BHARAT HEAVY ELECTRICALS LTD.

(TRANSMISSION BUSINESS GