peg mark the tower positions on ground conforming to the approved profile and tower schedule using GPS, Total Station, Digital Theodolites etc. In the process, it is necessary to have the pit centres marked according to the excavation marking charts. The levels, up or down of each pit centre with respect to the centre of the tower location shall be recorded at intervals of 2 metre using Total station/GPS/ Digital Theodolites and digitised contour plains shall be made and recorded for determining the amount of earthwork required to meet the approved design parameters.

Changes in the preliminary tower schedule after detailed survey, if required, shall be carried out by the contractor and he shall thereafter submit a final tower schedule for the approval of owner. The tower schedule shall show position of all towers, type of towers, span length, type of foundation for each towers and the deviation at all angles as set out with other details.

6.0 RIGHT OF WAY, CUTTING / TRIMMING OF TREES, ETC.

Any lopping or trimming of tree branches obstructing the line of sight during detailed survey shall be the responsibility of the contractor. Clearing of obstructions falling in the right-of-way as per IS: 5613 (Part 3/Section 2)-1985 and lopping or trimming of the portion of the trees falling within the minimum electrical clearance zone shall be the responsibility of the Contractor.

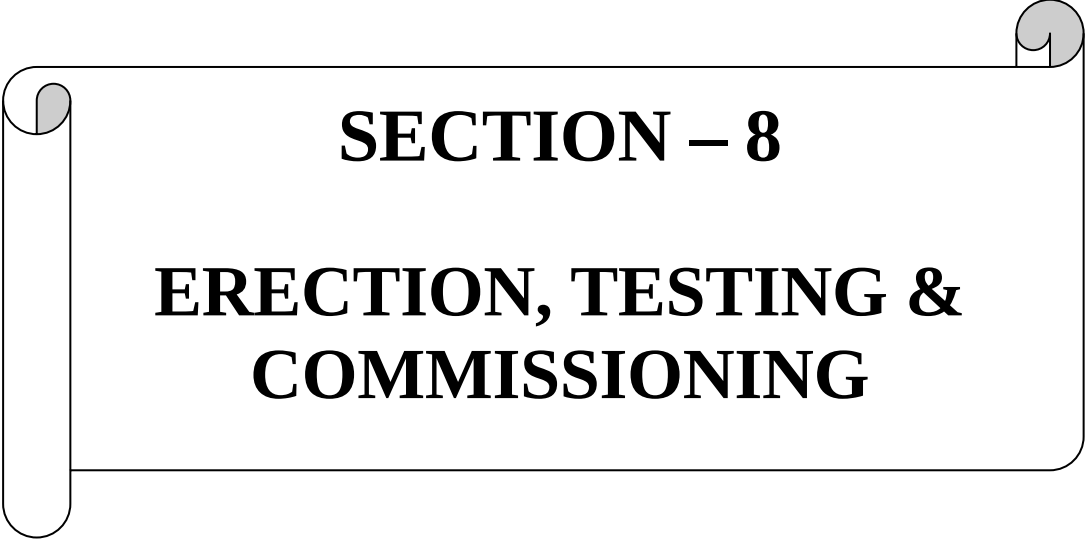
The contractor shall take all reasonable steps for preventing damage to crops during detailed survey.

7.0 SOIL RESISTIVITY :-

Soil resistivity along the alignment, shall preferably be measured in dry weather by the four electrodes method keeping inter electrode spacing of 50 meters. For calculating soil resistivity, formula $2 \frac{\rho}{\pi a} \ln \frac{4a}{r}$ (where $a = 50$ meters, $r =$ megger reading in ohms, $\rho = 3.14$) shall be adopted. Measurements shall be made at every 2 to 3 km along the route. In case soil characteristics change within 2 to 3 km, the value shall also be measured at intermediate locations. The megger reading and soil characteristics shall also be indicated in the soil resistivity results.

8.0 TOWER SCHEDULE :-

- 8.1 Tower schedule shall be prepared for planning of tower & line materials. The proforma shall be made on a convenient sheet size of 280 x 508 mm. Tower schedule shall further be checked by means of the tower capacity charts furnished by the purchaser. If the limits are exceeded anywhere, the spotting should be relocated by trials.
- 8.2 Along with the tower schedule, a line schedule should also be prepared which should cover in details the total quantity of all line materials required and the quantity in which these are required at various points on the line.
- 8.3 In addition to furnishing finalised copy of route alignment, plan & elevation profiles, sag template, diagonal profiles tower capacity chart etc., a reproducible copy each of these documents shall also be furnished.



SECTION – 8

ERECTION, TESTING & COMMISSIONING

SECTION - 8

ERECTION, TESTING & COMMISSIONING

1.0 SCOPE

- 1.1 This section covers erection, testing and commissioning of the transmission lines enumerated in "TECHNICAL SPECIFICATION" and also taking delivery, handling and transportation of Tower Parts, tower accessories and other line materials to destination stores. In case of road transport the materials will be dispatched directly to the contractors designated store, approved by the purchaser. The contractor shall also transport the line materials to the respective work sites at his own cost. The erection work shall also include the cost of labour, all tools and plants including tension stringing equipment and all other incidental expenses in connection with the check-survey, erection, testing and commissioning of the lines.

The scope also includes submission of route maps, tower schedules, quantity of towers and line materials consumption in the line and as built drawings and BOMs, foundation drawings 5 sets (one set to design division) shall be handed over to TSTRANSCO.

1.2 VARIATION IN QUANTITIES:

The erection contractor shall take up check survey soon after handing over the profiles and complete check survey within **Three Weeks** from the date of handing over of the profiles of detailed survey by the field officer and furnish estimated quantities for all items of contract covered in the schedules for completing erection of transmission lines in full shape within 7 days of completion of check survey.

The rates accepted for individual items of material / equipment covered under Schedule-A and works items covered in Schedule –B shall hold good for the actual quantities of material supplied and works executed, including any increase necessitated during actual execution.

When quantity against any item exceeds scheduled quantity the contractor shall bring the fact to the notice of the Chief Engineer/400kV well in advance and obtain his approval before commencing the execution of such excess quantity.

2.0 SPECIFIC TECHNICAL REQUIREMENTS

2.1 TRANSMISSION LINE ROUTE

- 2.1.1 The approved route map of the transmission lines are to be obtained from the field officers. The detailed survey profiles proposed for various sections of the line, to the extent available shall be handed over to the contractor within fifteen (15) days from the date of LOI / execution of contract. For the sections of the line for which detailed survey profiles have not been performed, the same shall be carried out by the contractor as per the approved route map.

The contractor(s) shall conduct a complete check survey on receipt of profiles. He shall furnish, details of benching, revetments, hillside extensions along with necessary estimates before proceeding with tower foundation works and obtain clearance from the Purchaser for proceeding with foundation works of respective tower locations.

- 2.1.2 The specific technical requirements for erection, testing and commissioning of the line and the particulars of the line, etc. are specified in *Section- 9* of this volume.

2.2 STANDARDS

- 2.2.1 Except where otherwise specified or implied, the erection, testing and commissioning shall conform to the provisions of IS: 5613 (Part 3, section-2) - 1985.
- 2.2.2 The Indian Standard specifications mentioned below, JIS or equivalent International Standards should be applicable to the materials and processes used in executing the work.

i)	IS:383-1990 Part-I	Coarse and fine aggregates from Natural sources for concrete. Earthwork.
ii)	IS:456-1991	Code of practice for plain and reinforced concrete.
iii)	IS:2502-1990	Code of practice for bending and fixing of bars for concrete reinforcement.
iv)	IS:3043-1991	Code of practice for earthing.
v)	IS:3764-1992	Safety code for excavation work.
vi)	IS: 2911-2010	Code of practice for design and construction of pile foundations.
vii)	IS:4081-1986	Safety code for blasting and related drilling operation.
viii)	IS:4091-1979	Code of practice for design and construction of foundations for Transmission line towers and poles.
ix)		IE RULES 1956 and other applicable regulations
x)	CBI&P Publication No 268	Transmission line manual.

- 2.2.3 Screw Guage, Vernier Callipers, Theodolite, Elco meter and steel tape (30 mts) should be readily available at site.

3.0 COMMUNICATION AND TRANSPORT

- 3.1 The information about the existing communication and transport facilities may be verified from the concerned authorities before submitting the bid by the bidder.

4.0 MATERIAL HANDLING AND ACCOUNTING

- 4.1 This is a total turn key contract and the successful bidder shall supply all the material required for erection of the line. The material is to be delivered by the contractor at the site stores. The contractor will be responsible for the proper handling and maintenance of the materials upto the time of handing over of the completed works to the TSTRANSCO and return of the surplus materials if any to the TSTRANSCO'S stores.

After completion of the check survey, the contractor has to furnish the actual quantity of the material required for each item covered schedule-I (*Vol-I*) and proceed to procure the requisite quantity of material only.

No separate charges shall be paid for head loading of materials, tools and tackles.

5.0 SURPLUS MATERIALS

As per Vol. I

6.0 ERECTION LOSSES:

- 6.1** The contractor shall make every effort to minimize the breakages, losses and wastages of line materials procured against this contract during line erection.
- 6.2** For accountable breakages, wastages and losses of items exceeding the specified percentage erection losses detailed below, the contractor shall compensate the purchaser, at double the issue rates.

Item	Unit	Max. Accountable Erection losses in %	Compensation payable for excess Loss in Rs.
Insulator discs and hardware	Nos.	1	Double the issue rate
Conductor and earth wire	Km	1(*)	-do-
Conductor and Earth wire accessories	Nos.	1	-do-
Bolts & Nuts	MT	2	-do-

(*) Up to 1% of the route length of the line for each conductor/ earthwire. (The 1% wastage includes the additional lengths required to account for sag and jumpers).

- 6.3** The contractor shall compensate the purchaser as specified in clause 6.2 for the quantities exceeding the maximum accountable erection losses. The empty wooden conductor and ground wire drums need not be returned to the purchaser. The steel empty drums for conductor and ground wire shall be returned to the Purchaser stores.

7.0 GENERAL STORAGE OF MATERIAL

- 7.1** The contractor shall procure the Cement and store in suitable weather proof, properly ventilated buildings with dry floors so as to prevent deterioration. The cement shall be “ordinary Portland” of standard make conforming to the IS and manufactured by one of the following
- **Larsen & Toubro / Birla Supreme / Madras Cements / Penna Cement / India Cement / Priya Cement / Zuari Cement / ACC / CCI / Andhra Cement** Or any other make whose plant capacity is more than 1,00,000 Tons per annum and to be got approved by the purchaser.

- 7.2 The contractor shall stack the fabricated steel members in separate piles member-wise and tower-wise. These shall be stacked clear off the ground with their heels upward in order to avoid entrapping of water between the angle-sections. The reinforcement bars shall also be stored in separate piles in a suitable manner to minimize corrosion. Other line material shall be stocked properly with a view of ease of handling, issue, accounting, minimum exposure to inclement weather etc.
- 7.3 The contractor shall store the aggregates on hard smooth and clean surfaces so that there is no possibility of inclusion of any foreign materials. Aggregates of different grades shall be stored in piles, which shall be spaced well apart to prevent their intermixing.

8.0 TREE / CROP COMPENSATION RIGHT-OF-WAY, CUTTING OF TREES, ETC.

- 8.1 Payment of compensation for damaged crops or fruit bearing trees shall be initially made by the contractor, which will be reimbursed by TSTRANSCO later on. The compensation so payable in respect of damaged crops shall be based on the assessment of MRO. In respect of the trees, compensation so payable is the lowest of the rates fixed by the Horticulture/NABARD/MRO. The contractor shall take up the payment of compensation amount only after written approval by the Executive Engineer. The payment shall be made in the presence of representatives of 400kV, Accounts and Vigilance wings of TSTRANSCO. The Superintending Engineer/ 400kV shall finalise the compensation claims.
- 8.2 The contractor shall take all possible steps to see that standing crops etc. are not damaged during execution of works. When such damage is inevitable, the compensation will be borne by the TSTRANSCO to the extent of land required for laying of foundation, provided the damage is with prior concurrence of the Executive Engineer. The contractor shall bear the compensation for damages caused without prior concurrence of the Executive Engineer concerned. Any extra land required by the contractor temporarily for dumping of the construction material and consequent damage to the crops etc. shall be the responsibility of the contractor.
- 8.3 In the event of any obstruction being encountered from the local villagers or authorities, the contractor shall immediately notify the Executive Engineer who shall take such steps as may be necessary to clear the obstruction. The contractor or his representative or gangs shall not adopt antagonistic attitude towards the village authorities with whom they may come into contact, but shall immediately report to the Executive Engineer any case of obstruction which cannot be settled amicably. No trees shall be cut until the TSTRANSCO has made necessary arrangement with the authorities concerned and permission is given to the contractor to fell such trees. The TSTRANSCO shall arrange to remove the obstacles as soon as possible. At times however, it may not be possible for the TSTRANSCO to arrange right-of-way for laying foundations or erecting the towers or stringing the line. At all such times, the contractor shall shift his gangs to other locations. The rates quoted shall cover all such contingencies and no extra payments shall be claimed for such contingencies.
- 8.4 *The TSTRANSCO will arrange the right-of-way along the transmission line route. Any avoidable or deliberate damage done to standing crop or private property by the erection contractor's labourers shall be the erection contractor's responsibility.*

The erection contractor shall take all reasonable steps for preventing damage to crops during execution of the contract work.

Clearing of obstructions falling in the right-of-way as per IS:5613 (part-2, section-2) – 1985 and lopping or trimming of the portion of the trees falling within the minimum electrical clearance zone shall be the responsibility of the contractor. And also, any lopping or trimming of tree branches obstructing the line of sight during check survey shall be the responsibility of the erection contractor.

9.0 ROADS, RIVER, KHUD/NALLAH, POWER AND TELECOMMUNICATION LINE AND RAILWAY CROSSINGS

9.1 The crossings of roads, river, khuds / nullahs, power and telecommunication lines, and railway tracks falling in the line route shall be carried out with the types of structures and at angles as indicated in the approved profile sheets and tower schedules, ensuring that the minimum clearances at maximum temperature in still wind condition, after taking the affect of conductor creep and slack caused by the broken conductor in the adjoining span are not less than the relevant clearances specified in Section - 9 of this volume.

9.1.1 The crossings of railway tracks, telecommunication lines and erection of lines in the vicinity of aerodromes shall in addition meet the requirements of the regulations /code listed below:

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- i) Regulation for Power line crossing of Railway tracks issued by the Ministry of Railways.
- ii) Code of practice for crossings between power and telecommunication lines issued by T&D Circle, P&T Dept Jabalpur (MP).
- iii) Requirements for routing of overhead lines in the vicinity of Aerodromes laid down by the Director, General of Civil Aviation, Govt. of India.
- iv) The Contractor has to arrange necessary maps, drawings etc., as required for obtaining approvals from external utilities.

10.0 CROSSING OF PUBLIC UTILITIES

10.1 The contractor shall be responsible for giving requisite notice to the appropriate authorities and intimate them the date and time when he proposes to carry out erection of the conductors and groundwires across power lines or telecommunication lines, public roads, water way, Railway etc. The lowering of conductor and/or groundwires of the existing power lines and its restringing and taking all necessary precautions to avoid damage to the existing lines will be the responsibility of the contractor. Any guying, temporary reinforcement required for the existing structures will also be the responsibility of the contractor.

10.2 Where other authorities or public undertakings affected, deem it necessary for the protection of their employees, property, public or for the assistance of traffic to provide flagmen or watchmen, the cost of such provision shall be borne by the contractor.

Where it is necessary to provide scaffolding over roads, power lines or telecommunication lines; this shall be carried out by the Contractor at such times as may be convenient to the requisite authority and such work shall be deemed to be covered in the rates. The contractor

to ensure safety of the public shall provide Flagmen and approved types of danger, or warning notices. The time taken to effect the crossing shall be kept to the minimum.

11.0 ERECTION TOOLS AND PLANTS

- 11.1 The contractor shall provide at his own expenses all necessary erection tools and plants such as surveying instruments, tackles, spanners, wrenches, pumps, timbering, scaffoldings, jacks, winches, ropes and all construction machinery such as tractors, bulldozers, hydraulic compressors and dies, dynamometers, come-along clamps, tension stringing equipment, camping requisites etc.

12.0 EXECUTION OF WORKS

The erection activities shall only be started after the tower schedules and profile approved by the purchaser is received by the contractor. The contractor shall be responsible for correct setting out of towers as per the finally approved profile sheets and tower schedules. If tower, after erection are found to be out of approved alignment, the contractor shall dismantle and re-erect them correctly at his own cost without extension of time.

13.0 ELECTRIC POWER FOR CONSTRUCTION PURPOSES

- 13.1 The contractor shall make all necessary arrangements and provide all necessary electric power for construction purposes at his own cost. In case the power is available with the purchaser, the same shall be supplied at the prevailing tariff rates.

14.0 SOIL INVESTIGATION AND CLASSIFICATION OF SOILS

14.1 General

The scope of work includes detailed soil investigation at tower locations for railway crossings, major road crossing, Power line crossings, river crossings and wherever soil strata differ.

However, the soil investigation activities shall be completed much before the commencement of main erection activities. Soil investigation need not be carried out in all the locations of the line.

14.2 Soil Investigation At Normal Locations

One bore hole of 150 mm dia shall be drilled at the center point of the tower. Standard penetration Test (S.P.T) shall be carried out at 1.50 m interval or change of strata upto the required depth of 2 1/2times below the depth of foundation below existing surface elevation or refusal whichever occurs earlier (By refusal it shall be mean that a standard penetration blow count 'N' of 100 is recorded for 30 cm penetration). Bore details and water table upto required depth below existing surface elevation or refusal whichever occurs earlier shall be furnished in the report.

14.3 Soil Investigation At Special Locations

At certain locations such as river banks, river beds or midstream of river and at other places, special soil investigation shall be carried out by drilling two holes each of 150 mm diameter at each tower location on the diagonally opposite legs of the tower, considering the base width of tower as 20m.

Standard penetration tests shall be carried out at every 3.0 m intervals or change of strata till refusal is met subject to maximum of 50 m below the existing surface elevation.

Undisturbed samples of soil shall be collected at every 5m intervals up to 15 mts and 3mts beyond 15 mts. or change of strata whichever occurs earlier.

In the hard rock the bore drilling shall be continued atleast 5m to ascertain its sufficient thickness.

14.4 Preparation Of Test Reports

The investigation report shall contain the following test results:

1. Grain size analysis
2. Nomenclature of soil
3. Atterbergs limit (Liquid and plastic limit only)
4. Triaxial shear test results containing information about angle of internal friction and cohesion.
5. S.P.T results containing information about natural moisture content, Specific gravity and Bulk unit weight.
6. Consolidation test.
7. Unconfined compression test
8. Unconsolidated un-drained test.
9. Presence of carbonates, sulphates, nitrates and organic matters and any other chemicals harmful to the concrete foundation –obtained from chemical test on soil sample.
10. For rocky, soil core recovery and crushing strength of the rock shall be furnished.
11. The bearing capacities of soil at 3.5 m below the existing surface elevation for normal investigation and at a depth fixed considering the bore log data as mentioned in clause 11.13.3 below the existing surface elevation for special soil investigation shall be furnished considering approximate base width of foundation.

In addition to the above the following data also shall be furnished in the report of special soil investigation.

1. Scouring depth in case the locations area at the bank of river or at midstream duly collecting the Hydraulic particulars of the river from CWC or State authorities corresponding to the nearby station. However, the hydraulic data may be corrected / modified with respect to the topography / cross section of the river at that particular location.
2. Silting factor in case of midstream and river bank locations where submergence is envisaged.
3. Depth of fill, if any
4. Details of water table, water struck etc.
5. Compressibility of sub-soil stratification.
6. Settlement characteristics of the shallow foundations.

The above test results shall be summarised strata-wise as well as in a combined tabular form with all relevant graphs, charts, tables, diagrams and photographs, if any, shall be furnished in the test reports.

The test report shall include bore logs. Bore logs of each bore hole clearly identify the stratification and type of soil stratum with depth upto the refusal. The locations of water table shall be identified on the bore log. The value of SPT at depth where conducted and various laboratory tests conducted from samples collected at various depths shall be clearly shown against the particular stratum.

The report should contain specific recommendation for the type of foundation. In case the soil parameters obtained from the soil investigation report for a particular tower location differ from the ones considered during design, the Purchaser will develop a fresh design.

- 14.5 The type of foundations to be constructed at each tower site shall be based on the soil characteristics indicated on the route profile sheets and as determined by the contractor and approved by the Purchaser during the progress of the work. The Purchaser reserves the right to change the type of foundation at any location where conditions during the progress of work indicated the use of a different type of foundation.
- 14.6 The Purchaser will furnish the foundations designed for the soil conditions encountered in the excavations. If the soil conditions vary significantly between different excavations on one tower then foundations of different classes may be installed. Each foundation shall have steel stub angle embedded in concrete. The foundations for each tower in a straight section of the line shall be placed so that the longitudinal axis of the tower cross arm will be in a plane perpendicular to the transverse of the line. Unless otherwise directed by the purchaser, the foundations for each angle tower shall be placed in a manner so that the tower cross arms lie in a plane bisecting the interior angle formed by the intersection of the transverses of adjacent sections of the line.
- 14.7 Foundations shall be constructed in accordance with the approved drawings. These foundation drawings are also subject to modification based on actual angle of deviation. The revised foundation drawings will be communicated as and when required.
- 14.8 All locations located in the paddy fields or low land areas, extended stub or an additional muffing of dimensions (length X breadth X height) as approved by the purchaser, shall be provided /constructed around the chimney of each leg. The unit rates provided in the bid for similar work shall be applicable.
- 14.9 When determining the classification of the foundation at site the following procedure shall be followed.
- i) The initial excavation shall be done to the dimensions of the next smaller foundation classification to that determined by the soil investigation.
 - ii) The base of the excavation shall be examined to determine the bearing capacity of the soil and the minimum foundation classification ascertained.
 - iii) The walls of the excavation shall be examined to determine the soil classification, angle of repose, and a suitable foundation classification selected to meet the soils encountered.
 - iv) The level of ground water, or the expected level of ground water during the rainy season or standing water over the site shall also be considered when determining the foundation classification.

15.0 SETTING OF STUBS

- 15.1 The stubs shall be set correctly at the exact locations and alignment and precisely at correct levels. Stubs shall be set in the presence of authorised representative of the purchaser available at site, for which adequate advance intimation shall be given to the purchaser by the contractor. This shall not, however, absolve the contractor of his responsibility for correctness of stub setting and for the correct erection of towers, within the tolerances specified in IS: 5613 (Part-3/Section-2)-1989.
- 15.2 The stubs shall be set with their tops 200 mm (minimum) above ground level and coping shall be of 50mm above the chimney.
- 15.3 The embedded end of the stub angle shall have a 150mm thick clear concrete cover over the top of lean concrete sub-base in case of dry foundations and a 200mm thick clear cover in case of wet, PS, and FS foundations.
- 15.4 The minimum length of stub encased in concrete below the ground level shall not be less than 1.5 m. However the stub shall extend up to the bottom of foundation having a clear concrete cover as specified in clause 15.3 above.
- 15.5 The depth of foundation below ground level shall be 3.5m. Except in hard rock foundation, the cutting of stub length is not allowed in any circumstances.
- 15.6 **In any case the foundation should be 3.0m for each leg in original soil irrespective of the level difference between any two legs. The level difference up to 1.5m should be covered with extended stub along with chimney in addition to the standard length. The extended stub and chimney details will be furnished by Purchaser at the time of execution.**

16.0 EXCAVATION

- 16.1 This item covers technical specification for excavation for foundation work of transmission line towers. This shall include all works involved in excavation, dressing of soil, shoring for foundation work and carting for good quality earth, if required for back filling. Boring and sub-surface data regarding nature of soil, sub-soil water etc. shown on Adrawings or otherwise furnished to the contractor shall be taken as guidance only, and variations there from shall not affect the terms of the contract. The contractor must satisfy himself of the character and volume of all the works under this item and expected surface, sub-surface, and/or sub-soil to be encountered. He must also satisfy himself about general conditions of transmission line route and ascertain the existing and future obstructions likely to come up during the execution of the contract to carry out the work under this scope.
- 16.2 The contractor shall control the grading in the vicinity of all excavations so that the surface of the ground shall be properly sloped or dyked to prevent surface water from running into the excavated areas during construction.

- 16.3 Excavations shall include the removal of all materials required to execute the work properly and shall be made with sufficient clearance to permit the placing, inspection, setting of forms and completion of all works for which the excavation has been made.
- 16.4 Sides of excavations shall be vertical and the base shall be horizontal. If the foundation dimensions are exceeded then the contractor shall install the next larger foundation at no additional cost to the Purchaser. Boulders that protrude into the excavation but do not interfere with the accurate and safe placement of the foundation may be left undisturbed. The concrete base slabs of the foundations shall be poured against undisturbed soil. The use of formwork for the base slab shall be provided for all foundations unless an undercut is provided.
- 16.5 When machines are used for excavation, the last 300mm before reaching the required level shall be excavated by hand or by such equipment that will leave the soil at the required final level, in its natural condition.
- 16.6 Suitability for bearing of the bottom of excavations shall be determined by the contractor and approved by purchaser.
- 16.7 The bottom of excavations shall be trimmed to the required levels and when carried below such levels due to contractor's fault, the excess depth shall be filled to the required level at the contractor's cost. The fill material shall be concrete not leaner than PCC (1:4:8) with 40 mm HBG metal or richer as directed by the purchaser in each individual case.
- 16.8 If the contractor is directed by the purchaser to excavate to a lower level than that indicated in the drawings, such additional excavation shall be paid for at the applicable unit rate. The additional length of stub and/or additional chimney reinforcement shall be paid for at the applicable unit rate.
- 16.9 Excavated material shall be placed up to 1 Km from the pit or further away as instructed by Engineer-in-charge.
- 16.10 Excavation shall be as per approved drawing.
- 16.11 The contractor shall be responsible for assumptions and conclusions regarding the nature of materials to be excavated and the difficulty of making and maintaining the required excavations and performing the work required as shown on the drawing and in accordance with these specifications. Cofferdams, sheeting, shoring, bracing, draining, dewatering etc. shall be furnished and installed as required. The contractor shall be held responsible for any damage to any part of the work and property caused by collapse of sides of excavation. Material may be salvaged if it can be done with safety for the work and structures, as approved by the purchaser and no extra claim shall be entertained for materials not salvaged or any other damage to contractor's property as a result of the collapse. He shall not be entitled to any claim for re-doing the excavation as a result of the same.
- 16.12 Excavation for foundations where specified shall be carried at least 100mm below the bottom of structural concrete and then be brought to the required level of placing lean concrete of CC (1:4:8) mix with aggregate of 40mm maximum nominal size.

16.13 Shoring and Shuttering

- (a) Shoring and shuttering shall be done keeping in view the requirements given in IS: 3764 (latest). For excavations to be made in sandy soils or water bearing strata or in any other type of soil where there is every likelihood of pits collapsing, shoring and shuttering made out of timber planks or steel frames of adequate strength as per requirements shall necessarily be provided.
- (b) Where excavation required bracing, sheeting or shoring etc. the contractor shall submit to the purchaser the design and drawings showing arrangement and details of proposed installation for examination and approval, and shall not proceed until he has received approval from the purchaser.

16.14 For purposes of excavation of earthwork, the term 'soil' shall apply to all kinds of soil containing any percentage of small boulders, morrum or/and shingle etc. other than hard rock.

16.15 Excavation Below Water Table

- a) Wherever water table is met with during the excavation, the contractor shall immediately report the fact to the purchaser who shall arrange to record the exact level of the water table. The decision of the purchaser in the matter shall be final.
- b) The contractor shall dewater and maintain the water table below bottom of the excavated level during excavation, concreting and back fillings.
- c) The guidelines for de-watering during construction specified in IS: 9759 (latest) shall be followed. Dewatering shall be carried out either manually or by mechanical pumps or power driven pumps to facilitate excavation and casting of foundation. The pumps shall be suitable for handling muddy water. The pits shall be kept dewatered until 24 hours after the concreting the foundations.

17.0 EXCAVATION AROUND TOWER FOUNDATIONS, DRAINAGE AND LINE CLEARANCE etc.,

17.1 This item covers excavation for levelling around the individual tower foundations, drainage, line clearance, etc. but excludes the excavation for tower foundations. The excavation shall be carried out as per clause 16.0 above and as described herein.

17.2 The excavations for tower sites, drainage and line clearance shall be made to the approved dimensions and shall be finished according to the specified lines and grades. Where the purchaser considers it necessary, adequate drainage shall be provided around tower foundations. Except as otherwise provided in this specification, excavated materials shall be used for grading as directed, around the site from where the materials are excavated. The requirement of excavation for tower sites, drainage and line clearance and the amount of excavation required at a location shall be optional with the purchaser.

17.3 Measurement and Payment:

Measurement for payment for excavation for tower sites, line clearance and drainage shall be made to the most practicable lines and grades as approved by the purchaser. Payment for such excavation, including the associated grading shall be made at the unit rate per cubic metre quoted in the Schedule of Prices.

18.0 EXCAVATION FOR TOWER FOUNDATIONS

18.1 Scope

This item covers excavation for the individual tower foundations etc. The excavation shall be carried out as per clause 16.0 above and as described herein.

- 18.2** Except as hereinafter provided, all excavations for foundations shall be made to the lines and grades of the foundation drawings given by the Purchaser. The contractor shall remove other undesirable materials, which may have accumulated in the excavated pits, before placing the concrete. The rate of excavation shall include all associated activities like shoring, shuttering, dewatering, stocking, piling, dressing, backfilling the foundation after concreting with excavated/borrowed earth (irrespective of distance from the source of borrow) and consolidation of earth, carriage of surplus earth to the suitable point of disposal as required by the purchaser or any other activities related to the completion of foundation works.

18.3 Classification of Soil For Excavation

The materials to be excavated shall be classified in accordance with IS: 5613 (Part-2/ Section-2) and IS: 1498 and as follows unless otherwise specified. Excavation rates for foundation pits shall be quoted by the bidder for the following type of soils.

18.3.1 Type of Soils

Generally any soil which yields to the ordinary application of pick and shovel, or PHWRA, rake or other ordinary digging implement such as vegetable or organic soil, turf, gravel, sand, silt, loam, clay, peat etc is classified as normal dry soil. This shall also include rock and boulders of maximum volume of 3cu.m each that may be quarried or split with crowbars. This will also include laterite and hard conglomerate.

HARD ROCK (REQUIRING BLASTING)

Any rock or boulder, of a volume of more than 3cu.m per each boulder, of the excavation for which blasting is required.

HARD ROCK (BLASTING PROHIBITED)

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

18.4 Classification Of Foundations

Depending on the location of water table the foundation shall be classified as dry, wet, partially submerged and fully submerged as defined in IS:5613(Part3/Section-II) and as under.

a) DRY FOUNDATION (NDS)

Dry foundation shall be that where sub-soil water is met below the foundation base i.e., below foundation base level and the soil is cohesive and homogenous upto full depth having clay content of 10 to 15%.

b) DRY FISSURED ROCK (DFR)

DFR shall be that where fissured rock encountered from top level onwards will be treated as DFR. In these the boulder should be more than 200 mm and the boulders percentage should be more than 85% of total excavation volume.

c) PARTIALLY DRY FISSURED ROCK

This foundation may be adopted where the normal dry soil is encountered for more than 1.5 m from ground level and balance is dry fissured rock. The boulder should be more than 85% in total excavation volume.

d) WET FOUNDATION:

Wet foundation shall be that where sub-soil water rises in the foundation pit up to 1.5 m below ground for level, or where there is water over the ground for long period but does not penetrate beyond 1.0 m below ground such as paddy fields.

e) PARTIALLY SUBMERGED FOUNDATION:

Partially submerged foundation shall be that where sub-soil water rises in the foundation pit up to 0.75 m below ground level.

f) FULLY SUBMERGED FOUNDATION:

Fully submerged foundation shall be that where the sub-soil water rises in the foundation pit within 0.75 m below ground level. While classifying foundations of wet, partially submerged, fully submerged foundation mentioned above, the worst conditions should be considered and not necessarily the condition prevailing at the time of inspection. For instance there are areas where subsoil water raises when canal water is let out in the fields raising subsoil water to a considerable degree.

Similarly the effect of monsoon or when the near by reservoirs are full should also be considered and not the conditions prevailing in open season or summer when work is carried out normally.

g) PARTIALLY BLACK COTTON:

This foundation may be adopted where the BC soil is encountered from 0.3 m to 1.5 m and balance may be normal soil with wet condition.

h) MIXED DRY FISSURED ROCK:

This foundation may be adopted where the BC soil is encountered from 0.3 m to 1.5 m and balance is DFR soil as mentioned for dry fissured rock foundation.

i) BLACK COTTON SOILS:

The type of foundation can be used at locations when soil is clay type, not necessary black in colour, which shrinks when dry, swells when wet, resulting in differential movement extending to a maximum depth of about 3.5 m below ground level and the soil strata at 3.5 m depth will have poor bearing pressure. Fully submerged foundation shall be that where sub-soil water rises in the foundation pit within 0.75 m below ground level. This type of foundation classification will be given by Chief

Engineer / Construction / 400 kV or his authorised officer after excavation of the pits. This type of classification will be given duly following the necessary investigation.

j) **HARD ROCK**

The locations where chiselling, drilling and blasting are required sheet rock for excavation, hard rock type foundations are to be used. The rock portion thickness should be at least 3.0 m. For these foundations, rock anchoring is to be provided to resist uplift forces.

In addition to the above, depending on the site conditions more variation of foundations may be introduced suitable for intermediate conditions under the above classifications to affect more economy.

NOTE : In all cases, the water level shall be measured with respect to the tower centre line as per previous information in rainy season.

*** Higher classification is not necessary in case of angle towers other than soil conditions prevailing.**

- 18.5** Where soils at tower locations are of composite nature, i.e., partly soil and partly hard rock, the payment for excavation shall be made at the unit rate mentioned in *Erection Schedule-II of Volume-I* the volumes of hard rock and soil excavations shall be within the volume of excavation. The decision of the purchaser shall be final and binding with reference to the classification of soils.
- 18.6** The cost of drilling and blasting shall be included in the quoted rates for hard rock excavation. Blasting materials and approval for blasting operations shall be arranged by the contractor from the Central, State, Quasi Govt authorities at his own cost, and stored in an approved manner. For soils other than hard rock, the excavation rate to be quoted shall include the cost of back filling with excavated soil/ borrowed soil.
- 18.7** Where rock is encountered, the holes for tower foundations shall preferably be machine drilled and the rock excavated manually or with chemical expanders. Where blasting is required it shall be done in accordance with the relevant Indian Standard and with utmost care to minimise the use of concrete for filling up the blasted areas. All necessary precautions for handling and use of the blasting materials shall be taken as per the requirements of the relevant safety code. Only the persons having certificate for blasting issued by the competent authority shall be deployed for carrying out the blasting.

In case unnecessarily large quantities are blasted resulting in the use of large volumes of additional concrete, payment for concrete shall be limited to the approved volume as per the drawing and the cost of any concrete in excess of that shall be borne by the contractor.

18.8 Measurement and Payment

Measurement for payment will be based on volume calculations determined by the existing grade and upto the bottom elevation of structural/lean concrete. If adjacent foundations overlap, the overlapped portion shall be paid only once. Payment for excavations for tower foundations shall be made at the unit rate per cubic metre quoted for the appropriate type of soil. The unit prices quoted shall include the cost of necessary labour and material for all timbering, shoring and spreading and compacting the excess material evenly around the site. Unit rate quoted shall also include the cost of dewatering during excavation and as well as laying of foundations and nothing extra shall be paid on this account. However payments shall be restricted to actual volumes as per unit rates.

Measurement for payment of excavation of foundation for tower sites shall be made to the most practicable lines as approved by the Purchaser. 60% of quoted rates per cum will be paid after completion of excavation and 40% of quoted rates per cum will be paid after Backfilling in standard procedures.

If during the progress of excavation or after the completion of excavation, any alterations in the dimensions of excavation actually made become necessary, compensation therefore shall be determined as follows:

a) The contractor shall be responsible for all costs resulting from the remedial works required to correct errors caused by his improper methods of excavation etc.

b) Hard rock (requiring blasting):

This shall include:

Any rock without faults & fissures or cement concrete for the excavation of which the use of mechanical plant or blasting is required.

Reinforced Cement Concrete (reinforcement cut through but not separated from the concrete) below ground level and

Boulders requiring blasting.

c) Hard rock (blasting prohibited):

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

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

d) The excavated hard rock should be stacked at site for inspection of Engineer in charge. 40% voids should be deducted in stacked volume, for hard rock excavation measurement purpose.

19.0 EXCAVATION OF BORROWED EARTH FOR BACKFILL

19.1 This item covers excavation of borrowed earth required for backfill at the borrow areas identified by the contractor and approved by the purchaser.

19.2 The contractor shall strip the borrow area of all unsuitable material as may be necessary to obtain the required quantities of borrowed materials. The surfaces of borrow areas shall be left in reasonably even condition.

Measurement

No separate payment shall be made to contractor for borrowed earth.

20.0 BACKFILLING

20.1 The contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings as described herein.

20.2 After completion of foundation work and other construction below the elevation of the final grades and prior to backfilling, all forms, temporary shoring, timber etc. shall be removed and the excavation cleaned of all trash, debris and perishable materials. Backfilling shall begin only with the approval of the purchaser.

- 20.3** Back filling shall normally be done with the excavated soil unless it consists of large boulders/stones in which case the boulders shall be broken to a maximum size of 80mm. The backfill material shall be clean and free from vegetation, pieces of timber and other undesirable materials. Back filling shall be done with inorganic materials, obtained from the excavation or borrow pits and subject to the approval of the purchaser.
- 20.4** Backfill shall not be dropped directly upon or against any foundation or facility where there is danger of displacement or damage.
- 20.5** Backfill shall be placed in horizontal layers not to exceed 300mm in thickness. Each layer shall be compacted with proper moisture content with such equipment as may be required. Trucks or heavy equipment for depositing or compacting backfill shall not be used within 1.75 M of foundation that may be damaged by their weight or operation. The methods of compaction shall be proposed by the bidder in his bid and the successful bidder shall obtain the approval of the purchaser for the methods proposed. Pushing of earth for backfilling shall not be adopted under any circumstances.
- 20.6** After backfilling, 100mm high earthen embankment (Bund) along the sides of excavation pits shall be made and sufficient water poured in the back-filled pits so that standing water remains above the back-filled earth for at least 24 hours.
- 20.7** While backfilling of foundations, the pad shall be covered with about 300mm layer of fine material before any coarse material is deposited. Care shall be taken to avoid damage to the concrete during back filling and compaction of soil.
- 20.8** All top soil shall be placed at the surface in the case of towers located on cultivated land.
- 20.9** Where excavated material is not considered to be suitable by the purchaser for use as back-fill, borrowed earth shall be used for back filling, for which the provision of clause 18.0 above shall be applicable.
- 20.10** On completion of foundation work, the earth surrounding them shall be accurately finished to natural line and grade or as directed by the purchaser. Finished surface shall be free of irregularities and depressions and shall be within 50mm of the specified level.
- 20.11** **All the extra surplus earth left over after backfilling must be removed from the site.**

20.12 Measurement

The cost of backfilling inclusive of backfill with borrowed earth, if required and compaction is deemed to be included in the unit prices quoted for excavation in clause 16.8.

21.0 FORM WORK

- 21.1** This section covers technical requirements for furnishing and installation of formwork for construction of foundations. The contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings and as described herein. The diameter of steel can be 6mm to 32mm depending on foundation designs furnished by the Purchaser.

- 21.2 Formwork shall be as per IS:456-2000 and shall be composed of steel and/or best quality shuttering wood of non-absorbent type timber. The timber shall be free from knots and shall be of medium grain as far as possible.
- 21.3 The formwork shall conform to the shape, lines and dimensions of the foundations as per the design drawings. All details of the formwork, placing, tying, etc. shall be subject to the approval of the purchaser. The contractor shall submit the design and drawings showing details of the form construction to the purchaser for approval before commencement of actual work. The formwork shall be adequate to withstand the pressure of freshly placed concrete or other loads imposed, without failure, movement or deflection of the component parts. Formwork shall be sufficiently tight to prevent the loss of liquid from the concrete.
- 21.4 The inner surfaces of formwork coming in contact with concrete shall be smooth and free from projections. All rubbish particularly chipping, shavings, dust and traces of concrete, if any, shall be removed from the interior of the formwork before the concrete is placed. The surface in contact with the concrete shall be wetted and sprayed with fine sand or treated with an approved composition to prevent absorption of water from the concrete. Such composition shall be kept out of contact with reinforcement and shall be non-staining and non-injurious to concrete.

22.0 REINFORCEMENT

22.1 Scope

This section covers the technical requirements of supply, fabrication and fixing of reinforcement steel for foundation work of transmission line towers. The contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings and as described herein. The steel bars used for reinforcement may be of 6mm to 32 mm dia as per the design requirement.

- 22.2 Reinforcement steel shall be VSP, SAIL, TATA & JINDAL and it shall be clean and free from loose mill scales, dust, loose rust and coats of paints, oil, grease or other coatings, which may impair or reduce bond. It shall conform to the following IS Specification.
- a) Mild steel & medium Tensile Steel deformed bars and hard drawn steel wire shall conform to latest edition of IS:432(Part-I).
 - b) High yield strength deformed bars conforming to latest editions of IS:1139 and IS:1786.
- All steel reinforcements including and above 6mm diameter shall necessarily be of tested quality.
- 22.3 The high yield strength steel reinforcement rods used in foundation shall be of Fe-500/500D/550D Grade quality of TSTRANSCO approved brands i.e., VSP, SAIL, TATA & JINDAL and the name be embossed suitably indicating the name of the manufacturer..
- 22.4 The contractor shall furnish reinforcement accessories. Binding wire shall be annealed iron wire quality not less than No.16 SWG (1.65mm dia.). Bar support, chairs and bolsters shall be sufficiently strong to support the steel properly. Chairs shall be provided.

- 22.5 The bending and fixing of reinforcement bars for reinforced concrete work shall be in accordance with IS: 2502, SP-34 and IS:456.
- 22.6 The measurement will be based on the calculated weights of reinforcement steel as per approved drawing in tonnes correct to 3rd place of decimal, no allowance being made for wastage. No payment shall be made for wire required for binding the reinforcement, chairs and spacers as the cost of these is deemed to be included in the unit rate quoted for the item of reinforcement. The payment shall be limited to actual quantity as per approved drawing.

23.0 CONCRETE

- 23.1 This section covers the technical requirements in respect of materials used in forming, mixing, placing, finishing, curing and testing of plain and reinforced concrete for foundation work for transmission line towers. The contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings and as described herein.

23.2 Standards

The latest Indian Standard specifications mentioned below shall be applicable to the materials and processes used in the preparation of concrete.

- i) IS: 456-2000 Code of practice for plain and reinforced concrete for general building construction.
- ii) IS: 269-1990 Specification for ordinary Portland cement.
- iii) IS: 383-1991 Specification for coarse and fine aggregate from natural sources for concrete.
- iv) IS: 5613(Part-3) Code of practice for design installation and maintenance of
Section-2-1989 overhead power lines.
- v) IS: 4091-1979 Code of practice for design and construction of foundations for transmission line towers and poles.
- vi) [IS: 2911-2010](#) [Code of practice for design and construction of pile foundations.](#)

- 23.3 The provision of the latest revision of IS: 456 shall be complied with unless permitted otherwise and any other Indian Standard Code shall form a part of this specification to the extent it has been referred to or applicable within this specification. This specification shall have precedence in case anything contrary to this is stated anywhere in the bidding document.

23.4 General Requirements

All materials, tests, mixing, placing, formwork, reinforcing and workmanship shall conform to IS: 456-2000 'CODE OF PRACTICE FOR PLAIN AND REINFORCED CONCRETE FOR GENERAL BUILDING CONSTRUCTION' and other relevant Indian Standard codes.

23.5 Materials

23.5.1 Cement

Cement used shall be ordinary Portland cement conforming to IS: 269, Cement that has set or partially set shall not be used in case of PPC, prior approval from the competent authority shall be obtained duly submitting the test reports of cement. While using PPC on

approval, the mix design shall be carried out for concrete to find out the exact quantity of PPC for the respective grade of structural concrete.

The list of approved brands of cement adopted by TSTRANSCO.

- 1) ACC limited (2) Kesoram cement (3) Orient cement (4) Zuari cement
- (5) CCI Limited (6) Andhra Cement (7) Coromandel cement (8) Raasi cements
- (9) Sri Vishnu cements (10) Madras cements (11) Ultra Tech cements limited
- (12) KCP Limited (13) Penna cements (14) Panyam cement (15) Grasim
- (16) Rajashree cements (17) Mysore cement (18) Century cement (19) Ambuja cement
- (20) Priya cement.

23.5.2 Aggregates

The aggregates shall conform to the provisions of IS: 383 'Specification for Coarse & Fine Aggregates from Natural Sources for concrete'.

(i) COARSE AGGREGATES

The maximum size of coarse aggregate shall be as follows:

Structural concrete for foundations

Slab : 20mm graded

Chimney : 20mm graded

Lean concrete : 40mm

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

(ii) FINE AGGREGATES

Fine aggregates shall be well graded within the limits by weight as specified in IS: 383. Fineness modulus shall not vary by more than plus or minus 0.20 from that of the approved sample. Fineness modulus for sand shall not be less than 2.5. Fine aggregate of Zone IV shall not be used for concrete work.

23.5.3 Water

Water used for forming and curing the concrete shall be clean, fresh and free from injurious amounts of oil, acids, alkali's, organic material or other deleterious matters in solution or in suspension in such amounts that may impair the strength or durability of the concrete. Potable water shall be generally satisfactory. Latest IS:3025 and IS:3550 may be followed for testing of water, if required, by the purchaser.

23.5.4 Admixtures

The use of admixtures in concrete for promoting workability, improving strength, entrained air or for any other purpose may be used only with the approval of the purchaser. Addition of admixture shall not reduce the specified strength of concrete in

any case. The admixtures shall conform to IS:9103 . Admixtures shall be used, if necessary, only with the written permission of the purchaser.

23.6 Grade Of Concrete

Concrete shall be of grades designated as M-20 in accordance with IS: 456-2000 and these specifications.

23.7 Ordinary Concrete

23.7.1 Ordinary concrete is recommended only when accurate control is impracticable and not necessary. However, if the purchaser allows ordinary concrete, it shall be used only in the lean concrete.

23.7.2 If ordinary concrete made in accordance with the proportions given in IS: 456 for a particular grade does not yield the specified strength and fails to satisfy the requirements of 'Acceptance Criteria' as specified in IS: 456, the cement content shall be increased as directed by the purchaser to obtain a specified strength at no extra cost to the purchaser.

23.7.3 Ordinary concrete proportion for a given grade specified under relevant paragraph above shall not however, be classified as a higher grade on the ground that the test strengths were found higher than the minimum specified.

23.8 Controlled Concrete

23.8.1 Controlled concrete shall be used on all concrete works, except where specified otherwise. Controlled concrete for use in plain and reinforced concrete structures shall be in grade M-20.

23.8.2 The mix proportions for all grades of concrete shall be designed to obtain strengths corresponding to values specified hereinafter for respective grades of concrete. Preliminary tests as specified in the IS:456 and required by the purchaser, shall be carried out sufficiently ahead of the actual commencement of the work with different grades of concrete made from representative samples of aggregates and cement expected to be used on the job to ascertain the ratios by weight of cement to total quantities of fine and coarse aggregate and the water cement ratio required to produce a concrete of specified strength and desired workability.

23.8.3 Mix design for all grades of controlled concrete shall be undertaken to investigate the grading of aggregates water cement ratio, workability and the quantity of cement required to give cubes the minimum strength specified in IS:456 used as mentioned below.

The proportions at the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made:

Grade of concrete		M-20
i)	Preliminary Tests	20.0 N/sq.mm
	at 28 days	204 kg/sq.cm

ii)	Work Tests	10.0 N/sq.mm
	at 7 days	102 kg/sq.cm
iii)	Work Tests	15.0 N/sq.mm
	at 28 days	153 kg/sq.cm

NOTE :-

i) Preliminary Tests

A test conducted in laboratory on the trial mix of concrete produced in a laboratory with the object of:

Designing of a concrete mix before the actual concreting operation start;

Determining the adjustments required in the design mix when there is a change in the materials used during the execution of work;

Verifying the strength of the concrete mix.

ii) Work Tests

A test conducted in the field or in a laboratory on the specimen made on the works, out of the concrete being used on the works.

- a) Design mix concrete shall be used on all concrete works, except where specified otherwise. Work shall not commence until the Purchaser has approved the control/design concrete mix. The contractor shall allow sufficient time for all the obligations and tests etc. to be carried out prior to approval.

NOTE: Mix design shall take account of any chemicals harmful to concrete found to be present during soil investigation.

23.9 Concrete Mix Requirements

23.9.1 The minimum quantity of cement content for each grade of concrete, notwithstanding the strength requirements specified in the specification, shall be as below:

Grade of concrete	Minimum cement content per Cubic Meter.
For M-20 Nominal mix	400 Kgs
For M-20 Design mix	350 Kgs

23.9.2 Based on the Contractor's mix design, if the actual requirement of cement for a grade of concrete is found to be more than those specified above, such excess quantity of cement shall be used for which no extra payment shall be made, and if the requirement is found to be less, minimum cement as specified above (i.e. 350 Kgs) shall be used.

23.9.3 Concrete slump shall be kept as Contractor's mix design.

23.9.4 The concrete shall be consistency as to give a slump of as per IS code 456.

23.9.5 The admixture content, batching method and time of adding to the mix shall be in accordance with the manufacturer's recommendations for compliance with these specifications.

23.10 Concrete Mix Review

23.10.1 The source and quality of concrete materials and concrete proportions proposed for the work shall be submitted to the purchaser for review before the concrete work is started. Complete certified reports prepared by an independent testing laboratory and covering the materials and proportions shall be submitted to the purchaser. Review of these reports will be for generally acceptability only and continued compliance with all contract provisions only will be required. The purchaser shall have the option to witness the preparation of the trial mixes, testing etc.

23.10.2 Reports on admixture shall include the classification, brand, manufacturer and active chemical ingredient. All admixtures, conforming to relevant IS Codes, shall be the products of one manufacturer approved by the purchaser.

23.10.3 Reports on the fine aggregates shall include the sources, type, gradation, deleterious substance, soundness and the results of all tests required to verify compliance IS:383.

23.10.4 Reports on the coarse aggregates shall include the source, type, gradation, deleterious substances, soundness, abrasion loss and the results of all tests required to comply with IS:383.

23.10.5 Using concrete materials acceptable to the purchaser, a concrete mix shall be designed and tested for each size and gradation of aggregates and for consistency intended for use on the work. Design quantities and test results of each mix shall be submitted for review. Acceptable mixes shall be subjected to field adjustments as necessary to meet the requirements of these specifications. Should the contractor wish to use alternative sources for sand and aggregate the additional design mixes must be supplied.

23.10.6 The report for each concrete mix submitted for review shall include the following information:

- (a) Slump on which the design is based.
- (b) Total litres of water per cubic meter.
- (c) Water-cement ratio.
- (d) Ratio of fine to coarse aggregates.
- (e) Weight (surface dry) of each aggregate per cubic meter.
- (f) Quantity of each admixtures.
- (g) Air content, if any.
- (h) Compressive strength based on 7 days and 28 day's compression test.
- (i) Time of initial set.
- (j) Time of final set.

(k) Weight of cement used in the mix.

- 23.10.7** Concrete test specimens shall be made, cured and tests in conformity with IS:516. These tests shall be conducted at approved laboratory. Calibration certificates for the test equipment shall be available on demand. The mould and materials for cubes and cylinders shall be supplied by the contractor who shall also arrange to transport the cubes/ cylinders to laboratory at his own cost. The cost of the testing shall also be borne by the contractor.

23.11 CONCRETE MIXING

- 23.11.1** Concrete mixing shall conform to IS:456-1992. Concrete shall only be mixed in a mechanical mixer. Mixing by hand is specifically prohibited.

On sites where access is very difficult then “one bag” mixers capable of being dismantled and carried in shall be employed.

- 23.11.2** The proportion of fine and coarse aggregates, cement and water shall be as determined by the mix design in case of controlled concrete. The quantities of fine and coarse aggregates shall be determined by weight. The purchaser may allow the quantity of aggregates to be determined by equivalent volume basis after the relationship between the weight and volume is well established by trial and the same will be verified frequently. The quantity of cement shall always be determined by weight. The water shall be measured accurately after giving proper allowance for surface water present in the aggregates for which regular check shall be made for bulking in the case of volume batching in accordance with IS:2386 (Part-III).

- 23.11.3** All concrete shall be mixed until there is a uniform distribution of materials and shall be discharged completely before the mixer is recharged. Mixing shall be done in a mechanical mixer and the type and size shall be subjected to the approval of the purchaser. Mixers shall rotate at the speed recommended by the manufacturer. The water shall not be added to the mix until all the cement and aggregates constituting the batch are already in the drum and dry mixed for at least one minute and thereafter mixing shall continue for at least 2 minutes or at least forty (40) revolutions. All concrete shall be discharged within 3 minutes after the introduction of mixing water to the cement and aggregates, unless otherwise specified by the Purchaser.

- 23.11.4** Before beginning a run of concrete all partially set or hardened concrete and foreign material shall be removed from the inner surfaces of mixing and conveying equipment. The first batch of concrete, through a cleaned mixer, for use in the works, shall contain 10% additional cement at no extra cost to allow for loss in the drum. All conveyances, buggies and barrows shall be thoroughly cleaned at frequent intervals during the placing of concrete. Concrete shall be rapidly handled from the mixer to the place of final deposit and shall not be delivered by tube, chute or wheelbarrow with a free fall from the mixer of more than 1.0 m. Every possible precaution shall be taken to prevent separation or loss of the ingredients while transporting the concrete.

23.12 Concrete Placement

- 23.12.1** The handling, depositing, and compacting of concrete shall conform to these specifications, subject to adjustments by the purchaser for weather or placements

conditions. During hot or cold weather, the concreting shall be done as per the procedure set out in IS:7861 (Part-I & Part-II)

- 23.12.2 Concrete shall not be placed until the formwork; reinforcements and preparation of surfaces involved in casting are approved by the purchaser and shall be placed only in the presence of purchaser or his representative. Preferably concrete shall not be placed under water and all excavations prepared for concrete shall be maintained free of water until the concreting is completed 24 hours thereafter. All surfaces of foundations upon or against which concrete is placed shall be free from mud and loose earth.
- 23.12.3 Contractor shall keep an accurate record of the date on which the concrete is cast for each part of work and date on which the forms are removed.
- 23.12.4 Concrete shall be conveyed to the point of final deposit by methods that will prevent the separations or loss of the ingredients. Concrete shall be deposited in its final position without moving it laterally in the forms for a distance in excess of 1.5 meter.
- 23.12.5 Concrete shall be deposited in approximately horizontal layers to proper depth for effecting compaction. However, the depth of a layer shall not exceed 500mm. Each layer of concrete shall be plastic when covered with the following layer and the forms shall be filled at a rate of vertical rise of not less than 150mm per hour. Construction joints shall be provided as necessary and as accepted by the purchaser to comply with these requirements.
- 23.12.6 Plastic concrete is defined as concrete that can be re-vibrated least to the extent that an immersion type vibrator stud will penetrate the concrete at least 25mm by vibration action and its weight. Concrete which is not longer plastic but which must be covered by an additional lift shall be immediately chipped back to well consolidate concrete and flushed with mortar puddle as follows.
- 23.12.7 The surface of hardened concrete upon which fresh concrete is to be placed shall be rough and clean and damp. Surface mortar shall be removed to expose the aggregate. The hardened surface shall be cleaned of all foreign substances (including curing compound), washed with clean water, and kept saturated during the 24 hours period preceding placement of fresh concrete. Coarse aggregates shall be omitted from the batches of concrete deposited on hardened concrete. This mortar puddle shall convert the hardened concrete to a depth of not less than 15mm at every point.
- 23.12.8 To secure maximum density and eliminate formation of air pockets, the concrete shall be thoroughly vibrated and worked around all reinforcements, embedded facilities and into corners of forms during and immediately after placing. Unless other methods are authorised by the Purchaser, mechanical vibrators conforming to IS:2505, IS:2506, IS:2514 and IS:4656 shall be used for this purpose, the type and operation of which is subject to the approval of the purchaser.
- 23.12.9 The placing of concrete shall be in a continuous operation with no interruption in each location. Concrete shall be handled from the place of mixing to the place of final deposit as rapidly as practicable by methods, which will prevent segregation.
- 23.12.10 Concrete shall normally be placed in continuous horizontal layers. Construction joints in foundations shall not be permitted. Concrete shall be compacted to the maximum

practicable density during the placement and thoroughly worked around the reinforcement if any and around the embedded stubs and into the corners of the formwork, with vibrators or any other means approved by the purchaser.

- 23.12.11 Repairs of imperfection in concrete shall be completed within 24 hours after the removal of forms. Repair of concrete shall be performed only in the presence of the purchaser or his representative. All exposed corners shall be slightly rounded or chamfered. Concrete in the top of foundations shall be sloped to provide drainage away from stub angles.

23.13 Temperature of Concrete

- 23.13.1 In hot weather, the temperature of concrete when it is placed in the forms shall not be more than 38 deg. C. In extreme hot weather a suitable means shall be employed to lower the temperature of concrete: A list of acceptable methods are given below,

- (a) Using cold mixing water.
- (b) Cooling coarse aggregate with cold water by sprinkling or inundation.
- (c) Insulating mixer drums or cooling with sprays or with wet burlap coverings.
- (d) Shading materials and facilities not otherwise protected from heat.
- (e) Working only at night. Use of ice for mixing water should be carefully controlled to ensure complete melting before mixing is completed.

- 23.13.2 In cold weather, the temperature of concrete when it is placed at or below freezing temperatures shall be maintained atleast 4.5 deg. C. No frozen material or material containing ice shall be used. Depending upon the severity of weather, it is necessary to heat the mixing water or aggregate. Heating of mixing water shall be preferred. Very hot water shall not be allowed to touch the cement to avoid quick or flash setting. Hot water and coldest portion of aggregate shall be brought together in the mixer first.

- 23.13.3 Subject to the approval of purchaser, the aggregate shall be heated uniformly and carefully avoiding overheating and excessive drying. The average temperature of aggregate shall not exceed 65 deg. C. and the maximum temperature shall not exceed 100 deg. C.

23.14 Stripping Time

Under fair weather conditions with average daily temperature not less than 20 deg. C. and when ordinary cement is used, forms may be struck after 24 hours of placing the concrete. In very cold temperatures, the forms shall be struck after 48 hours of the placing of concrete.

23.15 Protection Of Concrete

- 23.15.1 In very cold weather the concrete shall be protected from freezing for at least 48 hours of placement when the mean daily temperature is 4.5 deg. C. When the mean daily temperature in the vicinity of work site falls below 4.5 deg. C. for more than one day, the concrete shall be maintained at a temperature not less than 10 deg. C. for at least 72 hours after it is placed. Concrete cured by water curing shall be protected at 10 deg. C.
- 23.15.2 In hot weather, the curing shall be commenced even before stripping the form work by loosening the forms and allowing curing water to run down between the concrete forms.

3.16 Curing

- 23.16.1 The concrete after setting for 24 hours shall be cured by keeping the concrete wet continuously for a period of 14 days after laying. The pit may be backfilled with selected earth sprinkled with necessary amount of water and well consolidated in layers not exceeding 200mm after a minimum period of 24 hours and there after both the back filled earth and exposed chimney top shall be kept wet for the remainder of the prescribed time of 14 days. The uncovered concrete chimney above the back filled earth shall be kept wet by providing empty gunny bags dipped in water fully wrapped around the concrete chimney for curing and ensuring that the bags kept wet by the frequent pouring of water on them.

For curing the foundations below ground level, after backfilling, 150mm high earthen embankment along the sides of excavation pits shall be made and sufficient water shall be poured in the backfilled pits so that standing water may remain above the backfilled earth.

- 23.16.2 In high temperature and low humidity areas, more frequent sprinkling shall be done.
- 23.16.3 In cold weather at or below freezing temperature, concrete shall be insulated with layer of straw or similar material covered with a waterproof sheet material to help retention of the original heat of concrete plus heat of hydration. Curing shall be carried out for longer periods to the satisfaction of purchaser, to ensure that the concrete attains the strength and quality.
- 23.16.4 The stubs of foundations constructed in fully Submerged soil shall be painted after installation with black bituminous paint overlapping the steel / concrete interface from 150 mm below the top of concrete to 500 mm above.

23.17 Sampling And Testing:

- 23.17.1 Samples of concrete shall be taken at the direction of the purchaser in the field in accordance with IS: 1199 'Methods of Sampling & Analysis of concrete'. The testing shall be carried out as per IS: 456 and other relevant codes.
- 23.17.2 The samples shall be tested for strength and consistency at any approved laboratory in accordance with IS:516. These tests shall be conducted at approved laboratory or at the contractors premises under the supervision of the Purchaser's representative. Calibration certificates for the test equipment shall be available on demand. The mould and materials for cubes and cylinders shall be supplied by the contractor who shall also arrange to transport the cubes/ cylinders to laboratory at his own cost. The cost of the testing shall also be borne by the contractor.
- 23.17.3 The number of samples to be taken for testing and verifying concrete strength shall be in accordance with IS: 456 but shall be a minimum of four (4) cubes per foundation and as per the directions of purchaser.

23.17.4 Samples shall be cured under laboratory conditions except when in the opinion of the purchaser extreme weather conditions may prevail at which time the purchaser may require additional cubes cured under job conditions.

23.17.5 The contractor shall promptly furnish to the purchaser certified reports of all tests made by the testing laboratory.

23.17.6 If the strength of the cubes for any portion of the concrete work falls below the specified compressive strength, the criteria for acceptance of the portion of the work shall be as stipulated in IS:456.

If the concrete falls below the specified compressive strength then the contractor shall:

- i) Analyse the actual loads on the foundation to determine its adequate strength. If acceptable, this shall require a payment to the purchaser for the reduced quality.
- ii) Propose modifications to bring the strength of the foundation to a level acceptable to the purchaser. All modifications shall be at the contractor's expense.
- iii) Break out and replace the foundation as per the Purchasers instruction at the contractor's expense.

23.17.7 The purchaser shall also reserve the right to reject whole or any part of the work. In case of acceptance of such works, the standard deviations shall be worked out, and examined by the purchaser and if he is satisfied only then such works can be accepted at the reduced rates. Furthermore, the purchaser shall have the right to order a change in the mix or the water cement ratio for the remaining portion of the foundations at no extra cost to the purchaser.

23.17.8 Material samples viz sand, metal, bricks etc of approved test samples should be exhibited at site for comparison. All approved test certificates along with Quality Assurance Plan, Technical Specifications etc. should be made available site.

23.18 Concreting Of Foundation

The contractor shall inform the purchaser or his authorised representative sufficiently in advance about the programme of concreting the location.

23.19 Measurement

Measurement of concrete shall be in cubic meter correct up to second place of decimal and it shall be based on approved drawings of foundations, no deduction shall be made for embedment and reinforcements. Reinforcement steel shall be measured to the nearest kilogram. The payment shall be limited to actual quantity as per approved drawing.

24.0 PROTECTION OF TOWER FOUNDATIONS

24.1 The work shall include all necessary stone revetment, concreting and earth filling above ground level. Special measures for protection of foundations shall be taken in respect of locations close to/in nallah, riverbeds, etc. by providing suitable crate of galvanised wire

netting and meshing packed with boulders. The top seal cover of the revetment work shall be done with PCC 1:3:6 nominal mix. The contractor shall furnish recommendations for providing protection at such locations.

- 24.2 Where the ground surface is irregular the foundation shall be finished off in a substantial and permanent way by forming a plinth by side cutting and building a suitable random stone revetment or in case of rock foundation by building up with concrete as desired by the purchaser. The number of retaining walls and breast walls en-route transmission line shall be intimated by the contractor for obtaining the decision of the purchaser before taking up erection.

24.3 Measurement

- 24.3.1 The unit rate of revetment for protection of the tower foundation shall be quoted in the schedule of prices and shall include excavation, 100mm thick P.C.C(1:3:6) at bottom weep holes of size 100x100mm @ 2.0m interval, dry stone packing of 300x300mm size at mouth of weep hole, top seal cover with P.C.C (1:3:6) 100mm thick and raised pointing for out side of revetment with C.M(1:4).

- 24.3.2 For calculation of volume of revetment, the *P.C.C (1:3:6) at bottom and P.C.C (1:3:6) top seal cover* volumes shall be added to the revetment volumes for payment purpose. Stone packing volumes and weep holes volumes are neglected for payment purpose.

24.3.3 T & P Required:

i)	Concrete mixers	2 Nos.
ii)	Needle vibrators	4 Nos.
iii)	Cube moulds	8 Nos.
iv)	Water tankers	2 Nos.
v)	Compaction rammers	2 Nos.
vi)	Template supporting jacks	20 Nos.
vii)	IS Sieves (all sizes)	1 set.
viii)	Vernier callipers & screw guage	1 set.
ix)	Steel ladders	2 Nos.
x)	Dewatering pumps	3 Nos.

25.0 GROUNDING

- 25.1 The installation of earthing sets shall be in accordance with relevant standard specifications. The galvanised steel pipe sets shall be installed in the ground near the towers and connected to the tower legs by means of galvanised steel flat as shown in Drawing enclosed. The grounding shall be effected by making about 300mm dia and 3600mm deep pit at a distance of not less than 6000mm diagonally away from the stubs and filling in the pits with finely broken coke having grain sizes not more than 25mm thick. Coke shall be maintained upto a distance of 150mm from the pipe on all sides. The top edge of the pipe shall be at least 600mm below the ground level. The steel strip shall be buried not less 450mm deep from the ground level. Where tower foundation resistance exceeds the value specified in Section-9 of this specification, the desired earthing resistance shall be obtained by

installing additional pipe earthing sets. The distance between the electrodes in such cases shall preferably be not less than twice the length of electrode.

- 25.2 At locations, where it is not possible to obtain the desired foundation resistance by the means mentioned in clause 25.1, installation of counterpoise earthing shall be resorted to. Four galvanised steel stranded conductors shall be radiated from tower as shown in Drawing enclosed. The measured earthing resistance of tower shall not exceed 10 ohms in dry weather.
- 25.3 In case the measured resistance of the earthing arrangement described in 25.2 still exceeds the values, use of continues counterpoise shall be made as per the arrangement shown in enclosed drawing.
- 25.4 Where a tower stands on rock, efforts shall be made to obtain a good ground by carrying a length of galvanised steel flat from the tower legs to earthing pipe driven in damp soil at the shortest possible distance from the tower. The connecting flat shall be buried in a groove cut in the rock surface and adequately protected from damage.
- 25.5 The contractor shall measure and record the resistance of each tower to earth after erection and before installing the earthwire and submit the same to the purchaser. He shall provide adequate notice to the Purchaser so the Purchaser can witness the measurements if he so wishes. The measurements shall be made during the dry season.
- 25.6 All towers are to be earthed properly before stringing operation is taken up.

26.0 HANDLING AND TRANSPORTATION OF STEEL

- 26.1 All galvanised *steel* towers, including stub angles, shall be handled and transported to work site by the contractor with care to avoid bending of members and damage to galvanised surfaces.

27.0 TOWER ERECTION

- 27.1 Towers shall be erected member by member assembly or any other standard method without overstressing any member on foundations at least after 14 days of casting but a gap of 28 days shall be preferred. The tower erection shall be done in strict accordance with approved drawings.
- 27.2 The contractor shall be entirely responsible for correct erection for all towers as per the approved drawings and their correct setting on the alignment finally approved by the purchaser. The towers must be truly vertical after erection, the permitted tolerance in verticality being 1 in 360 of the tower height. No straining will be permitted to make the towers vertical.
- 27.3 A reasonable amount of drifting as permissible in IS:5613 (Part 3, section-2)-1989 shall be allowed in assembling, but reaming for correction of mismatched holes due to shop errors will not be permitted. If any shop errors are discovered, the contractor shall notify the purchaser, who will decide whether the errors may be corrected in the field or members returned to tower fabricator for correction or replacement. All galvanised surfaces damaged as a result of correction shall be made good as directed by the purchaser.

- 27.4 All errors and omissions in erection of towers shall be corrected by the contractor at no additional cost to the purchaser. Any tower damaged during erection due to incomplete bolting, improper guying or any other reasons, shall be repaired/replaced by the contractor as directed by the purchaser. The base width of tower shall be recorded before commencement of tower erection at concrete level.

27.5 ASSEMBLY

27.5.1 The contractor shall give complete details of the erection procedures.

The method followed for the erection of towers, shall ensure the following.

Straining of the members shall not be permitted for positioning. It may, however, be necessary to match hole positions at joints and to facilitate this, tommy bars not more than 450mm in length.

Before starting erection of an upper section, the lower section shall be completely braced and all bolts provided in accordance with approved drawings.

All plan diagonals relevant to a section of tower shall be placed in position before assembly of upper section is taken up.

The bolt positions in assembled towers shall be as per IS:5613 (Part- 3/ Section-2) 1989.

Tower shall be fitted with number plate, danger plate, phase plates, circuit plates and anti-climbing device as described.

After complete erection of tower ,all blank holes , if any ,are to be filled by Bolts and nuts of correct size.

Suspension towers shall be fitted with Bird guards.

28.0 TIGHTENING AND PUNCHING OF BOLTS AND NUTS

- 28.1 All nuts shall be tightened properly using correct size torque wrenches. Before tightening, it will be ensured that filler washers and plates are placed in relevant gaps between members, bolts of proper size and length are inserted and one spring washer used under each nut, and in case of step bolts, spring washers have been placed under the outer nuts. The tightening shall progressively be carried out from the top downwards, care being taken that all bolts at every level are tightened simultaneously. The threads of bolts projecting outside of the nuts shall be punched at three positions on the diameter to ensure that the nuts are not loosened in course of time. If during tightening a nut is found to be slipping or running over the bolt threads, the bolt together with the nut shall be replaced.
- 28.2 All the bolts projected outside the nuts shall be welded with the nuts at two diametrically opposite places. The length of each welding shall be at least 10mm. The welding shall be provided from ground level upto bottom cross arm level. After welding cold galvanised paint (zinc rich paint) having at least 90% (per cent) zinc content shall be applied to the welded portion. At least two coats of the paint shall be applied. The cost of welding including application of paint shall be deemed to be included in the erection price. If the tack welding is not carried out at the time of tower erection itself Rs.10,000/- per tower be deducted from the tower erection bill.

- 28.3 Alternative to the tack welding of nuts with bolts, as described above the contractor can also propose some other arrangement, like use of epoxy resin Adhesive which can serve the purpose of locking the nuts permanently with the bolts and nuts and this prevents pilferage of the tower members.
- 28.4 All the inter contact surfaces especially in coastal and highly polluted areas at the joint shall be painted with zinc rich paint to avoid formulation rust as per clause 14.3 of IS: 5613 (part 3/ Section-2) – 1989.

29.0 TOWER ACCESSORIES

Please refer clause 27.5.

30.0 INSULATOR HOISTING

- 30.1 The number of insulator units, required per string, are given in Section -9 of this specification for suspension as well as tension strings. Single suspension insulator strings shall be used on tangent towers and double tension insulator strings on all tension towers.
- 30.2 Damaged insulators and fittings, if any, shall not be used in the assemblies. All insulators shall be cleaned in a manner that will not spoil, injure or scratch the surface of the insulator, but in no case shall any oils be used for the purpose. Before hoisting, the components of the insulator string shall be checked for any damage, crack and missing of security clips etc. Corona control rings in case of 400kV lines only shall be fitted in an approved manner. The yoke arrangements shall be horizontal for tension and longitudinal for suspension strings. Torque wrench shall be used for fixing different components, like suspension clamp for conductor and ground-wire, etc. whenever recommended by the manufacturer of the same. The contractor shall include in his erection costs for insulators for the IR testing of each insulator unit. The insulator shall be tested with a suitable calibrated Megger as approved by the field officer and only in insulators which not less than achieve a 50 Mega ohm resistance shall be utilised for stringing.
- 30.3 The installation of string assemblies shall also include the installation of armour rod sets at suspension locations.
- 30.4 The compression dead ends and jumper connection in tension assemblies shall be fixed to conductor in accordance with manufacturer's recommendations that shall be furnished to the contractor.
- 30.5 Sacking shall be wrapped over the cross arm members of towers to prevent damage to the galvanised surface during hoisting of string assemblies.
- 30.6 Payment for installing insulator assemblies of various types shall be included in the rates quoted in the Schedule of Prices for stringing of conductors.

31.0 HANDLING OF CONDUCTOR AND GROUNDWIRE

Running out of the Conductors.

- 31.1 Before commencement of stringing, the contractor shall submit stringing charts for the conductor and earthwire for various temperatures corresponding to ruling spans. These charts shall be prepared on the basis of the data given in Section – 9 of this specification and

also on the data obtained from the detailed survey for the approval of the purchaser. The contractor shall provide a drum schedule, based upon the tower schedule and line profile, to show efficient use of the conductor for the Purchasers approval. Wherever possible 12 drums from the same lot shall be used in the same position on each conductor pull.

- 31.2 The contractor shall be entirely responsible for any damage to the towers or conductors during stringing. While paving out the conductors, care shall be taken that the conductors do not touch and rub against the ground or objects that could cause scratches or damage to the strands. The conductor shall be run out of the drums from the top in order to avoid damage due to chafing. Immediately after paving out, the conductor shall be raised at the supports to the levels of the clamp and placed into the running blocks.
- 31.3 The conductor shall be continuously observed for loose or broken strands or any other damage. When approaching the end of a drum length, at least three coils shall be left when the stringing operations are to be stopped. These coils are to be removed carefully, and if another length is required to be run out, a joint shall be made as per the recommendations of the conductor accessory manufacturers. The contractor shall use running out blocks suitable for joint protectors to ensure that the joints remain straight during tension stringing.
- 31.4 The contractor shall take adequate steps to prevent clashing of sub-conductors from the process of paving out to the installations of the spacers/spacer dampers. Care shall be taken that both sub-conductor of a bundle are from the same conductor supplier and preferably from the same batch so that creep behaviour of the sub-conductor remains identical. During sagging care shall be taken to eliminate differential sag in the sub-conductor as far as possible. However, in no case sag mismatch shall be more than 25mm.
- 31.5 Conductor splices shall be so made that they do not crack or get damaged in the stringing operation. The contractor shall use only such equipment/methods during conductor stringing which ensures complete compliance in this regard.
- 31.6 Suitable guards/sheaves shall be used to protect the conductor from damage in places where it would otherwise be impossible to save the conductors from coming in contact with objects which may injure the conductors. Guards shall consist of material over which the conductor may slide without injury and shall be subject to the approval of purchaser.
- 31.7 The sequence of paving out shall be from top downwards, i.e., the ground wire shall be run out first, followed by the conductors in succession alternating across the tower between phases. Unbalance of loads on towers shall be avoided as far as possible.
- 31.8 The proposed 400kV transmission line may run parallel for certain distance with the existing 400kV, 220kV, 132kV lines which may remain energised during the stringing period. As a result there is a possibility of dangerous voltage build-up due to electromagnetic and electrostatic coupling in the pulling wire conductors and groundwires. It shall be the contractor's responsibility to take adequate safety precautions to protect his employees and others from this potential danger. Running grounds and earthing of running blocks at each tower shall be installed as a minimum requirement.
- 31.9 The towers are not designed for one side stringing. Proper guying arrangement shall therefore be made by the contractor during stringing to avoid unbalanced loads on towers.

All the expenditure on account of the above work is deemed to be included in the price schedule and no extra payment shall be made for the same. The sagging and landing of the conductors phases and ground wires shall be done in pairs i.e. both top phases or both middle phases etc.

Running Blocks

- 31.10 The groove of the running blocks shall be of such a design that the seat is semicircular and larger than the diameter of the conductor, ground wire and it does not slip over or rub against the sides. The grooves shall be lined with hard rubber or neoprene to avoid damage to conductor and shall be mounted on properly lubricated bearings.
- 31.11 The running blocks shall be suspended in a manner to suit the design of the cross-arm. All running blocks, especially those at the tensioning end shall be fitted on the cross arms with jute cloth wrapped over the steel work and under the slings to avoid damage to the slings as well as to the protective surface finish of the steel work. Normally, suspension towers shall not be used even for temporary termination. In case small or medium angle towers are used even for temporary terminations, these shall be well guyed and steps be taken by the contractor to avoid damage. Guying proposals along with necessary calculations shall be submitted, for approval, by the contractor to the Purchaser. Proper "T & P" shall also be made available to the purchaser by the contractor for checking the tensions in the guy wires. The drums shall be provided with a suitable braking device to avoid damages, loose running out and kinking of the conductor.

Repairs To Conductors

- 31.12 Repairs to conductors, if necessary, shall be carried out during the paving out operations, with repair sleeves. Repairing of conductor surface shall be done only in case of minor damage, scuff marks or not more than 2 broken strands in the outer layer etc. keeping in view both electrical and mechanical safe requirements. The final conductor surface shall be clean smooth and shall be without any projections, sharp points, cuts, abrasions etc. If the damage is greater than above or extends to the successive layers then a midspan joint shall be used.

Crossings

- 31.13 Derricks and scaffolding shall be used where roads, rivers, channels, telecommunication or overhead power lines, railways lines, fences or walls have to be crossed during stringing operations. It shall be seen that normal services are not interrupted or damage caused to property. Shutdown shall be obtained when working at crossing of overhead power lines. The contractor shall be entirely responsible for the proper handling of the conductor, ground wire and accessories in the field.

32.0 STRINGING OF CONDUCTOR AND GROUNDWIRE

- 32.1 The paving out and tensioning of the conductor line shall be done by the control tension method. The equipment shall be capable of maintaining a continuous tension of not less than about 50 kN per bundle that shall be such that the sag for each conductor is maintained about twenty per cent greater than the sags specified in the stringing sag table. The

stringing equipment shall comprise a tensioner, puller, pilot line winder, conductor let-off reel stand, pulling rope take-up reel stand, pilot lines, Triple sheave stringing blocks, running board, running grounds, spacing cart, conductor lifting hook, insulator lifter, sagging winch, wire cutters, dynamometers etc. The capacity of the tension stringing equipment shall be as indicated in schedule –VIII of Volume - I of this specification.

- 32.2 Controlled stringing method suitable for simultaneous stringing of the sub-conductors shall be used. Both the conductors making one phase bundle shall be pulled in and paid off simultaneously. Both the conductors of the bundle shall be of matched length. After being pulled, the conductor and earthwire shall not be allowed to hang in the stringing blocks for more than 96 hrs. before being pulled to the specified sag. Stringing must be carried out in accordance with approved stringing charts with creep compensation.

33.0 JOINTING

- 33.1 All the joints on the conductor and groundwire shall be of compression type, in accordance with the recommendations of the manufacturer for which all necessary tools and equipment like compressors, dies, etc. shall have to be arranged by the contractor. Each part of the joint shall be cleaned by wire brush to make it free of rust or dirt etc. and shall properly be greased with anti-corrosive compound, if required and as recommended by the supplier before the final compression is done with the compressors.
- 33.2 All joints or splices shall be made at least 30 metres away from all the tower structures. No joints or splices shall be made in the spans crossing main roads, railway crossing, rivers crossing and high way crossings. No joints in the conductor or earthwire shall be permitted without the approval of the Purchaser. Not more than one joint per sub-conductors shall be allowed in a span. The compression type fitting used shall be self-centering type or care shall be taken to mark the conductor to indicate when the fitting is sitting on the conductor properly. During compression or splicing operations the conductor shall be handled in such a manner as to prevent lateral or vertical bearing against the dies. After pressing the joint, the aluminium sleeve shall have all corners rounded, burrs and sharp edges removed and smoothened. The compression of the joints shall be as the manufacturer's instructions.
- 33.3 During stringing of conductor, to avoid any damage to the joint, the contractor shall use a suitable protector with mid span compression joints in case joints are to be passed over pulley blocks/aerial rollers. The size of the groove of the pulley shall be such that the joint along with protector can be passed over it smoothly. The arrangement to be adopted shall be explained in the bid.
- 33.4 No joints shall be made in a single span between two angle towers.

34.0 SAGGING OPERATION

- 34.1 The conductors shall be pulled upto the desired sag as per sag board fixed on tower and left in running block for at least one hour after which the sag shall be re-checked and adjusted, if necessary, before transferring the conductors from the running blocks to the suspension clamps. The conductors shall be clamped within 36 hours of sagging in. Thermometer should be used to site for fixing sag boards on tower.
- 34.2 The sag will be checked in the first and the last span of the section in case of sections upto eight spans and in one intermediate span also for sections with more than eight spans. The sag shall also be checked when the conductors have been drawn up and transferred from running blocks to the insulator clamps.

- 34.3 The running blocks attached to the suspension string, when suspended from the tower shall be so adjusted that the conductors on running blocks will be at the same height as the suspension clamp to which it is to be secured.
- 34.4 At sharp vertical downward angles, the sags and tensions shall be checked on both sides of the angles, the conductor and earthwire shall be checked on the running block for equality of tension on both sides. The suspension insulator assemblies shall normally assume vertical positions when the conductor is clamped.
- 34.5 Tensioning and sagging operations shall be carried out in calm weather when rapid changes in temperatures are not likely to occur. In areas where calm weather is not prevalent during working season, the contractor shall recommend the precautions to be taken during final tensioning and sagging of conductor.

35.0 TENSIONING AND SAGGING OF CONDUCTORS AND GROUNDWIRE

- 35.1 The tensioning and sagging shall be done in accordance with the approved stringing charts before the conductors and groundwire are finally attached to the towers through the groundwire clamps for the groundwire and insulator strings for the conductor. Dynamometers shall be employed for measuring tension in the conductor and groundwire. The dynamometers employed shall be periodically checked and calibrated with a standard dynamometer.
- 35.2 Provision for ground undulations, errors in stringing and compensation for creep in conductors. This shall be considered at the time of stringing of conductors and as per approved stringing charts developed by the Contractor.
- 35.3 No pre-stressing/over-tensioning of the groundwire shall be done.
- 35.4 The adjustment of sub-conductor sag by means of sag adjustment devices provided in the insulator string shall invariably be not permitted at the time of stringing of the conductors. The sag adjustment plates shall be kept in fully open position at the time of stringing of the conductor.
- 35.5 The contractor shall terminate the line conductors and groundwires at the dead-end towers on each end of the line. Payment for stringing work shall be made for the actual route length of the line at the unit rates quoted for the stringing of conductors and groundwires in the Schedule of Prices.

36.0 CLIPPING IN

- 36.1 Clipping of the conductors in position shall be done in accordance with the recommendations of the purchaser. Conductor shall be fitted with the armour rods at suspension point and with vibration dampers at suspension and tension points.
- 36.2 The jumpers at the section and angle towers shall be formed to parabolic shape to ensure maximum clearance requirements. Pilot suspension insulator string shall be used, where required by the existing tower design.
- 36.3 Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and strung into position.

37.0 FIXING OF CONDUCTOR AND GROUNDWIRE ACCESSORIES

- 37.1 Spacers, spacer dampers, vibration dampers and other conductor and groundwire accessories that will be supplied by the contractor shall be installed by the contractor as per the design requirements and respective manufacturer's instruction. Spacer and vibration dampers/spacer dampers shall be fitted within 24 hrs. of the conductor clamping. While installing the conductor and groundwire accessories proper care shall be taken to ensure that the surfaces are clean and smooth and no damage shall occur to any part of the accessories.
- 37.2 The contractor shall ensure that drain holes, if provided, in the weights of the vibration dampers are open. The spacer/spacer dampers shall be installed at the intervals indicated by the purchaser. The required number of spacer cars/cycles with metre counters suitable for installing spacer/spacer damper shall be arranged by the contractor.
- 37.3 Rates for installing vibration dampers and spacers or spacer dampers shall be included in the rates of stringing of conductor and earthwire.

38.0 REPLACEMENT

If any replacements are to be effected after stringing and tensioning or before handing over, leg members and bracings shall not be removed without reducing the tension on the tower with proper guying or releasing the conductor. If the replacement of cross arms becomes necessary after stringing, the conductor shall be suitably tied to the tower at tension points or transferred to suitable roller pulleys at suspension points.

39.0 FINAL CHECKING, TESTING AND COMMISSIONING

After completion of the works, final checking of the line shall be done by the contractor to ensure that all the foundation works, tower erection, and stringing have been done strictly according to the specifications and as approved by the purchaser. All the works shall be thoroughly inspected keeping in view of the following main points:

- a) Sufficient backfilled earth is lying over each foundation pit and it is adequately compacted.
- b) Concreted chimneys and their copings are in good finally shaped conditions.
- c) All the tower members are correctly used, strictly according to final approved drawings and are free from any defect or damage whatsoever.
- d) All bolts are properly tightened and punched/and half round welded (as specified).
- e) The stringing of the conductors and groundwire has been done as per the approved stringing charts and desired clearances are clearly available.
- f) All conductor and groundwire accessories are properly installed.
- g) All other requirements to complete the work like fixing of danger plates, phase plates, number plate, circuit plates, anti-climbing device, bird guards etc. are properly installed.
- h) Wherever required, it should be ensured that revetment is provided.
- i) Two copies of the profile, route alignment and tower design, structural drawings, bill of material, shop drawings of all towers are to be modified "AS BUILT" and submitted to the purchaser for reference and record.

- j) The line insulation is tested by the contractor by providing his own equipment, labour etc. to the satisfaction of the purchaser.
- k) The line is tested satisfactorily for commissioning purpose.
- l) The right-of-way all along the route of line is clear of all obstructions and meets requirements of clause 5.3 of IS: 5613 (Part-3, Section-2)-1989.
- m) In addition to the tests stipulated in IS:5613 (Part-3, Section-2)-1989 the tower foundation resistance at the locations decided by the purchaser, shall be measured. All arrangements for testing shall be made by the contractor and the necessary labour, transport and equipment shall be provided by him.
- n) Any defects found as a result of testing shall be rectified by the contractor forthwith to the satisfaction of the purchaser without any extra charges.
- o) Before taking over of the line by the purchaser, the line shall be energised at full working voltage.
- p) Inspection details for each tower should be furnished by the contractor in **PROFORMA FOR TRANSMISSION LINE FINAL INSPECTION**.

40.0 PAYMENTS

- 40.1 The payment to the contractor for various items of works shall be based on the rates quoted in the schedule of prices for erection.
- 40.2 The payment for excavation and concreting shall be based on the approved design volumes of excavation and concreting,
- 40.3 The payment for super-structure erection shall be based on the calculated weights of towers and their extensions as per the approved bill of material for each type of tower
- 40.4 No claim for idle period resulting from any "Force Majeure" condition shall be entertained by the purchaser.

41.0 ERECTION EXPERIENCE AND FINANCIAL RESOURCES OF BIDDER

The Bidder should have experience of erection and commissioning of Transmission lines as per Section – II (Qualifying Requirements) of the Specification of Volume-I. The bids received from the bidders who do not fulfill these requirements shall not be considered. The bidders shall submit details of the Transmission lines of similar construction erected by them, which are in operation, as mentioned in Annexure – V of Volume -I, along with certificates from their customers in support of the satisfactory construction and operation of the lines. Information about financial resources of the bidder shall also accompany the tender.

42.0 ERECTION SCHEDULE

- 42.1 The transmission line(s) covered under this specification are required to be completed as per the programme given to in the bidding document.

- 42.2 The Contractor shall submit erection schedule(s) covering all phases of work starting from the date of award of contract upto the commissioning of the transmission line, in the form of flow-diagrams showing critical path construction schedule of all phases of work simultaneously or in the form of Bar Chart for all the lines separately.

43.0 PROGRESS REPORT

- 43.1 Progress reports of erection work in triplicate shall be submitted by the contractor as required by the Purchaser.

44.0 FIELD QUALITY PLAN

TSTRANSCO will provide a copy of Field Quality Plan to the Contractor prior to starting of Erection works. However it is the responsibility of the contractor to maintain Quality & Standards in all respects as per technical specification and relevant IS during the execution of the subject works. Also the contractor shall arrange ten (10) sets of the FQAP copies for TSTRANSCO use.

PROFORMA**TRANSMISSION LINES FINAL INSPECTION****LINE NAME :**

Inspected by

Structure

Type Ht.

Serial

Tower No.

A. CONDUCTOR : Suspension Structures

Date.

Corr.

Type of Hardware Assembly ?

Insulators - Clean ?

Broken ? Count

Properly Installed ?YesNoRYBRYB

Suspension clamp ?

.....

Grading Rings/ Corona Control Rings ?

.....

Armour Rod ?

.....

Dampers ?

.....

Over Head Groundwire (OHGW)

.....

OHGW Dampers ?

.....

B. CONDUCTOR : Angle Structure

.....

Type of Hardware Assembly correct ?

.....

Insulators - Clean ? Broken ? Count

.....

Properly Installed ?YesNoRYBRYB

Dead End Bodies ?

.....

Hardware Components, Cotter Pins

.....

Dampers ?

.....

Grading Rings/ Corona Control Rings ?

.....

Dampers ?

.....

Over Head Groundwire (OHGW)

.....

OHGW Dampers ?

.....

C. OTHER OBSERVATIONS : When Applicable

		<u>Properly Installed ?</u>	
		<u>Yes</u>	<u>No</u>
		<u>R</u> <u>Y</u> <u>B</u>	<u>R</u> <u>Y</u>
<u>B</u>			
Span ahead – Correct number of Spacers ?			
Spacers properly installed ?			
Adequate ground clearance obvious ?			
Obvious danger trees ?			
Broken strands or debris on conductor ?			
Span ahead – sag mismatch ?			

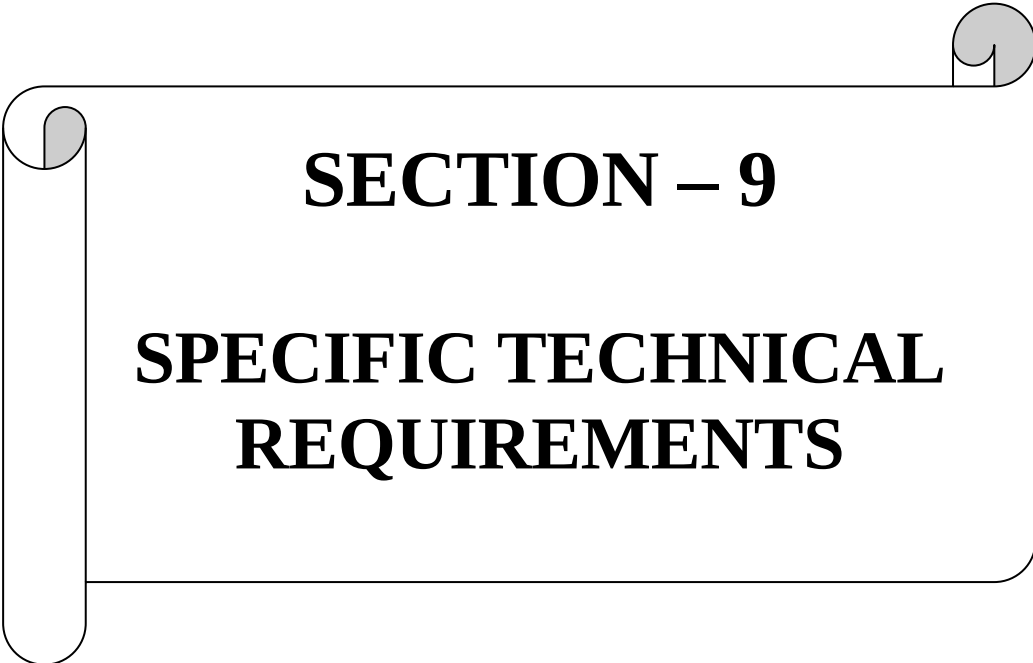
D. STRUCTURES : Steel

		<u>Properly Installed ?</u>	
		<u>Yes</u>	<u>No</u>
Towers	: Is there any loose, missing or damaged numbers ?	.....	
	: Are there any missing or loose bolts ?	.....	
Signs	: Number Plate ?	.....	
	: Danger Plate ?	.....	
	: Phase Plate ?	.....	
	: Bird Guards ?	.....	
	: Aerial Warning Required ?	.....	
Backfill	: Is all backfill at proper level	.....	
	: Are there rocks in cultivated area ?	.....	
Counter poise	: Required ?	.....	
	: Does route differ from drawing ?	.....	
	: Is site restoration satisfactory ?	.....	

E. BOLT TORQUE AND COMPRESSION JOINTS (based on site records)

		<u>Yes</u>	<u>No</u>
1.	Bolts and nuts of suspension clamps, spacers, Dampers, etc., tightened properly ?	.....	
2.	Compression joints made properly ?	.....	

F. REMARKS :



SECTION – 9

SPECIFIC TECHNICAL REQUIREMENTS

SECTION - 9**SPECIFIC TECHNICAL REQUIREMENTS**

This section of specification covers climatic conditions, System Particulars and Technical requirements for Towers, Foundations, tension, Conductor, Earthwire, OPGW, Insulator etc.,

1.0 CLIMATIC CONDITIONS.

i.	400 kV Quad Moose DC line	
ii.	Maximum ambient temperature (degree C)	50
iii.	Minimum ambient air temperature (degree C)	10
iv.	Daily average ambient temperature (degree C)	32
v.	Max. relative humidity	74%
vi.	Annual Rainfall (max) mm	1500
vii	Rainy days in a year (days)	June to October - 120
viii	Basic wind speed m/sec	44 for Zone-III
ix	Maximum altitude above mean sea level(meters)	1000
x	Seismic level (horizontal acceleration)	0.03
	(vertical acceleration)	0.015
xi	Average number of thunderstorm days per year	50

2.0 SYSTEM PARTICULARS

a)	Line Voltage (kV)	400
b)	Highest System Voltage	420
c)	Number of circuits	2
d)	Frequency (Hz)	50
e)	Neutral	Effectively earthed
f)	Number of sub conductors	4
g)	Bundle arrangement	Square
h)	Bundle spacing	450
i)	Basic insulation level BIL kV(RMS) (peak)	1550
j)	Power frequency withstand voltage wet (kV) rms	680
k)	Switching Surge withstand voltage wet kV peak	1050
l)	Corona extinction voltage Dry condition kV rms	320
m)	Radio interference voltage at one MHz for phase to earth voltage of 266 kV rms dry	1000
n)	Short circuit level KA	63
o)	Maximum temperatures deg C	
	Conductor	75
	Earthwire	53
p)	Power line crossing	400kV
	(i) Another power line (mm)	5490
	(ii) Telecommunications line (mm)	4480
	(iii) Railway line (mm)	
	Above track (mm)	17900
	Above crane (mm)	6000
	(iv) Major roads	as per IE rules - 1956

3.0 TOWER PARTICULARS

The parameters used for towers, the structural drawings of which will be handed over by the purchaser to the successful bidder for fabrication of towers are given as under

a)	Configuration	Double Circuit-Vertical

4.0 TOWER PARTICULARS

The parameters used for towers, the structural drawings of which will be handed over by the purchaser to the successful bidder for fabrication of towers are given as under

a)	Configuration	Double Circuit-Vertical

b) Spans / Tower spotting requirements

Tower spotting requirements of 400kV DC circuit Quad Moose ACSR Conductor Zone 3 span 400 Mtrs										
Sl. No.	Description		QA		QB		QC		QD	
1	Deviation not to exceed in degrees		2		15		30		60	
2	Normal span (m)		400		400		400		400	
3	Max Wt Span (m)									
			Down		Down		Down		Down	
	Vertical load limitation									
	<u>Conductor</u>									
	Effect of both spans (m)		600		600		600		600	
	Effect of one span (m)		360		360		360		360	
	<u>Earthwire</u>									
	Effect of both spans(m)		600		600		600		600	
	Effect of one span (m)		360		360		360		360	
	Min wt span (m)		Down		Up		Up		Up	
	<u>Condcutor</u>									
	Effect of both spans(m)		300		0		0		0	
	Effect of one span (m)		50		0		-200		-200	
	<u>Earthwire</u>									
	Effect of both spans(m)		300		0		0		0	
	Effect of one span (m)		50		0		-200		-200	
			Deg		Deg		Deg		Deg	
	Permissible sum of adjacent spans in meters for various deviation angles based on the condition that required		2	800	15	800	30	800	60	800
			1	822	12	854	28	835.3	58	832
			0	844	10	891	12	1123	56	864

	minimum ground clearance is available				8	927	10	1159	54	896
					6	963	8	1195	52	929
					4	1000			50	962
									48	995
	Permissible one span for various anles should not exceed 50% of values shown for sum of adjacent spans									
	Broken wire		Any		Any		Any		Any	
			one		Two		Two		three	
			wire		wires		wires		wires	

*The above limitations indicated regarding weight spans are considering full angle of deviation and maximum spans for which towers are designed, hence site specific spans cannot be generalized to limit the spans indicated, hence while changing tower from other higher towers with weight span limitations may be referred to designs division for further clarifications.

c)		Number of sub conductors per phase	4
d)		Sub conductor spacing (mm)	457
e)		Bundle arrangement	Square
f)		Number of earthwires	One no.HTGS & one no.OPGW
g)		Shielding angle (deg)	20
h)		Tower footing resistance (ohm)	10
i)		Clearances	
	i)	Minimum ground clearance from power conductor (mm)	8840
	ii)	Provision for survey and sag errors (mm)	150
	iii)	Minimum phase to phase distance (mm)	8000
	iv)	Minimum vertical midspan clearance between power conductor and earthwire in still air (mm)	9000
j)		Swing angles and minimum clearance from live to earthed metal	As per IS-5613. Or CBIP manual technical report 268
	i)	Suspension insulator string in still air and when deflected up to 22 deg from the vertical (mm)	3050
	ii)	Suspension insulator when deflected by wind up to 44 deg from the vertical (mm)	1860
	iii)	Jumpers in still air and when deflected up to 20 deg from the vertical (mm)	3050
	iv)	Jumpers when deflected by wind up to 40 deg ms from the vertical (mm)	1860
	v)	Tension insulator string (mm)	3050
	vi)	Design wind pressure kg/mt ²	94.33 or 103

4.0 STRUCTURAL STEEL PARTICULARS

The parameters of steel used in the design of towers, the structural drawings of which will be handed over to the successful bidder for fabrication of towers are given as under :

- a) Details of structural steel
- i) Steel quality IS:2062, BS:4360
- ii) Minimum guaranteed yield stress (kg/cm^2)
- | | |
|----|------|
| MS | 2550 |
| HT | 3600 |
- iii) Maximum allowable stress (kg/cm^2)
- For tension members (on net area)
- | | |
|----|------|
| MS | 2550 |
| HT | 3600 |
- For compression members (on gross area)
- | | |
|----|---------------|
| MS | as per IS:802 |
| HT | as per IS:802 |
- b) Details of 16 mm diameter nuts and bolts
- i) Shear stress on gross area of bolt shank of grade 5.6 bolts (kg/cm^2) 3160
- ii) Bearing stress on shank of grade 5.6 bolts (kg/cm^2)
- | | |
|-----------|------|
| MS | 6322 |
| HT | 6322 |
| Grade 5.6 | |
- iii) Tension on net area of the thread (kg/cm^2) 2590

5.0 FOUNDATION PARTICULARS

The soil characteristics and other parameters adopted for design of foundations for towers, the foundation drawing of which will be handed over by the purchaser to the successful bidder are given as under :

a) Foundations 400kV	
Classification	i) Normal soil ii).Black cotton soil iii).Soft/Decomposed rock iv).Hard Rock v).Sandy soil
Water table	i) Dry ii) Wet iii) Partially submerged (PS)

		iv) Fully submerged (FS)	
Partial Factors of Safety for foundation design			
Towers upto an angle of 15 deg deviation		1.1	
Towers above an angle of 15 deg deviation		1.1	
Grounding of towers		Solid Earthing	
Maximum tower footing resistance		10 ohms	
Maximum distance between counterpoise wires		30m	
Maximum bearing capacity (kg/m ²)	Dry	Wet, PS and FS	
i) Normal soil	26500	13250	
ii).Black cotton soil	—	10200	
iii).Soft/Decomposed rock	60000	60000	
iv).Hard Rock	120000	120000	
v).Sandy soil	26500	13250	
Angle of internal friction			
i) Normal soil	30	15	
ii).Black cotton soil	0	0	
iii).Soft/Decomposed rock	20	10	
iv).Hard Rock	20	10	
v).Sandy soil	20	10	
Weight of soil(kg/ m ³)			
i) Normal soil	1440	940	
ii).Black cotton soil	1440	940	
iii).Soft/Decomposed rock	1440	940	
iv).Hard Rock	2200	1200	
v).Sandy soil	1440	940	
Weight of concrete(kg/ m ³)	Dry	Wet, PS and FS	
i) Plain (M10)	2300	1300	
ii) RCC (M15)	2400	1400	

6.0 CONDUCTOR AND EARTHWIRE SAG PARTICULARS

The sag tension considered in the design of towers the structural drawings of which will be handed over to the successful bidder for fabrication of towers are given as under :

Temp deg C	Wind Kg/Sq m	Conductor Sag(m)	Conductor Tension(Kg)	Earth wire Sag(m)	Earth wire Tension(kg)
5	0	10.796	3007.2	9.716	972
	64.80	--	4095.5	--	1560.5
	--	--	--	--	--

32	0	11.788	2754.1	10.365	911.2
	135	--	5808.9	--	--
	180	--	7129.4	--	2959.1 at 215kg/m2
53	--	--	--	--	--
75	0	13.257	2448.9	--	--

7.0 CONDUCTOR PARTICULARS

a)	Type	Moose ACSR
b)	No/Wire diameter Aluminium mm Steel mm	54/3.53 7/3.53
c)	Sectional Area of Aluminium Sq.mm	528.5
d)	Total Sectional Area Sq.mm	597.0
e)	Overall diameter mm.	31.77
f)	Approximate weight Kg./Km.	2004
g)	Calculated D.C. resistance at 20 degrees C, maximum. ohm/km.	0.05552
h)	Ultimate tensile strength KN.	161.2
i)	Final modulus of elasticity Kg./ Cm	0.703×10^6
j)	Coefficient of Linear expansion. per deg. C	19.3×10^{-6}

8.0 EARTHWIRE PARTICULARS

a)	Type	GSS
b)	No/Wire diameter Steel mm	7/3.66
d)	Total Sectional Area Sq.mm	73.65
e)	Overall diameter mm.	10.98
f)	Approximate weight Kg./Km.	583
g)	Calculated D.C. resistance at 20 degrees C, maximum. ohm/km.	2.5
h)	Ultimate tensile strength KN.	6972
i)	Final modulus of elasticity Kg./ Cm	1.933×10^6
j)	Coefficient of Linear expansion. per deg. C	11.5×10^{-6}

Note: Particulars of OGPW are enclosed in the specification for supply & installation of OPGW.

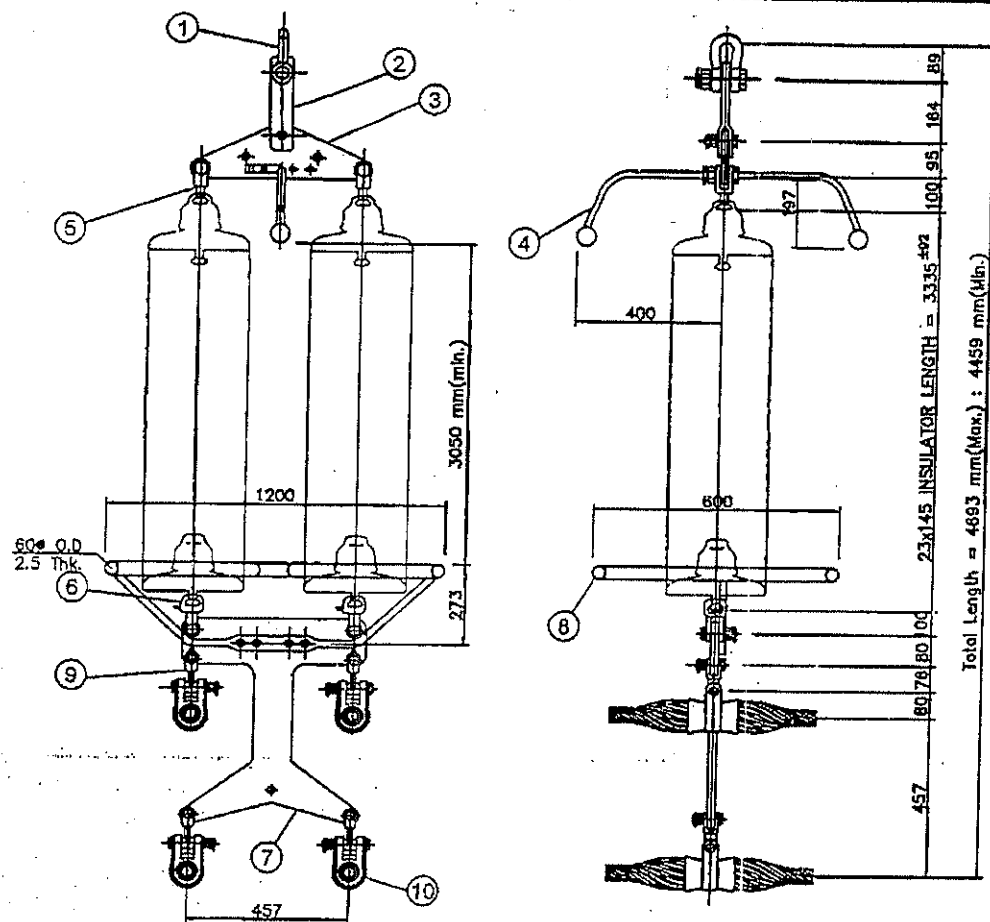
9.0 INSULATOR PARTICULARS**Disc insulators:**

SL NO	PARTICULARS	DOUBLE SUSPENSION STRING	SINGLE SUSPENSION AND PILOT STRING	QUADRAPLE TENSION STRING FOR ANGLE TOWERS	QUADRAPLE TENSION STRING FOR ROAD, RAIL CROSSINGS AND T.TS
1.	No. of Standard discs	2x23	1x23	4x23	4x24
2.	Size of Porcelain Disc Insulators	305 x 145	305 x 145	320 x 170	320 x 170
3.	E & M strength each string (kN)	120	120	160	160
4.	Ball and Socket Designation (mm)	20	20	20	20
5.	Creepage distance of each porcelain Insulator Disc (mm)	460	460	475	475

10.0 OPGW (Fibre) PARTICULARS:

(ITUG-652 D Standard Compliance)

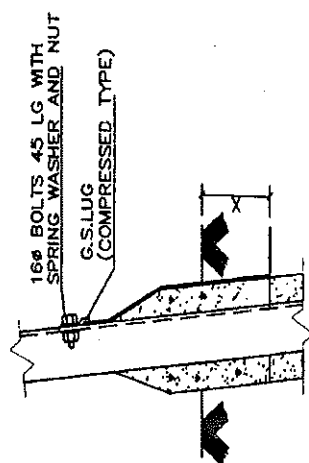
1	Number of optical fibres in OPGW/ OFAC	24
2	Mode	DWSM
3	Optimised wavelength (nm)	1310/1550 nm
4	Mode field diameter(μm)	9.2 +/-0.5
5	Outside (clad) diameter (μm) :	125 +/- 0.5
6	Attenuation:	0.22dB/Km Max. at 1550 nm 0.36dB/Km Max. at 1310 nm
7	Chromatic Dispersion At 1310 nm At 1550 nm	2.8 ps (nm.Km) 18 ps (nm.Km)
8	Polarisation Mode dispersion	≤ 0.1 ps Sqrt.Km



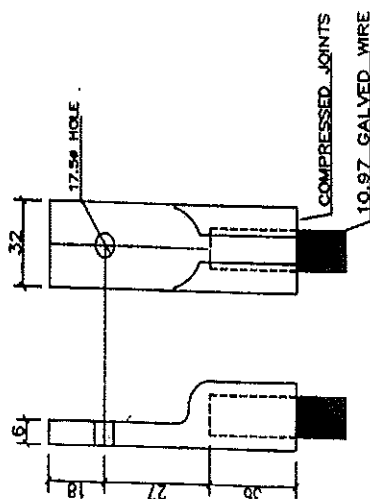
10	Cushion	Polychloroprene Compound & Aluminium Alloy	MAGS-517	4 pair	70
	Armour Grip Helix	Aluminium Alloy Helical Rods 65032/6061 IS: 739		4 set	
	Armour Grip Suspension Clamp	Aluminium Alloy (LM-6) 4600, IS: 617		4 set	
9	Clevis Eye	Forged Steel as per IS: 2004 (CL-IV)	J-12	4	70
8	Corona Grading Ring & Brackets	Ext. Aluminium (Gr. 1100F/6063)	MGS-6M	1	1.5
7	Yoke Plate (Line Side)	Mild Steel as per IS: 2062	L-5DSQL	1	240
6	Socket Clevis	Forged Steel as per IS: 2004 (CL-IV)	D-24	2	120
5	Ball Clevis	Forged Steel as per IS: 2004 (CL-IV)	E-24	2	120
4	Arcing Horn (Tower Side)	Mild Steel as per IS: 2062	M-514R3	2	1.5
3	Yoke Plate (Tower Side)	Mild Steel as per IS: 2062	L-4DSQT	1	240
2	Extension Link	Mild Steel as per IS: 2062	EL-4DSQ	1	240
1	Anchor Shackle	Forged Steel as per IS: 2004 (CL-IV)	Q-5A	1	240
Sl.	Description	Material	Cat. No.	Qty.	UTS(kN)

1. ALL DIMENSIONS ARE IN MM.
2. 10.97MM GALVANISED WIRE WITH G.S. LUG FORGED AT ONE END AND FREE FOR A REQUIRED LENGTH OF COUNTER POISE WIRE.
3. FOUR G.S LUG WILL BE REQUIRED PER TOWER
THREE LUGS WILL BE CONNECTED ON THREE LEGS AND
FOURTH LUGS WILL BE CONNECTED WITH FLAT TYPE 'C'
PROVIDED FOR PIPE TYPE EARTHING.
4. 10.97MM WIRE SHALL BE OUTSIDE COPPING.
5. ONE SET COMPRISING OF 4NOS OF REQUIRED LENGTH
OF COUNTER POISE WIRE.
6. FOR SOIL RESISTIVITY LESS THAN 1500 OHMS-METER, 4
LENGTHS OF 30M WIRE SHALL BE PROVIDED, AND FOR SOIL
RESISTIVITY GREATER THAN 1500 OHMS-METER, 4 LENGTH
OF 70M WIRE SHALL BE PROVIDED.

LIST OF BOLTS & NUTS / TOWER.						
S.NO	SIZE					QTY
1	STUB THROCK (mm)	7-11	12-16	17-21	22-24	5
	LENGTH OF M16	40	45	50	55	
	BOI T					
2	M-18 x 35LG					1
3	16MM DIA 3.5MM THK.SP.WASHER					6



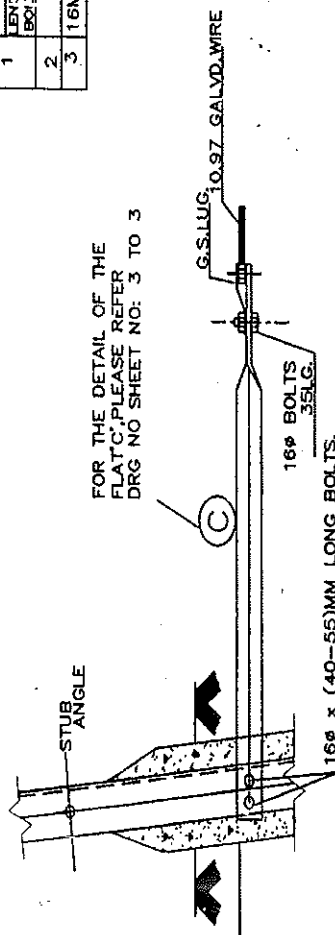
X - NOT LESS THAN 100MM
LUG FITTING FOR
THREE LEGS (TYPICAL)



DETAIL OF LUG.

DETAIL OF LUG.

WIRE SUBJECT TO MIN. OF
30M
READ L.G. OF COUNTER F.



FOR THE DETAIL OF THE
FLAT'C,PLEASE REFER
DRG NO SHEET NO: 3 TO 3

PLUG FITTING ON FOURTH LEG

STANDARD DRAWING

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	NOUSIABE				TSTRANSCO	
					TITLE	COUNTERPOISE EARTHING

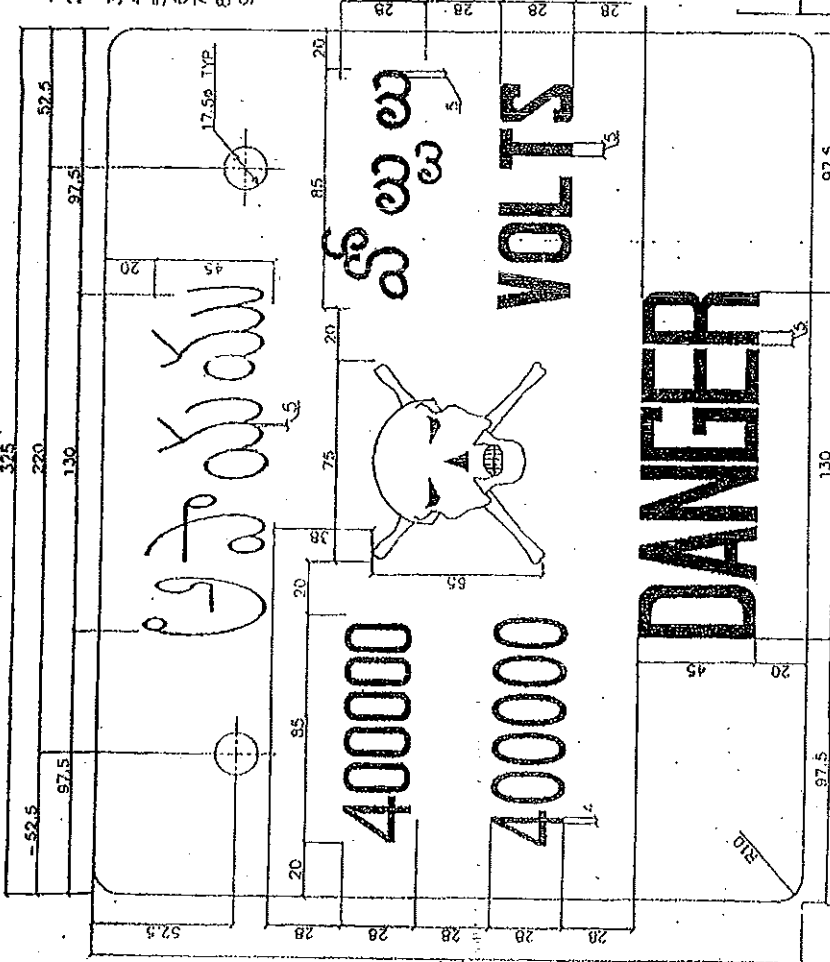
FIGURE -- 13: COUNTERPOISE EARTHING

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. THE FRONT OF THE PLATE SHALL BE VITREOUS ENAMELLED RED WITH LITTER FIGURES AND THE CONVENTIONAL SKULL AND BONES IN WHITE COLOUR.
3. BACKS: BLACK VITREOUS ENAMELLED.
4. MINIMUM 2.0THK. M.S. PLATE AS PER IS: 1079-1994 (GRADE-0).
5. GENERAL TOLERANCE $\pm 3\%$ UNLESS OTHERWISE SPECIFIED.
6. THE CORNERS OF THE PLATES SHOULD BE ROUNDED OFF.
7. ALL LETTERS SHOULD BE CENTRALLY SPACED.
8. BOLT / NUT TO BE GALVANIZED AS PER IS: 1367 (P-13)-1983.
9. DESIGN OF DANGER PLATE IS AS PER IS 2551:1982

LIST OF 16mm BOLTS, NUTS & WASHER
TO BE SUPPLIED WITH EACH PLATE

DETAILS	QTY
M-16x35MM LONG HRH BOLT AS PER IS:12427-2001 CLASS 5.8 AND NUT AS PER IS:14394-1996 CLASS 5	2
2MM THK. LEAD WASHER	4



CLIENT	TRANSMISSION CORPORATION OF TELEGANA LIMITED (TS TRANSCO)
TITLE:-	DANGER PLATE

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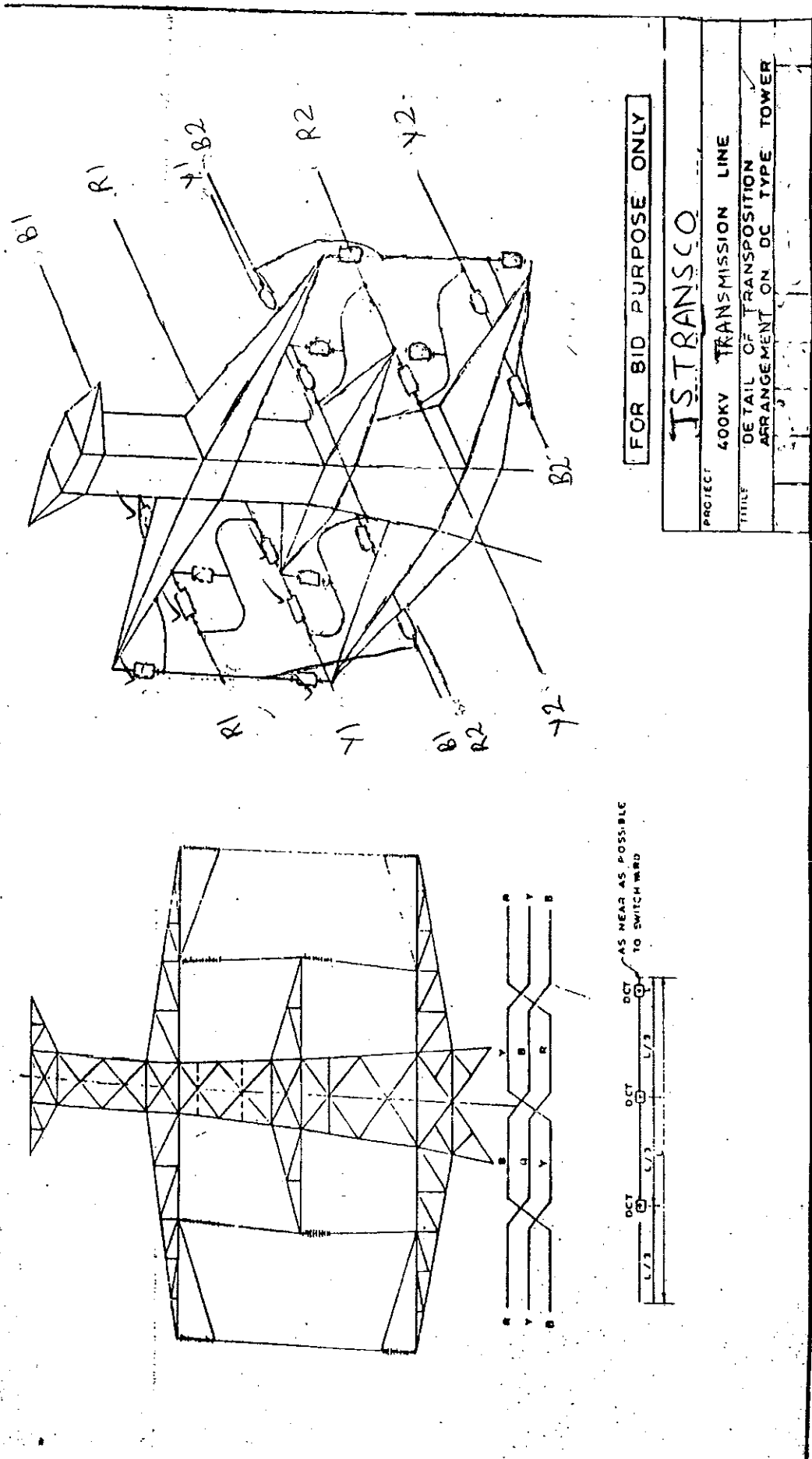
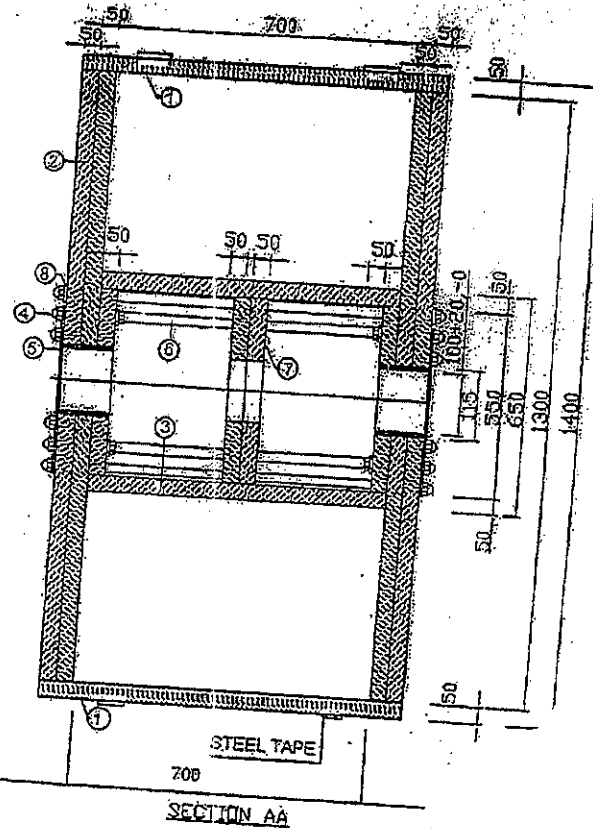
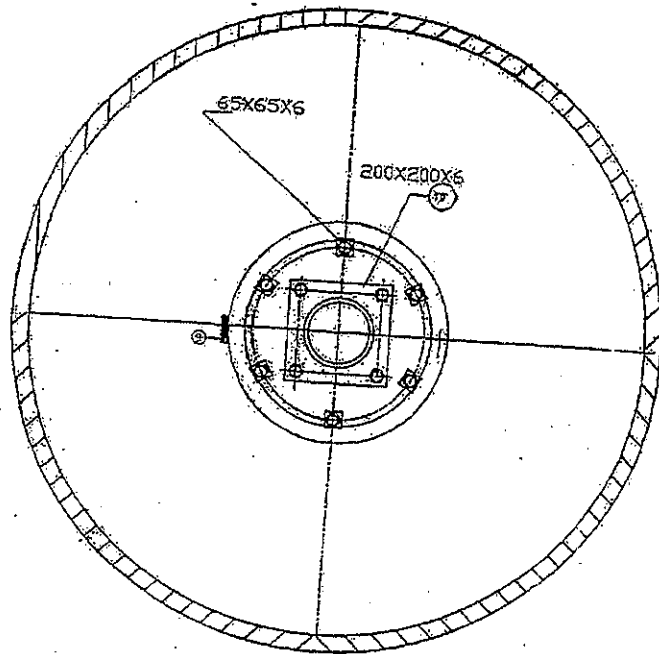


FIGURE -2 : DETAIL OF TRANSPOSITION ARRANGEMENT ON D/C TYPE TOWER

BEDMUTHA INDUSTRIES LTD.



NOTES

- 1: All dimensions are in mm.
- 2: Clearance from outer surface of outer layer of earth wire to inner surface of protective lagging is at least 50mm.
- 3: Two lengths of earthwire are wound on every drum. Lengths welded and ends of weld marked by RED TAPE also if 4000Mtr. continuous length are declared RED TAPE will be applied after 2000 mtr.
- 4: Thickness of protective lagging should be 50 mm.
- 5: The Standard length of earthwire 2000m $\pm$ 5%.
- 6: Tolerance on wood dimension = $\pm$ 3mm.
- 7: Type of Wood as per Specification and IS:1778/1980
- 8: Tare Weight of wooden drum 380Kg approx. with outer lagging.
- 9: Gross weight of wooden drum with earthwire and outer lagging 2650 Kg approx.

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S.NO.	DESCRIPTION	QTY	MATERIAL	DIMENSIONS (MM)
10	BUSH PLATE	2	MS	200X200X6
9	SLOT FOR INNER END OF EARTH WIRE	4	MS	65X65X6
8	WASHER	24	MS	550 DIA
7	BARREL SUPPORT	4	WOOD	M11 X 950
6	TIE RODS	2	MS	M16 X 135
5	MILD-STEEL BUSH	2	MS	M16 X 135
4	BARREL STUD	2	MS	M16 X 135
3	BARREL	1	WOOD	50X75X1000
2	FLANGE	2	WOOD	300X100
1	PROTECTIVE EXTERNAL LAGGING	1	WOOD	50X75X950

TSTRANSCO

Drum drawing of
7/3.66 mm G/S Earthwire.
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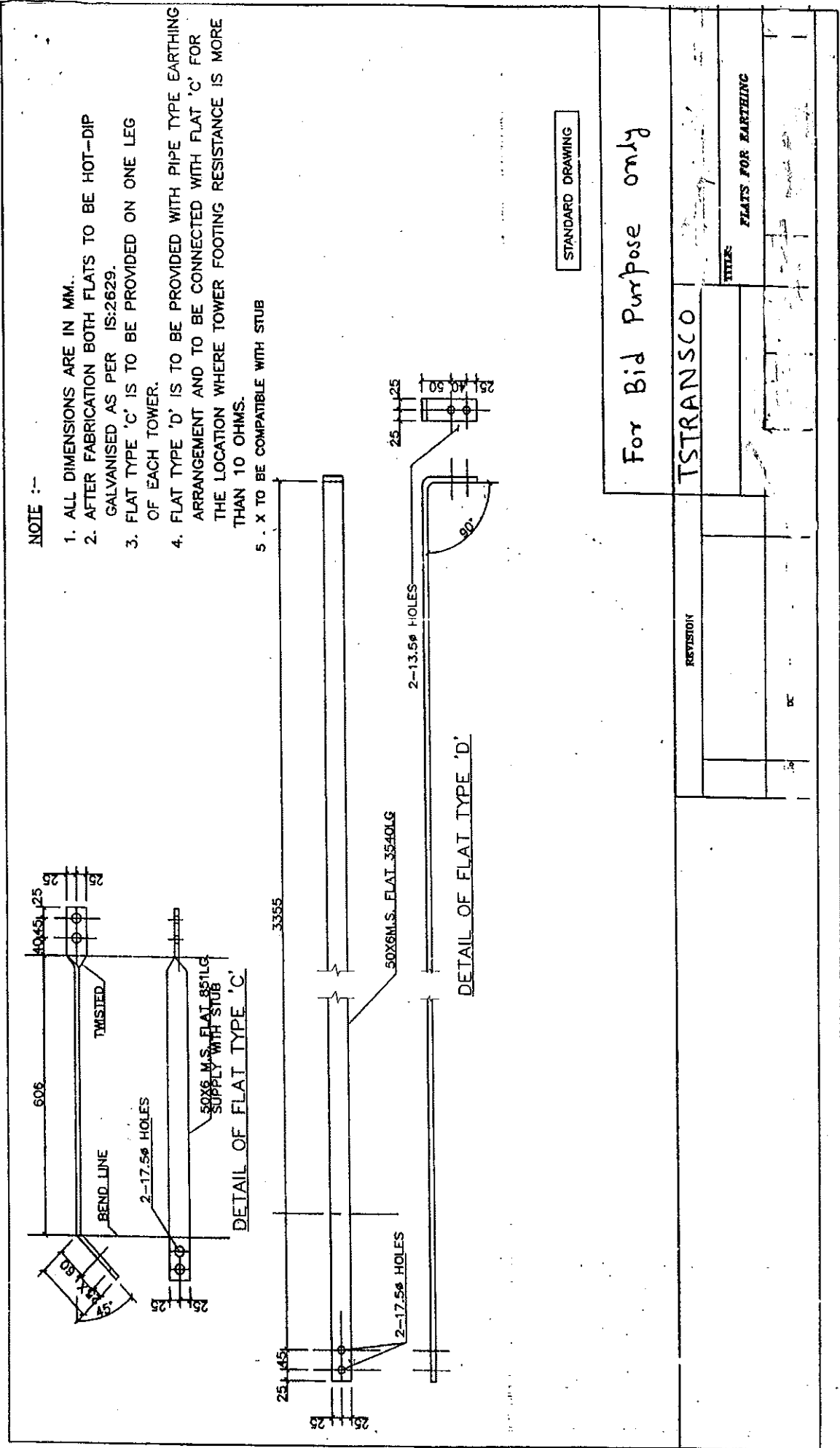
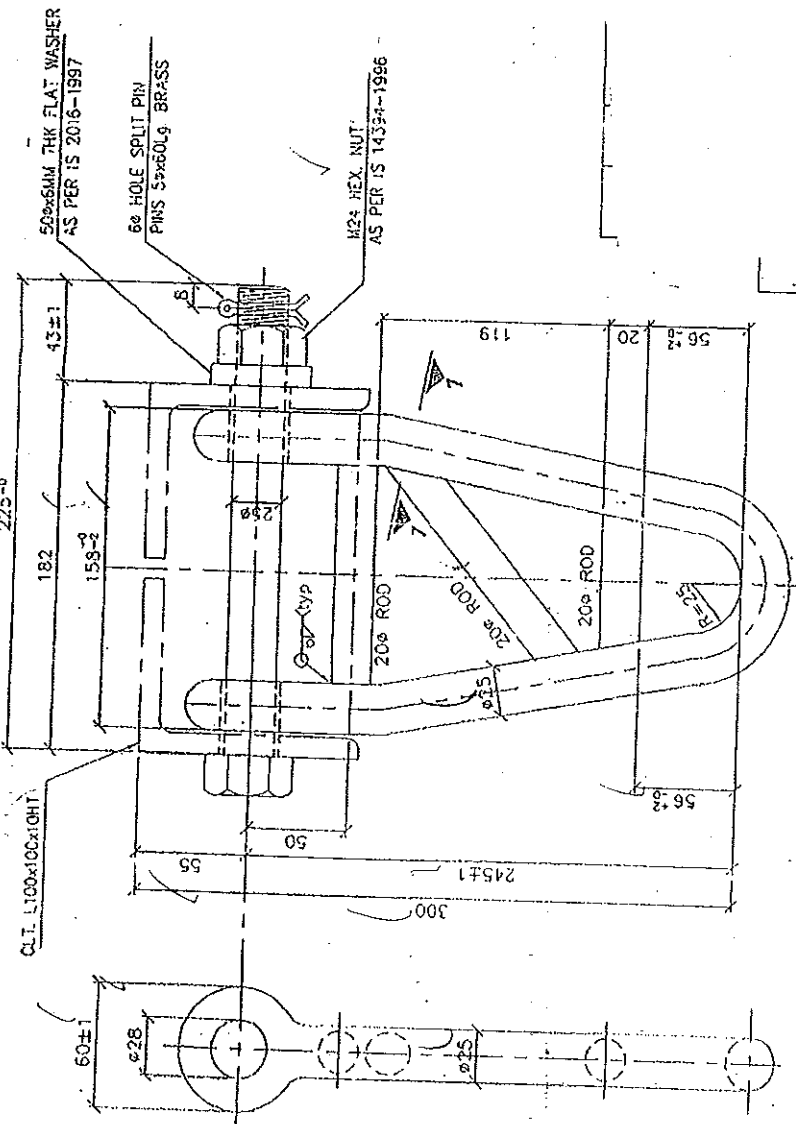


FIGURE - 15: FLATS FOR EARTHING

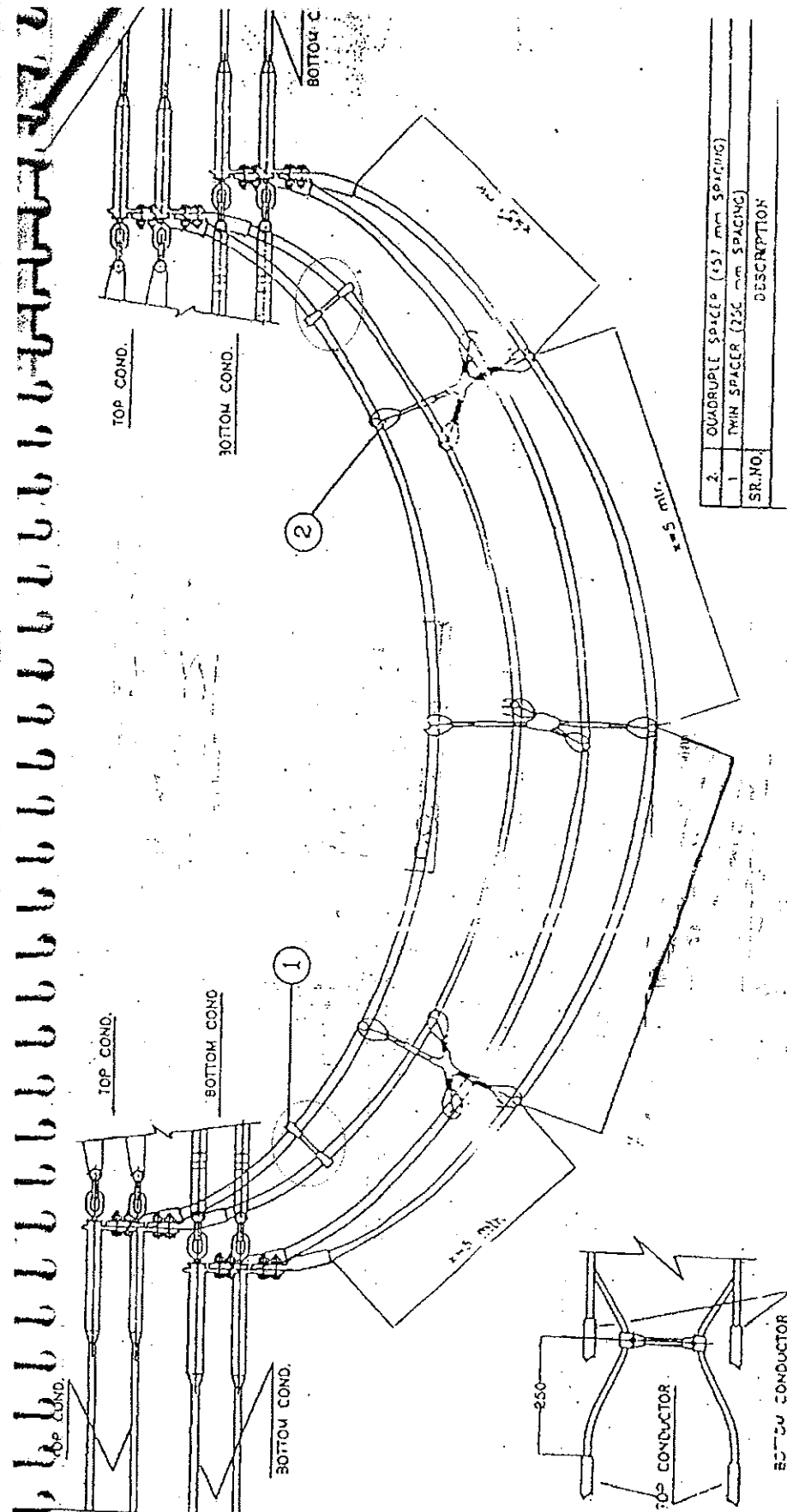


- NOTES:**
1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
 2. TO BE GALVANISED AFTER MANUFACTURE AS PER IS:2629
 3. MATERIAL
 - A. HANGER BODY FORGED STEEL CONFORMING TO IS:2004-1993. CLASS-4.
 - B. ROUND WASHER :- CONFORMING TO IS:2062.
 4. WT. PER PIECE 4.95 KG. (APPROX.)
 5. THREADS TO BE UNDER CUT FOR GALVANISING
 6. WELDING SHALL BE DONE AFTER MANUFACTURE OF FORGED HANGER BODY
 7. BOLT NUT CONFORM TO AS PER IS 823.
 8. BOLT NUT CONFORM TO ISO 898 (PART 1 & 2) WITH MECHANICAL PROPERTIES
 9. CONFORMING TO PROPERTY 8.8 FOR BOLT AND CLASS 8.0 FOR NUT
 10. PROOF LOAD 67% OF 240 KN.
 11. ULTIMATE STRENGTH = 240 KN (MIN)
 12. QTY. PER TOWER 6 NOS.

CLIENT	TRANSMISSION CORPORATION OF TELEGANA LIMITED (TS TRANSCO)
TITLE:-	DETAILS OF 250 HANGER ROD FOR "QA" TYPE TOWER

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FIGURE-18:JUMPER DRAWING



TITLE: PLACEMENT CHART FOR QUADRUPEL JUMPER SPACER.

TECHNICAL DETAILS :-

1) GENERAL TOLERANCES $\pm 2\%$

2) DIMENSION X MAY CHANGE AS PER THE ACTUAL LENGTH OF THE CONDUCTOR BETWEEN JUMPERS AND SHALL BE ASSESSMENT ACCORDINGLY

3) QUANTITY OF SPACERS MENTIONED IS PER JUMPER/TOWER

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TSTRANSCO

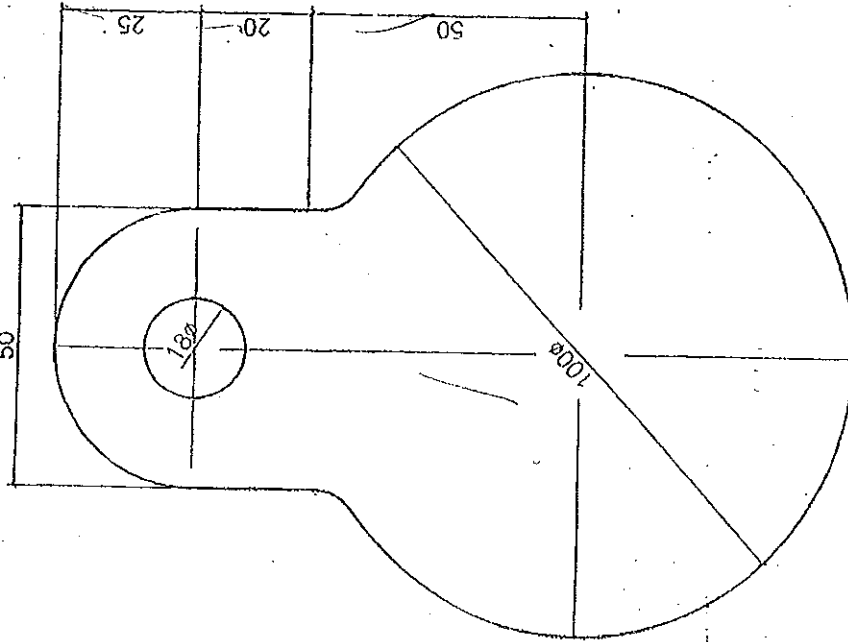
REVISION	NO.	DATE	BY

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. M.S. PLATE-2.0MM THK.(MIN) AS PER IS:1079-1994 (GRADE O).
3. PHASE PLATE TO BE ENAMELLED RED, YELLOW AND BLUE ON FRONT AND B
4. GENERAL TOLERANCE $\pm 3\%$ UNLESS OTHERWISE SPECIFIED.
5. PHASE PLATE SHALL BE AS PER IS:5613 (PART-3).
6. BOLT / NUT TO BE GALVANIZED AS PER IS:1367 (P-13)-1983.
7. QUANTITY PER SET: ONE PLATE EACH OF RED, YELLOW & BLUE.
8. ONE SET FOR EACH CIRCUIT IS TO BE SUPPLIED.

LIST OF 16mm ϕ BOLTS, NUTS & WASHER
TO BE SUPPLIED WITH EACH SET

DETAILS	QTY
M-16x35MM LONG HRH BOLT AS PER IS:12427-2001 CLASS 5.6 AND NUT AS PER IS:14394-1996 CLASS 5	6
2MM THK. LEAD WASHER	12



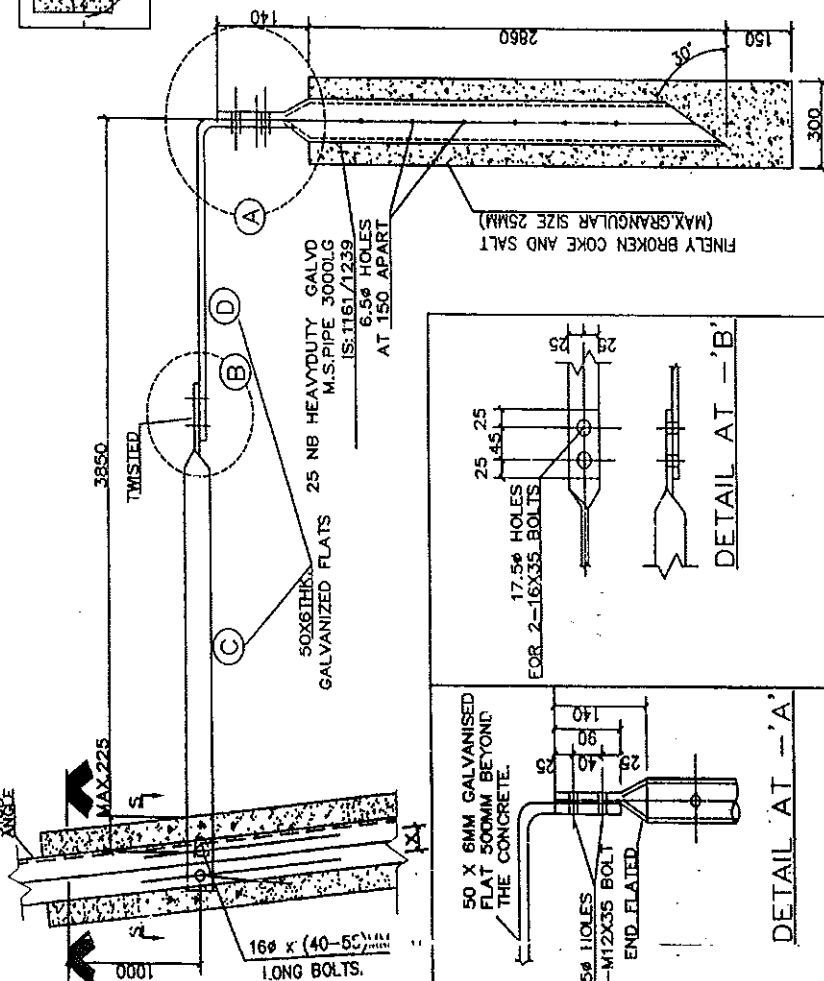
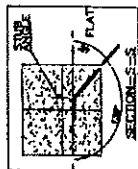
LOWER PHASE PLATE

CLIENT	TRANSMISSION CORPORATION OF TELEGANA LIMITED (TS TRANSCO)
TITLE:-	PHASE PLATE

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NOTE :-

1. "C" STRIP IS TO BE PROVIDED ON ONE LEG OF EACH TOWER. WHICH WILL BE SUPPLIED WITH STUB.
2. "D" STRIP WITH PIPE EARTHING ARRANGEMENT IS TO BE PROVIDED ON ONLY ONE LEG.
3. 17.5 ϕ HOLES SUITABLE FOR 16MM ϕ BOLT CONFORMING TO IS:12427-2001, CLASS 5.6 & IS:14394-1996, Gr. 5 FOR HEX NUT UNLESS OTHERWISE SPECIFIED.
4. FOR COUNTERPOISE : EARTHING STRIP "C" SHALL BE CONNECTED WITH COUNTERPOISE WIRE THROUGH 'A' LUG.
5. ALL DIMENSIONS ARE IN MM.
6. 12 & 16MM DIA SPRING WASHER SHALL CONFORM TO IS:3063-1994 TYPE B AND ELECTRO GALVANIZED AS PER IS:1573-1986.
7. HDG BOLT/NUTS TO BE GALVANIZED AS PER IS:1367(P-13)-1983.
8. C & D FLATS TO BE HOT DIP GALVANIZED AS PER IS:2629-1985.
9. MATERIAL FOR C & D FLAT AS PER IS:2062 GRADE "A".
10. X TO BE COMPATIBLE WITH STUB



S.NO	LIST OF BOLTS & NUTS / TOWER	SIZE	QTY
1	STUB THICK (mm)	7-11 12-16 17-21 22-30	2
2	LENGTH OF M16 BOLT (mm)	40 45 50 55	2
3	M-16 x 35LG		2
4	M-12 x 35LG		2
5	16MM DIA 3.5MM THK.SP.WASHER		4
6	12MM DIA 2.5MM THK.SP.WASHER		2

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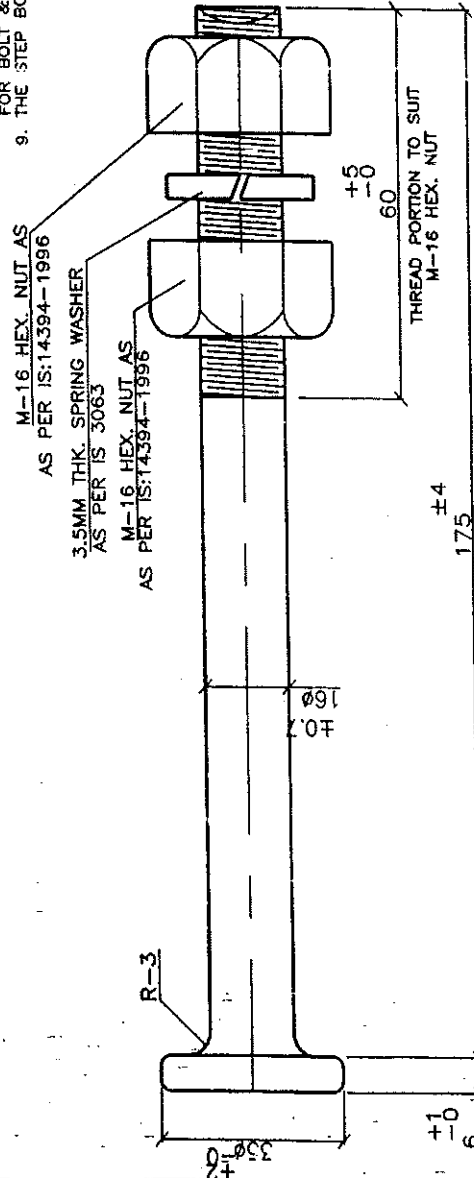
REVISION

TITLE: PIPE TYPE EARTHING

FIGURE - 16: PIPE TYPE EARTHING

NOTE :-

1. ALL DIMENSIONS ARE IN MM.
2. STEP-BOLT SHALL BE HOT-DIP GALVANISED AS PER IS:1367(P.13)-1983.
3. WEIGHT/PIECE WITH TWO NUTS AND ONE SPRING WASHER=0.417 Kg
4. THREADS TO BE UNDER CUT BY 0.3MM.
5. THE STEP-BOLT SHALL BE CAPABLE OF WITHSTANDING A VERTICAL LOAD NOT LESS THAN 1.5KN.
6. SPRING WASHER SHALL CONFORM TO IS:3063 & ELECTRO GALVANIZED AS PER IS: 1573 SERVICE CONDITION 4.
7. GENERAL REQUIREMENT SHALL CONFORM TO IS 10238.
8. MECHANICAL PROPERTIES SHALL CONFORM TO CLASS 4.6 AS PER IS:1367(PART-3) FOR BOLT & CLASS 5 AS PER IS:1367 (P-VI) FOR NUT.
9. THE STEP BOLT SHALL WITH STAND CANTILEVER TEST AS PER IS:10258



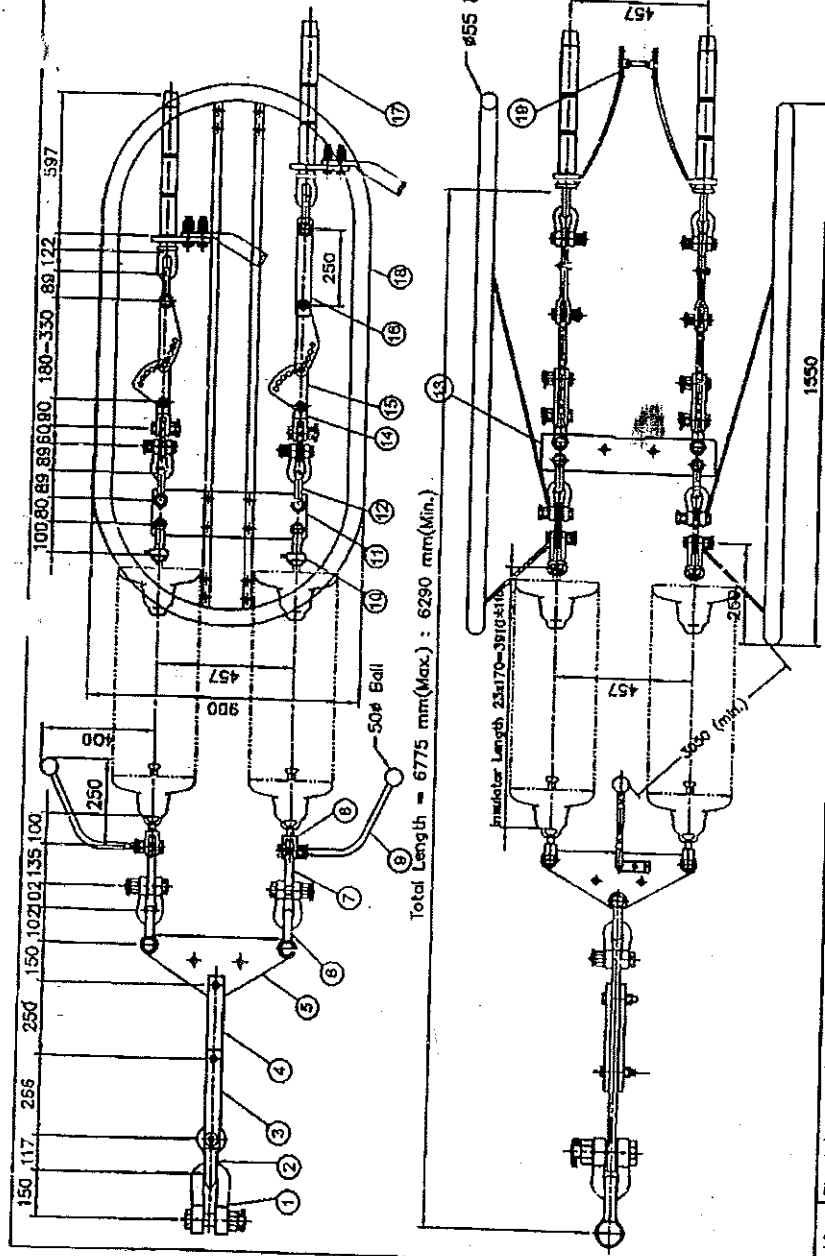
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STANDARD DRAWING

TSRANSO

STEP BOLT

FIGURE -- 17: STEP BOLT



Notes:

Tolerance on length of hardware fitting $\pm 2\%$
 General Tolerance $\pm 3\%$ unless otherwise specified
 All ferrous parts hot dip galvanised as per IS:2629 & Powergrid Spec.
 Ball & socket designation -20mm as per IS:2486
 Ultimate Tensile Strength of assembly -640 kN
 Slip strength of Deadend Assembly - 153.14 kN
 Spring washer are electro galvanised as per PGCIL spec.
 Flat Washers are hot dip galvanised as per PGCIL spec.
 Min. Corona extinction voltage dry -320 KV (RMS)
 RIV at 305 KV (RMS) dry below 1000 Micro Volt.
 Electrical resistance Max. 75% of equiv. length of ACSR
 Approximate Weight = 250.39 Kg

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(TSTRANSCO)

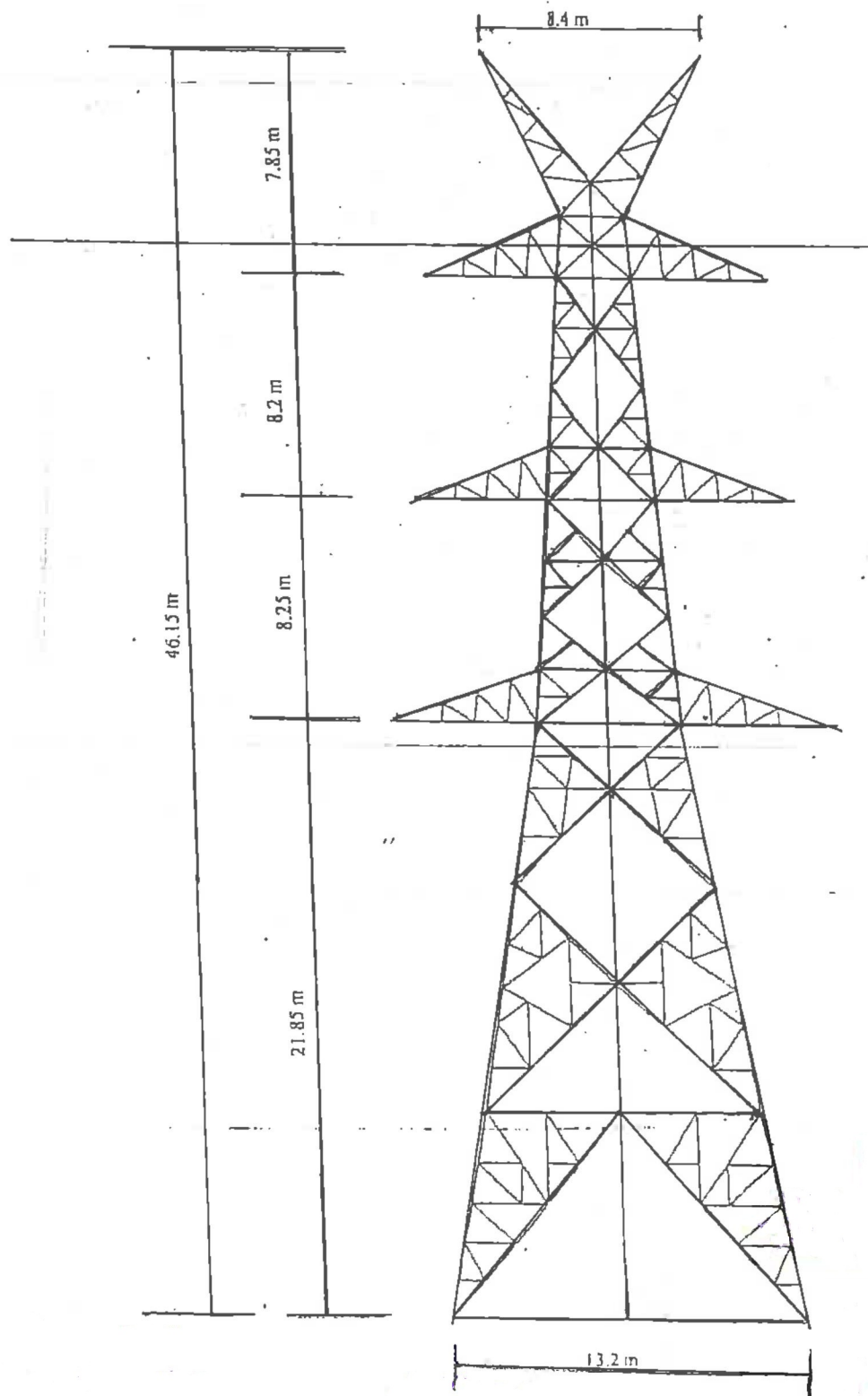
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Sl.No	Description	Material	Cat. No.	Qty	UTS(KN)
19	Rigid Spacer (250 mm)	Aluminium Alloy Body & Steel bolt, nut as per IS-1367	SP 108(250mm)	1	-
18	Corona Control Ring	Extruded Aluminium (Q-1100F/6063) & Mild steel as per IS-2004	MGT-6M/1	1	1.5
17	Compression Deadend Clamp	Ext. Aluminium (99.5% purity) & Forged Steel IS-2004 CL-(II)	MMCP-517A	4	1.5
16	Extension Link	Mild Steel as per IS:2062	EL-6QT	2	160
15	Sag Adjustment Plate	Mild Steel as per IS:2062	SAP-6C	4	160
14	Clevis Eye	Forged Steel as per IS:2004 (CL-IV)	J-124T	4	160
13	Yoke Plate (Line Side)	Mild Steel as per IS-2062	L47TT/1	2	320
12	Anchor Shackle	Forged Steel as per IS:2004 (CL-IV)	Q-5A	12	160
11	Yoke Plate	Mild Steel as per IS-2062	L-46TT/1	2	320
10	Socket, Clevis	Forged Steel as per IS:2004 (CL-IV)	D-24T	4	160
9	Arching Horn (Tower Side)	Mild Steel as per IS-2062	M-514R2	2	1.5
8	Ball Clevis	Forged Steel as per IS:2004 (CL-IV)	E-24T	4	160
7	Yoke Plate	Mild Steel as per IS-2062	L-45TT	2	320
6	Anchor Shackle	Forged Steel as per IS:2004 (CL-IV)	Q-6	4	320
5	Yoke Plate (Tower Side)	Mild Steel as per IS-2062	L6-4QT	1	640
4	Extension Strap	Mild Steel as per IS-2062	EL-7QT/3	1	840
3	Extension Link	Mild Steel as per IS-2062	EL-6QT/2	1	840
2	Anchor Shackle	Forged Steel as per IS:2004 (CL-IV)	Q-7	1	640
1	Anchor Shackle	Forged Steel as per IS:2004 (CL-IV)	Q-7A	1	840

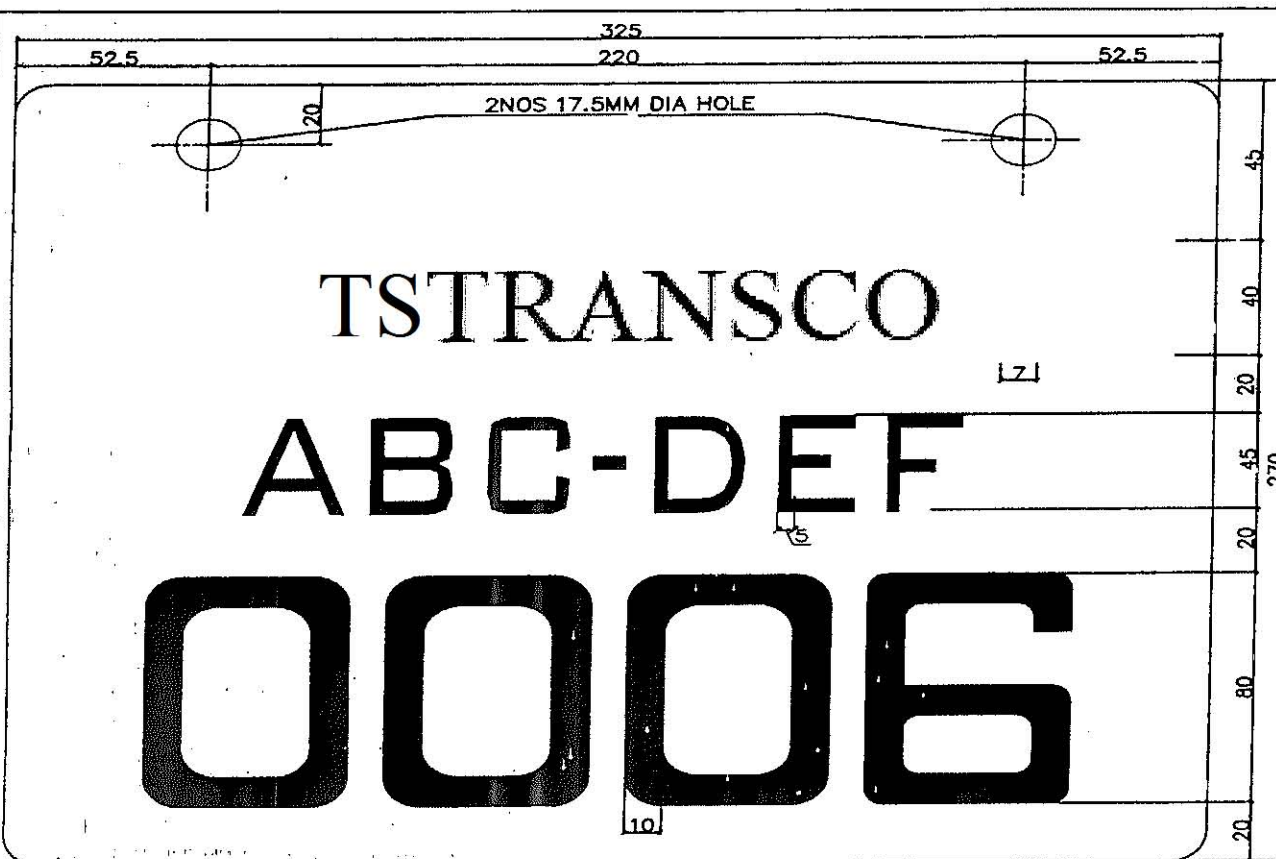
400 KV QUAD. TENSION INSULATOR STRING
 FOR QUADRUPL MOOSE ACSR

Tower configuration

400kV D/C tower QUad



Note : APTRANSCO may be read as TSTRANSCO



NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. LETTERING: RED ENAMELLED.
3. BACKGROUND: WHITE VITREOUS ENAMELLED.
4. BACK: BLACK VITREOUS ENAMELLED.
5. MINIMUM 1.6THK. M.S. PLATE AS PER IS:1079-1994 (GRADE-0).
6. EACH NUMBER WILL HAVE FOUR DIGITS AS SHOWN.
NUMBERS TO BE STARTED FROM '0001' ONWARDS.
7. GENERAL TOLERANCE $\pm 3\%$ UNLESS OTHERWISE SPECIFIED.
8. THE CORNERS OF THE PLATES SHOULD BE ROUNDED OFF.
9. ALL LETTERS SHOULD BE CENTRALLY SPACED.
10. BOLT / NUT TO BE GALVANIZED AS PER IS:1367 (P-13) - 1933.

ABC CODE FOR SENDING END AND DEF CODE FOR RECEIVING END.
TO BE FURNISHED BY SITE IN-CHARGE.

LIST OF 16mm# BOLTS, NUTS & WASHER
TO BE SUPPLIED WITH EACH PLATE

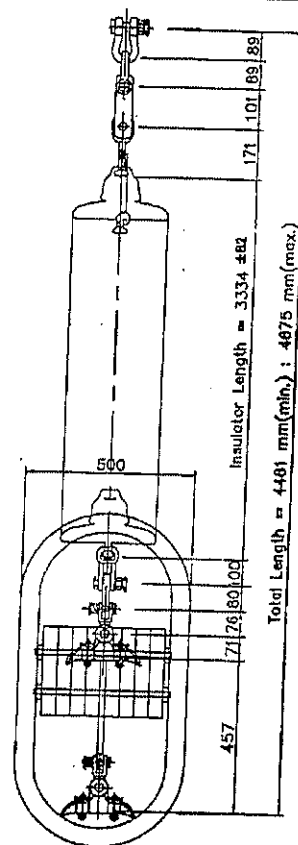
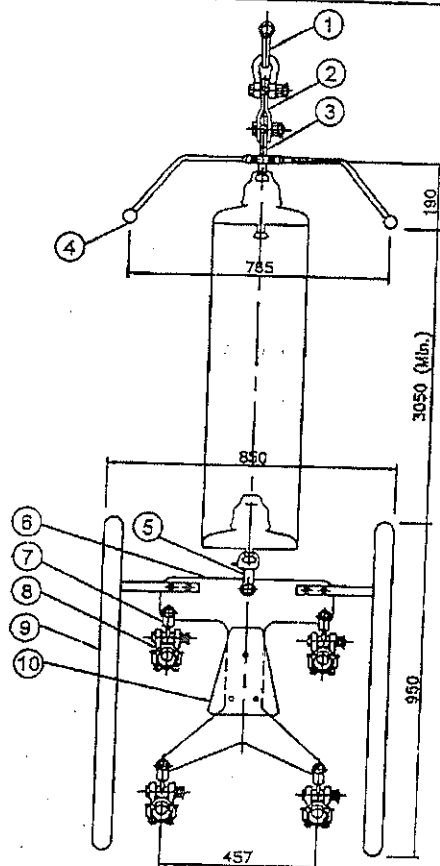
DETAILS	QTY
M-16x35MM LONG HRH BOLT AS PER IS:12427-2001 CLASS 5.6 AND NUT AS PER IS:14394-1996 CLASS 5	2
2MM THK. LEAD WASHER	4

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REVISION				TSTRANSCO	TITLE	
					TOWER NUMBER PLATE	

FIGURE -11: TOWER NUMBER PLATE



Notes :

General Tolerance $\pm 3\%$ unless otherwise specified.
 Tolerance on length of hardware fitting $\pm 2\%$
 Ferrous Parts are hot dip galvanised as per IS:2629
 Ball & socket designation 20mm as per IS:2486
 Ultimate Tensile Strength of assembly 120 kN
 Slip strength of clamp 20 to 29 kN
 Clamp is suitable for ACSR Moose (dia. 31.77 mm)
 Spring washer are electro galvanised as per PGCIL Spec.
 Flat washer are hot dip galvanised as per PGCIL Spec.
 Min corona extinction voltage (Dry) 320 kV (Rms)
 RIV at 305 kV (Rms) (Dry) below 1000 microvolts.
 Magnetic power loss at 600 Amp. conductor current less than
 2 Watt per suspension clamp
 Approximate Weight = 39.5 Kg for String
 200.0 Kg for C/W

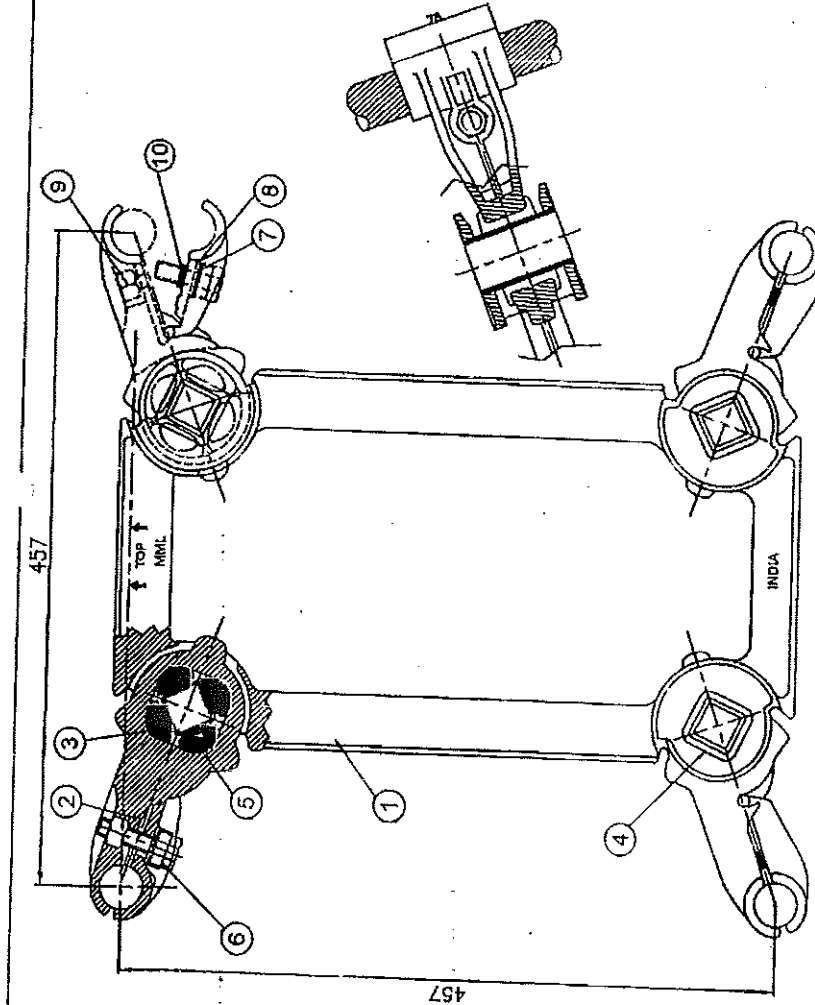
Sl.	Description	Material	Cat. No.	Qty.	UTS(kN)
10	Counter Weight Assem.(200 Kgs)	Galvanised C. I. as per IS:210/M.S. as per IS-2062	4CW-200	1set	-
9	Corona Control Ring	Ext. Aluminium Gr-1100/6063 & Mild Steel IS-2062	MGS-4PQ	1pair	1.5
8	Suspension Clamp	Aluminium Alloy as per IS:617 (LM-6)	B-13	4	70
7	Clevis Eye	Forged Steel as per IS-2004 (CL-IV)	J-12	4	70
6	Yoke Plate	Galvanised Mild Steel as per IS-2062	L-4PQ	1	120
5	Socket Clevis	Forged Steel as per IS-2004 (CL-IV)	D-24	1	120
4	Arcing Horn (Tower Side)	Mild Steel as per IS-2062	M-164SR1	1	1.5
3	Ball Link (Horn holder)	Galvanised Forged Steel as per IS-2004 (CL-IV)	G-5D	1	120
2	Extension Link	Mild Steel as per IS-2004	EL-3PQ	1	120
1	Anchor Shackle	Forged Steel as per IS-2004 (CL-IV)	Q-5	2	120

Customer TRANSMISSION CORPORATION OF TELANGANA LIMITED

(TSTRANSCO)

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400KV SINGLE PHASE SUSPENSION PILOT INSULATOR STRING
 FOR QUADRUPLE ACSR MOOSE CONDUCTOR



Notes:

All Dimensions are in mm
 General Tolerance $\pm 3\%$ unless otherwise specified.
 Torsion movement : $\pm 5^\circ$
 Vertical movement : ± 25 mm
 Longitudinal movement : ± 50 mm
 Compressive strength : 15 KN
 Tensile strength : 5 KN

Slipping Strength of Spacer Damper Clamp :

(With maximum slip of 1.0 mm)
 - Before vibration test : 6.5 kN
 - After vibration test : 5.2 kN
 Temperature range for which elastomer is designed 95°C
 Shore hardness of elastomer 65-80
 All ferrous parts hot dip galvanised and Belleville Washer
 electro galvanised as per PGQIL specification
 RIV at 305 kV rms dry : 1000 micro volts max.
 Min. Corona Extinction voltage dry : 320 kV rms
 Magnetic Power Loss - Maximum 1 Watt at 600 amp.

Customer

TRANSMISSION CORPORATION OF TELANGANA LIMITED

(TSTRANSCO)

For Bid Purpose only

400 KV SPACER DAMPER FOR
 QUADRUPLE MOOSE ACSR

Sl.	Description	Material	Qty.
10	O' Ring	Polychloroprene	
9	Mi2 Nut	Galvanised Steel as per IS-1367	4
8	Plain Washer	Galvanised Mild Steel as per IS-1062	4
7	Belleville Washer	Electro Galvanised spring steel	4
6	Mi2 bolt	Galvanised steel grade 6.8/3.8 as per IS-1367	4
5	Rubber Barrel	Synthetic rubber Compounded NBR	4
4	Tube	Aluminium Alloy 6061/65032 as per IS-739	16
3	Clamp Keeper	Aluminium Alloy A6 as per IS-617	4
2	Clamp Body	Aluminium Alloy A6 as per IS-617	4
1	Main Frame	Aluminium Alloy A6 as per IS-617	4
			1

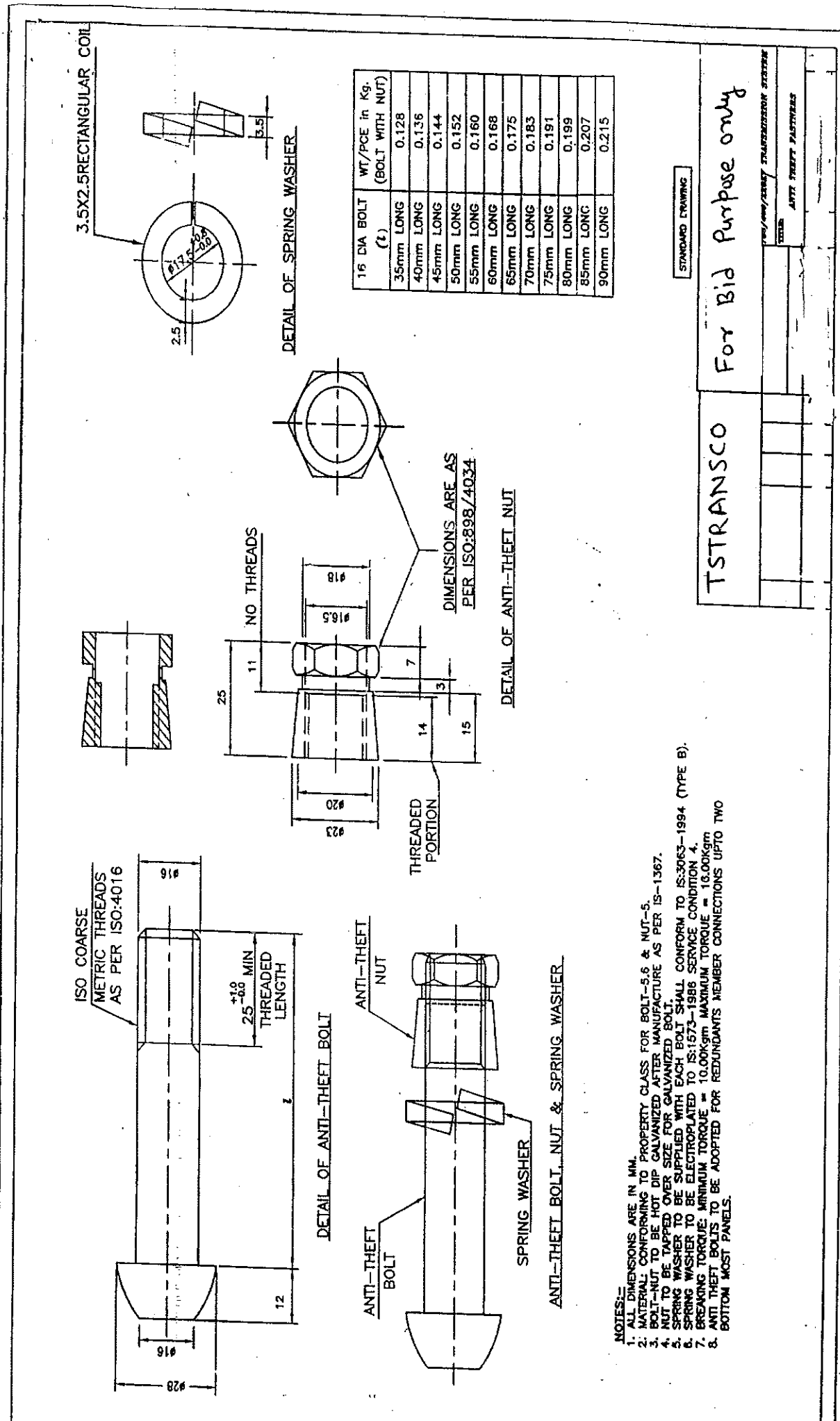


FIGURE -7 : ANTI THEFT FASTNERS

NOTES:-

- 1) ALL DIMENSIONS ARE IN mm
- 2) ALL HOLES ARE OF 17.5 ϕ TO SUIT M16 BOLT
- 3) ALL ERECTION MARKS ARE TO BE PREFIXED WITH 'TSTAC'
- 4) BLANK HOLES AT GATE TO RECEIVE BARBED WIRE
- 5) ONE 3.5mm SPRING WASHER TO BE PROVIDED UNDER NUT
- 6) GALVANISED STEEL BARBED WIRE SHALL CONFORM TO A-11S:278.
- 7) ALL STEEL SHALL BE HOT DIP GALVANIZED AS PER IS:2625
- 8) ALL STEEL SHALL CONFORM TO IS:2002-2011 GRADE-E7550A.
- 9) BARBED WIRE SHALL BE GIVEN CHROMATING OIL AS PER PROCEDURE LAID DOWN IN IS:1340
- 10) BOLT / NUT TO BE HOT DIP GALVANIZED AS PER IS:1367 (P-13)-1983. BOLT TO BE CONFORMING TO IS:12427-2001 (GR.5.6) & NUT CONFORMING TO IS:14394-1986 (GR.5)
- 11) NOMINAL LENGTH OF BARBED WIRE SHALL BE WORKED OUT AS PER FOLLOWING FORMULA:-

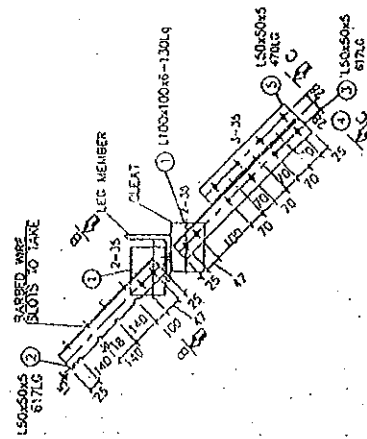
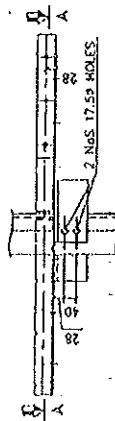
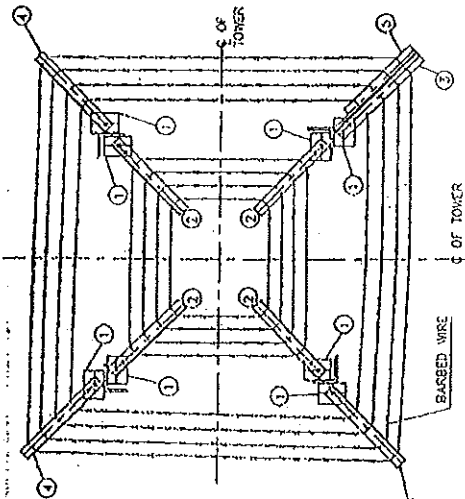
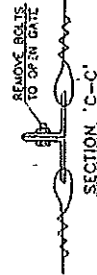
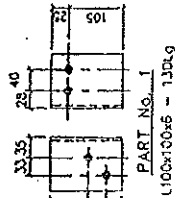
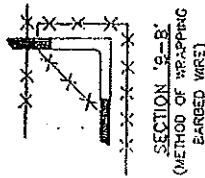
$$L = [B + (X-3.5) \times 2 \times \tan \theta] \times N \times 4$$

$$B = B/B \text{ WIDTH AT CL FOR NORMAL TOWERS IN MTRS.}$$

$$X = \text{HEIGHT OF BODY EXTN IF ANY IN MTRS.}$$

$$N = \text{NUMBER OF BARBED WIRE TURNS.}$$

$$P = \text{TOWER SLOPE.}$$
- 12) ARRANGEMENT SHALL BE AS PER IS:5613 (P.3-1)

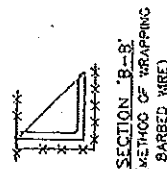
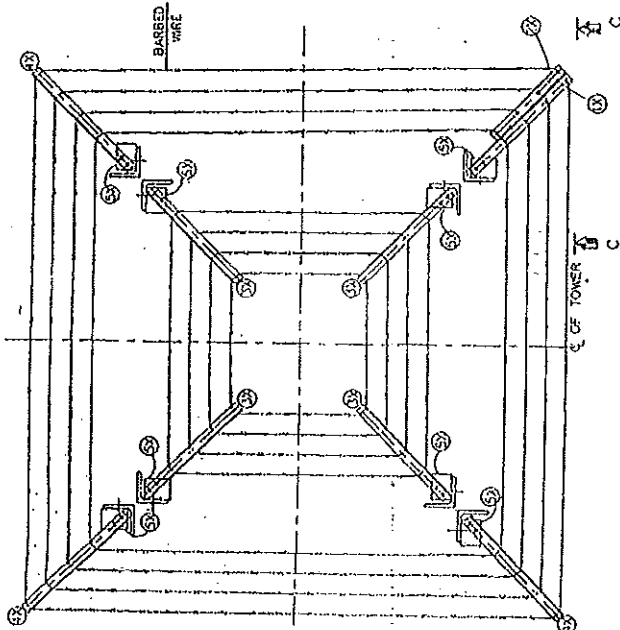


GATE DETAILS PLAN AT 'A-A'

MARK NO	SECTION	LENGTH (mm)	WT/PC KGS	QTY NOS	TOTAL WT KGS
1	100x100x6	130	1.135	2	2.270
2	150x50x5	617	2.345	4	9.380
3	150x50x5	617	2.345	1	2.345
4	150x50x5	617	2.345	3	7.035
5	150x50x5	470	1.785	1	1.785
	TOTAL IN KGS				30.114
1	615 x 35 (TT-DA)		0.117	19	2.223
2	615 x 50 (TT-DA)		0.141	8	1.128
	SPRING WASHERS		0.009	27	0.243
	GROSS TOTAL IN KGS FOR TT-DA				3.594
1	615 x 35 (TT-DB & DC)		0.117	19	2.223
2	615 x 50 (TT-DB & DC)		0.157	8	1.256
	SPRING WASHERS		0.009	27	0.243
	GROSS TOTAL IN KGS FOR TT-DB & DC				3.722

CLIENT	TRANSMISSION CORPORATION OF TELEANGANA LIMITED (TS TRANSCO)
TITLE:-	DETAILS OF ANTI CLIMBING DEVICE FOR "QA,QB,QC" TYPE TOWER

For Bid Purpose only

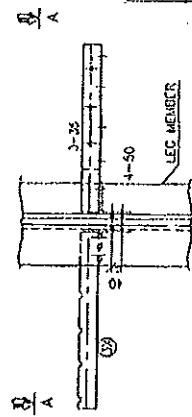
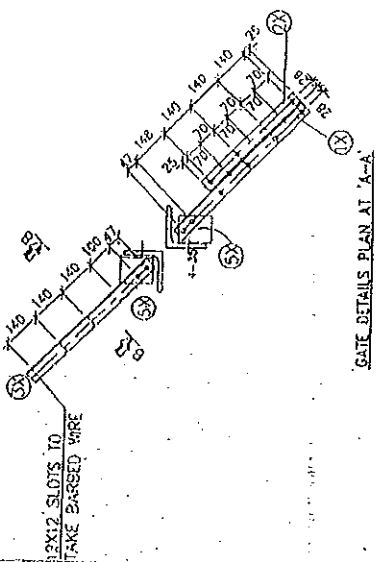


PART No. 5X

BILL OF MATERIAL				
MARK NO	SECTION	LENGTH (mm)	WT/PC KGS	QTY NOS
1X	1. 50x50x5	650	2.527	1
2X	1. 50x50x5	170	1.786	1
3X	1. 50x50x5	617	2.115	4
4X	1. 50x50x5	650	2.527	3
5X	1. 100x100x6	125	1.155	6
TOTAL IN KGS			12.117	19
1	105 x 35		2.217	18
2	416 x 50		2.41	16
SPRING WASHERS			2.008	25
GROSS TOTAL IN KGS FOR T-100			20.815	55.268

NOTES:-

1. ALL DIMENSIONS ARE IN mm.
2. ALL HOLES ARE 17.5mm TO SUIT 16mm BOLTS.
3. ALL ERECTION MARKS ARE TO BE PREFIXED WITH 'TSTAC'
4. BLANK HOLES AT GATE ARE TO RECEIVE BARBED WIRE
5. ONE 3.5mm SPRING WASHER TO BE PROVIDED UNDER EACH NUT.
6. BARBED WIRE SHALL CONFORM TO IS 278 (SIZE DESIGNATION A1)
7. ALL FABRICATED MEMBERS GALVANISED AS PER IS:2629
8. THE BARBED WIRE SHALL BE GIVEN CHROMATING DIP AS PER PROCEDURE LAID DOWN IN IS:1340
9. ALL PARTS SHALL BE HOT DIP GALVANISED
10. BARBED WIRE SHALL BE SUPPLIED BY M/S L&T.
11. ARRANGEMENT SHALL BE AS PER IS:5613 (P.3-1)



CLIENT	TRANSMISSION CORPORATION OF TELEGANA LIMITED (TS TRANSCO)
TITLE:-	DETAILS OF ANTI CLIMBING DEVICE FOR "QD" TYPE TOWER

For Bid purpose only



1. ALL DIMENSIONS ARE IN MM.
2. MINIMUM 2THK. M.S. PLATE.
3. WHITE ENAMELLED BACK GROUND AND BLACK OR BLUE ENAMELLED LETTERING.
4. REAR SIDE OF THE PLATE SHALL BE ENAMELLED BLACK.
5. EQUAL NOS. CKT PLATES FOR CKT-I & CKT-II ARE TO BE SUPPLIED
6. BOLTS / NUTS TO BE GALVANIZED AS PER IS:1367 (P-13) - 1983.
7. WEIGHT PER PIECE IS 0.275 Kgs.
8. 4nos. 2MM THK. LEAD WASHER TO BE SUPPLIED WITH EACH PLATE.
9. ALL BOLTS, NUTS AND ACCESSORIES AS PER REQUIREMENTS SHALL BE SUPPLIED.

LIST OF 16mm BOLTS NUTS & WASHER
TO BE SUPPLIED WITH EACH PLATE

DETAILS	QTY
M-16x35MM LONG BOLT & NUT	2
M16X2MM THK. LEAD WASHER	4

CLIENT	TRANSMISSION CORPORATION OF TELENGANA LIMITED (TS TRANSCO)
TITLE:--	CIRCUIT PLATE-I

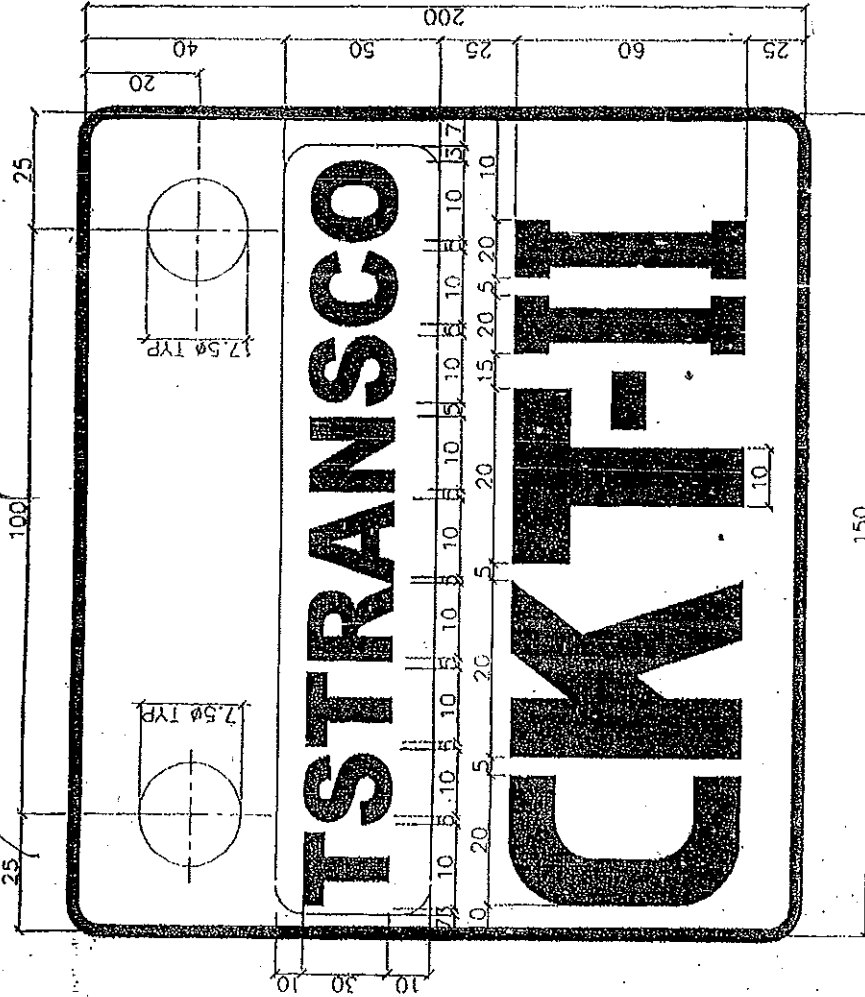
For Bid Purpose only

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. MINIMUM 2THK. M.S. PLATE.
3. WHITE ENAMELLED BACK GROUND AND BLACK OR BLUE ENAMELLED LETTERING.
4. REAR SIDE OF THE PLATE SHALL BE ENAMELLED BLACK.
5. EQUAL NOS. CKT PLATES FOR CKT-I & CKT-II ARE TO BE SUPPLIED.
6. BOLTS / NUTS TO BE GALVANIZED AS PER IS: 1367 (P-13) - 1983.
7. WEIGHT PER PIECE IS 0.275 Kgs.
8. 4NOS. 2MM THK. LEAD WASHER TO BE SUPPLIED WITH EACH PLATE.
9. ALL BOLTS, NUTS AND ACCESSORIES AS PER REQUIREMENTS SHALL BE SUPPLIED.

LIST OF 16mm^d BOLTS, NUTS & WASHER
TO BE SUPPLIED WITH EACH PLATE

DETAILS	QTY
M-16x35MM LONG BOLT & NUT	2
M16x2MM THK. LEAD WASHER	4



CLIENT TRANSMISSION CORPORATION OF TELEGANA LIMITED
(TS TRANSCO)

TITLE:- CIRCUIT PLATE-II

For Bid Purpose only

Technical Specification of OPGW cable and associated hardware & fittings

This section describes the functional & technical specifications of OPGW cabling and associated hardware & fittings.

1.1 Fibre Optic Cabling

This section defines the requirements for G.652D & G655 Dual-window Single mode (DWSM) telecommunication grade fibre optic. Bidders shall furnish with their bids, detailed descriptions of the fibres & cable (s) proposed.

All optical fibre cabling including fibre itself and all associated installation hardware shall have a minimum guaranteed design life span of 25 years. Documentary evidence in support of guaranteed life span of cable & fibre shall be submitted by the Contractor during detailed engineering.

1.1.1 Required Optical Fibre Characteristics

This section describes the characteristics of optical fibre to be provided under this specification.

1.1.1.1 Physical Characteristics

Dual-Window Single mode (DWSM), G.652D optical fibres shall be provided in the fibre optic cables. DWSM optical fibres shall meet the requirements defined in Table 2-1 (a).

1.1.1.2 Attenuation

The attenuation coefficient for wavelengths between 1525 nm and 1575 nm shall not exceed the attenuation coefficient at 1550 nm by more than 0.05 dB. The attenuation coefficient between 1285 nm and 1330 nm shall not exceed the attenuation coefficient at 1310 nm by more than 0.05 dB. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.10 dB. The fibre attenuation characteristics specified in table 2-1 (a) shall be “guaranteed” fibre attenuation of any & every fibre reel.

The overall optical fibre path attenuation shall not be more than calculated below:

Maximum attenuation @ 1550nm: 0.21 dB/km x total km + 0.05dB/splice x no. of splices + 0.5 dB/connector x no. of connectors.

Maximum attenuation @ 1310nm: 0.35dB/km x total km + 0.05 dB/splice x no. of splices + 0.5 dB/connector x no. of connectors.

Table 1-1 (a)
DWSM OPTICAL Fibre Characteristics

Fibre Description:	Dual-Window Single-Mode
Mode Field Diameter:	8.6 to 9.5 μm (± 0.6 μm)
Cladding Diameter:	125.0 μm ± 1 μm
Model field concentricity error	≤ 0.6 μm
Cladding non-circularity	≤ 1%
Cable Cut-off Wavelength λ _{cc}	≤ 1260 nm
1550 nm loss performance	As per G.652 D
Proof Test Level	≥ 0.69 Gpa
Attenuation Coefficient:	@ 1310 nm ≤ 0.35 dB/km @ 1550 nm ≤ 0.21 dB/km
Chromatic Dispersion; Maximum:	18ps/(nm x km) @ 1550 nm 3.5 ps/(nm x km) 1288-1339 nm 5.3 ps/(nm x km) 1271-1360 nm
Zero Dispersion Wavelength:	1300 to 1324 nm
Zero Dispersion Slope:	0.092 ps/(nm ² xkm) maximum

Polarization mode dispersion coefficient	$\leq 0.2 \text{ ps/km}^{1/2}$
Temperature Dependence:	Induced attenuation $\leq 0.05 \text{ dB}$ (-60°C - +85°C)
Bend Performance:	@ 1310 nm (75±2 mm dia Mandrel), 100 turns; Attenuation Rise $\leq 0.05 \text{ dB}$ @1550 nm (30±1 mm radius Mandrel), 100 turns; Attenuation Rise $\leq 0.05 \text{ dB}$ @ 1550 nm 32±0.5 mm dia Mandrel, 1 turn; Attenuation Rise $\leq 0.50 \text{ dB}$

1.1.2 Fibre Optic Cable Construction

Overhead Fibre Optic Cables shall be OPGW (Optical Ground Wire). The OPGW cable is proposed to be installed on transmission lines. The design of cable shall account for the varying operating and environmental conditions that the cable shall experience while in service.

1.1.2.1 Transmission Line Details

Typical details of transmission lines are indicated in the Appendices. Any other details, as required for cable design etc, shall be collected by the Contractor during survey.

1.1.2.2 Optical Fibre Cable Link Lengths

The estimated optical fibre link lengths are provided in Appendices. However, the Contractor shall supply & install the optical fibre cable as required based on detailed site survey to be carried out by the Contractor during the project execution. The Contract price shall be adjusted accordingly.

For the purpose of payment, the optical fibre link lengths are defined as transmission line route lengths from Gantry at one terminating station to the Gantry in the other terminating station. The actual cable lengths to be delivered shall take into account various factors such as sag, service loops, splicing, working lengths & wastage etc, and no additional payment shall be payable in this regard. The unit rate for FO cable quoted in the Bid price Schedules shall take into account all such factors.

1.1.2.3 Optical Fibre Identification

Individual optical fibres within a fibre unit and fibre units shall be identifiable in accordance with EIA/TIA 598 OR IEC 60304 or Bellcore GR-20 colour-coding scheme.

Colouring utilized for colour coding optical fibres shall be integrated into the fibre coating and shall be homogenous. The colour shall not bleed from one fibre to another and shall not fade during fibre preparation for termination or splicing.

Each cable shall have traceability of each fibre back to the original fibre manufacturer’s fibre number and parameters of the fibre. If more than the specified number of fibres are included in any cable, the spare fibres shall be tested by the cable manufacturer and any defective fibres shall be suitably bundled, tagged and identified at the factory by the vendor.

1.1.2.4 Buffer Tube

Loose tube construction shall be implemented. The individually coated optical fibre(s) shall be surrounded by a buffer for protection from physical damage during fabrication, installation and operation of the cable. The fibre coating and buffer shall be strippable for splicing and termination. Each fibre unit shall be individually identifiable utilizing colour coding. Buffer tubes shall be filled with a water-blocking gel.

1.1.2.5 Optical Fibre Strain & Sag-tension chart

The fibre optic cable shall be designed and installed such that the optical fibres experience no strain under all loading conditions defined in IS 802. Zero fibre strain condition shall apply even after a 25 year cable creep.

For the purpose of this specification, the following definitions shall apply;

- Maximum Working Tension (MWT) is defined as the maximum cable tension at which there is no fibre strain.
- The no fibre strain condition is defined as fibre strain of less than or equal to 0.05%, as determined by direct measurements through IEC/ETSI(FOTP) specified optical reflectometry techniques.
- The Cable strain margin is defined as the maximum cable strain at which there is no fibre strain.
- The cable Maximum Allowable Tension (MAT) is defined as the maximum tension experienced by the Cable under the worst case loading condition.
- The cable max strain is defined as the maximum strain experienced by the Cable under the worst case loading condition
- The cable Every Day Tension (EDT) is defined as the maximum cable tension on any span under normal conditions.
- The Ultimate / Rated Tensile Strength (UTS/RTS/breaking strength) is defined as the maximum tensile load applied and held constant for one minute at which the specimen shall not break.

While preparing the Sag-tension charts for the OPGW cable the following conditions shall be met:

- The Max Allowable Tension (MAT) / max strain shall be less than or equal to the MWT/Strain margin of the cable
- The Sag shall not exceed the earth wire sag in all conditions.
- The Max Allowable Tension shall also be less than or equal to 0.4 times the UTS.
- The 25 years creep at 25% of UTS (creep test as per IEEE 1138) shall be such that the 25 years creep plus the cable strain at Max Allowable Tension (MAT) is less than or equal to the cable strain margin.
- The everyday tension (EDT) shall not exceed 20% of the UTS for the OPGW cable.

The Sag-tension chart of OPGW cable indicating the maximum tension, cable strain and sag shall be calculated and submitted along with the bid under various conditions mentioned below:

1. 53°C, no wind and no ice
2. 32°C, no wind and no ice
3. 0°C, no wind and no ice
4. 32°C, full wind and no ice
5. 32°C, 75% full wind and no ice
6. 0°C, 2/3rd / 36% of full wind (IS 802:1977/1995)

The above cases shall be considered for the spans from 100 m to 600 m or higher span length in the range of 50 m spans. Max. vertical sag, max. tension and max sag at 0° C & no wind shall be considered for in line with the design parameter of transmission line. The typical details are indicated in the appendices. The full wind load shall be considered as the design wind load for all the specified transmission lines as per relevant IS 802 version and the sag-tension chart shall be submitted considering the transmission lines. The contractor shall submit the stringing chart for review of Employer.

1.1.2.6 Cable Materials

The materials used for optical fibre cable construction, shall meet the following requirements:

1.1.2.6.1 Filling Materials

The interstices of the fibre optic unit and cable shall be filled with a suitable compound to prohibit any moisture ingress or any water longitudinal migration within the fibre optic unit or along the fibre optic cable. The water tightness of the cable shall meet or exceed the test performance criteria as per IEC-794-1-F-5.

The filling compound used shall be a non-toxic homogenous waterproofing compound that is free of dirt and foreign matter, nonhygroscopic, electrically nonconductive and non-nutritive to fungus. The compound shall also be fully compatible with all cable components it may come in contact with and shall inhibit the generation of hydrogen within the cable.

The waterproofing filling materials shall not affect fibre coating, colour coding, or encapsulant commonly used in splice enclosures, shall be dermatologically safe, non-staining and easily removable with a non-toxic cleaning solvent.

1.1.2.6.2 Metallic Members

When the fibre optic cable design incorporates metallic elements in its construction, all metallic elements shall be electrically continuous.

1.1.2.6.3 Marking, Packaging and Shipping

This section describes the requirements for marking, packaging and shipping the overhead fibre optic cable.

- (a) Drum Markings: Each side of every reel of cable shall be permanently marked in white lettering with the vendors' address, the Purchaser's destination address, cable part number and specification as to the type of cable, length, number of fibres, a unique drum number including the name of the transmission line & segment no., factory inspection stamp and date.
- (b) Cable Drums: All optical fibre cabling shall be supplied on strong drums provided with lagging of adequate strength, constructed to protect the cabling against all damage and displacement during transit, storage and subsequent handling during installation. Both ends of the cable shall be sealed as to prevent the escape of filling compounds and dust & moisture ingress during shipment and handling. Spare cable caps shall be provided with each drum as required.

The spare cable shall be supplied on sturdy, corrosion resistant, steel drums suitable for long periods of storage and re-transport & handling.

There shall be no factory splices allowed within a continuous length of cable. Only one continuous cable length shall be provided on each drum. The lengths of cable to be supplied on each drum shall be determined by a "schedule" prepared by the Contractor.

1.1.2.6. OPGW cable Installation requirements

OPGW cables shall be installed in OFF - Line/ LIVE-Line conditions. The tentative bill of quantities for both live- line as well as off-line OPGW cable system installations have been specified in the appendices and the actual quantities for both types shall be finalized during project execution after detailed survey.

Supervision of Installation – The Contractor shall supervise the stringing at site as per the approved stringing procedure. Site visit for supervision shall be carried out as per instruction of Employer. However, the contract price shall be adjusted as per the actual requirement. The Supervision/Inspection work in Contractor's scope shall mainly include inspection as per stringing procedure, proper location of drum site, installation of stringing blocks/pulleys, proper sagging, proper installation of hardware, proper tension as per Sag-Tension chart, provision of service loops of OPGW in jointing locations etc.

1.1.2.7 Optical Ground Wire (OPGW)

OPGW cable construction shall comply with IEEE-1138, 1994. The cable provided shall meet both the construction and performance requirements such that the ground wire function, the optical fibre integrity and optical transmission characteristics are suitable for the intended purpose. The cable shall consist of optical fibre units as defined in this specification. There shall be no factory splices within the cable structure of a continuous cable length.

The composite fibre optic overhead ground wire shall be made up of buffered optical fibre units (fibres in the buffer tube) embedded in a water tight aluminium / aluminium alloy / stainless steel protective central fibre optic unit surrounded by concentric-lay stranded metallic wires in single or multiple layers. The dual purpose of the composite cable is to provide the electrical and physical characteristics of conventional overhead ground wire while providing the optical transmission properties of optical fibre.

1.1.2.7.1 Central Fibre Optic Unit

The central fibre optic unit shall be designed to house and protect multiple buffered optical fibres units from damage due to forces such as crushing, bending, twisting, tensile stress and moisture. The central fibre optic unit and the outer stranded metallic conductors shall serve together as an integral unit to protect the optical fibres from degradation due to vibration and galloping, wind and ice loadings, wide temperature variations, lightning an fault current, as well as environmental effects which may produce hydrogen.

Central fibre optic unit may be of aluminium or stainless steel tube with aluminium protective coating. In case of aluminium protective coating, the coating must completely cover the tubes leaving no exposed areas of tubing that can make electrical contact either directly or indirectly through moisture, contamination, protrusions, etc with the surrounding stranded wires. The tube may be fabricated as a seamless tube, seam welded, or a tube without a welded seam.

1.1.2.7.2 Breaking Strength

The rated breaking strength of the completed OPGW shall be taken as no more than 90 percent of the sum of the rated breaking strengths of the individual wires, calculated from their nominal diameter and the specified minimum tensile strength.

The rated breaking strength shall not include the strength of the optical unit. The fibre optic unit shall not be considered a load bearing tension member when determining the total rated breaking strength of the composite conductor.

1.1.2.7.3 Electrical and Mechanical Requirements

Table 2-2(a) provides OPGW Electrical and Mechanical Requirements for the minimum performance characteristics. Additionally, the OPGW mechanical & electrical characteristics shall be similar to that of the earthwire being replaced such that there is no or minimal consequential increase in stresses on towers. For the purpose of determining the appropriate Max Working Tension limit for the OPGW cable IS 802:1995 and IS 875:1987 shall be applied. However the OPGW installation sag & tension charts shall be based on IS 802 version to which the line is originally designed. For the OPGW cable design selection and preparation of sag tension charts, the limits specified in this section shall also be satisfied. The Bidder shall submit sag-tension charts for the above cases with their bids.

Table 1.2(a)
OPGW Electrical and Mechanical Requirements

(1)	Everyday Tension	≤ 20% of UTS of OPGW
(2)	D.C. Resistance at 20°C:	< 1.0 ohm/Km
(3)	Short Circuit Current:	≥ 6.32 kA for 1.0 second

1.1.2.7.4 Operating conditions

Since OPGW shall be located at the top of the EHV transmission line support structure, it will be subjected to Aeolian vibration, Galloping and Lightning strikes. It will also carry ground fault currents. Therefore, its electrical and mechanical properties shall be same as those required of conventional ground conductors.

1.1.2.7.5 Installation

OPGW installed under off line condition, shall be generally in accordance with the IEEE Guide to the Installation of Overhead Transmission Line Conductors (IEEE STD. 524 with latest revisions), with additional instructions and precautions for fibre optic cable handling. The stringing procedure shall be submitted by the Contractor prior to stringing for Employer's approval.

The OPGW cable sections shall normally be terminated & spliced only on tension towers. In exceptional circumstances, and on Employer specific approval, cable may be terminated on Suspension towers, but in this case tower strength shall be examined to ensure that tower loads are within safe limits and if required, necessary tower strengthening shall be carried out by the Contractor.

1.1.2.7.6 Installation Hardware

The scope of supply of the optical cable includes the assessment, supply and installation of all required fittings and hardware such as Tension assembly, Suspension assembly, Vibration dampers, Reinforcing rods, Earthing clamps, Downlead clamps, splice enclosure etc. The Bidder shall provide documentation justifying the adequacy and suitability of the hardware supplied. The Contractor shall determine the exact requirements of all accessories required to install and secure the OPGW.

The OPGW hardware fittings and accessories shall follow the general requirements regarding design, materials, dimensions & tolerances, protection against corrosion and markings as specified in clause 4.0 of EN 61284:1997 (IEC 61284). The shear strength of all bolts shall be at least 1.5 times the maximum installation torque. The OPGW hardware & accessories drawing & Data Requirement Sheets (DRS) document shall consist of three parts: (1) A technical particulars sheet (2) An assembly drawing i.e. level 1 drawing and (3) Component level drawings i.e. level 2 & lower drawings. All component reference numbers, dimensions and tolerances, bolt tightening torques & shear strength and ratings such as UTS, slip strength etc shall be marked on the drawings.

The fittings and accessories described herein are indicative of installation hardware typically used for OPGW installations and shall not necessarily be limited to the following:

- (a) Suspension Assemblies: Preformed armour grid suspension clamps and aluminium alloy armour rods/reinforcing rods shall be used. The suspension clamps shall be designed to carry a vertical load of not less than 25 kN. The suspension clamps slippage shall occur between 12kN and 17kN as measured in accordance with type test procedures.

The Contractor shall supply all the components of the suspension assembly including shackles, bolts, nuts, washers, split pins, etc. The total drop of the suspension assembly shall not exceed 150 mm (measured from the center point of attachment to the center point of the OPGW). The design of the assembly shall be such that the direction of run of the OPGW shall be the same as that of the conductor.

- (b) Dead End Clamp Assemblies: All dead end clamp assemblies shall preferably be of preformed armoured grip type and shall include all necessary hardware for attaching the assembly to the tower strain plates. Dead end clamps shall allow the OPGW to pass through continuously without cable cutting. The slip strength shall be rated not less than 95% of the rated tensile strength of the OPGW.
- (c) Clamp Assembly Earthing Wire: Earthing wire consisting of a 1500 mm length of aluminium or aluminium alloy conductor equivalent in size to the OPGW shall be used to earth suspension and dead end clamp assemblies to the tower structure.

- The earthing wire shall be permanently fitted with lugs at each end. The lugs shall be attached to the clamp assembly at one end and the tower structure at the other.
- (d) Structure Attachment Clamp Assemblies: Clamp assemblies used to attach the OPGW to the structures, shall have two parallel grooves for the OPGW, one on either side of the connecting bolt. The clamps shall be such that clamping characteristics do not alter adversely when only one OPGW is installed. The tower attachment plates shall locate the OPGW on the inside of the tower and shall be attached directly to the tower legs/cross – members without drilling or any other structural modifications.
 - (e) Vibration Dampers: Vibration dampers type 4R Stockbridge or equivalent, having four (4) different frequencies spread within the Aeolian frequency bandwidth, shall be used for suspension and tension points in each span. The Contractor shall determine the exact numbers and placement(s) of vibration dampers through a detailed vibration analysis as specified in technical specifications. Vibration damper clamps shall be made of aluminium or aluminium alloy, shall support the dampers during installation and shall maintain the dampers in position without damage to the OPGW and without causing fatigue. Armour or patch rods made of aluminium or aluminium alloy shall be provided as required to reduce clamping stress on the OPGW. The vibration damper body shall be hot-dip galvanized mild steel/cast iron or shall be permanent mould cast zinc alloy.

1.1.3 Fibre Optic Splice Enclosures (Joint Box)

All splices shall be encased in Fibre Optic Splice Enclosures. Suitable splice enclosures shall be provided to encase the optical cable splices in protective, moisture and dust free environment. Splice enclosures shall comply to ingress protection class IP 66 or better. The splice enclosures shall be designed for the storage and protection of required number of optical fibre splices and equipped with sufficient number of splice trays for splicing all fibres in the cable. No more than 6 fibres shall be terminated in a single splice tray. They shall be filled with suitable encapsulate that is easily removable should re-entry be required into the enclosures. Splice enclosures shall be suitable for outdoor use with each of the cable types provided under this contract. Splice enclosures shall be appropriate for mounting on transmission line towers above anti-climb guard levels at about 10 metres from top of the tower and shall accommodate pass-through splicing. The actual mounting height and location shall be finalized after Survey. Contractor shall be responsible for splicing of fibres and installation of splice enclosures.

1.1.3.1 Optical Fibre Splices

Splicing of the optical fibre cabling shall be minimized through careful contractor planning. There shall be no mid-span splices allowed. All required splices shall be planned to occur on tower structures. All optical fibre splicing shall comply with the following:

- (a) All fibre splices shall be accomplished through fusion splicing.
- (b) Each fibre splice shall be fitted with a splice protection sheath fitted over the final splice.
- (c) All splices and bare fibre shall be neatly installed in covered splice trays. No more than six (6) fibres shall be installed in each splice tray.
- (d) For each link, bi-directional attenuation of single mode fusion splices, shall not average more than 0.05 dB and no single splice loss shall exceed 0.1 dB when measured at 1550 nm.
- (e) For splicing, fibre optic cable service loops of adequate length shall be provided so that all splices occurring at tower structures can be performed at ground level.

1.1.4 Fibre Optic Approach Cables

For purposes of this specification, a fibre optic approach cable is defined as the Armoured underground fibre optic cable required to connect Overhead Fibre Optic Cable (OPGW) between the final in line splice enclosure on the gantry / tower forming the termination of the fibre cable on the power line and the Fibre Optic Distribution Panel (FODP) installed within the building. The estimated fibre optic approach cabling length requirements are indicated in the appendices. However, the Contractor shall supply & install the optical fibre approach cable as required based on detailed site survey to be carried out by the Contractor during the project execution and the Contract price shall be adjusted accordingly.

1.1.4.1 Basic Construction

The cable shall be suitable for direct burial, laying in trenches & PVC/Hume ducts, laying under false flooring and on indoor or outdoor cable raceways.

1.1.4.2 Jacket Construction & Material

The approach cable shall be a UV resistant, rodent proof, armoured cable with metallic type of armoring. The outer cable jacket for approach cable shall consist of carbon black polyethylene resin to prevent damage from exposure to ultra-violet light, weathering and high levels of pollution. The jacket shall confirm to ASTM D1248 for density.

1.1.4.3 Optical, Electrical and Mechanical Requirements

Approach cable shall contain fibres with identical optical/physical characteristics a those in the OPGW cables. The cable core shall comprise of tensile strength member(s), fibre support/bedding structure, core wrap/bedding, and an overall impervious jacket.

1.1.5 Installation of Approach cable

The existing cable trenches/cable raceways proposed to be used shall be identified in the survey report. The Contractor shall make its best effort to route the cable through the existing available cable trenches. Where suitable existing cable trenches are not available, suitable alternatives shall be provided after Employer approval. However, the approach cable shall be laid in the 40/33 mm HDPE pipe in all condition.

Suitable provisions shall be made by the contractor to ensure adequate safety earthing and insulated protection for the approach cable.

All required fittings, supports, accessories, ducts, inner ducts, conduits, risers and any item not specially mentioned but required for laying and installtion of approach cables shall be supplied and installed by the Contractor.

1.1.6 Optical Fibre Termination and Splicing

Optical fibre terminations shall be installed in Fibre Optical Distribution Panels (FODP) designed to provide protection for fibre splicing of preconnectorized pigtails and to accommodate connectorized termination and coupling of the fibre cables. The contractor shall provide rack/wall mounted fibre optic distribution panels (FODPs) sized as indicated in the appendices and shall terminate the fibre optic cabling up to the FODPs. The location of FODP rack shall be fixed by the Contractor, with the Employer's approval.

1.1.6.1 Fibre Optic Distribution Panel

At each location requiring the termination of at least one fibre within a cable, all fibres within that cable shall be connectorized and terminated in Fibre Optic Distribution Panels in a manner consistent with the following:

- a) All fibre optic terminations shall be housed using FODPs provisioned with splice organizers and splice trays. All fibres within a cable shall be fusion spliced to preconnectorized pigtails and fitted to the "Back – side" of the provided fibre optic couplings.
- b) FODPs shall be suitable for use with each of the cable types provided as part of this contract. FODPs shall accommodate pass-through splicing and fibre terminations.
- c) FODPs for indoor use shall be supplied in suitable cabinets/racks with locking arrangement.
- d) ALL FODPs shall be of corrosion resistant, robust construction and shall allow both top or bottom entry for access to the splice trays, Ground lugs shall be provided on all

FODPs and the Contractor shall ensure that all FODPs are properly grounded. The FODP shall meet or exceed ingress protection class IP55 specifications.

- e) Flexible protection shall be provided to the patch cord bunches going out from FODP to other equipment.
- f) FODPs shall be supplied in separate rack with provision for Floor mounting.

1.1.6.2 Optical Fibre Connectors

Optical fibres shall be connectorised with FC-PC type connectors preferably. Alternatively connector with matching patch cord shall also be acceptable. Fibre optic couplings supplied with FODPs shall be appropriate for the fibre connectors to be supported. There shall be no adapters.

1.1.7 Service Loops

For purposes of this specification, cable and fibre service loops are defined as slack (extra) cable and fibre provided for facilitating the installation, maintenance and repair of the optical fibre cable plant.

- (a) Outdoor Cable Service Loops: In – line splice enclosures installed outdoors and mounted on the utility towers, shall be installed with sufficient fibre optic cable service loops such that the recommended minimum bend radius is maintained while allowing for installation or maintenance of the cable to be performed in a controlled environment at ground level.
- (b) Indoor Cable Service Loops: FODPs shall provide at least three (3) metres of cable service loop. Service loops shall be neatly secured and stored, coiled such that the minimum recommended bend radius' are maintained.
- (c) Fibre Units Service Loops: For all fibre optic cable splicing, the cable shall be stripped back a sufficient length such that the fan-out of fibre units shall provide for at least one (1) metre of fibre unit service loop between the stripped cable and the bare fibre fan-out.
- (d) Pigtail Service Loops: Connectorised pigtails spliced to bare fibres shall provide at least 1 metre of service loop installed in the FODP fibre organizer and at least one (1) metre of service loop to the couplings neatly stored behind the FODP coupling panels.
- (e) Fibre Service Loops: At least 0.5 metre of bare fibre service loop shall be provided on each side of all fibre splices. The bare fibre service loops shall be neatly and safely installed inside covered splice trays.

1.1.8 Methodology for Installation and Termination

All optical fibre cable termination, installation, stringing and handling plans, guides and procedures, and engineering analysis (e.g. tension, sag, vibration etc.) shall be submitted to the Employer for review and approval in the engineering/design phase of the project, prior to establishing the final cable lengths for manufacture. Installation procedures including details of personnel and time required shall be documented in detail and submitted to Employer for approval. All installation practices shall be field proven and ISO accredited.

All cable segments shall include service loops as specified in this specification. The maximum allowable stringing tension, maximum allowable torsional shear stress, crush strength and other physical parameters of the cable shall not be exceeded. The preventative measures to be taken shall be documented in details and submitted to Employer in advance of installation.

Optical fibre attenuation shall be measured after installation and before splicing. Any increase in attenuation or step discontinuity in attenuation shall not be acceptable and shall constitute a cable segment failure. In the event of cable damage or any fibre damage, the complete section (tension location to tension location) shall be replaced as mid-span joints are not acceptable.

Any or all additional steel work or modifications require to attach the fibre cabling to the overhead transmission/distribution line towers shall also be carried out by the contractor. It shall be the Contractors responsibility to provide adequate communications among all crew members and support staff to ensure safe and successful installations.

1.1.9 Cable Raceways

To the extent possible, existing cable raceways shall be utilized. The Contractor is required to provide and install any additional indoor cable raceways which maybe required for proper implementation of and communication system. This requirement shall be finalized during survey. The cable raceways shall conform to the following:

- (a) All cable raceways shall be sized to support full loading requirements plus at least a 200% safety loading factor
- (b) Indoor cable raceways shall be fabricated from construction grade aluminium, galvanized iron or anodized sheet metal or any other suitable material approved by the Employer. Suitable anticorrosion measures shall be provided. Steel fabricated raceways shall be finished inside and out, treated to resist rust and to form a metal-to-paint bond.
- (c) Mechanical construction drawings of the cable raceways shall be submitted for Employer's information & review.

2.0 Type Testing

"Type Tests" shall be defined as those tests which are to be carried out to prove the design, process of manufacture and general conformity of the materials to this specification. Type testing shall comply with the following:

- a) All cable being supplied shall conform to type tests as per technical specification.
- b) The test reports submitted shall be of the tests conducted within last seven (7) years for OPGW cable prior to the date of bid opening. In case the test reports are older than seven (7) years for OPGW cable on the date of bid opening, the contractor shall repeat these tests at no extra to the purchaser.
- c) The contractor shall submit, within 30 days of contract award, copies of test reports for all of the type tests that are specified in the specifications and that have previously (before contract award) been performed. These reports may be accepted by the employer only if they apply to materials and equipment that are essentially identical to those due to be delivered under the contract and only if test procedures and parameter values are identical to those specified in this specifications carried out at accredited labs and witnessed by third party / customer's representatives.

In the event of any discrepancy in the test reports or any type tests not carried out, same shall be carried out by contractor without any additional cost implication to the employer.

- d) Type tests shall be certified or performed by reputed laboratories using material and equipment data sheets and test procedures that have been approved by the employer. The test procedures shall be formatted as defined in the technical specifications and shall include a complete list of the applicable reference standards and submitted for employer approval at least four (4) weeks before commencement of test(s). The contractor shall provide the employer at least 30 days written notice of the planned commencement of each type test.
- e) The contractor shall provide a detailed schedule for performing all specified type tests. These tests shall be performed in the presence of a representative of the employer, if required.
- f) The contractor shall ensure that all type tests can be completed within the time schedule offered in his technical proposal.

- g) In case of failure during any type test, the supplier is either required to manufacture a fresh sample lot and repeat all type tests successfully or repeat that particular type test(s) at least three times successfully on the samples selected from the already manufactured lot at his own expenses. In case a fresh lot is manufactured for testing then the lot already manufactured shall be rejected.

2.1 Type Test Samples

The contractor shall supply equipment/material for sample selection only after the quality assurance plan has been approved by the employer. The sample material shall be manufactured strictly in accordance with the approved quality assurance plan. The contractor shall submit for employer approval, the type test sample selection procedure. The selection process for conducting the type tests shall ensure that samples are selected at random. At least three samples of each of the proposed equipment / item / cable drum except FO cable installation hardware & fittings shall be offered for selection. For FO cable installation hardware & fittings at least ten (10) samples shall be offered for selection.

2.1.2 List of Type Tests

The type testing shall be conducted on the following equipment/items

- (a) Optical fibres
- (b) OPGW Cable
- (c) OPGW Cable fittings
- (d) Vibration Damper
- (e) Splice Enclosure (Joint Box)

2.3 Type Tests for Optical Fibres

The type tests listed below in table 2.1 shall be conducted on DWSM fibres to be supplied as part of overhead cables. The tests specific to the cable type are listed in subsequent sections.

Table 2.1

Type Tests for Optical Fibres

S.No.	Test Name	Acceptance Criteria	Test procedure
1	Attenuation	As per section-02 of TS	IEC 60793-1-40 Or EIA/TIA 455-78A
2	Attenuation Variation with Wavelength	As per section-02 of TS	IEC 60793-1-40 Or EIA/TIA 455-78A
3	Attenuation at Water Peak	As per section-02 of TS	IEC 60793-1-40 Or EIA/TIA 455-78A
4	Temp. Cycling (Temp dependence of Attenuation)		IEC 60793-1-52 Or EIA/TIA 455-3A cycles
5	Attenuation with bending (bend performance)		IEC 60793-1-47 Or EIA/TIA 455-62A

6	Mode Field dia		IEC 60793-1-45 Or EIA/TIA 455- 164A/167A/174
7	Chromatic Dispersion		IEC 60793-1-42 Or EIA/TIA 455- 168A/169A/175A
8	Cladding Diameter		IEC 60793-1-20 Or EIA/TIA 455-176
9	Point Discontinuities of attenuation		IEC 60793-1-40 Or EIA/TIA 455-59
10	Core-Clad concentricity error		IEC 60793-1-20 Or EIA/TIA 455-176
11	Fibre Tensile proof testing		IEC 60793-1-30 Or EIA/TIA 455-31B
- End of table -			

2.4 Type Test for OPGW cables

The type tests to be conducted on the OPGW cable are listed in Table 2.2 Type Tests for OPGW Cables. Unless specified otherwise in the technical specifications or the referenced standards, the optical attenuation of the specimen, measured during or after the test as applicable, shall not increase by more than 0.05 dB/Km.

Table 2.2

Type tests for OPGW Cable

S.No.	Test Name	Test Description	Test Procedure	
1	Water Ingress Test	IEEE 1138-2009	IEEE 1138-2009 (IEC 60794-1-2 Method F5 or EIA/TIA 455-82B): Test duration: 24 hours	
2	Seepage of filling compound	IEEE 1138-2009	IEEE 1138-2009 EIA/TIA 455-81B	Preconditioning period: 72 hours. Test duration: 24 hours

3	Short Circuit Test	IEEE 1138-2009	IEEE 1138-2009	Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. A suitable temperature sensor such as thermocouple shall be used to monitor and record the temperature inside the OPGW tube in addition to monitoring & recording the temperatures between the strands and between optical tube and the strand as required by IEEE 1138. Test shall be conducted with the tension clamps proposed to be supplied. The cable and the clamps shall be visually inspected for mechanical damage and photographed after the test.
		Or IEC60794-4-10/IEC 60794-1-2 (2003) Method H1		Initial temperature during the test shall be greater than or equal to ambient field temperature.
4	Aeolian Vibration Test	IEEE 1138-2009 Or IEC 60794-4-10/IEC 60794-1-2, Method E19	IEEE 1138-2009	Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. The vibration frequency and amplitude shall be monitored and recorded continuously. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring. Test shall be conducted with the tension/suspension clamps proposed to be supplied. The cable and the clamps shall be visually inspected for mechanical damage and photographed after the test.

5	Galloping test	IEEE 1138-2009	IEEE 1138-2009	Test shall be conducted with the tension/suspension clamps proposed to be supplied. The cable and clamps shall be visually inspected for mechanical damage and photographed after the test. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring.
6	Cable Bend Test	Procedure 2 in IEC 60794-1-2 Method E11		The short-term and long term bend tests shall be conducted in accordance with procedure 2 in IEC 60794-1-2 E11 to determine the minimum acceptable radius of bending without any increase in attenuation or any other damage to the fibre optic cable core such as bird caging, deformation, kinking and crimping.
7	Sheave Test	IEEE 1138-2009 OR IEC 60794-1-2 (2003) Method E1B	IEEE 1138-2009	Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. The Sheave dia. Shall be based on the pulling angle and the minimum pulley dia employed during installation. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring.
8	Crush Test	IEEE 1138-2009	IEEE 1138-2009 (IEC 60794-1-2, Method E3/EIA/TIA 455-41B)	The crush test shall be carried out on a sample of approximately one (1) metre long in accordance with IEC 60794-1-2 E3. A load equal to 1.3 times the weight of a 400 – metre length of fibre optic cable shall be applied for a period of 10 minutes. A permanent or temporarily increase in optical attenuation value greater than 0.1 dB change in sample shall constitute failure. The load shall be further increased in small increments until the measured attenuation of the optical waveguide fibres increases and the failure load recorded along with results.

9	Impact Test	IEEE 1138-2009	IEEE 1138-2009, (IEC 60794-1-2 E4/EIA/TIA 455-25B)	The impact test shall be carried out in accordance with IEC 60794-1-2 E4. Five separate impacts of 0.1-0.3kgm shall be applied. The radius of the intermediate piece shall be the reel drum radius $\pm 10\%$. A permanent or temporary increase in optical attenuation value greater than 0.1 dB/km change in sample shall constitute failure.
10	Creep Test	IEEE 1138-2009	IEEE 1138-2009	As per Aluminium Association Method, the best-fit straight line shall be fitted to the recorded creep data and shall be extrapolated to 25 years. The strain margin of the cable at the end of 25 years shall be calculated. The time when the creep shall achieve the strain margin limits shall also be calculated.
11	Fibre Strain Test	IEEE 1138-2009	IEEE 11-38-1994	
12	Strain Margin Test	IEEE 1138-2009	IEEE 1138-2009	
13	Stress strain test	IEEE 1138-2009	IEEE 1138-2009	
14	Cable Cut-off wavelength test	IEEE 1138-1994	IEEE 1138-1994	
15	Temperature Cycling Test	IEEE 1138-2009	IEEE 1138-2009 Or IEC 60794-1-2, Method F1	
16	Corrosion (Salt Spary) test	EIA/TIA 455-16A		
17	Tensile performance test	IEC 60794-1-2 E1/EIA/TIA 455-33B		The test shall be conducted on a sample of sufficient length in accordance with IEC 60794-1-2 EI. The attenuation variation shall not exceed 0.05 dB/Km up to 90% of RTS of fibre optic cable. The load shall be increased at a steady rate up to rated tensile strength and held for one (1) minute. The fibre optic cable sample shall not fail during the period. The applied load shall then be increased until the failing load is reached and the value recorded.

18	Fault current/ lightning test	IEC 60794-4-10/IEC 60794-1-2 (2003)	The OPGW cable construction shall be tested in accordance with IEC 60794- 1-2, Method H2 for Class 1.
19	DC Resistance Test (IEC 60228)	On a fibre optic cable sample of minimum 1 metre length, two contact clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially zero metre and subsequently one metre apart. The tests shall be repeated at least five times and the average value recorded after correcting at 20°C.	
- End of table -			

2.5 Type Test on OPGW cable fittings

The type tests to be conducted on the OPGW cable fittings and accessories are listed below:

(i) Mechanical Strength Test for suspension/tension assembly

Applicable Standards: IEC 61284, 1997

Suspension Assembly

The armour rods/reinforcement rods are assembled on to the approved OPGW using the Installation Instructions to check that the assembly is correctly fitted and is the same that will be carried out during installations.

Part 1:

The suspension assembly shall be increased at a constant rate up to a load equal to 50% of the specified minimum failure load increased and held for one minute for the test rig to stabilize. The load shall then be increased at a steady rate to 67% of the minimum failure load and held for five minutes. The angle between the cable, the suspension assembly and the horizontal shall not exceed 16°. This load shall then be removed in a controlled manner and the protection splice disassembled. Examination of all the components shall be made and any evidence of visual deformation shall be documented.

Part 2:

The suspension clamp shall then be placed in the testing machine. The tensile load shall gradually be increased up to 50% of the specified Minimum failure load of the suspension assembly and held for one minute for the test rig to stabilize and the load shall be further increased at a steady rate until the specified minimum failure load is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value shall be documented.

Tension Assembly

The Tension Assembly is correctly fitted and is the same that will be carried out during installations.

Part 1:

The tension assembly (excluding tension clamp) shall be increased at a constant rate up to a load equal to 50% of the specified of the specified minimum failure load increased at a constant rate and held for one minute for the test rig to stabilize. The load shall then be increased at a steady rate to 67% of the minimum failure load and held of five minutes. This load shall then remove in a controlled manner and the tension assembly disassembled. Examination of the tension dead-end and associated components shall be made and any evidence of visual deformation shall be documented.

Part 2:

The Tension Dead-End and associated components shall then be reassembled and bolts tightened as before. The tensile load shall gradually be increased up shall gradually be increased up to 50% of the specified minimum failure load of the tension assembly and held for one minute for the test rig to stabilize and the load shall be further increased at a steady rate until the specified minimum failure load is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value shall be documented.

Acceptance Criteria for Tension/Suspension assembly:

- No evidence of binding of the Nuts or Deformation of components at end of Part 1 of test.
- No evidence of fracture at the end of one minute at the minimum failure load during Part 2 of the test.

Any result outside these parameters shall constitute a failure.

(ii) Clamp slip strength test for suspension assembly

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length fibre optical cable shall be fixed in the clamps. Once the suspension clamp has been assembled, the test rig is tensioned to 1 KN and the position scale on the recorder 'zeroed'. The test rig is then tensioned to 2.5 KN and the relative positions of the Reinforcing Rods, Armour Rods and suspension clamp shall be marked by a suitable means to confirm any slippage after the test has been completed. The relative positions of the helical Armour Rods and associated Reinforcing Rods at each end shall be marked and also 2 mm relative position between clamp body and Armour Rods shall be marked on one side. The load shall be increased to 12KN at a loading rate of 3 KN/min and held for one minute. At the end of this one minute period, the relative displacement between clamp body and the armour rods shall be observed. If the slippage is 2mm or above, the test shall be terminated. Otherwise, at the end of the one minute the position of the clamp body and 2mm. relative positions between clamp body and armour rods shall be marked on the other side. After the one minute pause, the load shall be further increased at a loading rate of 3 KN/min, and recording of load and displacement shall continue until either the relative position displacement between clamp body and armour rods reaches more than 2 mm or the load reaches the maximum slip load of 17 KN. On reaching either of the above values the test is terminated. Visual examination of all paint marks shall be recorded, and a measurement of any displacement recorded in the table of results.

Acceptance Criteria:

The suspension clamp has passed the slip test if the following conditions are met:

- No slippage* shall occur at or below the specified minimum slip load.
 - * Definition of no slippage in accordance with IEC 61284, 1997:- Any relative movement less than 2 mm is accepted. The possible couplings or elongations produced by the cable as a result of the test itself are not regarded as slippage.
- Slippage shall occur between the specified maximum and minimum slip load of 12-17KN.
- There shall be no slippage of the Reinforcing Rods over the cable, and no slippage of the Armour Rods over the Reinforcing Rods.
- The relative movement (i.e. more than 2 mm between Armour Rods & Clamp body) between minimum 12KN and maximum slip 17KN, shall be considered as slip.
- The Armour Rods shall not be displaced from their original lay or damaged**.

**** Definition of no damage in accordance with convention expressed in IEC 61284: 1997 no damage, other than surface flattening of the strands shall occur.**

Any result outside these parameters is a failure.

(iii) Slip strength test of tension clamp

Tension clamps shall be fitted on a 8 m length of fibre optic cable on both ends. The assembly shall be mounted on a tensile testing machine and anchored in a manner similar to the arrangement to be used in service. A tensile load shall gradually be applied up to 20% of the RTS of OPGW. Displacement transducers shall be installed to measure the relative movement between the OPGW relative to the Reinforcing Rods and Tension Dead – End relative to Reinforcing Rods. In addition, suitable marking shall be made on the OPGW and Dead – End to confirm grip. The load shall be gradually increased at a constant rate up to 50% of the UTS and the position scale of the recorder is zeroed. The load shall then gradually increased up to 95% of the UTS and maintained for one minute. After one minute pause, the load shall be slowly released to zero and the marking examined and measured for any relative movement.

Acceptance Criteria:

- No movement* shall occur between the OPGW and the Reinforcing Rods, or between the Reinforcing Rods and the Dead-End assembly.
- No failure or damage or disturbance to the lay of the Tension Dead – End, Reinforcing Rods or OPGW.

*Definition of no movement as defined in IEC 61284: Any relative movement less than 2 mm is accepted. The possible couplings or elongations produced by the conductor as a result of the test itself are not regarded as slippage.

Any result outside these parameters shall constitute a failure.

(iv) Grounding Clamp and Structure Mounting Clamp Fit Test

For structure mounting clamp, one series of test shall be conducted with two fibre optic cables installed, one series of tests with one fibre optic cable installed in one groove, and one series of tests with one fibre optic cable in the other groove. Each clamp shall be installed including clamping compound as required on the fibre optic cable. The nut shall be tightened on to the bolt by using torque wrench with a torque of 5.5 kgm or supplier's recommended torque and the tightened clamps shall be held for 10 minutes. After the test remove the fibre optic cable and examine all its components for distortion, crushing or breaking. Also the fibre optic cable shall be checked to ensure free movement within the core using dial callipers to measure the diameter of the core tube. The material shall be defined as failed if any visible distortion, crushing, cracking or breaking of the core tube is observed or the fibre optic cable within the core tube is not free to move, or when the diameter of the core tube as measured at any location in the clamped area is more than 0.5 mm larger or smaller of the core diameter as measured outside the clamped area.

(v) Structure Mounting Clamp Strength Test

The clamp and mounting assembly shall be assembled on a vertical 200 mm x 200 mm angle and a short length of fibre optic cable installed. A vertical load of 200 kg shall be applied at the end of the mounting clamp and held for 5 minutes. Subsequently, the load shall be increased to 400 kg and held for 30 seconds. Any visible distortion, slipping or breaking of any component of the mounting clamp or assembly shall constitute failure.

2.6 Type Test on Vibration Damper

(a) Dynamic Characteristic Test

The damper shall be mounted with its clamp tightened with torque recommended by the manufacturer on shaker table capable of simulating sinusoidal vibrations for Critical Aeolian Vibration frequency band ranging from $0.18/d$ to $1.4/d$ – Where d is the OPGW cable diameter in meters. The damper assembly shall be vibrated vertically with a ± 1 mm amplitude from 5 to 15

Hz frequency and beyond 15 Hz at 0.5 mm to determine following characteristics with the help of suitable recording instruments.

- (i) Force Vs frequency
- (ii) Phase angle Vs frequency
- (iii) Power dissipation Vs frequency

The force Vs frequency curve shall not show steep peaks at resonance frequencies and deep troughs between the resonance frequencies. The resonance frequencies shall be suitably spread within the Aeolian vibration frequency-band between the lower and upper dangerous frequency limits determined by the vibration analysis of fibre optic cable without dampers.

Acceptance criteria for vibration damper:

- (i) The above dynamic characteristics test on five damper shall be conducted.
- (ii) The mean reactance and phase angle Vs frequency curves shall be drawn with the criteria of best fit method.
- (iii) The above mean reactance response curve should lie within following limits:
 $V.D. \text{ for OPGW} - 0.060 f \text{ to } 0.357 f \text{ kgf/mm}^*$
Where f is frequency in Hz.
- (iv) The above mean phase angle response curve shall be between 25° to 130° within the frequency range of interest.
- (v) If any above curve lies within the envelope, the damper design shall be considered to have successfully met the requirement.
- (vi) Visual resonance frequencies of each mass of damper is to be recorded and to be compared with the guaranteed values.

(b) Vibration Analysis

The vibration analysis of the fibre optic cable shall be done with and without damper installed on the span. The vibration analysis shall be done on a digital computer using energy balance approach. The following parameters shall be taken into account for the purpose of analysis.

- (i) The analysis shall be done for single fibre optic cable without armour rods. The tension shall be taken as 25% of RTS of fibre optic cable for a span ranging from 100 m to 1100 m.
- (ii) The self damping factor and flexural stiffness (EI) for fibre optic cable shall be calculated on the basis of experimental results. The details to experimental analysis with these data shall be furnished.
- (iii) The power dissipation curve obtained from damper characteristics test shall be used for analysis with damper.
- (iv) Examine the Aeolian Vibration level of the fibre optic cable with and without vibration damper installed at the recommended location or wind velocity ranging from 0 to 30 Km per hour, predicting amplitude, frequency and vibration energy input.
- (v) From vibration analysis of fibre optic cable without damper, antinode vibration amplitude and dynamic strain levels at clamped span extremities as well as antinodes shall be examined and thus lower and upper dangerous frequency limits between which the Aeolian vibration levels exceed the specified limits shall be determined.
- (vi) From vibration analysis of fibre optic cable with damper(s) installed at the recommended location, the dynamic strain level at the clamped span extremities,

damper attachment point and the antinodes on the fibre optic cable shall be determined. In addition to above damper clamp vibration amplitude and antinodes vibration amplitudes shall also be examined.

The dynamic strain levels at damper attachment point, clamped span extremities and antinodes shall not exceed the specified limits. The damper clamp vibration amplitude shall not be more than that of the specified fatigue limits.

(c) Fatigue Tests

(i) Test Set Up

The fatigue tests shall be conducted on a laboratory set up with a minimum effective span length of 30m. The fibre optic cable shall be tensioned at 25% of RTS of fibre optic cable and shall not be equipped with protective armour rods at any point.

Constant tension shall be maintained within the span by means of level arm arrangement. After the fibre optic cable has been tensioned, clamps shall be installed to support the fibre optic cable at both ends and thus influence of connecting hardware fittings are eliminated from the free span. The clamps shall not be used for holding the tension on the fibre optic cable. There shall be no loose parts, such as suspension clamps, U bolts, on the test span supported between clamps mentioned above. The span shall be equipped with vibration inducing equipment suitable for producing steady standing vibration. The inducing equipment shall have facilities for step less speed control as well as step less amplitude arrangement. Equipment shall be available for measuring the frequency, cumulative number of cycles and amplitude of vibration at any point along the span.

(ii) Fatigue Test

The vibration damper shall be installed on the test span with the manufacturer's specified tightening torque. It shall be ensured that the damper shall be kept minimum three loops away from the shaker to eliminate stray signals influencing damper movement.

The damper shall be vibrated at the highest resonant frequency of each damper mass. For dampers involving torsional resonant frequencies, tests shall be done at torsional modes also in addition to the highest resonant frequencies at vertical modes. The resonance frequency shall be identified as the frequency at which each damper mass vibrates with the maximum amplitude on itself. The amplitude of vibration of the damper clamp shall be maintained not less than $\pm 25/f$ mm where f is the frequency in Hz.

The test shall be conducted for minimum ten million cycles at each resonant frequency mentioned above. During the test, if resonance shift is observed, the test frequency shall be tuned to the new resonant frequency.

The clamp slip test as mentioned herein shall be repeated after fatigue tests without retorquing or adjusting the damper clamp, and the clamp shall withstand a minimum load equal to 80% of the slip strength for a minimum duration of one minute.

After the above tests, the damper shall be removed from fibre optic cable and subjected to dynamic characteristics test. There shall not be any major deterioration in the characteristics of the damper. The damper then shall be cut open and inspected. There shall not be any broken, loose, or damaged part. There shall not be significant deterioration or wear of the damper. The fibre optic cable under clamp shall also be free from any damage.

For purpose of acceptance, the following criteria shall be applied:

- (1) There shall not be any resonant frequency shift before and after the test by more than $\pm 20\%$
- (2) The power dissipation of the damper before and after test at the individual resonant frequencies do not differ by more than $\pm 20\%$

Beside above tests, the type tests listed below in the table shall also be conducted on vibration damper.

S.No.	Test Name	Test Procedure
1	Visual examination & Dimensional and material verification	IEC 61897 Clause 7.1 & 7.2
2	Clamp Slip test	IEC 61897 Clause 7.5
3	Clamp bolt tightening test	IEC 61897 Clause 7.7
4	Attachments of weights to messenger cable	IEC 61897 Clause 7.8
5	Attachment of clamps to messenger cable	IEC 61897 Clause 7.8
6	Damper effectiveness evaluation	IEC 61897 Clause 7.11.3.2

2.7 Type Tests for Splice Enclosures (Joint Box)

Following type tests shall be demonstrated on the splice enclosure(s) (Splice Enclosure/Box). For certain tests, lengths of the fibre optic cable shall be installed in the splice box, and the fibres must be spliced and looped in order to simulate conditions of use. The attenuation of the fibres shall be measured, during certain tests, by relevant fibre optic test procedures (EIA/TIA 455 or IEC 60794-1 procedures).

(i) Temperature Cycling Test

FO cable is installed in the splice enclosure and optical fibres spliced and looped. The box must be subjected to 5 cycles of temperature variations of -40°C to + 65 °C with a dwell time of at least 2 hours on each extreme.

Fibre loop attenuation shall be measured in accordance with EIA 455-20/IEC 60794-1-C10. The variation in attenuation shall be less than $\pm 0.05\text{dB}$. The final humidity level, inside the box, shall not exceed the initial level, at the closing of the box.

(ii) Humid Heat test

The sealed splice enclosure, with fibres spliced and looped inside, must be subjected to a temperature of $+55\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ with a relative humidity rate of between 90% and 95% for 5 days. The attenuation variation of the fibres during the duration of the test shall be less than $\pm 0.05\text{dB}$, and the internal humidity rate measured, less than 2%.

(iii) Rain Withstand Test/Water Immersion test

The splice enclosure with optical fibres cable installed and fibres spliced fixed, shall be subjected to 24 hours of simulated rain in accordance with IEC 60060 testing requirements. No water seepage or moisture shall be detected in the splice enclosure. The attenuation variation of the fibres after the test shall be less than $\pm 0.05\text{dB}$.

(iv) Vibration Test

The splice enclosure, with fibres united inside, shall be subjected to vibrations on two axes with a frequency scanning of 5 to 50 Hz. The amplitude of the vibrations shall be constant at 0.450mm, peak to peak, for 2 hours, for each of the vibrations' axes. The variation in attenuation, of the fibres, shall be less than $\pm 0.05\text{dB}$. The splice enclosure shall be examined for any defects or deformation. There shall be no loosening or visible damage of the FO cable at the entry point.

(v) Bending and Torsion test

The splice enclosure, with fibres spliced inside, shall be firmly held in place and be subjected to the following sequence of mechanical stresses on the cable:

- a) 3 torsion cycles of $\pm 180^\circ$ shall be exercised on the cable. Each cycle shall be less than one minute.
- b) 3 flexure cycles of the cable, of $\pm 180^\circ$ with one cycle less than one minute.

The variation in the attenuation, of the fibres, shall be less than $\pm 0.05\text{dB}$. The cables connection ring shall remain securely fixed to the box with the connection maintained firmly. No defects/fissures shall be noted on the joint ring or on the splice enclosure.

(vi) Tensile test

The splice enclosure with cable fixed to the boxes shall be subjected to a minimum tension of 448 N for a period of two minutes. No fissure shall be noted in the connections or on the box.

(vii) Drop test

With 2 lengths of 11 metres of cable fixed to the box, it shall be dropped five times from a height of 10 metres. There shall be no fissure, at all, of the box, and the connections shall remain tight. The test surface shall be carried out in accordance with IEC 60068-2-32.

2.8 Factory Acceptance Tests

Factory acceptance tests shall be conducted on randomly selected final assemblies of all equipment to be supplied. Factory acceptance testing shall be carried out on OPGW cable and associated hardware & fittings, Joint box.

Material shall not be shipped to the employer until required factory tests are completed satisfactorily, all variances are resolved, full test documentation has been delivered to the employer, and the employer has issued material inspection & clearance certificate (MICC). Successful completion of the factory tests and the employer approval to ship shall in no way constitute final acceptance of the system or any portion thereof. These tests shall be carried out in the presence of the employer's authorized representatives unless waiver for witnessing by employer's representatives is intimated to the contractor.

Factory acceptance tests shall not proceed without the prior delivery to and approval of all test documentation by the employer.

The factory acceptance test shall demonstrate the technical characteristics of the equipment in relation to this specifications and approved drawings and documents. List of factory acceptance tests for fibre optic transmission system. Termination equipment Sub-system, NMS are given in specified tables in this section. This list of factory acceptance tests shall be supplemented by the contractor's standard FAT testing program The factory acceptance tests for the other items shall be proposed by the contractor in accordance with technical specifications and contractor's (including Sub-Contractor's/supplier's) standard FAT testing program. In general the FAT for other items shall include at least: Physical verification, demonstration of technical characteristics, various operational modes, functional interfaces, alarms and diagnostics etc.

For Test equipment & clock, FAT shall include supply of proper calibration certificates, demonstration of satisfactory performance, evidence of correct equipment configuration and manufacturer's final inspection certificate/report.

2.9 Sampling for FAT

From each batch of equipment presented by the contractor for factory acceptance testing, the employer shall select random sample(s) to be tested for acceptance. Unless otherwise agreed, all required FAT tests in the approved FAT procedures, shall be performed on all samples. The sampling rate for the factory acceptance tests shall be minimum 10% of the batch size (minimum 1) for all items. The physical verification shall be carried out on 100% of the offered quantities as per the approved FAT procedure. In case any of the selected samples fail, the failed sample is rejected and additional 20% samples shall be selected randomly and tested. In case any sample from the additional 20% also fails the entire batch may be rejected. In case a number of equipments are required for demonstration of the performance of any equipment during FAT, the sample size shall be taken as that number of equipments which are necessary to demonstrate the performance, irrespective of the percentage.

For the OPGW cable hardware fittings & accessories, the minimum sampling rate, and batch acceptance criteria shall be as defined in IS 2486.

The sampling rate for the factory acceptance tests shall be 10% of the batch size (minimum 2) for FO cable drums, FODPs Joint box and other similar items.

Since FAT testing provides a measure of assurance that the quality control objectives are being met during all phases of production, the employer reserves the right to require the contractor to investigate and report on the cause of FAT failures and to suspend further testing/approvals until such a report is made and remedial actions taken, as applicable.

Production testing shall mean those test which are to be carried out during the process of production by the contractor to ensure the desired quality of end product to be supplied by him. The production tests to be carried out at each stage of production shall be based on the contractor's standard quality assurance procedures. The production tests to be carried out shall be listed in the Manufacturing Quality Plan (MQP), along with information such as sampling frequency, applicable standards, acceptance criteria etc.

The production tests would normally not be witnessed by the employer. However, the employer reserves the right to do so or inspect the production testing records in accordance with inspection rights specified for this contract.

3.0 Factory Acceptance Tests on Optical fibre to be supplied with OPGW

The factory acceptance tests listed in table below are applicable for the Optic fibres to be supplied. The listed tests follow testing requirements set forth in IEEE standard 1138, 1994 section 4.2.2.1 and section 5.2.2.1. The referenced sections specify the detailed test description. The acceptance norm shall be as specified in the above mentioned IEEE standards unless specified otherwise in the technical specifications.

Table 3.1 Factory Acceptance Tests for Optical Fibres: Optical Tests

Sl.No.	Test Name	Acceptance Criteria	Test procedure
1	Attenuation Coefficient	Table 1-1 (a)	EIA/TIA 455-78A
2	Point Discontinuities of attenuation	Section 1.1.1.2	EIA/TIA 455-59
3	Attenuation at Water Peak	Table 1-1 (a)	EIA/TIA 455-78A
4	Chromatic Dispersion		EIA/TIA 455-168A/169A/175A
5	Core-Clad Concentricity Error		EIA/TIA 455-176
6	Cladding diameter		EIA/TIA 455-176
7	Fibre Tensile proof testing		EIA/TIA 455-31B
- End of table -			

The test report for the above tests for the fibers carried out by the fiber manufacturer and used in the OPGW cables shall be shown to the inspector during OPGW cable FAT and shall be submitted along with the OPGW cable FAT report.

3.1 Factory Acceptance Test on OPGW cable

The factory acceptance tests for OPGW cable specified below in table follow the requirements set forth in IEEE standard 1138/IEC 60794. The FAT shall be carried out on 10% of offered drums in each lot as specified in technical specifications and the optical tests shall be carried out in all fibres of the selected sample drums. The Rated Tensile strength test shall be carried out on one sample in each lot.

Table 3.2

Factory Acceptance Tests on OPGW Applicable standard: IEEE 1138/IEC 60794

Sl.No.	Factory Acceptance Test on Manufactured OPGW
1	Attenuation Co-efficient at 1310 nm and 1550 nm
2	Point discontinuities of attenuation
3	Visual Material verification and dimensional checks as per approved DRS/Drawings
4	Rate Tensile Strength
5	Lay Length Measurements

2.2 Factory Acceptance Test on OPGW Fittings

The factory acceptance tests for OPGW fittings as specified below in Table 3.3. The sampling plan shall be as per relevant standard:

Table 3.3

Factory Acceptance Tests on OPGW Fittings

Sl.No.	Factory Acceptance Test
Suspension Assembly	
1	UTS/Mechanical Strength of the assembly
2	Clamp Slip Test
3	Visual Material verification and dimensional checks as per approved DRS/Drawings
4	Mechanical Strength of each component
5	Galvanising test
Tension Assembly	
6	Clamp Slip Strength Test
7	Visual Material verification and dimensional checks as per approved DRS/Drawings
8	Mechanical Strength of each component
9	Galvanising test
Vibration Damper	
10	Galvanising test on damper, masses and messenger wires
11	Damper response (resonant frequencies)
12	Clamp Slip test
13	Strength of messenger wires
14	Attachments of weights to messenger cable
15	Attachments of clamps to messenger cable

16	Clamp bolt tightening test
17	Clamp bolt torque test
18	Dynamic characteristic test
19	Visual Material verification and dimensional checks as per approved DRS/Drawings
Structure Mounting Clamp	
20	Clamp fit test
21	Clamp Strength Test
22	Visual Material verification and dimensional checks as per approved DRS/Drawings
- End of Table -	

2.3 Factory Acceptance Test on Splice Enclosure (Joint Box)/FODP

The factory acceptance tests for Splice Enclosures/FODP as specified below in Table:

Table 3.4

Factory Acceptance Tests on Splice Enclosures (Joint Box)/FODP	
Sl.No.	Factory Acceptance Tests
1.	Visual check of quantities and specific component number for each component of splice enclosure/FODP and dimensional checks against the approved drawings

3.4 Factory Acceptance Tests on test equipment, Pigtail & other items

As per technical specification and approved DRS/Documents.

3.5 Site Acceptance Tests

The contractor shall be responsible for the submission of all equipment & test equipment supplied in this contract for site tests and inspection as required by the employer. All equipment shall be tested on site under the conditions in which it will normally operate.

The tests shall be exhaustive and shall demonstrate that the overall performance of the contract works satisfies every requirement specified. At a minimum Site Acceptance Testing requirement for FO cable is outlined in following section. This testing shall be supplemented by the contractor’s standard installation testing program, which shall be in accordance with his quality plan(s) for FO equipment installation.

During the course of installation, the Employer shall have full access for inspection and verification of the progress of the work and for checking workmanship and accuracy, as maybe required. On completion of the work prior to commissioning, all equipment shall be tested to the satisfaction of the employer to demonstrate that it is entirely suitable for commercial operation.

3.6 Minimum Site Acceptance Testing Requirement for FO Cabling

Prior to installation, every spooled fibre optic cable segment shall be tested for compliance with the pre-shipment data previously received from the manufacturer. This requirement will preclude the installation of out of specification cable segments that may have been damaged during shipment.

3.7 Phase of Site Acceptance Testing

SAT shall be carried out link from FODP to FODP. SAT may be performed in parts in case of long links.

The tests, checks, adjustments etc conducted by the contractor prior to offering the equipment for SAT shall be called Pre-SAT activities. The Pre-SAT activities shall be described in the installation manuals and field quality plan documents.

Sag and tension of OPGW shall generally be as per approved sag-tension chart and during installation, sag and tension of OPGW shall be documented. Upon completion of a continuous cable patch, all fibres within the cable patch shall be demonstrated for acceptance of the cable path. Fibre Optic cable site testing minimum requirements are provided in Table 3.5 through 3.6 below:

Table 3.5

Fibre Optic cable Pre-Installation Testing

Item	Description
1	Physical Inspection of the cable assembly for damage
2	Optical fibre continuity and fibre attenuation with OTDR at 1550 nm
3	Fibre optic cable length measurement using OTDR

Table 3.6

Fibre Optic Cable Splicing Testing

Item	Description
1	Pre splice bi-directional average attenuation with OTDR
2	Physical inspection of splice box/enclosure for proper fibre/cable routing techniques
3	Physical inspection of sealing techniques, weatherproofing, etc.

Table 3.7

Fibre Optic Cable Commissioning Testing

Item	Description
1	End to End (FODP to FODP) bi-directional average attenuation of each fibre at 1310 nm and 1550 nm by OTDR
2	End to End (FODP to FODP) bi-directional average attenuation of each fibre at 1310 nm and 1550 nm by Power meter.
3	Bi-directional average splice loss by OTDR of each splice as well as for all splices in the link (including at FODP also)
4	Proper termination and labeling of fibres & fibre optic cables at FODP as per approved labeling plan.
- End of Table -	

4. TECHNICAL PARAMETERS of OPGW

Sl.No.	Description	Tech. Particulars
1	Make & Model	
2	No. of Fibres in OPGW	48
3	Mode	DW-SM
4	Buffer type	Loose
5	Buffer tube diameter	2.2 mm
6	Buffer tube material	PBT(Polybutylene Terephthalate)
7	No. of buffer tubes	4
8	No. of fibres per tube	12
9	Identifiaction/numbering of individual tubes	Red, green blue and natural
10	No. of empty tubes(if any)	1
11	Filling material	moisture proof & Hydrozen adherent jelly
12	Strength members	1 (FRP and ACS)
13	Binding yarn/tape	Tapes
14	10%Aluminium clad steel wire(Diameter & number)	2.45 mm & 13 Nos.
15	Aluminium tube diameter	6.2 mm
16	Approximate outside diameter	7.9 mm
17	Cable diameter	12.80mm +/- 0.15mm
18	Cable cross section area	113 mm ²
19	Min. Breaking load /Ultimate Tensile Strength	84.00 k N
20	Fibre Strain margin	0.6%
21	Weight	490 kgs / km +/- 10kg
22	Crush strength	1000 kg with a 10 cm ² piste
23	Modulus of Elasticity	137.1 kN / mm ²
24	Minimum bending radius	200 mm (Operation)
25	Maximum bending radius	Short term 300 mm(Installation) long term 400 mm
26	Permissible CTS Tensile stress	0.669 k N / mm ²
27	Coeffieicint of inner expansion	15.3 X 10 ⁻⁶ Per °C
28	Coefficient of expansion	6.3 X 10 ⁻⁶ Per °C
	Cladding	
	Core	
29	Nominal operating temperature range	- 10 °C to 70 °C
30	SC current transient peak temperature	41 KA
31	Maximum allowable temperature for lightning strike	200

32	Available length of cable per drum: Min	1000 mtrs.
	Max	5000 mtrs.
33	Splice loss(Max. & Min. allowable)	0.05 dB, 0.01dB
34	Operating Temperature range -	- 10 °C to 70 °C
35	Expected Cable Life	40years
36	Fibre production method	
37	Core diameter	9.2 +/- 0.5 µm
38	Core non circularity	
39	Cladding diameter	125 +/-0.5 µm
40	Core Clad Concentricity Error	< 1µm
41	Cladding noncircularity	< 2 %
42	Protective coating type & material Primary Secondary	Acrylate PBT
43	Coating concentricity	> 70%
44	Colour coding scheme compliant with EIA395A/IEC3047	Yes
45	Attenuation Coefficient @1310nm -	.36 d B /km
	@1550nm -	.22 d B /km
46	Attenuation variation With Wavelength(+/-5nm Temperature-	0.05 d B /km 0.05d B /km
47	Mode field non Circularity -	< 2%
48	Chromatic Dispersion	
	At 1310 nm	2.8 ps/ (nm.km)
	At 1550 nm	18 ps/ (nm.km)

13. TECHNICAL SPECIFICATIONS FOR EARTH TESTER

- 1) The Digital Earth Tester is required for the measurement Resistance of Earth in difficult situations, where noise is present in the earth, Measurement of Earth Resistance for large complex earthing systems, Accurate measurement of Earth Resistance in sub-station site where variation of soil resistivity values will be large.
- 2) The instrument should provide all the functions required for ground system testing: variable frequency, 2 pole, 3 pole, 4 pole, leakage current and ground noise voltage measurement.
- 3) The instrument should be micro processor controlled, flexible and user friendly with rechargeable battery operation with built in voltmeter to measure the ground voltage.
- 4) The instrument should be capable of rejecting noise voltage of 40 V peak to peak and the user can select different test frequencies to minimise the effect of interference and accurate testing in noisy environments.
- 5) Mounted in a robust case and provided with hammer & 4 GI spikes and 50M long cable on a cable winder. Having following features:
 - a. Earth resistance : 0.01 ohm-~~20~~10K Ohms (Auto ranging) with ~~1~~ 10m ohm resolution. (as given is specific to vendor)
 - b. Accuracy : $\pm$ ~~0.5%~~ 3 of reading $\pm$ 2 digits.
 - c. Test frequency : ~~105-160~~ 125Hz in 0.5 Hz steps (as given is specific to vendor and 125hz is more than sufficient)
 - d. Test current : ~~50~~ 20mA (as given is specific to vendor and 20mA is more than sufficient)
 - e. Max output voltage: ~~<50~~ 40V (RMS) (as given is specific to vendor and 40V is more than sufficient)
 - f. Max. Interference : 40V peak to peak (50 Hz)
 - g. Display : 3½ digit Alpha numeric LCD with backlit.
 - h. Operation : Rechargeable LR6 NiMh battery
 - i. Standard : Should comply with KEMA K85B EN61557, VDE 0413 part 7.
 - j. Safety standard : IEC 1010-1 100V CAT-IV & EMC in accordance with IEC61326
 - k. Environmental Protection : IP54
 - l. Operating Temp : 10-55degC, 0-90%RH non condensing.
- 6) Instrument should automatically check and indicate the status on the display (backlit):
 - a. The noise interference in the soil passing the test current is excessive.
 - b. The current spike resistance is too high
 - c. The potential spike resistance is too high.
 - d. The battery status Indication
- 7) Should be supplied complete with leads (50 meters), spikes, hammer.

Bidder should give specification wise compliance statement in their bid

14. Technical Specification For Off-Line Over Head Transmission Line Fault Locator And Line Signature Analyzer

1) **SCOPE:** This specification covers design, manufacture, assembly, testing at site, manufacturer's works, packing for transport, delivery F.O.R destination. Installation, demonstration and training at site of microprocessor based Off-line Overhead Transmission line fault locator and line signature Analyser system at FADS anywhere in Telangana. The microprocessor based off-line overhead transmission line fault locator system should be capable of locating and detecting accurately the faults on overhead EHT Transmission lines such as (a) Open Circuit (b) Phase to Earth (c) Phase to Phase (d) Three Phase to Earth faults (e) faults like decapping of insulators, snapping of conductor, flash over of discs, falling of tree branches on the lines, high resistance faults etc.,

The line Signature Analyser system should be capable of identifying in homogeneities present on EHT lines up to 800 kV single, double and multi circuit lines in 100 meters steps and also grade the in homogeneities present in the line based on the severity level of the in homogeneity.

2) **CONSTRUCTION:** The equipment should be robust in construction, facilitate easy operation and should withstand the tropical humid climate and severe seasonal variations. The construction should be suitable for use of indoors as well as outdoors.

3) **GENERAL:** The construction and manufacture of equipment should be mechanically sound and suitable for their grade and purpose. Robustness of construction and performance are the primary consideration and the instruments must be suitable for rough handling during transport to various substation sites by lorry or pick-up van.

4) **DESIGN FEATURES:** The equipment shall be microprocessor based and operate by sending a pulse of high voltage, frequency and duration on the overhead power transmission line to be tested so as to overcome all extraneous noise present on the line and detects the reflected pulse from a discontinuity or change of impedance in the line and the result of detection shall be indicated automatically in kilometers on digital display with a resolution of +/- 100 meters precisely indicating the type of fault. The equipment should be suitable for use on dead HT/EHT lines up to 800 kV single, double or multi- circuit lines. The equipment should also have facility for locating faults on spur lines.

5) **ACCURACY:** The equipment shall be accurate to +/- 100 meters over the entire range of operation and also to overcome, the impact of the following factors on the final result:

- i. Long/Short line.
- ii. Parallel lines (mutual coupling)
- iii. Environmental disturbances

6) **RANGE OF OPERATION:** The equipment should have a minimum range of 1000 km and any fault (open circuit and short circuit) within the range must be displayed.

7) **CALIBRATION:** The calibration of instrument shall be stable over long periods of time without requiring calibration checks and adjustments. The tender should also include a line simulator, electrically equivalent to a suitable length of overhead transmission line, to simulate the indications obtained upon an actual overhead line, both for open and short circuit faults for testing purposes.

8) **LITERATURE:** The tender should be accompanied by full descriptive literature and photographs of the equipment offered, indicating the general layout and circuitry. Any offer not accompanied by the detailed literature will be rejected. In case an order is placed, each equipment should be accompanied with at least 6 manuals showing the drawings and other literature relating to O&M of the equipment.

Any other information & latest features incorporated that is useful for proper functioning of the equipment, which are not specified herein, may be indicated in the offer.

9) **SAMPLES:** If considered necessary, the tenderer should be willing to offer a sample for testing.

10) **FIELD DEMONSTRATION:** If necessary, field demonstration of the off-line overhead transmission line fault locator and line Signature Analyser system may have to be arranged before finalization of tenders.

11) **GUARANTEED TECHNICAL PARTICULARS:** The guaranteed technical particulars in respect of the equipment offered, should be furnished with the tender in a typical form as per schedule-A, in addition to any other technical information which the tenderer intends to furnish and which highlights the performance of the equipment offered. The tenderer should also furnish para-wise comments against each para of the general conditions of the technical specification. The tenderer is free to evolve his own design of the equipment. However, the final choice of accepting any deviations from the above specifications rests with TSTRANSCO.

12) **TRAINING:** The equipment shall be demonstrated for all the specifications at the user site after delivery and the user personnel should be trained for use of the equipment at site on intimation by the field officers after its drawal from the stores and transport to the site.

13) **SERVICE GUARANTEE PERIOD:** The equipment should be designed with the latest state of art technique and shall be serviceable for a minimum period of 5 years and the manufacturer shall be give guarantee of maintenance for a minimum period of 5 years.

14) **SAFETY OF OPERATING PERSONNEL:** The equipment should be safe for operation as it is to be connected on highly induced power lines.

15) **DRAWINGS:** Drawings along with any other literature should be sent with the tender indicating the general layout and circuitry. In case an order is placed, each fault locator should be accompanied with at least six manuals showing the drawings and other literature particulars relating to operation and maintenance.

16) **TESTING, INSPECTION & INSTALLATION:** The supplier should submit factory test results with the equipment. TSTRANSCO reserves its right to carryout any test or inspection, if so warranted in overall interest of TSTRANSCO. The relevant test certificates in respect of satisfactory performance of various components shall be furnished with the tender.

17) Technical features should be as follows:

Sl.No.	Description	Particulars
1.	Range Of Operation (In Kilometers)	1000 kM
2.	Accuracy and resolution	±100 meters & resolution of 100 meters
3.	Voltage range of eht lines	66kV to 800 kV AC Transmission lines including spur lines.
4.	Types of faults/inhomogeneities detected	a. All types of open circuit faults. b. All types of phase to phase faults. c. All types of phase to earth faults. d. Three phase to earth faults. e. Faults like decapping of insulators, snapping of conductor, flash over of discs, falling of tree branches on the lines, high resistance faults etc., f. Signature Analyser: It Should provide the information about in homogeneities present on the entire EHT line in steps of 100 meters and grading of in homogeneities based on these verity level.
5.	suppression of induced voltages	In-built mechanism suitable for operation under heavy induction from adjacent live lines
6.	temperature range of operation	-10 to 70 degrees
7.	provision for testing /calibration of equipment	Testing mechanism should be built-in and/or suitable simulator should be provided.
8.	power supply	230 V, 50 Hz AC mains or in built rechargeable batteries.
9.	type of material used for casing	MS
10.	display	Direct digital reading in kilometers
11	TECHNICAL PARTICULARS OF FAULT LOCATOR	
A	ELECTRICAL	
a	Range of detection of fault	1000kms
b	Resolution	100mts
c	Display of Indication	1”4 digit led display
d	Type of Fault Detection	(a) Short fault (b) Open circuit
e	Type of Transmission	Pulse
f	Detection and Ranging	Transmission pulse return echo. Twelve pulse to pulse correlation and detection.
g	Processing Frequency	>1.5 mHz
h	Power Output	>50kw
i	Temperature Range	-10 to 70 degrees
j	Operation	Power supply from battery power pack
12	TECHNICAL PARTICULARS OF ADAPTER UNIT	
a	Range of Operation	66kV to 800kV, auto matching to any of the lines in the aforesaid ratings
13	TECHNICAL PARTICULARS OF SIGNATURE ANALYZER UNIT	
a	ELECTRICAL	
b	Range	1000 kms
c	Types of lines	overhead eht 66kv to 800kv

Sl.No.	Description	Particulars
d	Resolution	50mts
e	Outputs	4 format printouts
f	Display type	static dynamic
g	Control	automatic mode manual mode
h	Display	backlit lcd 240x128 dots
i	Sensitivity	min. 40 db below short or open circuit reflections
j	Dynamic range of display	auto range 24 db manual range: adjustable to 60 db or better with top clipping
k	Display format	individual R,Y,B phase display and also ryb together all individual phase display could be moved towards left in 5km steps & could be stopped in any position.
l	Printer	external 80 col. 9 pin dot matrix

18) Each Over head Transmission Line Fault Analyser system for 66KV to 800KV EHT line comprising of :

A(i). Fault Locator unit: -- 1No.

- With direct reading of LCD digital display, rugged & portable.
- Maximum range : 1000Kms
- Resolution:100Mts
- Capable of locating various types of short circuit & open circuit faults.
- High resolution zoom blanking capability to locate high resistance category faults & faults on Spur lines from the base location itself.
- Heavy Duty twist lock splash proof output connectors.
- Extremely simple operation. Does not require any line parameter input or pre-calibration.

A(ii) 3 Phase Heavy Duty Adapter unit: -- 1No.

- Complete suppression of all induced voltages from adjacent charged lines including double circuit/multi circuit lines.
- Automatic impedance matching for all lines from 132KV to 800KV.
- In built filter module to eliminate HVDC switching noise as well as other RF noise.
- In built transmitter module housing sophisticated oscillator crystals
- Scale indicator reflecting the dynamic state of the transmitter.
- Heavy duty twist lock splash proof connectors for
 - Power supply input
 - Connection to fault locator/Analyser unit
 - Connection to the 3 phases
- This unit to be connected to the isolated & de-energized line after connecting ground to power line ground.

A(iii). Signature Analyser Unit: --1 No.

- Line Vision cum Auto Analyzer unit.
- Auto Mode: Automatic gain selection and Scan.
- Multi sequence auto run-9 self driven independent data acquisition of the 3 phases.
- Automatically noise eliminated & correlated processed data.

- e) Detailed analysis & hard copy documentation of the entire length of the line.
- f) Analysis of every 100 meter of the line with indication of all in homogeneities present and the degree to which they have developed and their corresponding distances.
- g) Multi formats of printout.
- h) Line Vision Mode: Real time graphic image capture of all the three phases of the line condition providing you clear information of the in homogeneities prevalent.
- i) Manual gain setting is provided for visual & detailed observation of all the three phase simultaneously or individually.
- j) Vision Mode operation for detailed line study; Image Freeze, Image Zoom and Display Scroll- desired areas of the line can be brought into close scrutiny up to a range of 400Km. Increased range print out is optional.
- k) Various formats of printout.
- l) Integrated with T-DAM module.
- m) Direct data transfer to Pentium laptop.

B) Line Simulator Unit & Power pack --1No.

- a) Digital Microprocessor controller heavy duty power supply with 12VAAA dry batteries.
- b) Sustained DC power supply for long period.
- c) Both DC & AC mode choice.
- d) Digital Simulator Facility.
- e) Ideal functional check.
- f) Splash proof twist locking connectors.

C) Data management software incorporated & integrated with specially configured Laptop(HP/Compaq/Lenova/Dell/Fujitsu/Toshiba/BenqQ).

- a) Data management software
- b) Color coded display in multiple formats.
- c) Auto intensity level tabulation.
- d) Processed data output.
- e) Raw data output & storage.
- f) Interpretation into 'open' & 'short' categories for the various inhomogeneous points on the line.
- g) Graphically reconstructed color coded format of EHT lines.
- h) Manual review & scroll of line vision.
- i) Edited & noise erased LSA computation.

D) Accessories for each Units:

- a) Laptop(HP/Compaq/Lenova/Dell/Fujitsu/Toshiba/BenqQ) --1No
- b) Latest printer suitable for printing legible & clear
Print outs of line signatures -- 1No.
- c) Five core cable with connecting terminals. -- 2Nos
- d) Flexible cable with crocodile clip. -- 1No.
- e) Instructions manual. -- 1No.
- f) Log book for test data entry. -- 1No.
- g) Printing papers -- (500 sheets)

Bidder should give the compliance statement against above specifications in offer.

15. Technical Specification : Tower Foot Earth Resistance Meter

1	Functional Requirements	a. The instrument should be suitable for measuring earth impedance of tower, without isolating earth wire. b. The test results should be consistence repeatable and immune to electromagnetic interface in live transmission line and substation up to 400kV. c. The instrument should be suitable for 3 and 4 terminal measurement.
2	Operating Frequency	Between 20-40KHz
3	Measurement Range	0.1 to 200Ω, auto ranging type, digital LCD display.
4	Accuracy	±2% of reading
5	Test leads and Accessories	a. One complete set of cables with suitable clamps and connectors as required for earth resistance measurement in transmission lines. b. Earth spikes and hammer to drive spikes. c. Test leads should be wound on durable plastic reel. d. Hard carry case for instrument and accessories. e. Operation manual
6	Power Supply	Rechargeable battery. Charger shall be provided.
7	Operating conditions	Temp : 10-50 deg.C, Humidity : up to 90% non condensing.
8	Protection	Should have protection against short circuit and over voltage
9	Testing Methods	High Frequency and Flexible clamp method
10	Display	Color LCD with Touch screen
11	Internal Memory	More than 500MB to store results for reporting purpose

Justification: Point no. 9,10, 11 are important and basic features of any instrument like methodology to be used , display and internal memory to record, also used in major Transco tender specifications

Bidder should give the compliance statement against above specifications in offer.

ABSTRACT OF TOWERS (Tentative)

Erection of 400 kV MDC Line for making LILO of both the circuits of 400 kV Jaipur - Ramadugu line to 400 kV Switching Station of line length M at Achapur Village Julapally Mandal in Peddapally District for additional 1 TMC works under Aleshwaram Lift Irrigation Project window - 3

Sl. No.	TYPE OF TOWERS	+0 NT	+3 BE	+6 BE	+9 BE	+12 BE	+18 BE	+25 BE	+30 BE	TOTAL
PROPOSED 400KV D/C & MC TOWERS										
1	'DA'	3	0	4	0	0	0	0	0	7
2	'DB'	1	0	0	0	0	0	0	0	1
3	'DC'	2	0	0	0	0	0	0	0	2
4	'DD'	9	0	1	0	0	0	0	0	10
Total =										20
CONTINGENCY QUANTITIES IN VIEW OF ANTICIPATED ROW PROBLEMS										
1	'DA'	1	0	0	0	0	0	0	0	1
2	'DB'	1	0	0	0	0	0	0	0	1
3	'DC'	1	0	0	0	0	0	0	0	1
4	'DD'	1	0	0	0	0	0	0	0	1
Total =										4
Total=										24

TOTAL TOWERS INCL. CONTINGENCIES

1	Tangent Towers incl. contingencies	8	No.s
2	Small Angle Towers incl. contingencies	2	No.s
3	Medium Angle Towers incl. contingencies	3	No.s
4	Large Angle and Dead End Towers incl. contingencies	11	No.s

ABSTRACT OF TOWERS (Tentative)
400 kV MDC line from proposed 400 kV MDC line from proposed 400 kV Switching Station at achapur to 400 kV
Ramadugu - Gajwel DC line of length m for additional 1 TMC works under aleshwaram Lift Irrigation Project wind
one - 3

Sl. No.	TYPE OF TOWERS	+0 NT	+3 BE	+6 BE	+9 BE	+12 BE	+18 BE	+25 BE	+30 BE	TOTAL
PROPOSED 400KV D/C & MC TOWERS										
1	'DA'	9	1	4	0	0	0	0	0	14
2	'DB'	2	0	1	0	0	0	0	0	3
3	'DC'	3	0	0	0	0	0	0	0	3
4	'DD'	5	0	1	0	0	0	1	1	8
Total =										28
CONTINGENCY QUANTITIES IN VIEW OF ANTICIPATED ROW PROBLEMS										
1	'DA'	1	0	0	0	0	0	0	0	1
2	'DB'	1	0	0	0	0	0	0	0	1
3	'DC'	1	0	0	0	0	0	0	0	1
4	'DD'	1	0	0	0	0	0	0	0	1
Total =										4
Total=										32

TOTAL TOWERS INCL. CONTINGENCIES

1	Tangent Towers incl. contingencies	15	No.s
2	Small Angle Towers incl. contingencies	4	No.s
3	Medium Angle Towers incl. contingencies	4	No.s
4	Large Angle and Dead End Towers incl. contingencies	9	No.s

ABSTRACT OF TOWERS (Tentative)

Erection of 400 kV MDC Line for making LILO of both the circuits of 400 kV NTPC - Narasapur line to 400 kV Switching Station of line length 5 M at achapur village Julapally Mandal in Peddapally District for additional 1 TMC works under aleshwaram Lift Irrigation Project wind one - 3										
Sl. No.	TYPE OF TOWERS	+0 NT	+3 BE	+6 BE	+9 BE	+12 BE	+18 BE	+25 BE	+30 BE	TOTAL
PROPOSED 400KV D/C & MC TOWERS										
1	'DA'	2	0	1	0	0	0	0	0	3
2	'DB'	1	0	2	0	0	0	0	0	3
3	'DC'	1	0	0	0	0	0	0	0	1
4	'DD'	2	0	3	0	0	0	4	0	9
Total =										16
CONTINGENCY QUANTITIES IN VIEW OF ANTICIPATED ROW PROBLEMS										
1	'DA'	1	0	0	0	0	0	0	0	1
2	'DB'	1	0	0	0	0	0	0	0	1
3	'DC'	1	0	0	0	0	0	0	0	1
4	'DD'	1	0	0	0	0	0	0	0	1
Total =										4
Total=										20

TOTAL TOWERS INCL. CONTINGENCIES

1	Tangent Towers incl. contingencies	4	No.s
2	Small Angle Towers incl. contingencies	4	No.s
3	Medium Angle Towers incl. contingencies	2	No.s
4	Large Angle and Dead End Towers incl. contingencies	10	No.s

ANNEXURE XXXIV

UNDERTAKING TO BE GIVEN BY THE BIDDER ALONG WITH THE BID:

I/We _____ representing the company responding to the bid invitation by the TSTRANSCO vide specification No. _____ hereby sincerely and solemnly affirm and state as follows:

(Strike out which is not applicable)

- (a) That my self or any of the representatives of my Company /Firm does not have any relatives as deferred in appended Annexure in the TSTRANSCO / DISCOM.
- (b) That the following Officers /employees of the TSTRANSCO / DISCOM are related to me and to my representative of my Company /Firm and their status in the TSTRANSCO / DISCOM is as under:

Sl.No.	Name of the Officer / Employee	Designation and Place of working	TSTRANSCO / DISCOM	Relationship
1				
2				
3				
4				
5				
6				

It is certified that the information furnished above is true to the best of my knowledge and belief. It is hereby undertaken that in the event of any of the above information found to be false or incorrect at a later date, the TSTRANSCO / DISCOM is entitled to terminate the contract agreement entered into besides recovering damages as may be found necessary with due notice.

Signature of the authorized representative/Bidder

Name:
(In block letters)

Seal:

Date:

Contd..2

: 2 :

7.0 The under signed certificates that he has received from Purchaser the following corrigendum/agenda, the contents of which have been taken into consideration while submitting this Bid and has enclosed them as a part of Bid document :

No. ----- Date: -----

No. ----- Date: -----

No. ----- Date: -----

8.0 The undersigned designates ----- with the following address ----- as its local representative to which notices may be delivered or mailed.

(Full Name of Bidder)

(Signature (s) and Official title or
Persons authorized to sign this Bid).

(Business address of Bidder)

ANNEXURE

LIST OF RELATIVES :-

1. Father	14. Daughter's Husband
2. Mother (including Step Mother)	15. Daughter's Son
3. Son (including Step Son)	16. Daughter's Son's Wife
4. Son's Wife	17. Daughter's Daughter
5. Daughter (including Step Daughter)	18. Daughter's Daughter's Husband
6. Father's Father	19. Brother (including Step Brother)
7. Father's Mother	20. Brother's Wife
8. Mother's Mother	21. Sister (including Step Sister)
9. Mother's Father	22. Sister's Husband
10. Son's Son	23. Son's Wife's Father and
11. Son's Son's Wife	24. Son's Wife's Mother their
12. Son's Daughter	25. Daughter's Husband's siblings
13. Son's Daughter's Husband	father
	26. Daughter's Husband's
	Mother

ANNEXURE XXXV

**FORM OF EXTENSION OF BANK GUARANTEE
(ON NON-JUDICIAL STAMP PAPER OF Rs. 100/-)**

Ref. No. _____

Dated: _____

TSTRANSCO
Vidyut Soudha,
Hyderabad, TS., India.

Dear Sirs,

Sub: Extension of Bank Guarantee No. _____ for Rs. _____
favouring yourselves expiring _____ on account of
M/s. _____ in respect of contract No. _____
dated _____ (herein after called original bank guarantee).

At the request of M/s. _____ we _____ bank
Branch office at _____ having its head office at
_____ do hereby extend our liability under the above mentioned
guarantee No. _____ dated _____ for
_____ except as provided above, all other terms and
conditions of the original bank guarantee No. _____ dated
_____ shall remain unaltered and binding.

Please treat this as an integral part of the original guarantee to which it would be
attached.

Yours faithfully

For _____
Manager/Agent/Accountant

Power of Attorney No. _____
Dated _____

SEAL OF BANK

Note: The non-judicial stamp paper of worth Rs. 100/- shall be purchased in the
name of the bank of the bank which has issued the bank guarantee.

ANNEXURE-XXXVI**CERTIFICATE OF EXPERIENCE OF WORK (for INFRA PROJECT)**

1	Name of work							
2	Agreement No. and Year							
3	Location							
	State							
4	Name of the Dept / Utility							
	Address							
5	Contractor Name & Address							
6	Total Contract Value (Rs.)							
7	Details of works executed/Material supplied (Annual Achievement)	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
	a) Supply portion (Rs.)							
	b) Erection portion (Rs.)							
	c) Civil portion (Rs.)							
	Total Financial progress yearwise in Rs.							
8	Period of Completion							
	i) Original Contract period							
	ii) Date of Commencement							
	iii) Actual Date of Completion							

Signature :-

Name of the Bidder :-

Note : The bidder shall enclose the proof of such successful executed/completed and commissioned any infra project obtained from the State Govt/Central Govt/PSU's issued by an officer not below the rank of Superintending Engineer or equivalent cadre.

ANNEXURE –VB (FOR Sub Station and line)

PARTICULARS OF REGISTRATION OF BIDDER/LEAD PARTNER OF J.V/PARTNERS OF J.V

1. Name and address of Company:
2. Please state whether:
 - a) Individual
 - b) Registered Partnership firm
 - c) Unregistered Partnership firm
 - d) Pvt.Ltd., Co.
 - e) Public Ltd., Co.
 - f) Others (please specify)
3. Type:
 - a) Class A, B etc.
 - b) Large/Medium or Small scale Industry
4. Names and full address of partners (in case of partnership firm)
Or Directors (in case of Ltd., Co.)
5. Whether registered under all applicable taxes.
6. Authority of the person signing the contract to represent the company.
7. Furnish a photocopy duly attested of each of the following documents:
 - a) Certificate of Registration from the Registrar of firms.
 - b) Copy of Partnership deed.
 - c) Copy of Memorandum of Articles.
 - d) Copy of registration certificates as per item 5 above.

Date:

Signature:

Place:

Name & Designation:

Seal:

ANNEXURE – IIIB (For SS)

In support of the Qualification Requirements (QR) for bidders, we furnish herewith our QR data/details/documents etc., along with other information, as follows.

1.0 General Information

[The information in this form is to be completed for individual firms and each Partner of a Joint Venture]

Sl. No.	Particulars	For Individual Firm	In case of Joint Venture		
			For Lead Partner	For Other Partner - 1	
1.	Name of the Firm				
2.	Head Office/ Registered Office Address				
3.	Telephone				
4.	Fax				
5.	Contact Person				
6.	Place of Incorporation/ Registration				
7.	Year of Incorporation/ Registration				
8.	Authorized signatory of the bid				
9.	Whether copy of Power of Attorney of the signatory to commit the bidder is attached	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
10.	Details/documentary evidence submitted in support of stated sub-station design infrastructure and erection facilities and capacity and procedures including quality control				

(Necessary documents to establish legal status of the bidder (all the partners in case of Joint Venture) should be enclosed with the bid)

2.0 Technical Requirements

2.1 Technical Experience: (Reference: As per Qualification requirements in Volume-I).

2.2 On a separate page, using the following format, Bidder is requested to furnish the details of the previous experience, on the basis of which the Bidder wishes to qualify, as detailed at Volume-I (qualification requirements). The information is to be summarized using following formats, as applicable, for each previous experience of the Bidder.

Documentary evidence, such as copies of utility certificates etc., in support of its experience shall be attached with the filled-up format for each experience/Contract.

A. Bidder/Associate (Substation and Line Contractor): Substation and Line construction

Format A: Format for the Bidder/Associate/Partner in case of Joint Venture [In case of Joint Venture bidder, the QR data of each of the partner (in support of meeting the requirement of Eligibility Criteria, Part A, NIT of Volume-I of the bidding documents) is also is to furnished, as applicable, using this format.

Name of the Bidder (Single Firm(Bidder or Associate)/Lead partner/other partners of JV)		
A1.	Name of Contract (executed during the last 7 years as on the date of bid opening):	
A2.	Contract Reference No. & Date of Award	
A3.	Name and Address of the Employer/Utility by whom the Contract was awarded e-mail ID _____ Telephone No. _____ Fax No. _____	
A4(i)	Name of sub-station executed under the Contract Voltage level of sub-station	_____ _____ _____
A5(i)	Date of successful execution of the Contract	_____
(ii)	No. of years the above referred substation is in successful operation as on the date of bid opening	_____ years
A6.	Scope of work executed under the above contract	
A7.	Capacity in which the Contract was undertaken (Check One)	☐ Sole Contractor ☐ Sub Contractor ☐ Partner of JV ☐ Lead ☐ Associate (Tick whichever is applicable)
A8.	Details/documentary evidence submitted in support of stated experience/Contract.	
A9.	In case of Associate(Substation Contractor), whether the Joint Deed of Undertaking along with the Associate firm(s) to guarantee timely construction	Yes/No

ANNEXURE –XXVII (For Sub Station and Line)

LIST OF SPANNERS, TOOLS, PLANTS AND APPLIANCES OFFERED BY THE BIDDER TO SUPPLY IN THE CONTRACT.

LIST OF GENERAL TOOLS AND PLANTS

Sl.No.	Description	Specification	Quantity	Remarks
1.	Ring Spanners	6 – 32 (12 Nos.)	2 Sets	
		32 - 36	2 Sets	
		36 – 41	2 Sets	
		41 – 46	2 Sets	
2.	DE Spanners	6 – 32	2 Sets	
		32 – 36	2 Sets	
		36 – 41	2 Sets	
		41 - 46	2 Sets	
3.	Single End	50 mm	2 Sets	
4.	Cutting Plier (Taparia)	6"	2 Sets	
		8"	2 Sets	
5.	Nose Plier (Round)	6"	2 Sets	
6.	Nose Plier (Cone)	6"	2 Sets	
7.	Box Spanner Set with ratchet and handle	6 – 46	2 Sets	
8.	Allen Key Set	1.5 mm to 10 mm	2 Sets	
9.	Screw Driver	150 mm	2 Sets	
		200 mm	2 Sets	
		300 mm	2 Sets	
		500 mm	2 Sets	
10.	Star Screw Driver	861 x 200	2 Sets	
		862 x 200	2 Sets	
		863 x 200	2 Sets	
11.	Hammer	Small (750 g)	2 Sets	
		Medium (1500 g)	2 Sets	
		Big (3 to 5 kg)	2 Sets	
12.	Monkey Plier		2 Sets	
13.	Adjustable Spanner	8"	2 Sets	
		10"	2 Sets	
		12"	2 Sets	
14.	Pipe Wrench	12"	2 Sets	
		14"	2 Sets	
15.	Torque Wrench	300 N	2 Sets	
16.	5 Compartment Tool Box		2 Sets	
17.	Vernear Caliper		1 No.	
18.	Screw guage		1 No.	
19.	Hack Saw Frame		3 Sets	
20.	Hand Drilling Machine		2 Nos.	
21.	Nut Driver (Box Type, Screw Driver)	Size 6, 8, 9, 12	2 Nos. each	

22.	Slings	3T, 5T Cap.		
23.	D Shackles	2T, 3T, 5T Cap.	2 Sets	
24.	Single Sleeve, Double Sleeve Pulleys		2 Sets	
25.	Poly Propylene Ropes	30mm, 25mm, 20mm Size	100 kg each	
26.	Poly Propylene Ropes	10mm size	25 Kg	
27.	Wire Rope	12mm	50 Mtrs.	
28.	Wire Rope	10mm	50 Mtrs.	
29.	Earthing Rods with Copper Hock		9 Nos	
30.	Set of Files	Rough, hard	2 Sets	

Signature of the Bidder

Name:

Seal of Company:

ANNEXURE - XXVIII

**UNDERTAKING TO ADHERE TO THE BAR CHARTS FOR COMPLETION OF
SUPPLIES/ WORKS**

From

To

The Chief Engineer,
Lift Irrigation of Schemes, TSTRANSCO,
Vidyut Soudha, Hyderabad.

Bid Ref:

Spec No.

Item:

Gentlemen:

We, _____ undertake, if our Bid is accepted, to commence and complete the supplies and works of all items of the scope of Bidding documents as per the delivery and completion schedule stipulated for Supply, Civil & construction works, Erection, testing and commissioning of works covered under specification no. e-TSTLI-03/2021 work as per the BAR CHART enclosed to Volume I of bidding documents.

We agree to abide by this Bid for a period of **90 days** from the date fixed for Bid opening

Dated this _____ day of _____ 2021

Signature _____
(in the capacity of)

Duly authorized to sign Bid for and on behalf of _____

SIGNATURE OF
THE BIDDER/ LEAD PARTNER OF J.V
WITH SEAL

Annexure -XXXIII

**STATEMENT OF PROFIT & LOSS ACCOUNT BIDDER/LEAD PARTNER OF
J.V/PARTNER OF J.V**

Sl. No.	Financial year	Contracts Executed	Amount of Turnover (Rs.)	Profit (Rs)	Loss (Rs)	Details of Documents enclosed
1	2020-19					
2	2018-19					
3	2017-18					
4	2016-17					
5	2015-16					

Signature of the Bidder :

Name :

Seal of the Company:

Seal and Stamp of Chartered

BIDDING SCHEDULE : B -7

LIST OF TEST CERTIFICATES

The following are the Type test certificates furnished with the Bid for similar to the equipment and material that are offered in the scope of bidding documents.

Sl. No.	Equipment/Materials Details	Test Certificate Reference	Tests covered under the certificate	Remarks

It is certified that valid type test certificates as per the Standards and specifications in the Bidding documents for all the equipment and material that are in the scope of supply in the Bid are furnished here with.

Company seal:

Signature of the Bidder:

Name:

Designation:

SCHEDULE - IV**Additional 1TMC works of Kaleshwaram Lift Irrigation Scheme****Bid No.e- TSTLI- 03/2021****GUARANTEED TECHNICAL PARTICULARS FOR TOWER AND TOWER ACCESSORIES****(TO BE FILLED IN BY THE BIDDER)**

1	Line Voltage	
2	Number of circuits	
3	Name of Manufacturer and country of origin	
	i) Steel	
	ii) Bolts, nuts and washers	
	iii) Tower accessories	
4	Name and adress of	
	i) Tower fabricator	
	ii) Galvaniser	
5.1	Standard specifications according to which the quality of steel for the sections will conform	
5.2	Standard to which fabrication, galvanising etc. will conform	
5.3	Minimum sheared edge distance (mm)	
5.4	Minimum rolled edge distance (mm)	
5.5	Quality of zinc used for galvanising (Purity) %	
5.6	Standard to which the bolts and nuts will conform	

SIGNATURE
(AUTHORISED ATTORNEY)

Place:

NAME:

DESIGNATION:

Dated:

COMPANY SEAL:

SCHEDULE – D

Specification No. e- TSTLI-03/2021

TIME SCHEDULE FOR EXECUTION OF WORK

Name of work :

Supply, Civil & Construction works, Erection, Testing and Commissioning of 400 KV Switching Station (including supply of 2 Nos Reactors) on turnkey basis under Additional 1 TMC works of Kaleshwaram Lift Irrigation Scheme in Karimnagar (old) district :

The supply of materials and equipment for the above work shall be completed within **Fifteen (15)** months from the date of handing over of site and Erection, Testing & Commissioning of above mentioned work within **Eighteen (18)** months from the date of handing over of site.

Name of work :

Supply, Civil & Construction works, Erection, Testing and Commissioning of i) LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS to Kachapur Switching Station -line Length 2 X 3.5 KM in Karimnagar (old) district.(ii) LILO of 400kV QMDC Line from Telangana STPP NTPC (2x800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district.(iii) 400kV QMDC Line from 400kV Kachapur(Vadkapur)Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district on turnkey basis under Additional 1 TMC works of Kaleshwaram Lift Irrigation Scheme in Karimnagar (old) district:

The supply of materials and equipment for the above work shall be completed within **Twelve (12)** months from the date of handing over of profiles and Erection, Testing & Commissioning of above mentioned work within **Fifteen (15)** months from the date of handing over of profiles

I / We agree to the above mentioned completion period.

SIGNATURE OF THE BIDDER WITH DATE AND SEAL

List of Schedules & Annexures required from JV partner (For TL)for
TSTRANSCO Projects

1. Schedule-II: Schedule of plant/Machinery available with the tenderer for use in the manufacture of towers and erection, testing and commissioning of 400kV Transmission lines.
2. Schedule-III: DETAILS OF TENSION STRINGING EQUIPMENT THAT IS OWNED/ HIRED BY THE BIDDER
3. Schedule-IV: GUARANTEED TECHNICAL PARTICULARS FOR TOWER AND TOWER ACCESSORIES
4. Schedule-C: Summary of Prices
5. Schedule-D: time schedule for execution of work
6. **SCHEDULE : B-1: DEVIATIONS TO GENERAL AND COMMERCIAL TERMS & CONDITIONS**
7. **SCHEDULE : B-2: DEVIATIONS TO Technical TERMS & CONDITIONS**
8. **SCHEDULE : B-3: Delivery & Completion period**
9. **SCHEDULE : B-4: List of manufacturers & suppliers**
10. **SCHEDULE : B-6: List of Drawings**
11. **SCHEDULE : B-7: List of test Certificate**
12. Annexure-I- Commercial confirmation
13. Annexure-II: Deviation to general Technical T&Cs
14. Annexure-III A: Manufacturing Capacity & Experience wrt TL
15. ANNEXURE – IIIB: General Information and Technical Qualification requirement data
16. Annexure-IV A: DETAILS OF ERECTION OF 400kV AND ABOVE VOLTAGE LINES in last 7 years
17. Annexure-V A: DETAILS OF 400kV LINE CONTRACTS EXECUTED BY THE BIDDER DURING THE LAST SEVEN (7) YEARS TO MEET THE QUALIFYING REQUIREMENTS
18. ANNEXURE –VB (FOR Sub Station and line)PARTICULARS OF REGISTRATION OF BIDDER/LEAD PARTNER OF J.V/PARTNERS OF J.V
19. Annexure-VII: Bid Form
20. Annexure-VIII: Bid security (for respective portion)
21. Annexure-Xi: Letter of Transmittal
22. Annexure-XII: Manufacturer's Authorization(for relevant part)
23. Annexure-XIII: JOINT DEED OF UNDERTAKING BY THE TOWER MANUFACTURER ALONGWITH THE BIDDER/CONTRACTOR(on Rs 100 stamp paper).
24. Annexure-XIV: Power of Attorney for JV(on Rs 100 stamp paper).
25. Annexure-XV: bank Certificate
26. Annexure- XVI: JOINT VENTURE AGREEMENT
27. ANNEXURE –XXVII (For Sub Station and Line) LIST OF SPANNERS, TOOLS, PLANTS AND APPLIANCES OFFERED BY THE BIDDER TO SUPPLY IN THE CONTRACT.
28. Annexure- XiX: Litigation History
29. Annexure-XX: UNDERTAKING TO BE GIVEN BY THE BIDDER / BOTH THE PARTNERS in case of JV
30. ANNEXURE - XXI: bank Acc details
31. ANNEXURE - XXII: Certification by Bidder

32. Annexure-XXIII: STATEMENT OF FINANCIAL TURNOVER OF BIDDER/LEAD PARTNER OF J.V/PARTNER OF J.V
33. Annexure-XXIV: DETAILS OF PERFORMANCE & TAKEN OVER CERTIFICATES ENCLOSED
34. Annexure-XXV: DETAILS OF OTHER WORKS TENDERED FOR AND ON HAND AS ON THE DATE OF SUBMISSION OF THIS BID
35. Annexure-XXVI: DETAILS OF THE TECHNICAL PERSONNEL IN THE ORGANISATION OF THE BIDDER TO BE ENTRUSTED WITH THIS CONTRACT AS PER SPECIFICATION REQUIREMENT
36. ANNEXURE – XXVIII: UNDERTAKING TO ADHERE TO THE BAR CHARTS FOR COMPLETION OF SUPPLIES/ WORKS
37. Annexure-XXIX: LIST OF MANUFACTURERS/SUB-SUPPLIERS
38. Annexure-XXX: DETAILS OF TOOLS & PLANTS AND VEHICLES FOR ERECTION OF SUBSTATION & BAYS AND LINES
39. Annexure-XXXI: LIST OF DRAWINGS
40. Annexure-XXXII: Test Certificate
41. Annexure-XXXIII: STATEMENT OF PROFIT & LOSS ACCOUNT BIDDER/LEAD PARTNER OF J.V/PARTNER OF J.V
42. ANNEXURE XXXIV: UNDERTAKING TO BE GIVEN BY THE BIDDER ALONG WITH THE BID:
43. Annexure XXXV: CERTIFICATE OF EXPERIENCE OF WORK (for INFRA PROJECT)

ABSTRACT ESTIMATE FOR SUPPLY WORKS ITEMS

Supply Material/equipment for erection of 400 KV Kachapur switching station in Link-II for lifting additional 1TMC water from Godavari basin under Kaleswaram Lift Irrigation scheme in karimnagar (old) district

Sl.No.	DESCRIPTION	Amount in Rs.
I	SCHEDULE - A2: SUPPLY OF 400 KV QMDC LINE FROM STPP JAIPUR - GAJWEL (RAMADUGU)(7KM)	13,44,75,057.10
II	SCHEDULE - A3: SUPPLY OF 400 KV QMDC LINE FROM KACHAPUR - GAJWEL (RAMADUGU) (9KM)	16,26,51,012.14
III	SCHEDULE - A4: SUPPLY OF 400 KV QMDC LINE FROM STPP NTPC TO NARSAPUR SS (5 KM)	12,42,14,044.72
SCHEDULE A TOTAL IN RS.		42,13,40,113.96

NOTES:

- 1 GST extra at actuals.
- 2 F&I inclusive in the above prices
- 3 All applicable taxes & duties including BOCW (if applicable), NAC are deemed to be included in above prices except GST as mentioned in Sl. No. 1.

Supply of material/Equipment for erection of 400 kV QMDC Line for making LILO of both the circuits of 400 kV Jaipur - Ramadugu line to 400 kV Switching Station of line length 7KM at Kachapur Village Julapally Mandal in Peddapally District in Link-II for lifting additional 1TMC water from Godavari basin under Kaleswaram Lift Irrigation scheme in Karimnagar (old) district wind Zone - 3

SCHEDULE - A2

SUPPLY PRICES

Sl. No.	Description of material	QTY	UOM	Unit rate (in Rs.)	Amount (in Rs.)
1	Stubs & Cleats for all Towers (including 2.5% Extra of Bolts & Nuts)	35	MT	65,762.48	2301686.70
2	Super Structure for all Towers (Including Bolts & Nuts)	848	MT	65,762.48	55766580.50
3	ACSR Moose Conductor	170.00	KM	2,59,848.40	44174228.00
4	Hard Ware Fittings, Hardware & Accessories Complete for Quadruple ACSR Moose Conductor				
a)	Double Suspension Insulator Hardware Complete	49	Sets	14,930.01	731570.59
b)	Quadruple/Double Tension Hardware Complete	208	Sets	33,641.09	6997346.20
c)	Single Pilot Insulator Hardware Complete	67	Sets	25,694.17	1721509.66
d)	Midspan compression Joints	96	Nos.	736.36	70690.90
e)	Quad Rigid spacers for ACSR Moose Conductor for Jumpers	294	Nos.	1,202.67	353586.01
f)	Bundle spacers dampers Quad Moose ACSR Conductor	918	Nos.	1,191.32	1093629.47
g)	Twin Moose Rigid Spacer (250mm spacing) for ACSR Moose	196	Nos.	241.01	47237.76
h)	Repair Sleeves for ACSR Conductor	28	Nos.	277.93	7782.12
5	7/3.66mm Galvanised Earthwire	7.00	KM	41,044.25	287309.73

Sl. No.	Description of material	QTY	UOM	Unit rate (in Rs.)	Amount (in Rs.)
6	Hard Ware Fittings & Accessories for 7/3.66mm GS Earthwire				
a)	Suspension Hardware Complete	8	Nos.	498.55	3988.40
b)	Tension Hardware Complete	37	Sets	492.71	18230.31
c)	Vibration Dampers	90	Nos.	304.92	27442.85
d)	Flexible Copper Bonds with suitable bolts & nuts	45	Nos.	589.76	26539.38
e)	Midspan compression Joints	4	Nos.	194.57	778.26
f)	Repair sleeves	4	Nos.	228.47	913.89
7a)	120KN Disc Insulators (Antifog type)	3801	Nos.	652.79	2481260.49
b)	120KN Long Rod Insulators (one Set = 23 Nos. Disc insulators)	0.000	Sets	14,303.66	0.00
8a)	160KN Disc Insulators (Antifog type)	19953	Nos.	716.92	14304614.97
b)	160KN Long Rod Insulators (one Set = 24 Nos. Disc insulators)	0.000	Sets	16,125.73	0.00
9	Number Plates with Bolts, Nuts & Washers	24	Nos.	175.63	4215.05
10	Danger Plates with Bolts, Nuts & Washers	24	Nos.	175.63	4215.05
11	Phase Plates with Bolts, Nuts & Washers (Set of Three R,Y & B)	48	Sets	175.63	8430.10
12	Circuit Plates with Bolts, Nuts & Washers (Set of Two)	24	Sets	175.63	4215.05
13	Bird Guards (1 Set = 6 Nos)	8	Sets	1,641.82	13134.54

Sl. No.	Description of material	QTY	UOM	Unit rate (in Rs.)	Amount (in Rs.)
14	Anti Climbing Devices for				
a)	Tangent Towers incl. contingencies	8	Sets	3,432.11	27456.90
b)	Small Angle Towers incl. contingencies	2	Sets	4,576.40	9152.80
c)	Medium Angle Towers incl. contingencies	3	Sets	5,719.98	17159.94
d)	Large Angle and Dead End Towers incl. contingencies	11	Sets	5,719.98	62919.80
15	Earthing of the Towers				
a)	Pipe type	24	Sets	1,113.26	26718.29
b)	Counter Poise	10	Sets	2,669.50	26695.02
16	Line Testing Equipments (Lates Models)				
a)	GPS (Garmin map 785 model)	2	No.s	18,504.76	37009.53
b)	Off line overhead EHVAC transmission Line Analyzer	1	Nos.	24,95,175.00	2495175.00
c)	Tower footing earth impedance measurement instrument. Make: Megger incl of all taxes	1	Nos.	4,99,035.00	499035.00
Total in Rs.(Electrical)					133652460.26
17	Telecom Line materials :				
A) OFC (OPGW) & Accessories Supply:(Overhead)					
1)	24F OPGW Cable of DWSM type	7	Km	74,417.50	520922.50
2)	Suspension clamp sets (grounding clamps are part of suspension assembly)	7	Sets	1,983.01	13881.05
3)	Tension Assembly (Dead end Clamps and Grounding clamps are part of Tension Assembly)	30	Sets	1,691.47	50743.98
4)	Vibration Dampers	46	Nos	518.30	23841.62
5)	24F Splice Boxes (OPGW - OPGW)	2	Nos	3,061.62	6123.25
6)	24F Splice boxes (OPGW - OFAC)	2	Nos.	3,061.62	6123.25
7)	Down Lead Clamps	80	Nos	154.09	12327.04

Sl. No.	Description of material	QTY	UOM	Unit rate (in Rs.)	Amount (in Rs.)
8)	Fibre Optic Distribution Panel (FODP) for termination of Fibres of 48 F capacity (Rack Mounted) with necessary pigtails and patch cord accessories	2	Nos	17,130.36	34260.73
9)	Fibre approach cable (OFAC) 24 Fibres of DWDM type with 40/33 mm HDPE pipe along with Rope, suitable for laying in Ducts/Trenches	2	KM	57,951.10	115902.19
Overhead line Material (OPGW) Total in Rs. (A)					7,84,125.61
B) Spares of OFC (OPGW) Accessories					
10	Suspension Assembly (Grounding clamps are part of suspension assembly)	2	Sets	1,983.01	3966.02
11	Tension Assembly (Dead end Clamps and Grounding clamps are part of Tension Assembly)	12	Sets	1,691.47	20297.59
12	Vibration Dampers	2	Nos	518.30	1036.59
13	24F Splice Boxes (OPGW - OPGW)	2	Nos	3,061.62	6123.25
14	24 FSplice boxes (OPGW - OFAC)	2	Nos.	3,061.62	6123.25
15	Down Lead Clamps	6	Nos	154.09	924.53
Line Material (OPGW) Spares Total in Rs. (B)					38,471.23
Total amount (Telecom) in Rs.					8,22,596.84
Grand Total(Electrical & Telecom) in Rs.- Schedule-A2					13,44,75,057.10

Supply of material/Equipment for erection of 400 kV QMDC line from proposed 400 kV Switching Station at Kachapur to 400 kV Ramadugu - Gajwel DC line of length 9 KminLink-II for lifting additional 1TMC water from Godavari basin under Kaleswaram Lift Irrigation scheme in karimnagar (old) district wind Zone - 3					
SCHEDULE - A3					
SUPPLY PRICES					
Sl.No.	Description of material	QTY	UOM	Unit rate (in Rs.)	Amount (in Rs.)
1	Stubs & Cleats for all Towers (including 2.5% Extra of Bolts & Nuts)	41	MT	65,762.48	2696261.56
2	Super Structure for all Towers (Including Bolts & Nuts)	1079	MT	65,762.48	70957712.68
3	ACSR Moose Conductor	218.00	KM	2,59,848.40	56646951.20
4	Hard Ware Fittings, Hardware & Accessories Complete for Quadruple ACSR Moose Conductor				
a)	Double Suspension Insulator Hardware Complete	92	Sets	14,930.01	1373561.10
b)	Quadruple/Double Tension Hardware Complete	214	Sets	33,641.09	7199192.73
c)	Single Pilot Insulator Hardware Complete	55	Sets	25,694.17	1413179.57
d)	Midspan compression Joints	123	Nos.	736.36	90572.71
e)	Quad Rigid spacers for ACSR Moose Conductor for Jumpers	312	Nos.	1,202.67	375234.13
f)	Bundle spacers dampers Quad Moose ACSR Conductor	1212	Nos.	1,191.32	1443876.81
g)	Twin Moose Rigid Spacer (250mm spacing) for ACSR Moose	184	Nos.	241.01	44345.66
h)	Repair Sleeves for ACSR Conductor	36	Nos.	277.93	10005.59
5	7/3.66mm Galvanised Earthwire	9.00	KM	41,044.25	369398.23
6	Hard Ware Fittings & Accessories for 7/3.66mm GS Earthwire				
a)	Suspension Hardware Complete	15	Nos.	498.55	7478.26
b)	Tension Hardware Complete	37	Sets	492.71	18230.31
c)	Vibration Dampers	104	Nos.	304.92	31711.73
d)	Flexible Copper Bonds with suitable bolts & nuts	52	Nos.	589.76	30667.73
e)	Midspan compression Joints	5	Nos.	194.57	972.83

Sl.No.	Description of material	QTY	UOM	Unit rate (in Rs.)	Amount (in Rs.)
f)	Repair sleeves	5	Nos.	228.47	1142.36
7a)	120KN Disc Insulators (Antifog type)	5490	Nos.	652.79	3583825.34
b)	120KN Long Rod Insulators (one Set = 23 Nos. Disc insulators)	0.000	Sets	14,303.66	0.00
8a)	160KN Disc Insulators (Antifog type)	21128	Nos.	716.92	15146990.68
b)	160KN Long Rod Insulators (one Set = 24 Nos. Disc insulators)	0.000	Sets	16,125.73	0.00
9	Number Plates with Bolts, Nuts & Washers	32	Nos.	175.63	5620.06
10	Danger Plates with Bolts, Nuts & Washers	32	Nos.	175.63	5620.06
11	Phase Plates with Bolts, Nuts & Washers (Set of Three R,Y & B)	64	Sets	175.63	11240.13
12	Circuit Plates with Bolts, Nuts & Washers (Set of Two)	32	Sets	175.63	5620.06
13	Bird Guards (1 Set = 6 Nos)	15	Sets	1,641.82	24627.26
14	Anti Climbing Devices for			0.00	
a)	Tangent Towers incl. contingencies	15	Sets	3,432.11	51481.70
b)	Small Angle Towers incl. contingencies	4	Sets	4,576.40	18305.60
c)	Medium Angle Towers incl. contingencies	4	Sets	5,719.98	22879.93
d)	Large Angle and Dead End Towers incl. contingencies	9	Sets	5,719.98	51479.83
15	Earthing of the Towers			0.00	
a)	Pipe type	32	Sets	1,113.26	35624.38
b)	Counter Poise	10	Sets	2,669.50	26695.02
16)	GPS (Garmin map 785 model)	2	No.s	18,504.76	37009.53
Total Amount in Rs. (Electrical)					16,17,37,514.77

Sl.No.	Description of material	QTY	UOM	Unit rate (in Rs.)	Amount (in Rs.)
17	Telecom Line materials :				
A) OFC (OPGW) & Accessories Supply:(Overhead)					
1)	24F OPGW Cable of DWSM type	9	Km	74,417.50	669757.50
2)	Suspension clamp sets (grounding clamps are part of suspension assembly)	14	Sets	1,983.01	27762.11
3)	Tension Assembly (Dead end Clamps and Grounding clamps are part of Tension Assembly)	30	Sets	1,691.47	50743.98
4)	Vibration Dampers	58	Nos	518.30	30061.17
5)	24F Splice Boxes (OPGW - OPGW)	2	Nos	3,061.62	6123.25
6)	24F Splice boxes (OPGW - OFAC)	1	Nos.	3,061.62	3061.62
7)	Down Lead Clamps	90	Nos	154.09	13867.92
8)	Fibre Optic Distribution Panel (FODP) for termination of Fibres of 48 F capacity (Rack Mounted) with necessary pigtails and patch cord accessories	2	Nos	17,130.36	34260.73
9)	Fibre approach cable (OFAC) 24 Fibres of DWSM type with 40/33 mm HDPE pipe along with Rope, suitable for laying in Ducts/Trenches	1	kM	57,951.10	57951.10
Overhead line Material (OPGW) Total Amount in Rs (A)					8,93,589.38
B) Spares of OFC (OPGW) Accessories					
10	Suspension Assembly (Grounding clamps are part of suspension assembly)	1	Sets	1,983.01	1983.01
11	Tension Assembly (Dead end Clamps and Grounding clamps are part of Tension Assembly)	6	Sets	1,691.47	10148.80
12	Vibration Dampers	2	Nos	518.30	1036.59
13	24F Splice Boxes (OPGW - OPGW)	1	Nos	3,061.62	3061.62
14	24 FSplice boxes (OPGW - OFAC)	1	Nos.	3,061.62	3061.62
15	Down Lead Clamps	4	Nos	154.09	616.35
	Line Material (OPGW) Spares Total Amount in Rs. (B)				19,907.99
	Total amount (Telecom) in Rs.				9,13,497.37
	Grand Total(Electrical & Telecom) in Rs.-Schedule A3				16,26,51,012.14

Supply of material/Equipment for erection of 400 kV QMDC Line for making LIL of both the circuits of 400 kV NTPC - Narasapur line to 400 kV Switching Station of line length 5 KM at Kachapur village Julapally Mandal in Peddapally District in Link-II for lifting additional 1TMC water from Godavari basin under Kaleswaram Lift Irrigation scheme in Karimnagar (old) district wind Zone - 3

SCHEDULE - A4

SUPPLY PRICES

Sl. No.	Description of material	QTY	UOM	Unit rate (in Rs.)	Amount (in Rs.)
1	Stubs & Cleats for all Towers (including 2.5% Extra of Bolts & Nuts)	34	MT	65,762.48	2235924.22
2	Super Structure for all Towers (Including Bolts & Nuts)	915	MT	65,762.48	60172666.46
3	ACSR Moose Conductor	121.00	KM	2,59,848.40	31441656.40
4	Hard Ware Fittings, Hardware & Accessories Complete for Quadruple ACSR Moose Conductor				
a)	Double Suspension Insulator Hardware Complete	24	Sets	14,930.01	358320.29
b)	Quadruple Tension Hardware Complete	208	Sets	33,641.09	6997346.20
c)	Single Pilot Insulator Hardware Complete	61	Sets	25,694.17	1567344.61
d)	Midspan compression Joints	68	Nos.	736.36	50072.72
e)	Quad Rigid spacers for ACSR Moose Conductor for Jumpers	294	Nos.	1,202.67	353586.01
f)	Bundle spacers dampers Quad Moose ACSR Conductor	771	Nos.	1,191.32	918505.79
g)	Twin Moose Rigid Spacer (250mm spacing) for ACSR Moose	196	Nos.	241.01	47237.76
h)	Repair Sleeves for ACSR Conductor	20	Nos.	277.93	5558.66
5	7/3.66mm Galvanised Earthwire	5.00	KM	41,044.25	205221.24
6	Hard Ware Fittings & Accessories for 7/3.66mm GS Earthwire				
a)	Suspension Hardware Complete	4	Nos.	498.55	1994.20
b)	Tension Hardware Complete	37	Sets	492.71	18230.31
c)	Vibration Dampers	82	Nos.	304.92	25003.48
d)	Flexible Copper Bonds with suitable bolts & nuts	41	Nos.	589.76	24180.32
e)	Midspan compression Joints	3	Nos.	194.57	583.70
f)	Repair sleeves	3	Nos.	228.47	685.41

Sl. No.	Description of material	QTY	UOM	Unit rate (in Rs.)	Amount (in Rs.)
7a)	120KN Disc Insulators (Antifog type)	2534	Nos.	652.79	1654173.66
b)	120KN Long Rod Insulators (one Set = 23 Nos. Disc insulators)	0.000	Sets	14,303.66	0.00
8a)	160KN Disc Insulators (Antifog type)	19377	Nos.	716.92	13891671.64
b)	160KN Long Rod Insulators (one Set = 24 Nos. Disc insulators)	0.000	Sets	16,125.73	0.00
9	Number Plates with Bolts, Nuts & Washers	20	Nos.	175.63	3512.54
10	Danger Plates with Bolts, Nuts & Washers	20	Nos.	175.63	3512.54
11	Phase Plates with Bolts, Nuts & Washers (Set of Three R,Y & B)	40	Sets	175.63	7025.08
12	Circuit Plates with Bolts, Nuts & Washers (Set of Two)	20	Sets	175.63	3512.54
13	Bird Guards (1 Set = 6 Nos)	4	Sets	1,641.82	6567.27
14	Anti Climbing Devices for			0.00	
a)	Tangent Towers incl. contingencies	4	Sets	3,432.11	13728.45
b)	Small Angle Towers incl. contingencies	4	Sets	4,576.40	18305.60
c)	Medium Angle Towers incl. contingencies	2	Sets	5,719.98	11439.96
d)	Large Angle and Dead End Towers incl. contingencies	10	Sets	5,719.98	57199.82
15	Earthing of the Towers				
a)	Pipe type	20	Sets	1,113.26	22265.24
b)	Counter Poise	10	Sets	2,669.50	26695.02
16	Supply of Testing Kits				
a)	GPS (Garmin map 785 model)	2	No.s	18,504.76	37009.53
b)	Binoculars (Latest version)	2	No.s	3,155.75	6311.51
c)	Off line overhead EHVAC Transmission Line Analyzer	1	Nos.	24,22,500.00	2422500.00
d)	Digital Earth Resistance Testing kit Make: Megger incl of all taxes.	2	Nos.	81,841.77	163683.55
17	Portable Inflatable Lighting System with inflatable baloon, Storage Box, Rain Protection Gear, Wind Support, Tool Kit, Lamp with Requisite Control Gear, Blower,Trolley and other accessories (Reputed make: Aska or Equivalent)	1.00	Nos	1,69,638.75	169638.75
18	Rechargable Long Range LED Dragon Search Light, Handheld, 10W (Reputed make:Aska or Equivalent)	4.00	Nos	5,763.00	23052.00
Total Amount in Rs. (Electrical)					12,29,65,922.48

Sl. No .	Description of material	QTY	UOM	Unit rate (in Rs.)	Amount (in Rs.)
19	Telecom Line materials :				
A) OFC (OPGW) & Accessories Supply:(Overhead)					
1)	24F OPGW Cable of DWSM type	12	Km	74,417.50	893010.00
2)	Suspension clamp sets (grounding clamps are part of suspension assembly)	6	Sets	1,983.01	11898.05
3)	Tension Assembly (Dead end Clamps and Grounding clamps are part of Tension Assembly)	56	Sets	1,691.47	94722.10
4)	Vibration Dampers	68	Nos	518.30	35244.13
5)	24F Splice Boxes (OPGW - OPGW)	2	Nos	3,061.62	6123.25
6)	24F Splice boxes (OPGW - OFAC)	2	Nos.	3,061.62	6123.25
7)	Down Lead Clamps	120	Nos	154.09	18490.56
8)	Fibre Optic Distribution Panel (FODP) for termination of Fibres of 48 F capacity (Rack Mounted) with necessary pigtails and patch cord accessories	2	Nos	17,130.36	34260.73
9)	Fibre approach cable (OFAC) 24 Fibres of DWSM type with 40/33 mm HDPE pipe along with Rope, suitable for laying in Ducts/Trenches	2	kM	57,951.10	115902.19
Overhead line Material (OPGW) Total in Rs.(A)					12,15,774.26
B) Spares of OFC (OPGW) Accessories					
10	Suspension Assembly (Grounding clamps are part of suspension assembly)	2	Sets	1,983.01	3966.02
11	Tension Assembly (Dead end Clamps and Grounding clamps are part of Tension Assembly)	12	Sets	1,691.47	20297.59
12	Vibration Dampers	2	Nos	518.30	1036.59
13	24F Splice Boxes (OPGW - OPGW)	0	Nos	3,061.62	0.00
14	24 FSplice boxes (OPGW - OFAC)	2	Nos.	3,061.62	6123.25
15	Down Lead Clamps	6	Nos	154.09	924.53
	Line Material (OPGW) Spares Total in Rs. (B)				32,347.98
	Total amount (Telecom) in Rs.				12,48,122.24
	Grand Total(Electrical & Telecom) in Rs.:- Schedule-A4				12,42,14,044.72

ABSTRACT - ERECTION

ERECTION OF 400KV KACHAPUR SWITCHING STATION CONNECTED LINES IN LINK-II FOR LIFTING ADDITIONAL 1TMC WATER FROM GODAVARI BASIN UNDER KALESWARAM LIFT IRRIGATION SCHEME IN KARIMNAGAR (OLD) DISTRICT

SL. No	DESCRIPTION OF WORK	AMOUNT IN Rs.
1	SCHEDULE - B2(a): ELECTRICAL ERECTION OF 400 KV QMDC LINE FROM STPP JAIPUR - GAJWEL (RAMADUGU) (7KM)	1,88,10,306.81
2	SCHEDULE - B2(b): CIVIL ERECTION OF 400 KV QMDC LINE FROM STPP JAIPUR - GAJWEL (RAMADUGU) (7KM)	3,26,49,687.05
3	SCHEDULE - B3 (a): ELECTRICAL ERECTION OF 400 KV QMDC LINE FROM KACHAPUR - GAJWEL (RAMADUGU)(9KM)	2,19,94,591.05
4	SCHEDULE - B3 (b): CIVIL ERECTION OF 400 KV QMDC LINE FROM KACHAPUR - GAJWEL (RAMADUGU)(9KM)	3,90,17,445.47
5	SCHEDULE - B4 (a): ELECTRICAL ERECTION OF 400 KV QMDC LINE FROM STPP NTPC TO NARSAPUR SS (5 KM)	1,77,38,307.27
6	SCHEDULE - B4 (b) CIVIL ERECTION OF 400 KV QMDC LINE FROM STPP NTPC TO NARSAPUR SS (5 KM)	3,15,84,562.12
	SCHEDULE - B TOTAL	16,17,94,899.77

NOTES:

- 1 GST extra at actuals.
All applicable taxes & duties including BOCW (if applicable), NAC are
- 2 deemed to be included in above prices except GST as mentioned in Sl. No. 1.
- 3 Calculation sheet for seignorage charges attached.

Erection of 400 kV QMDC Line for making LILO of both the circuits of 400 kV Jaipur - Ramadugu line to 400 kV Switching Station of line length 7KM at Kachapur Village Julapally Mandal in Peddapally District in Link-II for lifting additional 1TMC water from Godavari basin under Kaleswaram Lift Irrigation scheme in karimnagar (old) district wind Zone - 3

SCHEDULE - B2 (a)

ERECTION TESTING AND COMMISSIONING WORKS

Sl. No.	Description	Qty.	UOM	Unit Rate (in Rs.)	Amount (in Rs.)
1	Check Survey, peg marking the tower positions on ground, conforming to the approved Profile and tower schedules using GPS, Total stations, DGPS etc.	7	KM	9,722.81	68,059.67
2	Excavation of trail pit (1mt x 1 mt x 4mt)	24	No	3,937.17	94,491.98
3	Setting with stub for all types of towers with stub setting template which includes erection of stubs, fixing of jacks for supporting template, alignment and leveling excluding cost of excavation and concrete	24	sets	21,072.17	5,05,732.12
4	Super Structure Erection of all Types of Towers including Anchor Towers and their Extensions (complete) including Fitting of Step Bolts, Danger Plates, Number Plates, Phase Plates, Circuit Plates, Bird Guards, Anti Climbing Devices etc. and Tack Welding of all bolts & nuts including cost of zinc rich paint (upto bottom cross arm level)	848	MT	11,309.02	95,90,049.38
5	Dismantling of Super Structure Erection of all Types of Towers including Anchor Towers and their Extensions (complete) including Fitting of Step Bolts, Danger Plates, Number Plates, Phase Plates, Circuit Plates, Bird Guards, Anti Climbing Devices etc. and Transport the Dismantled material to the TSTRANSCO stores.	120	MT	8,481.77	10,17,812.10
6	Mounting of Insulators & Stringing of Double Circuit Line with Quadruple ACSR Moose Power Conductor (Quadruple Bundled) per Phase including Laying, Jointing, Tensioning etc. Sagging and Clamping with necessary Accessories and fixing spacers Under Normal Condition	6.0	KM	6,75,188.30	40,51,129.82
7	Mounting of Insulators & Stringing of Double Circuit Line with Quadruple ACSR Moose Power Conductor (Quadruple Bundled) per Phase including Laying, Jointing, Tensioning etc. Sagging and Clamping with necessary Accessories and fixing spacers Under Shutdown Condition	1.0	KM	11,51,461.22	11,51,461.22
8	Dismantling of Insulators & Dismantling of Double Circuit Line with Quadruple ACSR Moose Power Conductor (Quadruple Bundled) per Phase including Laying, Jointing, Tensioning etc. and Transport the Dismantled material to TSTRANSCO stores.	2	KM	5,06,391.22	10,12,782.45

Erection of 400 kV QMDC Line for making LILO of both the circuits of 400 kV Jaipur - Ramadugu line to 400 kV Switching Station of line length 7KM at Kachapur Village Julapally Mandal in Peddapally District in Link-II for lifting additional 1TMC water from Godavari basin under Kaleswaram Lift Irrigation scheme in karimnagar (old) district wind Zone - 3

SCHEDULE - B2 (a)

ERECTION TESTING AND COMMISSIONING WORKS

9	Stringing of 1No 7/3.66mm Galvanized Steel Earthwire including Laying, Jointing, Tensioning etc. with necessary Accessories Under normal Condition.	6.0	KM	14,100.08	84,600.48
10	Stringing of 1No OPG wire including Laying, Jointing, Tensioning etc. with necessary Accessories Complete Under normal Condition.	6.0	KM	69,414.80	4,16,488.80
11	Stringing of 1No 7/3.66mm Galvanized Steel Earthwire including Laying, Jointing, Tensioning etc. with necessary Accessories Under Shutdown Condition.	1.0	KM	24,046.18	24,046.18
12	Stringing of 1No OPG wire including Laying, Jointing, Tensioning etc. with necessary Accessories Complete Under Shutdown Condition.	1.0	KM	1,18,379.49	1,18,379.49
13	Dismantling of 1No 7/3.66mm Galvanized Steel Earthwire and Transport the Dismantled material to TSTRANSCO stores.	2	KM	10,575.06	21,150.13
14	Dismantling of 1No OPG wire and Transport the Dismantled material to TSTRANSCO stores.	2	KM	52,061.11	1,04,122.21
15	Earthing of Transmission Line Towers				
a)	Providing Pipe type Earthing including cost of BH Coke and Salt but excluding cost of earthing set	24	Each	5,794.81	1,39,075.37
b)	Providing Counter Poise Earthing excluding cost of all materials (4 sides of tower)	5	Each LOC.	4,857.73	24,288.67
c)	Providing Counter Poise Earthing using Bentonite and salt excluding cost of all materials (4 sides of tower)	5	Each LOC.	7,287.52	36,437.59
16	Transportation arrangement to supervise and recording the measurements of works (15 MonthsX 150kMs X 25 Trips per month)	56250	KM	4.50	2,52,928.13
Total Amount in Rs.					1,87,13,035.79
17	Erection & commissioning of Fibre distribution panels for termination of 24 Fibers	2	Each	16,514.36	33,028.72
18	Erection & Commissioning of OFAC along with HDPE Duct pipe in Trench	2	Km	32,121.15	64,242.30
Total Amount in Rs.					97,271.02
Grand Total -Schedule-B2 (a)					1,88,10,306.81

Schedule -B2 (b)						
Name of the Work: Erection of Quad Moose DC line from STPP Jaipur- 400/220/13.6 kV Ramadugu Substation DC line to proposed 400kV Switching station at Kachapur						
S.No.	QUANTITY		DESCRIPTION OF ITEM	Unit Rate (Rs)	PER	Amount (Rs.)
				Rs		Rs
1	12000.00	Cum	Earthwork excavation in all types of soils (including HDR, soft rock, F&F) (up to stone matrix) which can be excavated with pick axe and crow bars and do not require blasting in all conditions such as dry, wet and slushy etc. covering initial lead and lift etc and backfilling the foundations (after laying foundations) with excavated earth and consolidation in up to 0.15 m layer and constructing of platforms 150mm height around foundations utilizing the excavated earth etc. complete as per the directions of Engineer - In - Charge.	233.05	1 Cum	2796636.00
2	1200.00	Cum	Extra towards dewatering charges over an above the excavation rate for excavated earth quantity Where water table met at 1,50 m or more below G.L	29.28	1 Cum	35139.00
3	600.00	Cum	Extra towards dewatering charges over an above the excavation rate for excavated earth quantity Where water table met between 0.75m and 1.50m depth below G.L	103.91	1 Cum	62347.50
4	600.00	Cum	Extra towards dewatering charges over an above the excavation rate for excavated earth quantity Where water table met with in 0.75 m depth below G.L	201.98	1 Cum	121186.20
5	1410.00	Cum	Excavation in HDR, soft rock, F&F (requiring blasting) where ever necessary. The rate includes labour charges, cost of blasting materials, tools and tackles, safety measures, disposal of unuseful excavted material at all leads and lifts, complete for finished item of work as per directions of the Engineer-in-charge. (For Foundation Works).	318.84	1 Cum	449569.34
6	705.00	Cum	Excavation in Hard rock (requiring blasting) The rate includes labour charges, cost of blasting materials, tools and tackles, safety measures, disposal of unuseful excavted material at all leads and lifts, complete for finished item of work as per directions of the Engineer-in-charge	817.01	1 Cum	575993.11
7	500.00	Cum	Stone crusher dust filling below the foundations as per the standard specifications of APDSS in uniform horizontal layers including cost and conveyance of all materials, watering and ramming, tools & tackles, all labour charges, all leads & lifts etc, complete for finished item of work as per directions of the Engineer-in-charge.	832.80	1 Cum	416398.00
8	371.00	Cum	Laying of Cement Concrete (1:3:6) mix (M 10 Nominal mix) using 40mm size HBG metal (Mixing with concrete mixer) or foundations including cost and conveyance of all materials at all leads and lifts, ramming, consolidating, curing etc, complete. for finished item of work as per directions of the Engineer-in-charge.	4121.67	1 Cum	1529138.46
9	174.00	MT	Providing High Yield Strength Deformed (HYSD)/ Thermo Mechanically Treated (TMT) (Fe 500/ 500D/550D) grade as per IS 1786-1979) of TISCO/ SAIL/ VSP/Jindal make, different diameters for RCC works , including labour charges for straightening, cutting, bending to required sizes and shapes, placing in position with cover blocks of approved materials and size and tying and lap-splicing with binding wire of 18 SWG, forming grills for reinforcement work as per approved designs and drawings, including cost and conveyance of steel bars, including all wastages such as overlaps, couplings, chairs, spacer bars including cost and conveyance of binding wire, cover blocks and all incidental, operational, labour charges such as cutting, bending, placing in position, tying including sales and other taxes on all materials etc., complete for finished item of work in all floors.(APSS No.126) as per directions of the Engineer-in-charge .	51384.31	1 MT	8940870.03
10	1890.00	Cum	RCC M- 20 Nominal mix (Cement 400 kgs) using 20mm size graded machine crushed hard granite metal (coarse aggregate) from approved quarry including cost and conveyance of all materials like cement, fine aggregate (sand) coarse aggregate, water etc., to site and including Seigniorage charges, sales & other taxes on all materials including all operational, incidental and labour charges such as machine mixing, laying concrete, curing and centering, etc.,complete but excluding cost of steel and its fabrication charges for finished item of work.(cement 400 kg , sand 0.45 cum and metal 0.90 cum) as directed by Engineer in charge.	8455.60	1Cum	15981092.51

S.No.	QUANTITY		DESCRIPTION OF ITEM	Unit Rate (Rs)	PER	Amount (Rs.)
				Rs		Rs
11	50.00	Sqm	Plasteing in CM (1:4), 12 mm thick including cost and conveyance of all materials, labour charges , water lead, curing, all leads and lifts etc complete for finished item of work as per directions of the Engineer-in-charge .	146.24	1 Sqm	7312.13
12	200.00	Sqm	Providing shoring and strutting either with country wooden planks and scantlings or with steel sheets and props for excavation of pits for tower foundations wherever necessary including cost and conveyance of all materials, labour charges, tools & tackles, all leads & lifts and etc., complete for finished item of work as per directions of the Engineer-in-charge.	97.05	1 Sqm	19410.60
	Protection works					
13	300.00	cum	Earthwork excavation in all types of soils (upto stone matrix) which can be excavated in combination of mechanically and manually with pick axe and crow bars and don't require blasting in all conditions such as dry, wet, slushy etc., covering initial lead and lift etc., including backfilling, watering, compacting as per standard specification and disposing of surplus earth within site (up to 1KM lead) complete as per directions of Engineer in charge at site for finished item of work.	134.46	1 cum	40338.45
14	48.00	Cum	Laying of Cement Concrete (1:4:8) mix using 40mm size HBG Machine crushed metal for foundations including cost and conveyance of all materials at all leads and lifts, ramming, consolidating, curing etc,complete. for finished item of work as per directions of the Engineer-in-charge.	3799.30	1 cum	182366.62
15	300.00	cum	Construction of RR Masonry in CM (1:6) using hard CRS, rough granite stone and bond stones (0.16 cum) including cost and conveyance of all matreials., labour charges, water lead , Curing, all leads and lifts etc., complete for finished item of work as per directions of the Engineer-in-charge.	3580.26	1 cum	1074077.85
16	100.00	sqm	Providing and constructing 225mm thick rubble stone pitching (joints filled with cement mortar CM(1:5) proportion) including cost of all materials, labour, packing chips and mortar, finishing etc. complete for finished item of work as directed by the Engineer incharge.	286.42	1 sqm	28641.60
17	100.00	RM	Providing and fixing in position at all levels of Masonry walls as weep holes with 110 mm dia (4kg/cm2) PVC pipes of prince / sudhakar or any ISI brand make wherever necessary including fixing in position & at all leads & lifts etc. complete as per the directions of the Engineer in charge for the finished item of work.	174.32	1 RM	17431.80
18	100.00	sqm	Flush Pointing with CM (1:4) to RR Masonry walls including cost and conveyance of all materials, labour charges, water lead, curing,all leads and lifts complete as per the directions of the Engineer in charge for the finished item of work.	82.88	1 sqm	8287.50
19	10.00	cum	Plain Cement concrete - Nominal Mix (1:3:6) with 12 to 20mm HBG metal over RR wall including cost and conveyance of all materials, labour charges, water charges, tools and tackles, all leads & lifts etc., complete for finished item of work as per directions of the Engineer-in-charge. (IS-456)	4980.93	1 cum	49809.32
20	100.00	cum	Filling around the foundation / inside the rivetment walls if required where ever necessary with suitable borrowed earth other than clayey soils for filling as per the standard specifications of APDSS in uniform horizontal layers (0.15) including cost and conveyance of all materials, watering and ramming, tools & tackles, all labour charges, all leads & lifts etc, complete for finished item of work as per the directions of the Engineer-in-charge.	428.13	1 cum	42812.80
Sub - Total						323,78,858.82
21			Total considered estimate for CIVIL WORKS		Total	323,78,858.82
			Towards seignorage charges including SMET (2% on seignorage charges) Fund	238449.37		2,38,449.37
22	0.10%		Cess towards NAC	323,78,858.82		32,378.86
Grand Total Amount in Rs. (Schedule B2 (b))						326,49,687.05

SEIGNIORAGE CHARGE CALCULATION SHEET

Name of the Work: Erection of Quad Moose DC line from STPP Jaipur- 400/220/13.6 kV Ramadugu Substation DC line to proposed 400kV Switching station at Kachapur

Sl. No.	Description of Item	Item qty		Qty of Earth		Qty of Gravel		Qty of Sand		Qty of Metal incl Crusher dust and stones	
				Per unit	Total Qty in Cum	Per unit	Total Qty in Cum	Per unit	Total Qty in Cum	Per unit	Total Qty in Cum
1	Laying of CC 1:4:8	48.00	Cum					0.45	21.6	0.90	43.20
2	Construction of RR/ CRS Masonry	300.00	Cum					0.33	99	1.10	330.00
3	Laying of PCC 1:3:6	381.00	Cum					0.45	171.45	0.90	342.90
4	Flush pointing CM (1:4)	100.00	Sqm					0.003	0.3		
5	Plastering 12mm thk	50.00	Sqm					0.0158	0.7875		
6	Providing Sand cushion	0.00	Cum					1.00	0.00		
7	Providing Crusherdust cushion	500.00	Cum							1.00	500.00
8	RCC M20 / PCC M20 nominal mix	1890.00	Cum					0.45	850.50	0.90	1701.00
9	Filling Fdn with borrowed earth	100.00	Cum	1.00	100						
10	Filling Fdn with borrowed gravel	0.00	Cum			1.00	0				
11	Rubble stone pitching	100.00	sqm							1	100
Total Quantities					100.00		0.00		1143.64		3017.10
Seignorage charges				25.50	2550.00	25.50	0.00	34.00	38883.76	63.75	192340.13
Total seignorage charges				233773.89							
SMET 2% on above				4675.48							
Total Amount of seignorage charges in Rs.				238449.37							

Erection of material for 400 kV QMDC line from proposed 400 kV Switching Station at Kachapur to 400 kV Ramadugu - Gajwel DC line of length 9 Km in Link-II for lifting additional 1TMC water from Godavari basin under Kaleswaram Lift Irrigation scheme in karimnagar (old) district Zone - 3					
SCHEDULE - B3 (a)					
ERECTION TESTING AND COMMISSIONING WORKS					
Sl.No.	Description	Qty.	UOM	Unit Rate (in Rs.)	Amount (in Rs.)
1	Check Survey, peg marking the tower positions on ground, conforming to the approved Profile and tower schedules using GPS, Total stations, DGPS etc.	9	KM	9,722.81	87,505.29
2	Excavation of trail pit (1mt x 1 mt x 4mt)	32	No	3,937.17	1,25,989.31
3	Setting with stub for all types of towers with stub setting template which includes erection of stubs, fixing of jacks for supporting template, alignment and leveling excluding cost of excavation and concrete	32	sets	21,072.17	6,74,309.49
4	Super Structure Erection of all Types of Towers including Anchor Towers and their Extensions (complete) including Fitting of Step Bolts, Danger Plates, Number Plates, Phase Plates, Circuit Plates, Bird Guards, Anti Climbing Devices etc. and Tack Welding of all bolts & nuts including cost of zinc rich paint (upto bottom cross arm level)	1079	MT	11,309.02	1,22,02,433.12
5	Dismantling of Super Structure Erection of all Types of Towers including Anchor Towers and their Extensions (complete) including Fitting of Step Bolts, Danger Plates, Number Plates, Phase Plates, Circuit Plates, Bird Guards, Anti Climbing Devices etc. and Transport the Dismantled material to the TSTRANSCO stores.	50	MT	8,481.77	4,24,088.38
6	Mounting of Insulators & Stringing of Double Circuit Line with Quadruple ACSR Moose Power Conductor (Quadruple Bundled) per Phase including Laying, Jointing, Tensioning etc. Sagging and Clamping with necessary Accessories and fixing spacers Under Normal Condition	8	KM	6,75,188.30	54,01,506.42
8	Mounting of Insulators & Stringing of Double Circuit Line with Quadruple ACSR Moose Power Conductor (Quadruple Bundled) per Phase including Laying, Jointing, Tensioning etc. Sagging and Clamping with necessary Accessories and fixing spacers Under Shutdown Condition	1	KM	11,51,461.22	11,51,461.22
9	Dismantling of Insulators & Dismantling of Double Circuit Line with Quadruple ACSR Moose Power Conductor (Quadruple Bundled) per Phase including Laying, Jointing, Tensioning etc. and Transport the Dismantled material to TSTRANSCO stores.	1	KM	5,06,391.22	5,06,391.22
10	Stringing of 1No 7/3.66mm Galvanized Steel Earthwire including Laying, Jointing, Tensioning etc. with necessary Accessories Under normal Condition.	8	KM	14,100.08	1,12,800.64
11	Stringing of 1No OPG wire including Laying, Jointing, Tensioning etc. with necessary Accessories Complete Under normal Condition.	8	KM	69,414.80	5,55,318.40

Sl.No.	Description	Qty.	UOM	Unit Rate (in Rs.)	Amount (in Rs.)
12	Stringing of 1No 7/3.66mm Galvanized Steel Earthwire including Laying, Jointing, Tensioning etc. with necessary Accessories Under Shutdown Condition.	1	KM	24,046.18	24,046.18
13	Stringing of 1No OPG wire including Laying, Jointing, Tensioning etc. with necessary Accessories Complete Under Shutdown Condition.	1	KM	1,18,379.49	1,18,379.49
14	Dismantling of 1No 7/3.66mm Galvanized Steel Earthwire and Transport the Dismantled material to TSTRANSCO stores.	1	KM	10,575.06	10,575.06
15	Dismantling of 1No OPG wire and Transport the Dismantled material to TSTRANSCO stores.	1	KM	52,061.11	52,061.11
16	Earthing of Transmission Line Towers				
a)	Providing Pipe type Earthing including cost of BH Coke and Salt but excluding cost of earthing set	32	Each	5,794.81	1,85,433.82
b)	Providing Counter Poise Earthing excluding cost of all materials (4 sides of tower)	5	Each LOC.	4,857.73	24,288.67
c)	Providing Counter Poise Earthing using Bentonite and salt excluding cost of all materials (4 sides of tower)	5	Each LOC.	7,287.52	36,437.59
17	Transportation arrangement to supervise and recording the measurements of works (15 MonthsX 150kMs X 25Trips per month)	56250	KM	4.50	2,52,928.13
Total Amount in Rs. (Electrical)					2,19,45,955.54
LINE TELECOM ERECTION					
18	Erection & commissioning of Fibre distribution panels for termination of 24 Fibers	1	Each	16,514.36	16,514.36
19	Erection & Commissioning of OFAC along with HDPE Duct pipe in Trench	1	Km	32,121.15	32,121.15
	Total Amount in Rs. (Telecom)				48,635.51
Grand Total(Electrical & Telecom) in Rs.- Schedule B3 (a)					2,19,94,591.05

Schedule- B3 (b)

Name of the Work: Erection of 400kV Quad Moose DC line from proposed 400 kV Switching Station at Kachapur to 400 kV Ramadugu - Gajwel Substation DC line

SL. No.	QUANTITY	DESCRIPTION OF ITEM	Unit RATE Rs	PER	AMOUNT Rs
1	14500.00 Cum	Earthwork excavation in all types of soils (including HDR, soft rock, F&F) (up to stone matrix) which can be excavated with pick axe and crow bars and do not require blasting in all conditions such as dry, wet and slushy etc. covering initial lead and lift etc and backfilling the foundations (after laying foundations) with excavated earth and consolidation in up to 0.15 m layer and constructing of platforms 150mm height around foundations utilizing the excavated earth etc. complete as per the directions of Engineer - In - Charge.	233.05	1 Cum	3379268.50
2	1450.00 Cum	Extra towards dewatering charges over an above the excavation rate for excavated earth quantity Where water table met at 1,50 m or more below G.L	29.28	1 Cum	42459.63
3	725.00 Cum	Extra towards dewatering charges over an above the excavation rate for excavated earth quantity Where water table met between 0.75m and 1.50m depth below G.L	103.91	1 Cum	75336.56
4	725.00 Cum	Extra towards dewatering charges over an above the excavation rate for excavated earth quantity Where water table met with in 0.75 m depth below G.L	201.98	1 Cum	146433.33
5	1705.00 Cum	Excavation in HDR, soft rock, F&F (requiring blasting) where ever necessary. The rate includes labour charges, cost of blasting materials, tools and tackles, safety measures, disposal of unuseful excavated material at all leads and lifts, complete for finished item of work as per directions of the Engineer-in-charge. (For Foundation Works).	318.84	1 Cum	543628.17
6	853.00 Cum	Excavation in Hard rock (requiring blasting) The rate includes labour charges, cost of blasting materials, tools and tackles, safety measures, disposal of unuseful excavated material at all leads and lifts, complete for finished item of work as per directions of the Engineer-in-charge	817.01	1 Cum	696910.81
7	500.00 Cum	Stone crusher dust filling below the foundations as per the standard specifications of APDSS in uniform horizontal layers including cost and conveyance of all materials, watering and ramming, tools & tackles, all labour charges, all leads & lifts etc, complete for finished item of work as per directions of the Engineer-in-charge.	932.84	1 Cum	466420.50
8	450.00 Cum	Laying of Cement Concrete (1:3:6) mix (M 10 Nominal mix) using 40mm size HBG metal (Mixing with concrete mixer) or foundations including cost and conveyance of all materials at all leads and lifts, ramming, consolidating, curing etc, complete. for finished item of work as per directions of the Engineer-in-charge.	4198.17	1 Cum	1889175.15
9	204.00 MT	Providing High Yield Strength Deformed (HYSD)/ Thermo Mechanically Treated (TMT) (Fe 500/ 500D/550D) grade as per IS 1786-1979) of TISCO/ SAIL/ VSP/Jindal make, different diameters for RCC works , including labour charges for straightening, cutting, bending to required sizes and shapes, placing in position with cover blocks of approved materials and size and tying and lap-splicing with binding wire of 18 SWG, forming grills for reinforcement work as per approved designs and drawings, including cost and conveyance of steel bars, including all wastages such as overlaps, couplings, chairs, spacer bars including cost and conveyance of binding wire, cover blocks and all incidental, operational, labour charges such as cutting, bending, placing in position, tying including sales and other taxes on all materials etc., complete for finished item of work in all floors.(APSS No.126) as per directions of the Engineer-in-charge .	51384.31	1 MT	10482399.34
10	2230.00 Cum	RCC M- 20 Nominal mix (Cement 400 kgs) using 20mm size graded machine crushed hard granite metal (coarse aggregate) from approved quarry including cost and conveyance of all materials like cement, fine aggregate (sand) coarse aggregate, water etc., to site and including Seigniorage charges, sales & other taxes on all materials including all operational, incidental and labour charges such as machine mixing, laying concrete, curing and centering, etc.,complete but excluding cost of steel and its fabrication charges for finished item of work.(cement 400 kg , sand 0.45 cum and metal 0.90 cum) as directed by Engineer in charge.	8532.10	1Cum	19026593.04

SL.	QUANTITY		DESCRIPTION OF ITEM	Unit RATE	PER	AMOUNT
No.				Rs		Rs
11	50.00	Sqm	Plasteing in CM (1:4), 12 mm thick including cost and conveyance of all materials, labour charges , water lead, curing, all leads and lifts etc complete for finished item of work as per directions of the Engineer-in-charge .	145.77	1 Sqm	7288.33
12	200.00	Sqm	Providing shoring and strutting either with country wooden planks and scantlings or with steel sheets and props for excavation of pits for tower foundations wherever necessary including cost and conveyance of all materials, labour charges, tools & tackles, all leads & lifts and etc., complete for finished item of work as per directions of the Engineer-in-charge.	97.05	1 Sqm	19410.60
Protection works						
13	400.00	cum	Earthwork excavation in all types of soils (upto stone matrix) which can be excavated in combination of mechanically and manually with pick axe and crow bars and don't require blasting in all conditions such as dry, wet, slushy etc., covering initial lead and lift etc., including backfilling, watering, compacting as per standard specification and disposing of surplus earth within site (up to 1KM lead) complete as per directions of Engineer in charge at site for finished item of work.	134.46	1 cum	53784.60
14	64.00	Cum	Laying of Cement Concrete (1:4:8) mix using 40mm size HBG Machine crushed metal for foundations including cost and conveyance of all materials at all leads and lifts, ramming, consolidating, curing etc,complete. for finished item of work as per directions of the Engineer-in-charge.	3875.80	1 cum	248051.49
15	400.00	cum	Construction of RR Masonry in CM (1:6) using hard CRS, rough granite stone and bond stones (0.16 cum) including cost and conveyance of all matreials., labour charges, water lead , Curing, all leads and lifts etc., complete for finished item of work as per directions of the Engineer-in-charge.	3680.38	1 cum	1472152.40
16	100.00	sqm	Providing and constructing 225mm thick rubble stone pitching (joints filled with cement mortar CM(1:5) proportion) including cost of all materials, labour, packing chips and mortar, finishing etc. complete for finished item of work as directed by the Engineer incharge.	313.43	1 sqm	31342.90
17	100.00	RM	Providing and fixing in position at all levels of Masonry walls as weep holes with 110 mm dia (4kg/cm2) PVC pipes of prince / sudhakar or any ISI brand make wherever necessary including fixing in position & at all leads & lifts etc. complete as per the directions of the Engineer in charge for the finished item of work.	174.32	1 RM	17431.80
18	100.00	sqm	Flush Pointing with CM (1:4) to RR Masonry walls including cost and conveyance of all materials, labour charges, water lead, curing,all leads and lifts complete as per the directions of the Engineer in charge for the finished item of work.	82.79	1 sqm	8279.00
19	10.00	cum	Plain Cement concrete - Nominal Mix (1:3:6) with 12 to 20mm HBG metal over RR wall including cost and conveyance of all materials, labour charges, water charges, tools and tackles, all leads & lifts etc., complete for finished item of work as per directions of the Engineer-in-charge. (IS-456)	5057.43	1 cum	50574.32
20	100.00	cum	Filling around the foundation / inside the rivetment walls if required where ever necessary with suitable borrowed earth other than clayey soils for filling as per the standard specifications of APDSS in uniform horizontal layers (0.15) including cost and conveyance of all materials, watering and ramming, tools & tackles, all labour charges, all leads & lifts etc, complete for finished item of work as per the directions of the	428.13	1 cum	42812.80
Sub - Total in Rs.						386,99,753.27
21	Total for CIVIL WORKS in Rs. Total					386,99,753.27
			Towards seignorage charges including SMET (2% on seignorage charges) Fund	278992.45		2,78,992.45
22	0.10%		Cess towards NAC	386,99,753.27		38,699.75
Grand TOTAL Amount in Rs.- Schedule B3 (b)						390,17,445.47

SEIGNORAGE CHARGE CALCULATION SHEET										
Name of the Work: Erection of 400kV Quad Moose DC line from proposed 400 kV Switching Station at Kachapur to 400 kV Ramadugu - Gajwel Substation DC line										
Sl. No.	Description of Item	Item qty	Qty of Earth		Qty of Gravel		Qty of Sand		Qty of Metal incl Crusher dust and stones	
			Per unit	Total Qty in Cum	Per unit	Total Qty in Cum	Per unit	Total Qty in Cum	Per unit	Total Qty in Cum
1	Laying of CC 1:4:8	64.00 Cum					0.45	28.8	0.90	57.60
2	Construction of RR/ CRS Masonry	400.00 Cum					0.33	132	1.10	440.00
3	Laying of PCC 1:3:6	460.00 Cum					0.45	207	0.90	414.00
4	Flush pointing CM (1:4)	100.00 Sqm					0.003	0.3		
5	Plastering 12mm thk	50.00 Sqm					0.01575	0.7875		
6	Providing Sand cushion	0.00 Cum					1.00	0.00		
7	Providing Crusherdust cushion	500.00 Cum							1.00	500.00
8	RCC M20 / PCC M20 nominal mix	2230.00 Cum					0.45	1003.50	0.90	2007.00
9	Filling Fdn with borrowed earth	100.00 Cum	1.00	100						
10	Filling Fdn with borrowed gravel	0.00 Cum			1.00	0				
11	Rubble stone pitching	100.00 sqm							1	100
Total Quantities				100.00		0.00		1372.39		3518.60
Seignorage charges			25.50	2550.00	25.50	0.00	34.00	46661.26	63.75	224310.75
Total seignorage charges				273522.01						
SMET 2% on above				5470.44						
Total seignorage charges in Rs.				278992.45						

Erection of 400 kV QMDC Line for making LILO of both the circuits of 400 kV NTPC - Narasapur line to 400 kV Switching Station of line length 5 KM at Kachapur village Julapally Mandal in Peddapally District in Link II for lifting additional 1TMC water from Godavari basin under Kaleswaram Lift Irrigation scheme in karimnagar (old) district wind Zone - 3					
SCHEDULE - B4 (a)					
ERECTION TESTING AND COMMISSIONING WORKS					
Sl. No	Description	Qty.	UOM	Unit Rate (in Rs.)	Amount (in Rs.)
1	Check Survey, peg marking the tower positions on ground, conforming to the approved Profile and tower schedules using GPS, Total stations, DGPS etc.	5	KM	9,722.81	48,614.05
2	Excavation of trail pit (1mt x 1 mt x 4mt)	20	No	3,937.17	78,743.32
3	Setting with stub for all types of towers with stub setting template which includes erection of stubs, fixing of jacks for supporting template, alignment and leveling excluding cost of excavation and concrete	20	sets	21,072.17	4,21,443.43
4	Super Structure Erection of all Types of Towers including Anchor Towers and their Extensions (complete) including Fitting of Step Bolts, Danger Plates, Number Plates, Phase Plates, Circuit Plates, Bird Guards, Anti Climbing Devices etc. and Tack Welding of all bolts & nuts including cost of zinc rich paint (upto bottom cross arm level)	915	MT	11,309.02	1,03,47,753.76
5	Dismantling of Super Structure Erection of all Types of Towers including Anchor Towers and their Extensions (complete) including Fitting of Step Bolts, Danger Plates, Number Plates, Phase Plates, Circuit Plates, Bird Guards, Anti Climbing Devices etc. and Transport the Dismantled material to the TSTRANSCO stores.	100	MT	8,481.77	8,48,176.75
6	Mounting of Insulators & Stringing of Double Circuit Line with Quadruple ACSR Moose Power Conductor (Quadruple Bundled) per Phase including Laying, Jointing, Tensioning etc. Sagging and Clamping with necessary Accessories and fixing spacers Under Normal Condition	4	KM	6,75,188.30	27,00,753.21
7	Mounting of Insulators & Stringing of Double Circuit Line with Quadruple ACSR Moose Power Conductor (Quadruple Bundled) per Phase including Laying, Jointing, Tensioning etc. Sagging and Clamping with necessary Accessories and fixing spacers Under Shutdown Condition	1.000	KM	11,51,461.22	11,51,461.22
8	Dismantling of Insulators & Dismantling of Double Circuit Line with Quadruple ACSR Moose Power Conductor (Quadruple Bundled) per Phase including Laying, Jointing, Tensioning etc. and Transport the Dismantled material to TSTRANSCO stores.	2	KM	5,06,391.22	10,12,782.45
9	Stringing of 1No 7/3.66mm Galvanized Steel Earthwire including Laying, Jointing, Tensioning etc. with necessary Accessories Under normal Condition.	4	KM	14,100.08	56,400.32

Sl. No	Description	Qty.	UOM	Unit Rate (in Rs.)	Amount (in Rs.)
10	Stringing of 1No OPG wire including Laying, Jointing, Tensioning etc. with necessary Accessories Complete Under normal Condition.	4	KM	69,414.80	2,77,659.20
11	Stringing of 1No 7/3.66mm Galvanized Steel Earthwire including Laying, Jointing, Tensioning etc. with necessary Accessories Under Shutdown Condition.	1	KM	24,046.18	24,046.18
12	Stringing of 1No OPG wire including Laying, Jointing, Tensioning etc. with necessary Accessories Complete Under Shutdown Condition.	1	KM	1,18,379.49	1,18,379.49
13	Dismantling of 1No 7/3.66mm Galvanized Steel Earthwire and Transport the Dismantled material to TSTRANSCO stores.	2	KM	10,575.06	21,150.13
14	Dismantling of 1No OPG wire and Transport the Dismantled material to TSTRANSCO stores.	2	KM	52,061.11	1,04,122.21
15	Earthing of Transmission Line Towers				
a)	Providing Pipe type Earthing including cost of BH Coke and Salt but excluding cost of earthing set	20	Each	5,794.81	1,15,896.14
b)	Providing Counter Poise Earthing excluding cost of all materials (4 sides of tower)	5	Each LOC.	4,857.73	24,288.67
c)	Providing Counter Poise Earthing using Bentonite and salt excluding cost of all materials (4 sides of tower)	5	Each LOC.	7,287.52	36,437.59
16	Transportation arrangement to supervise and recording the measurements of works (15 MonthsX 150kMs X 25 Trips per month)	56250	KM	4.50	2,52,928.13
Total Amount in Rs. (Electrical)					1,76,41,036.25
	LINE TELECOM ERECTION				
17	Erection & commissioning of Fibre distribution panels for termination of 24 Fibers	2	Each	16,514.36	33,028.72
18	Erection & Commissioning of OFAC along with HDPE Duct pipe in Trench	2	Km	32,121.15	64,242.30
	Total Amount (in Rs.)				97,271.02
	Grand Total in Rs. -Schedule -B4 (a)				1,77,38,307.27

Schedule B4 (b)						
Name of the Work: Erection of Quad moose DC line from Telanagana STPP (2x800MW) -400/220/132 kV Narsapur Substation DC line to proposed 400kV Switching station at Kachapur						
S.No	QUANTITY		DESCRIPTION OF ITEM	UNIT RATE	PER	AMOUNT
				Rs		Rs
1	13000.00	Cum	Earthwork excavation in all types of soils (including HDR, soft rock, F&F) (up to stone matrix) which can be excavated with pick axe and crow bars and do not require blasting in all conditions such as dry, wet and slushy etc. covering initial lead and lift etc and backfilling the foundations (after laying foundations) with excavated earth and consolidation in up to 0.15 m layer and constructing of platforms 150mm height around foundations utilizing the excavated earth etc. complete as per the directions of Engineer - In - Charge.	233.05	1 Cum	3029689.00
2	1300.00	Cum	Extra towards dewatering charges over an above the excavation rate for excavated earth quantity Where water table met at 1.50 m or more below G.L	29.28	1 Cum	38067.25
3	650.00	Cum	Extra towards dewatering charges over an above the excavation rate for excavated earth quantity Where water table met between 0.75m and 1.50m depth below G.L	103.91	1 Cum	67543.13
4	650.00	Cum	Extra towards dewatering charges over an above the excavation rate for excavated earth quantity Where water table met with in 0.75 m depth below G.L	201.98	1 Cum	131285.05
5	1500.00	Cum	Excavation in HDR, soft rock, F&F (requiring blasting) where ever necessary. The rate includes labour charges, cost of blasting materials, tools and tackles, safety measures, disposal of unuseful excavted material at all leads and lifts, complete for finished item of work as per directions of the Engineer-in-charge. (For Foundation Works).	318.84	1 Cum	478265.25
6	750.00	Cum	Excavation in Hard rock (requiring blasting) The rate includes labour charges, cost of blasting materials, tools and tackles, safety measures, disposal of unuseful excavted material at all leads and lifts, complete for finished item of work as per directions of the Engineer-in-charge	817.01	1 Cum	612758.63
7	500.00	Cum	Stone crusher dust filling below the foundations as per the standard specifications of APDSS in uniform horizontal layers including cost and conveyance of all materials, watering and ramming, tools & tackles, all labour charges, all leads & lifts etc, complete for finished item of work as per directions of the Engineer-in-charge.	832.80	1 Cum	416398.00
8	350.00	Cum	Laying of Cement Concrete (1:3:6) mix (M 10 Nominal mix) using 40mm size HBG metal (Mixing with concrete mixer) or foundations including cost and conveyance of all materials at all leads and lifts, ramming, consolidating, curing etc, complete. for finished item of work as per directions of the Engineer-in-charge.	4130.69	1 Cum	1445742.90
9	166.00	MT	Providing High Yield Strength Deformed (HYSD)/ Thermo Mechanically Treated (TMT) (Fe 500/ 500D/550D) grade as per IS 1786-1979) of TISCO/ SAIL/ VSP/Jindal make, different diameters for RCC works , including labour charges for straightening, cutting, bending to required sizes and shapes, placing in position with cover blocks of approved materials and size and tying and lap-splicing with binding wire of 18 SWG, forming grills for reinforcement work as per approved designs and drawings, including cost and conveyance of steel bars, including all wastages such as overlaps, couplings, chairs, spacer bars including cost and conveyance of binding wire, cover blocks and all incidental, operational, labour charges such as cutting, bending, placing in position, tying including sales and other taxes on all materials etc., complete for finished item of work in all floors.(APSS No.126) as per directions of the Engineer-in-charge .	51384.31	1 MT	8529795.54
10	1810.00	Cum	RCC M- 20 Nominal mix (Cement 400 kgs) using 20mm size graded machine crushed hard granite metal (coarse aggregate) from approved quarry including cost and conveyance of all materials like cement, fine aggregate (sand) coarse aggregate, water etc., to site and including Seigniorage charges, sales & other taxes on all materials including all operational, incidental and labour charges such as machine mixing, laying concrete, curing and centering, etc.,complete but excluding cost of steel and its fabrication charges for finished item of work.(cement 400 kg , sand 0.45 cum and metal 0.90 cum) as directed by Engineer in charge.	8464.63	1Cum	15320983.02
11	50.00	Sqm	Plasteing in CM (1:4), 12 mm thick including cost and conveyance of all materials, labour charges , water lead, curing, all leads and lifts etc complete for finished item of work as per directions of the Engineer-in-charge .	146.56	1 Sqm	7327.85
12	200.00	Sqm	Providing shoring and strutting either with country wooden planks and scantlings or with steel sheets and props for excavation of pits for tower foundations wherever necessary including cost and conveyance of all materials, labour charges, tools & tackles, all leads & lifts and etc., complete for finished item of work as per directions of the Engineer-in-charge.	97.05	1 Sqm	19410.60
	Protection works					

S.No	QUANTITY		DESCRIPTION OF ITEM	UNIT RATE	PER	AMOUNT
				Rs		Rs
13	250.00	cum	Earthwork excavation in all types of soils (upto stone matrix) which can be excavated in combination of mechanically and manually with pick axe and crow bars and don't require blasting in all conditions such as dry, wet, slushy etc., covering initial lead and lift etc., including backfilling, watering, compacting as per standard specification and disposing of surplus earth within site (up to 1KM lead) complete as per directions of Engineer in charge at site for finished item of work.	134.46	1 cum	33615.38
14	40.00	Cum	Laying of Cement Concrete (1:4:8) mix using 40mm size HBG Machine crushed metal for foundations including cost and conveyance of all materials at all leads and lifts, ramming, consolidating, curing etc,complete. for finished item of work as per directions of the Engineer-in charge.	3808.33	1 cum	152333.26
15	250.00	cum	Construction of RR Masonry in CM (1:6) using hard CRS, rough granite stone and bond stones (0.16 cum) including cost and conveyance of all matreials., labour charges, water lead , Curing, all leads and lifts etc., complete for finished item of work as per directions of the Engineer-in-charge.	3586.88	1 cum	896720.25
16	100.00	sqm	Providing and constructing 225mm thick rubble stone pitching (joints filled with cement mortar CM(1:5) proportion) including cost of all materials, labour, packing chips and mortar, finishing etc. complete for finished item of work as directed by the Engineer incharge.	286.42	1 sqm	28641.60
17	100.00	RM	Providing and fixing in position at all levels of Masonry walls as weep holes with 110 mm dia (4kg/cm2) PVC pipes of prince / sudhakar or any ISI brand make wherever necessary including fixing in position & at all leads & lifts etc. complete as per the directions of the Engineer in charge for the finished item of work.	174.32	1 RM	17431.80
18	100.00	sqm	Flush Pointing with CM (1:4) to RR Masonry walls including cost and conveyance of all materials, labour charges, water lead, curing,all leads and lifts complete as per the directions of the Engineer in charge for the finished item of work.	82.93	1 sqm	8293.45
19	10.00	cum	Plain Cement concrete - Nominal Mix (1:3:6) with 12 to 20mm HBG metal over RR wall including cost and conveyance of all materials, labour charges, water charges, tools and tackles, all leads & lifts etc., complete for finished item of work as per directions of the Engineer-in-charge. (IS-456)	4989.96	1 cum	49899.59
20	100.00	cum	Filling around the foundation / inside the rivetment walls if required where ever necessary with suitable borrowed earth other than clayey soils for filling as per the standard specifications of APDSS in uniform horizontal layers (0.15) including cost and conveyance of all materials, watering and ramming, tools & tackles, all labour charges, all leads & lifts etc, complete for finished item of work as per the directions of the Engineer-in-charge.	428.13	1 cum	42812.80
Sub - Total						313,27,014.35
21			Total Amount for CIVIL WORKS in Rs.			313,27,014.35
			Towards seignorage charges including SMET (2% on seignorage charges) Fund	2,26,220.76		2,26,220.76
22	0.10%		Cess towards NAC	31327014.35		31,327.01
Add unforeseen items & PS & Contingencies						-
Grand TOTAL Amount in Rs. -Schedule B4 (b)						315,84,562.12

SEIGNIORAGE CHARGE CALCULATION SHEET											
Name of the Work: Erection of Quad moose DC line from Telanagana STPP (2x800MW) -400/220/132 kV Narsapur Substation DC line to proposed 400kV Switching station at Kachapur											
Sl. No.	Description of Item	Item qty		Qty of Earth		Qty of Gravel		Qty of Sand		Qty of Metal incl Crusher dust and stones	
				Per unit	Total Qty in Cum	Per unit	Total Qty in Cum	Per unit	Total Qty in Cum	Per unit	Total Qty in Cum
1	Laying of CC 1:4:8	40.00	Cum					0.45	18	0.90	36.00
2	Construction of RR/ CRS Masonry	250.00	Cum					0.33	82.5	1.10	275.00
3	Laying of PCC 1:3:6	360.00	Cum					0.45	162	0.90	324.00
4	Flush pointing CM (1:4)	100.00	Sqm					0.003	0.3		
5	Plastering 12mm thk	50.00	Sqm					0.0158	0.7875		
6	Providing Sand cushion	0.00	Cum					1.00	0.00		
7	Providing Crusherdust cushion	500.00	Cum							1.00	500.00
8	RCC M20 / PCC M20 nominal mix	1810.00	Cum					0.45	814.50	0.90	1629.00
9	Filling Fdn with borrowed earth	100.00	Cum	1.00	100						
10	Filling Fdn with borrowed gravel	0.00	Cum			1.00	0				
11	Rubble stone pitching	100.00	sqm							1	100
	Total Quantities				100.00		0.00		1078.09		2864.00
	Seignorage charges			25.50	2550.00	25.50	0.00	34.00	36655.06	63.75	182580.00
	Total seignorage charges					221785.06	Rs				
	SMET 2% on above					4435.70	Rs				
	Total Amount for seignorage charges in Rs.					226220.76	Rs				

Price Schedule / Price Bid

NAME OF WORK :- TENDER SPECIFIC STRATEGIC TIE-UP FOR EXECUTION AND HANDING OVER OF FOLLOWING 400 KV TRANSMISSION LINE WORK INCLUDING ARRANGEMENT /SETTLEMENT OF RIGHT OF WAY ON EPC BASIS) FOR TSTRANSCO'S TENDERS AT TELANGANA UNDER KALESWARAM LIFT IRRIGATION PROJECT".
DETAILS OF TRANSMISSION LINE UNDER THE TSTRANSCO'S TENDER BID NOTICE NO.:- e-TSTLI-03/2021:

- 1) LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS to Kachapur Switching Station -line Length 2 X 3.5 KM in Karimnagar (old) district.
- 2) LILO of 400kV QMDC Line from Telangana STPP NTPC (2X800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district.
- 3) 400kV QMDC Line from 400kV Kachapur (Vadkapur) Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district.

TENDER SPECIFICATION NO.:-TBSM/KACHAPUR /STE-04/TENDER /21-22 DATE: 30.04.2021

Name of Bidder						
(This BOQ template must not modified/ Replaced by the bidder and same shall be uploaded after filling the relevant columns , else the bidder is liable to be rejected for this tender. Bidders has to be fill the Bidder Name and values only)						
Sl No.	Item Description	Quantity	Units	Estimated Rate in Rs.	Total Amount Without taxes (Rs.)	Total Amount (in words)
1	Total amount as per rates in BOQ (as per "Schedule C") for "TENDER SPECIFIC STRATEGIC TIE-UP FOR EXECUTION AND HANDING OVER OF FOLLOWING 400 KV TRANSMISSION LINE WORK INCLUDING ARRANGEMENT /SETTLEMENT OF RIGHT OF WAY ON EPC BASIS) FOR TSTRANSCO'S TENDERS AT TELANGANA UNDER KALESWARAM LIFT IRRIGATION PROJECT". DETAILS OF TRANSMISSION LINE UNDER THE TSTRANSCO'S TENDER BID NOTICE NO.:- e-TSTLI-03/2021: 1) LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS to Kachapur Switching Station -line Length 2 X 3.5 KM in Karimnagar (old) district. 2) LILO of 400kV QMDC Line from Telangana STPP NTPC (2X800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district. 3) 400kV QMDC Line from 400kV Kachapur (Vadkapur) Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district.	1.00	Nos	5831,35,013.72	5831,35,013.72	Rs. Fifty Eight Crore Thirty One Lakhs Thirty Five Thousand & Thirteen and paise Seventy Two only.
Total in Figures					5831,35,013.72	Rs. Fifty Eight Crore Thirty One Lakhs Thirty Five Thousand & Thirteen and paise Seventy Two only.
Quoted Rate in Figures			Select	Excess/Less/ at par		
Quoted Rate in Words						

“SCHEDULE C ”
(Summary of Commercial "Schedule A" & "Schedule B")

Subject :- TENDER SPECIFIC STRATEGIC TIE-UP FOR EXECUTION AND HANDING OVER OF FOLLOWING 400 KV TRANSMISSION LINE WORK INCLUDING ARRANGEMENT /SETTLEMENT OF RIGHT OF WAY ON EPC BASIS) FOR TSTRANSCO'S TENDERS AT TELANGANA UNDER KALESWARAM LIFT IRRIGATION PROJECT".

DETAILS OF TRANSMISSION LINE UNDER THE TSTRANSCO'S TENDER BID NOTICE NO.:- e-TSTLI-03/2021:

- 1) LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS to Kachapur Switching Station -line Length 2 X 3.5 KM in Karimnagar (old) district.**
- 2) LILO of 400kV QMDC Line from Telangana STPP NTPC (2X800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district.**
- 3) 400kV QMDC Line from 400kV Kachapur (Vadkapur) Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district.**

Tender Spec. no.:-TBSM/KACHAPUR /STE-04/TENDER /21-22 DATE: 30.04.2021

SI No.	Description	Amount (Rs.)
SCHEDULE - A (SCHEDULE A2+ SCHEDULE A3+ SCHEDULE A4)		
1	TOTAL AMOUNT AS PER THE RATES IN BOQ FOR " SUPPLY OF MATERIAL/EQUIPMENT FOR ABOVE MENTIONED SUBJECT TRANSMISSION LINES " SCHEDULE - A (SCHEDULE A2 + SCHEDULE A3+ SCHEDULE A4)	4213,40,113.96
SCHEDULE -B (SCHEDULE B2 (a) + SCHEDULE B2 (b) + SCHEDULE B3 (a) + SCHEDULE B3 (b) + SCHEDULE B4 (a) + SCHEDULE B4 (b))		
2	TOTAL AMOUNT AS PER THE RATES IN BOQ FOR " CIVIL AND ERECTION FOR ABOVE MENTIONED SUBJECT TRANSMISSION LINES " SCHEDULE -B (SCHEDULE B2 (a) + SCHEDULE B2 (b) + SCHEDULE B3 (a) + SCHEDULE B3 (b) + SCHEDULE B4 (a) + SCHEDULE B4 (b))	1617,94,899.76
TOTAL AMOUNT IN RS.:- "SCHEDULE C" (SCHEDULE A + SCHEDULE B)		5831,35,013.72
Note :-	1) The tenderer shall quote a percentage above/ below/At Par the rates shown in the "Schedule-C i.e Summary of Commercial Schedule A & Schedule B" of subject tender. 2) Price Bid format is uploaded on https://eprocurebhel.co.in. and also attached with the tender in section "price schedules". Bidders may please be noted that the price bid to be submitted in uploaded format only. Price bid submitted by the bidders in other formats are not acceptable to BHEL and the bid/offer shall not be considered for further evaluation. 3) The quoted percentage will apply to the individual items of all the schedules (Schedule A & Schedule B) uniformly. 4) The offers will be evaluated on the basis of total price basis i,e as per Schedule C - "Schedule-C i.e Summary of Commercial Schedule A & Schedule B". 5) Bidders are advised to go through the Various commercial schedules carefully befor submitting their offer.	

SCHEDULE – D

Tender Specification No.: -TBSM/KACHAPUR/STE-04/TENDER /21-22 Date 30.04.2021

TIME SCHEDULE FOR EXECUTION OF WORK

Name of work :

As per the Tender of subject work and scope of work mentioned in the tender documents.

The supply of materials and equipment for the above work shall be completed within **Twelve (12)** months from the date of handing over of profiles and Erection, Testing & Commissioning of above mentioned work within **Fifteen (15)** months from the date of handing over of profiles

I / We agree to the above mentioned completion period.

SIGNATURE OF THE BIDDER WITH DATE AND SEAL

INTEGRITY PACT**Between**

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

and

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

Preamble

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

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

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

Section 1- Commitments of the Principal

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

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

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

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

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

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

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

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

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

Section 4 - Compensation for Damages

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

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

Section 5 - Previous Transgression

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

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

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

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

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

Section 8 - Independent External Monitor(s)

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

- 8.5 The role of IEMs is advisory, would not be legally binding and it is restricted to resolving issues raised by an intending bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some bidders. At the same time, it must be understood that IEMs are not consultants to the Management. Their role is independent in nature and the advice once tendered would not be subject to review at the request of the organization.
- 8.6 For ensuring the desired transparency and objectivity in dealing with the complaints arising out of any tendering process, the matter should be examined by the full panel of IEMs jointly as far as possible, who would look into the records, conduct an investigation, and submit their joint recommendations to the Management.
- 8.7 The IEMs would examine all complaints received by them and give their recommendations/ views to CMD, BHEL, at the earliest. They may also send their report directly to the CVO and the Commission, in case of suspicion of serious irregularities requiring legal/ administrative action. IEMs will tender their advice on the complaints within 10 days as far as possible.
- 8.8 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.
- 8.9 IEM should examine the process integrity, they are not expected to concern themselves with fixing of responsibility of officers. Complaints alleging mala fide on the part of any officer of the organization should be looked into by the CVO of the concerned organisation.
- 8.10 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant Indian Penal Code/ Prevention of Corruption Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.
- 8.11 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.
- 8.12 The word 'Monitor' would include both singular and plural.

Section 9 - Pact Duration

- 9.1 This Pact shall be operative from the date IP is signed by both the parties till the final completion of contract for successful bidder and for all other bidders 6 months after the contract has been awarded. Issues like warranty / guarantee etc. should be outside the purview of IEMs.
- 9.2 If any claim is made/ lodged during currency of IP, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 - Other Provisions

- 10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.

- 10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.
- 10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.
- 10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
- 10.5 Only those bidders / contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.



For & On behalf of the Principal

(Office Seal)

Place-----

Date-----

For & On behalf of the Bidder/
Contractor

(Office Seal)

Witness:-----

(Name & Address) -----

Witness:-----

(Name & Address) -----

Annexure-BHEL -02

DECLARATION BY AUTHORISED SIGNATORY OF BIDDER

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

To,

**BHARAT HEAVY ELECTRICALS LIMITED,
TRANSMISSION BUSINESS GROUP,
10TH Floor, Plot no.:- C-20, 1A/1, Joy towers,
C Block, Phase 2, Industrial Area
Sector-62, Noida, Distt. Gautambudh Nagar, UP-201309**

Dear Sir,

Sub : Declaration by Authorised Signatory regarding Authenticity of submitted documents.

Ref : 1) NIT/Tender Specification No: **TBSM/KACHAPUR /STE-04/TENDER /21-22** **DATE: 30.04.2021**

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:

Annexure-BHEL-03

DECLARATION BY AUTHORISED SIGNATORY OF BIDDER

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

To,
**BHARAT HEAVY ELECTRICALS LIMITED,
TRANSMISSION BUSINESS GROUP,
10TH Floor, Plot no.:- C-20, 1A/1, Joy towers,
C Block, Phase 2, Industrial Area
Sector-62, Noida, Distt. Gautambudh Nagar, UP-201309**

Dear Sir,

Sub : Declaration by Authorised Signatory

Ref : 1) NIT/Tender Specification No: **TBSM/KACHAPUR /STE-04/TENDER /21-22 DATE: 30.04.2021**

2) All other pertinent issues till date

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

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

We further certify that our firm/ company is:-

- a.** Presently not put on hold. Suspended, delisted, banned or Black – listed by any of the BHEL Units.
- b.** Not have been booked by CBI and /or indicted by a Court of law in any criminal case relating to transportation.

In case it comes to notice of BHEL at a later stage that the contract award was obtained giving incomplete/false/suppressed/forged Information then the contract is liable to be terminated & earnest money/ performance security deposit forfeited.

Yours faithfully,

(Signature, Date & Seal of Authorized

Signatory of the Bidder)

Date:

Enclosed : Power of Attorney

Annexure-BHEL-04

FORMAT OF NO DEVIATION CERTIFICATE (To be submitted in the bidder's letter head)

REF:

Dated.....

**BHARAT HEAVY ELECTRICALS LIMITED,
TRANSMISSION BUSINESS GROUP,
10TH Floor, Plot no.- C-20, 1A/1, Joy towers,
C Block, Phase 2, Industrial Area
Sector-62, Noida, Distt. Gautambudh Nagar, UP-201309**

SUB.: TENDER FOR “TENDER SPECIFIC STRATEGIC TIE-UP FOR EXECUTION AND HANDING OVER OF FOLLOWING 400 KV TRANSMISSION LINE WORK INCLUDING ARRANGEMENT /SETTLEMENT OF RIGHT OF WAY ON EPC BASIS) FOR TSTRANSCO’S TENDERS AT TELANGANA UNDER KALESWARAM LIFT IRRIGATION PROJECT”.

DETAILS OF TRANSMISSION LINE UNDER THE TSTRANSCO’S TENDER BID NOTICE NO.:- e-TSTLI-03/2021:

- 1) LILO of 400kV QMDC Line from STPP Jaipur- Gajwel 400/220/132kV SS to Kachapur Switching Station -line Length 2 X 3.5 KM in Karimnagar (old) district.**
- 2) LILO of 400kV QMDC Line from Telangana STPP NTPC (2X800MW)- 400/220/32kV Narsappur SS to Kachapur Switching Station - Length 2 X 2.5 KM in Karimnagar (old) district.**
- 3) 400kV QMDC Line from 400kV Kachapur (Vadkapur) Switching station to 400/220kV Ramadugu SS : Length 9 KM in Karimnagar (old) district.**

TENDER NO.:- TBSM/KACHAPUR /STE-04/TENDER /21-22

Date: 30.04.2021

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,

**BHARAT HEAVY ELECTRICALS LIMITED,
TRANSMISSION BUSINESS GROUP,
10TH FLOOR, JOY TOWER, PLOT NO. C-20, 1/1A,
C BLOCK, PHASE 2, INDUSTRIAL AREA,
SECTOR-62, NOIDA – 201301 (U.P.)**

Dear Sir,

Sub : Declaration for relation in BHEL

Ref : 1) NIT/Tender Specification No..... ,

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

Tick(√) any one as applicable:

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

OR

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

(i)

(ii)

Signature of the Authorised Signatory

Note:

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

Consortium Agreement between BHEL and M/s. -----

THIS CONSORTIUM AGREEMENT entered into at Noida, India on this ----- day of -----, 2021 by BHARAT HEAVY ELECTRICALS LIMITED, a company incorporated under the Companies Act, 1956, and having its registered office at BHEL HOUSE, Sri Fort, New Delhi, India and inter alia an office at Transmission Business Group, Joy Tower, 10th Floor, C-20, 1/1A, C-Block, Phase-2, Industrial Area, Sector-62, Noida-201301 (Uttar Pradesh) (hereinafter referred to as "BHEL" which expression shall unless repugnant to the context or meaning hereof include its successors in interest, administrators, executors and permitted assigns) of the FIRST PART and M/s ----- incorporated under the Companies Act, 1956 and having its registered Office at ----- (hereinafter referred to as ----- which expression shall unless repugnant to the context or meaning hereof include its successors in interest, administrators, executors and permitted assigns).

BHEL and ----- are individually referred to as "Party" and jointly referred to as the "Parties"

WHEREAS the Parties mentioned herein above desire to submit a "Tender" in "Consortium" to Transmission Corporation of Telangana Limited hereinafter referred to as "**TSTRANSCO**", for the contract designated as Relevant works (*Relevant works needs to be defined.....*) including but not limited to engineering, planning and design, supply of all equipment and materials (including spares), execution of civil works including foundations, installation and erection, testing and commissioning for establishment of Substations and Associated Transmission Lines and training to TSTRANSCO staff for the package (TENDER DETAILS TO BE INCORPORATED) and subsequent amendments.

AND WHEREAS to meet the requirements of the "**Tender**" documents issued by TSTRANSCO, Parties intend to form a consortium to jointly bid for the said Project (hereinafter defined).

AND WHEREAS BHEL shall be responsible for relevant works including but not limited to engineering, planning and design, supply of all equipment and materials (including spares), execution of civil works including foundations, installation and erection, testing and commissioning for establishment of Substations and training to TSTRANSCO staff for the package (*TENDER DETAILS.....*), M/s----- shall be responsible to relevant works (*Relevant works needs to be defined.....*) including but not limited to engineering, planning and design, supply of all equipment and materials (including spares), execution of civil works including foundations, installation and erection, testing and commissioning including permissions and clearances as per customer's contract for establishment of Associated Transmission Lines and training to TSTRANSCO staff for the package (*TENDER DETAILS.....*) and as described under this Agreement.

AND WHEREAS Parties hereto wish to set out in this Consortium Agreement their respective duties, rights, responsibilities and obligations with respect to the Project and each other, for the fulfillment and Compliance of the terms of the "Contract".

AND THEREFORE THIS AGREEMENT WITNESSETH AS UNDER.

1. DEFINITIONS

- 1.1 By **"Project"** is meant Relevant works including but not limited to engineering, planning and design, supply of all equipment and materials (including spares), execution of civil works including foundations, installation and erection, testing and commissioning for establishment of Substations and Associated Transmission Lines (with end-bays) and training to TSTRANSCO staff for the package (*TENDER NAME.....*) (Tender No.----- and subsequent amendments) in the state of TELANGANA
- 1.2 By **"Customer"** is meant TSTRANSCO.
- 1.2.1 By **"Consulting Engineer/Consultant"** is meant any firm or person, duly appointed by the Customer from time to time.
- 1.2.2 By "Agreement" is meant this "Consortium Agreement".
- 1.3 By **"Consortium"** is meant both parties to this **"Agreement"**.
- 1.4 By **"Tender"** is meant the Tender for the Project jointly prepared and submitted by the Consortium to the Customer.
- 1.5 By **"Consortium Leader"** is meant BHEL.
- 1.6 By **"Joint Bidder"** is meant M/s ----- (TL PARTNER DETAILS).
- 1.7 By **"Contract"** is meant the Implementation Agreement to be executed between the Customer and the Consortium relating to the Project as amended from time to time in accordance with the terms of the Contract including any and all documents forming part thereof, for the execution of the Project and this Agreement.
- 1.8 By **"Scope"** is meant all supplies and services which the "Consortium" has to perform in accordance with the Contract.
- 1.9 By **"Part of Scope"** is meant the supplies and services to be performed by any one Party under Contract Agreement with the Customer.
- 1.10 By **"Contract Value"** is meant the total amount including variations and escalation payable by the Customer to the Consortium in accordance with the Contract.
- 1.11 By **"Share of Scope"** is meant the ratio expressed as a percentage between the price for the Part of Scope of any one Party and the Contract Value.
- 1.12 By **"Cost"** is meant direct Cost plus overhead incurred by any Party and is thus exclusive of any profit. Cost shall not include any contribution to be paid by the parties in proportion to their respective shares of Scope.
- 1.13 By **"Components"** is meant equipment, material, necessary drawings /documentation for assembly

wherever applicable to be delivered by either party, intended for usage of the same for execution of scope specified under the Agreement.

- 1.14 By **"Product"** is meant supplies to be manufactured and/or supplied or performed/ provided by BHEL and M/s ----- as a Consortium under the Contract with the Customer and specified in Appendix 1.

2. APPENDIX

2.1 The following Appendices are an integral part of this Agreement:

Schedules to be finalized after award of the contract:

Sl. No	Document	Appendix Number
I	Distribution of equipment scope and services between BHEL & ----- -	1
II	Internal Time Schedule	
a	Document from ----- to BHEL	2A
b	Document from BHEL to -----	2B
c	Components from ----- to BHEL	2C
d	Components from BHEL to -----	2D
e	Products & services for the projects from ----- to BHEL	2E
f	Products & services for the projects from BHEL to -----	2F
III	Organization of the project team and project directors	3
IV	Responsibilities for project team, project directors and site facilities Contract structure	4A 4B
V	Work distribution for engineering Additional assistance required by either 5B	5A 5B
VI	Training of Customer's personnel	6

2.2 If there is any deviation between the terms of this Agreement and any of its Appendices with regard to the interpretation of terms, then the provisions of Appendices I to VI relating to such variation shall have an overriding effect on the provisions of this Agreement.

2.3 The relevant Appendix hereto shall be kept up-to-date and amendments thereof shall be executed by the parties as a result of agreed amendments to the Contract or agreed internal variations/modifications by way of supplemental agreements. These are to be recorded with

updated revision numbers and date of amendments/ revision for particular Appendices.

3. PURPOSE

The Parties hereby agree that this Agreement has the sole and limited purpose of detailing the preparing and submitting of the Tender for the Project to the Customer and defining the rights, duties, responsibilities and obligations between the Parties in connection with the preparation of the Tender and the performance of the Contract after award.

4. JOINT EFFORTS

4.1 Each Party shall use all reasonable efforts to secure the award of the Contract. No Party shall, however, have a claim against any other Party arising out of a failure to secure a Contract for the Project except as a result of material breach of this Agreement.

4.2. Each Party shall advance the objectives of the Consortium in co-operation with the other Party and refrain from any and all contravening acts prejudicial to the objective of this Agreement.

5. EXCLUSIVENESS

The parties shall as long as the Agreement remains in force co-operate with each other on an exclusive basis. No Party shall during the validity hereof enter into a Contract with the Customer or any other Party for the Project, either alone or in collaboration with any other third Party.

6. LEGAL STATUS

This Agreement shall relate solely to the Project and shall not in any way be construed to constitute, create, give effect to or otherwise recognize a corporation, partnership, association of persons or formal business entity of any kind or as creating any type of sponsorship, agency, or any similar relationship between the Parties hereto. In addition the execution of this Agreement by the Parties shall not in any way be deemed to create a precedence for the establishment of any future, similar relationships between the Parties in respect of any future project(s) or contract(s) for projects not covered under this Agreement. Nothing herein shall be construed as providing for the sharing of profits or losses arising out of the respective scope of the Parties under this Agreement.

7. RELATIONSHIP TO THE CUSTOMER

7.1 Tender stipulates that the lead member shall be responsible for ensuring the completion of all the projects in the Package/sub package and the successful fulfillment of all the rights and performance of all the duties and obligations of such Consortium. However with respect to

each other, the Parties shall be solely responsible for their Part of Scope and shall provide their supplies and services as if they had concluded a separate contract with the terms and conditions of the Contract with the Customer. However, all parties shall be jointly and severally responsible to the Customer towards fulfillment of the contract conditions/ obligations.

- 7.2 The rights and obligations of the Consortium towards the Customer are defined in the Contract which shall remain binding on the Parties hereto during the validity of this Agreement.

8. RELATIONSHIP BETWEEN THE PARTIES

- 8.1 The Agreement regulates the relationship between the Parties during its validity.
- 8.2 Except as otherwise provided in this Agreement, the Parties shall in their relationship enjoy equal rights.
- 8.3 No Party shall without explicit consent of the other Party in writing in each case create obligations, accept commitments or waive rights on behalf of the other Party.
- 8.4 Each Party shall comply with the terms of Contract and be responsible for the performance of its part of Scope and the related contractual duties and shall engage such personnel and perform such services as may be required therein.
- 8.5 Except as otherwise agreed, there shall be no common pool of goods, material, equipment or other resources.

9. SUBCONTRACTING BETWEEN PARTIES

- 9.1 If any of the Party hereto subcontracts certain goods or services pertaining to its part of Scope to another party, then the resulting terms between such Party and the subcontractor/sub-vendor shall be governed by a separate subcontract. The liabilities/responsibilities of the Parties inter se under this Agreement shall not in any way be affected thereby.
- 9.2 For Components, if mutually agreed, M/s ----- shall place separate order for Disc Insulators for Transmission Lines on BHEL. The payment terms shall be mutually agreed between the Parties hereto at the time of placing the order.

10. SHARES OF SCOPE AND PORTION OF CONTRACT VALUE

- 10.1 The final Share of Scope of each party shall be defined according to the billing Break-up of the Customer.
- 10.2 Additions or amendments to the Contract or this Agreement, which result in changes to the Contract value or the internal allocation of Scope, shall lead to a corresponding amendment of the shares of Scope and portions of Contract value.

- 10.3 For determining the share of liabilities, it shall be in proportion to each Party's Share of Scope. (as per clause 10.1).

11. COMPLETENESS

- 11.1 Having due regard to the character, objectives and scope of the Project, the Parties acknowledge that the Consortium is obliged to deliver a plant which is complete and functional irrespective of all necessary supplies and services being expressly set forth in the Contract.
- 11.2 Save as otherwise provided herein, should additional supplies or services be necessary to perform the Contract, the related Cost shall be assumed by the Party or Parties, to whose part(s) of Scope such supplies or services can be properly referred with no additional consideration unless agreed upon by the Customer.
- 11.3 In the event that such additional supplies or services cannot be reasonably attributed to any one Party's or Parties part of Scope, then the Cost thereof shall be borne by both parties in proportion to their shares of Scope.
- 11.4 Should the additional supplies or services be the result of unclear interface definitions between parties, both Parties shall be required to participate in the sharing of such Cost in proportion to their respective shares of Scope.

12. CONSORTIUM LEADER

- 12.1 The Consortium Leader shall act as leader of the contracting Parties towards the Customer.
- 12.2 The Consortium Leader shall with due diligence look after the interest of other Party.

12.3 The Consortium Leader shall not make any commitments or concessions to the Customer affecting the other Party without first having received the explicit written (including email) approval of such Party. The Leader shall keep the other Party informed currently and promptly at regular intervals and the approval of the parties shall not be unreasonably delayed. In the event of delay the provision set forth in Clause 28 shall apply.

12.4 Obligations of the Consortium Leader

The tasks of the Consortium Leader shall include the following functions which require coordination of the two Parties:

- To provide coordination of the parties in the bidding phase and during the performance of the Contract.
- To conduct negotiations with the Customer or any third party, including the necessary correspondence.
- To arrange for exchanging information between both Parties.
- To provide information relating to all important matters which the Consortium Leader becomes aware of, to the other Party without delay and provide the other Party with copies

of all important correspondence in its possession, particularly those relating to each Party's Part of Scope.

12.5 Obligations of the Joint Bidder

The Joint Bidder is responsible for:

- All the coordination and follow up for securing approvals from the customer and relevant authorities covering total scope of the tender.
- To provide information relating to all important matters which the Joint Bidder becomes aware of, to the other Party without delay and provide the other Party with copies of all important correspondence in its possession, particularly those relating to each Party's Part of Scope.

13. LIABILITY OF THE PARTIES

The liability of the parties shall be primarily be restricted to its performance of the duties set out in clause 12 above.

14. PROJECT MANAGEMENT

14.1 The current and running management of the project shall be carried out by two Project Directors, one appointed by BHEL and the other one appointed by M/s ----- . The Project Directors shall endeavor to attain unanimity on all issues. The overall requirements of the Project in order to complete the Project as per specification and time shall be laid down by the project director nominated by the Consortium Leader.

14.2 Upon request by one of the Project Directors any issue of major importance shall be referred to a steering committee which shall be established by the Consortium. The steering committee shall consist of two members, one appointed by BHEL and other appointed by M/s ----- . The steering committee shall meet when it deems necessary. Meetings of the steering committee may be held in person or by telephone or by an exchange of correspondence. The decision of the Steering Committee shall be final and binding on the Parties hereto.

14.3 Any decision having an impact on any of the Consortium Parties must be unanimous.

14.4 Organization and Administration

14.4.1 General

The Project Teams of each Party are created for administration of the Project to be led by Project Directors. The organization of the project teams by each party requires that a team shall be assembled which will comprise, as the job develops, the key personnel engaged in the administration on the works within the Project. The Project Directors are responsible for

coordinating the interfaces between each Party. Necessary co-ordination meetings shall be held at required intervals at a place agreed between both the Parties.

However, it shall also be recognized that each of the Parties to the Consortium is an autonomous entity with specific identifiable duties and responsibilities to perform to achieve the successful completion of the Project.

The responsibilities for provision and facilities for sites shall be as per Appendix-4A.

14.4.2 Function of the Project Team

The following administrative, commercial and engineering functions to be fulfilled by the project team under the management of the Project Directors shall include, but not be limited to:

- a, Consolidated planning, scheduling and auditing of time schedules
- b, Direct implementation of corrective actions with the Parties of the Consortium Overall quality assurance-direct implementation of corrective actions with the Parties to the Consortium
- c, Engineering & Coordination of the design work to be performed by each Party
- d, Site - Coordinate the site activities and communicate and coordinate with the customer at site.
- e, Interface - Coordinate the interfaces between the customer and the Consortium and also between the Parties of the Consortium
- f, Supervise deliveries and services from BHEL
- g, Supervise deliveries and services from M/s -----.
- h, Contract and finance administration-handling of all contractual & Financial matter with the customer.
- i, The Project Directors will act to minimize any interface problems of Project Team duties with those of the Parties of the Consortium and to secure an effective cooperation from all concerned in common efforts.
- j, Although the principal areas of interface lie in planning and quality assurance all activities of the Project involve constant cooperation among the Parties of the Consortium in order to achieve the successful completion of the Project.

14.4.3 Organization of the Project Team

The organization of the project team is shown in Appendix 4A and the Parties shall hold the respective position set out therein. The parties shall mutually agree upon which individuals shall be members of the project team.

14.4.4 Information and Meetings

- 14.4.4.1 Each Party is obliged on request to submit the information needed by the other Party for the preparation of its individual tender as well as the performance of its Part of Scope and to participate in the planning meetings requested by a Party.

14.4.4.2 At the request of the Consortium Leader, the other Party shall participate in negotiations with the Customer or any third Party in respect of the Project.

14.4.4.3 Each Party shall have the right to participate in any meetings held with the Customer and shall be notified in writing (including e-mail and tele-fax) well in advance of such meetings.

14.4.4.4 Meetings of the Project Management may be held in person or by telephone or by exchange of correspondence.

15. MINUTES OF MEETING

15.1 Minutes of Meeting shall be kept by the Consortium Leader of all meetings of the Project management or other meetings between the Parties and between Parties and Customer and copies of these minutes shall be promptly distributed to the Parties.

15.2 Such minutes shall be deemed approved by a Party unless written disagreement therewith stating the reasons therefore is notified by the Other Party within fourteen days (14 days) from receipt thereof.

16. BID PRICE

16.1 The consortium leader shall prepare and determine the prices as only single percentage (i.e. excess / on par / less on the total Estimated Contract Value of customer) is to be quoted to the customer.

16.2 The joint bidder shall provide the prices of Transmission Line scope to the consortium leader and shall be eligible to claim the prices as quoted to the Consortium leader only irrespective of the values quoted by the consortium leader to the customer due to strategic reasons.

16.3 In the event if the quoted prices to customer is in excess to the price quoted by joint bidder to consortium leader, joint bidder shall not make any additional claim on this account.

17. COSTS

17.1 Except as otherwise expressly set forth, each Party shall bear all costs incurred by it in connection with this Agreement such as the costs of Tender preparation, submission, attending to bidding and follow up, participation in the Project management, Contract negotiations and performance hereunder.

17.2 If there are any common costs incurred(Viz. Tender fee), then the costs shall be equally borne by both the parties

18. FINANCE

Unless otherwise agreed upon between the Parties, each Party shall arrange all financing and when applicable which it deems necessary for its Part of Scope. Each Party shall bear itself all costs and risks in connection with such financing.

19. BONDS, GUARANTEES, SECURITY

19.1 At Bidding Stage for lodging the bids, the Consortium Leader shall furnish the bid guarantee as per the bid specification. For this, the other Party shall provide a counter guarantee before hand in favour of the Consortium Leader for a value in proportion to the value of its Share of Scope.

19.2 In case of award of Contract and contract split, each Party is responsible to furnish the required guarantees(VIZ. Performance security, Security deposit, Bond etc) of their respective Contracts, if acceptable to the Customer. If not then the Consortium Leader will furnish all such guarantees to Customer and other Party to furnish counter guarantees to the Consortium Leader prior to submission of guarantees to Customer.

19.3 If these bonds of guarantees are invoked by the Customer in terms of the provisions of the Contract, the parties shall be liable in accordance with clause 22 and 33, mentioned below.

19.4 The counter Guarantees will remain valid till the main guarantees stay valid with Customer or settlement of claims/ dues between Parties are carried out fully, whichever is later. The counter guarantees are to be extended by the Party as communicated by the Consortium Leader time to time failing which Consortium Leader will have full right to invoke the counter guarantees.

20. BILLING and PAYMENT

- The terms of payment for _____ Scope of Work shall be in conformity with the terms of payment as per end Customer NIT on back-to- back basis.
- All payments (as agreed between the parties) shall be made by BHEL to _____ after receipt of payments from end customer not later than 30 (Thirty) days after receipt of payment from M/s TSTRANSCO.
- In case any ad-hoc or consolidated payment is received by BHEL from M/s TSTRANSCO including any verified invoices pertaining to _____ without specifying any invoice reference then BHEL will release payment to _____ in proportion to their then verified invoices.
- Delay in payments shall not entail _____ to claim any compensation from BHEL.

21. TIME SCHEDULE

_____ have agreed to deliver the aforesaid work within a timeline of Fifteen (15) months from the date of Handing over of profiles by TSTRANSCO. The supply of materials and equipment for the above work shall be completed within Twelve (12) months from the date of handing over of profiles by TSTRANSCO.

It is clearly understood and agreed that time is the essence of the resulting contracts with M/s TSTRANSCO and strictly adhered to by _____. _____ have agreed to perform all activities as defined in the scope of work as per the L1/ L2 schedule to be agreed with M/s

22. LIABILITY — GENERAL PRINCIPLES

- 22.1 Each Party shall be liable for carrying out its Part of Scope under this Agreement as if it had concluded a separate contract with the Terms and Conditions of the Contract with the Customer. Save as otherwise expressly provided herein, each Party shall assume all technical, commercial, financial, fiscal and legal risks, including but not limited to the risk of destruction or deterioration as well as the risk of delayed payments or no payment in relation to its Part of Scope.
- 22.2 In the event there is a breach of the Contract by the Customer, no Party shall abandon or otherwise cause or delay performance of the Contract or this Agreement without the prior written Consent of the other Party which Consent shall not be unreasonably withheld.

23. LIABILITY FOR INFORMATION:

BHEL is the Consortium Leader of the Project. BHEL and m/s -----, however, shall be responsible for the design and services of their respective part of Scope as defined in the enclosed Appendices. In case there are any extra costs involved to make good any component, product/ services due to incorrect supply of information and /or component and products and services by a Party to another, the same shall be borne by the Party who supplied incorrect, information/component/ product/ services. The Parties are not liable towards each other for any consequential damages.

24. RESPONSIBILITY FOR PROJECT ENGINEERING

The project design performed by BHEL and m/s ----- for their respective share of scope must be strictly observed and changed only with the written consent of the Party that carries the responsibility of the study.

25. LIABILITY FOR DEFECTS

- 25.1 Each Party shall at its own cost remedy defects in its part of supply.
- 25.2 If the cause of a defect cannot properly be attributable to any Party, the cost to remedy defect shall be paid by the parties in proportion to their respective Share of Scope.
- 25.3 Any defect shall immediately be corrected by the Party in whose Part of Scope it is located or occurs. The costs shall be borne by that Party who caused the defect. These costs shall also include expenses for establishing the defect, for additional measures necessitated as a result of the defect, for changes in the Part of Scope of another Party necessitated by correction of such defect, and for repeat inspections or acceptance tests.

- 25.4 If performance guarantees specified in the Contract are not met, liability shall rest solely with the Party responsible.
- 25.5 Any other claims of the Customer shall be borne by the Party responsible for the event giving rise to the claim

26. LIABILITY FOR DAMAGE TO PROPERTY OR PERSONAL INJURIES.

Each Party shall be liable for property damage (including costs and losses arising there from) to the equipment, material, supplies or other property of any other Party, or of the Customer or of third parties as well as for personal injuries or death (including costs and losses arising there from) , provided (i) such property damage or personal injury or death is caused by negligence of that Party, its personnel, its subcontractor or agents, or (ii) a mandatory law makes such Party liable for such property damage or personal injury or death.

27. LIMITATION OF LIABILITY

- 27.1 No claims for loss of revenue, loss of profit, production stoppage and loss of information and data, interest losses due to delayed or postponed payments from the Customer or any other indirect, or consequential damages shall be allowed between the parties.
- 27.2 Each Party shall be liable to the other Party for damages which it, its employees, agents or subcontractors cause to the other parties, including, damages caused through breach of its obligations. However, it is agreed that the total liability for each of the Parties for damages shall not exceed the Contract value for the Part of Scope of each Party.
- 27.3 Any limitation of liability provided for in this Agreement shall apply also to the liability of any one Party for damages caused by a third Party executing any obligation under this Agreement for such first mentioned Party and other Parties of the Agreement.
- 27.4 Notwithstanding anything contained in this Agreement in the event of gross negligence or intent of a Party including its employees, agents or subcontractors, the liability of the responsible Party shall be unlimited

28. DELAYS AND DISRUPTIONS

- 28.1 If the Consortium is liable to the Customer for payment of liquidated damages or like for delay and this is due to one of the Parties, such Party shall pay such damages or the like in accordance with the Contract terms & conditions up to 10% of the Contract Value for its Part of Scope and balance damages if any will be paid by both the parties including the defaulting Party in proportion to their respective Shares of Scope.
- 28.2 If the delay is due to both parties, liquidated damages or the like shall be paid by both parties in proportion to their contribution to the delay, duly identifiable.
- 28.3 If the responsibility for the delay cannot be properly referred to any of the Parties, claims for such

liquidated damages or the like shall be paid by the Parties in proportion to their respective shares of Scope.

- 28.4 If one Party causes disruptions resulting in delays including delay in the Part of Scope of another Party, the Party causing disruptions shall be liable for the extra Cost incurred by the other Party. Claims for such extra costs shall not be submitted continuously, but shall be deemed as a part of the accumulated balance of all such claims. The accumulated balance shall be settled at the time of Takeover of the Project.
- 28.5 In the event the Customer deducts liquidated damages from the non-defaulting Party for the breaches/defaults of the other party, the defaulting Party shall reimburse the non defaulting Party in line with above. Such reimbursements between parties will be settled within 3 months from the end of contract period of individual Customer contract.

29. TECHNICAL PERFORMANCE GUARANTEES

- 29.1 If the Customer claims Penalty or the like for non-compliance with technical performance guarantees, the Party responsible for the Part of Scope (Appendix 1) which has caused the non-compliance shall pay such liquidated damages or the like, specified in the Contract. If the non-compliance has been caused by the Parts of Scope of both parties, Penalty or the like shall be paid by such Parties in proportion to the non-compliance caused by their respective Parts of Scope.
- 29.2 Claims for liquidated damages or the like which cannot be properly referred to the Part of Scope of any of the Parties shall be paid by the Parties in proportion to their respective Shares of Scope.

30. INDEMNITY/JOINT LIABILITY

- 30.1 If any claim, for which one or more Parties is/are liable, is asserted against another Party then the liable Party promptly shall defend and hold harmless the affected Party and indemnify it in respect of such claims. The Party against whom the claim is initially asserted shall not make any admission or prejudicial statements or accept any liability thereof without the prior written (including email and tele-fax) consent of the defaulting Party.
- 30.2 Claims asserted against the Consortium or any Party for which no individual Party or Parties can be held liable under this Agreement shall be discharged jointly by all Parties in proportion to their respective Shares of Scope.
- 30.3 Such joint discharging shall also be applied if and to the extent that a limitation of liability (including a disclaimer for indirect and consequential damages/losses in the Contract) against the Customer cannot be enforced unless the unenforceability of the limitation of liability was due to gross negligence or intent of a Party in which case such Party shall indemnify the other Party for such claims.

31. PROVISIONAL SETTLEMENT

Should the Parties not come to an agreement regarding their respective responsibility for any claim from the Customer, such claim shall be provisionally settled jointly by both Parties in proportion to their respective Shares of Scope until the Parties arrive at a settlement amicably or until the Arbitration Tribunal according to clause 42 has finally determined the matter.

32. DEFAULT

32.1 If any defect, delay or other default should occur which could lead to cancellation or termination of the Contract by the Customer or to other serious consequences and, upon written notice being served by the other Party on the Party responsible thereof, if such Party does not immediately initiate adequate remedial measures or does not succeed with such measures within the period set forth in the Contract or, if no period is set forth in the Contract, within a reasonable time, then the other Party after serving a further written notice, are entitled to carry out such necessary remedial measures and the defaulting Party shall indemnify the Party/Parties performing the remedial work for the extra Cost incurred thereby to the extent such Cost is reasonable and justifiable.

32.2 If one Party is in default of its obligations set forth in this Agreement and/or the Contract and such Party, due to its insolvency, is not in a position to discharge its liabilities, such liability shall be discharged by the other Party, provided, that nothing contained herein shall release the defaulting Party from its liabilities hereunder.

32.3 If any of the events mentioned in Clause 33.1 should occur or in case a Party should become insolvent, the other Party shall, upon notice to the Party concerned, (the "Defaulting Party") be entitled to take over and complete any Part of Scope of the Defaulting Party. In such case, the other Parties shall automatically have the right to receive any and all payments which would otherwise be due to the Defaulting Party and apply the proceeds thereof to cover all Cost incurred by the other Party in taking over and completing (by subcontracting or otherwise) the Defaulting Party's Part of Scope and to cover any and all outstanding warranties or other obligations of the Defaulting Party. In addition, the other Parties shall have the right of exclusive use and possession of all the Defaulting Party's equipment being utilized for the Project, temporary works, materials, drawings, designs and other intellectual property rights and all other items prepared or used for the Project and shall have a preferred lien on all of the foregoing in order to satisfy any cost incurred by the other Party in completing the Defaulting Party's Part of Scope

32.4 In the event of any party becomes bankrupt or declared as insolvent, the other party may at any time, terminate the contract by giving a written notice of 30 days to the party at default. In such case if any party is required to execute the work on behalf of the other party (Party at default) and sum incurred towards execution of such balance work exceeds the contract

price, the party performing the work shall be entitled to recover such differential amount along with the overheads from the party at default through legal remedies available under Law of India.

33. CANCELLATION OR TERMINATION FOR DEFAULT

- 33.1 In the event of a cancellation or termination of the Contract in whole or in part by the Customer because of a default by any of the Parties as stated in Article 32, the liable Party shall compensate the other Party affected towards the actual costs and losses incurred as a result thereof.
- 33.2 Any damages payable to the Customer due to such cancellation or termination shall be paid by the Party or Parties in default.
- 33.3 The provisions of this clause take priority over any other provisions of this Agreement in case of cancellation or termination of the Contract.

34. INSURANCE

The parties shall insure adequately all the risks as per Customer's Contract provisions and shall take insurance covers individually covering their respective scope of work.

35. CLAIMS AGAINST THE CUSTOMER

If any Party considers that it has a claim against the Customer, it shall, after consultation with the other Party, be entitled at its own Cost to assert the claim and take all actions necessary to reach a final settlement of the claim including arbitration, court proceedings and enforcement proceedings. If in connection therewith it should become necessary for the Party which has the claim to act both in its own name and in the name of the other Party, then the other Party shall authorize the first Party to act in its name to the limited extent set forth herein. The first Party shall indemnify and hold harmless the other Party from all claims which may be brought against them as well as from all damages, losses and expenses incurred by them as a result of such actions as aforesaid (except such claims, damages etc. for which one or more of the other Party is liable according to other provisions of this Agreement). The respective Party who is making such a claim shall bear all costs relating thereto.

36. TAXES

- 36.1 Each Party shall be responsible for paying all taxes, duties and similar charges ("Taxes" for the purpose of this clause) levied upon it in connection with the performance of its Part of Scope and carry out all necessary filings, registrations and fulfill all other obligations towards relevant fiscal

authorities in relations thereto.

- 36.2 Should, however, the fiscal authorities in the country where the Scope has to be completed impose Taxes on the basis of the total Contract Value rather than on the individual Portions of contract Value, then all Parties shall bear the burden of such taxes in proportion to their respective Shares of Scope. The Project management shall in such cases discuss and decide how and by whom all necessary filings, registrations and other required formalities for the Consortium are going to be handled as well as possible remuneration for the fulfillment of such task.
- 36.3 Nothing contained in this clause shall limit the responsibilities of each Party to keep proper accounts, documentation and to comply with the relevant tax regulations in the country where the Scope has to be completed.
- 36.4 Each Party shall be responsible for due payment of all Taxes in respect of its own personnel as well as the personnel of its subcontractors.

37. CONFIDENTIALITY

- 37.1 Each of the Parties agrees to keep confidential all Information received from the other Party in connection with the Contract. "Information" shall mean any information or data (including, without limitation, business and technical documents, drawings, specifications, data transferred by electronic form such as email, products, software) disclosed by either PARTY to the other PARTY pursuant to this Agreement, either in a tangible, oral or visual form, provided, however, that; (a) if the information or data is disclosed in a tangible form, it shall be clearly marked as being "confidential" and (b) if the information or data is disclosed orally or visually, it shall be identified as being confidential upon disclosure and shall be reduced to writing clearly being marked as "confidential" immediately within seven days after such oral or visual disclosure
- 37.2 Each of the Parties also agrees not to make use of such information for any Purpose(s) other than (i) to further the purpose of the Consortium and (ii) to perform its Part of Scope.
- 37.3 This undertaking shall be valid until 5 years after the expiration of this Agreement.**
- 37.4 The above undertaking in this clause shall, however, not apply to information which through no fault of the receiving Party, is or becomes generally known through publication or otherwise, or is known as a matter of public record, or generally known and properly available to the receiving Party and/or to others in a reasonable integrated form or the receiving Party can establish in its possession, without any restrictions as to its disclosure, at the time of its receipt, or is subsequently lawfully acquired by the receiving Party independently of any other Party, or is developed independently by the receiving party and without reliance upon information disclosed hereunder, by enforcement of law, a government order/ directive or a court order the receiving PARTY is required to disclose; or
- 37.5 If a Party in order to perform its Part of Scope needs to disclose to a subcontractor information

received from another Party, then such first mentioned Party shall have the right to do so to extent needed for such purpose but shall first obtain from such subcontractor a confidentiality undertaking consistent with the provisions of this Clause.

38. INFRINGEMENT

It is specifically agreed upon by and between the Parties that the Designs, Drawings, Specifications and other intellectual material (herein after referred to as " IPR's") provided and disclosed by one Party to other in pursuance of and in the course of this agreement is a proprietary material of the Party who has provided & disclosed the same and shall always remain an absolute property of that Party ("the Proprietor"). Parties to the Agreement shall have no right whatsoever to retain, modify, alter, use and / or infringe the same without written permission of Proprietor during the course and /or anytime after completion/termination of this Agreement and Contract. It is further agreed that Party shall immediately return the IPRs to the Proprietor or destroy the copies of IPR's as per the instructions of the Proprietor after completion/termination of this Agreement and Contract. It is further agreed that the Party shall furnish an Undertaking to the Proprietor in a format provided by the Proprietor about non- retention and destruction of copies of the IPRs to the satisfaction of the Proprietor.

Each Party shall assume all liability under the Contract for infringement of patents or other industrial/intellectual property rights belonging to third parties and caused by its Part of Scope and shall indemnify and hold the other Party harmless from all such liability.

Publications of any kind referring to the work of another Party or of the Consortium shall require the prior approval of all Parties.

39. ENTIRE AGREEMENT AND CHANGES

- 39.1 This Agreement with all its appendices constitutes the entire agreement between the parties on the subject matter hereof and supersedes any and all prior understandings, correspondence or agreements (oral or written) between the parties and can only be modified or amended by written agreement between parties hereto.
- 39.2 If any provision of this agreement is or becomes invalid, such invalidity shall not affect the other provisions of this Agreement

40. ASSIGNMENT

Saving the appointment of the sub contractors/sub vendors in terms of this Agreement, the rights and obligations of a Party in accordance with this Agreement may only be assigned with the prior approval of the other Parties and the Customer in writing, which approval shall not unreasonably be withheld or delayed.

41. DURATION OF AGREEMENT

- 41.1 This Agreement shall become binding and enforceable upon execution thereof by all parties and shall terminate or come to an end on the earliest occurrence of the following events (whichever is later);
- i. The Tender has not been submitted to the Customer within the time stipulated for tendering.
 - ii. Award of the Contract as contemplated by the Agreement to a Party or parties other than the Consortium
 - iii. Final rejection by the Customer of the Tender.
 - iv. Expiry of the period of validity of the Tender unless the Parties have jointly agreed to extend the validity of the Tender beyond such period, or,
 - v. Fulfillment of all obligations by the Customer and the Parties in respect of the Project and fulfillment of all obligations by the Parties under this Agreement and final settlement of accounts between the parties including discharge of Bank Guarantees.
- 41.2 In the event that any one Party refuses to agree to extend the validity of the Tender beyond the validity period of the Tender as stated under 41.1.iv then the other Party shall be at liberty to extend the validity of the Bid and execute the Contract as sole Bidder without any Liability devolving on the other Party.
- 41.3 The Memorandum & Articles of Association / Constitution of both the parties authorizes them to enter into such agreement as an independent entity. Both the parties agree that it would be obligatory on its part to comply with the provisions of all statutes, ordinance, rules and regulations applicable to the Products manufactured and supplied pursuant to this Agreement and from time to time.
- 41.4 All notices required to be given or served by either party hereto on the other Party shall be deemed to have been given or served if the same shall have been delivered to, left at or sent by registered post acknowledgment due by either party to the other at its registered office provided that either party shall have the right to inform the other of any other address at which such shall be received by it, and the same shall be deemed to have been duly given or served if the same shall have been delivered to, left at or sent by registered post acknowledgment due to such party at such other address/addresses notices including e-mail and tele-faxes. Both the parties shall be under obligations to inform each other change of postal address, e-mail, tele-faxes, if any. In case of failure, the notice served on the last known address shall be deemed to have been duly served upon the party.

42. DISPUTES AND APPLICABLE LAW

In case of disputes, the Parties hereto shall mutually endeavor to resolve any difference or dispute arising out of this Consortium Agreement amicably failing which all such disputes shall be referred to

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the Steering committee to be constituted in pursuance of this Agreement. In the event the differences still remain unresolved then the same shall be referred to sole arbitration in terms of the provisions of Arbitration & Conciliation Act, 1996 of India and its subsequent amendments thereof, by appointing a sole arbitrator mutually agreed by both the parties. The arbitration proceedings shall be conducted in English language in accordance with the provisions of Arbitration and Conciliation Act. 1996 and its subsequent amendments. The decision of the arbitrators shall be final and binding upon the Parties. The seat of arbitration shall be at Delhi.

This Agreement shall be governed by and interpreted in accordance with Laws of India.

With regard to the adjudication of disputes in relation to or arising out of this agreement, Courts at New Delhi shall have the exclusive jurisdiction for adjudication of the said disputes.

This Agreement has been executed in two (2) originals, each of which shall be deemed an original, and each of which shall constitute one and the same instrument.

IN WITNESS WHEREOF the parties have caused this Agreement to be executed in two originals by their duly authorised representatives on the day and year first above written:

For and on behalf of
Bharat Heavy Electricals Limited

For and on behalf of
M/s -----

WITNESS

1. Signature
Name
Address

1. Signature
Name
Address

2. Signature
Name
Address

2. Signature
Name
Address

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Annexure- BHEL-06

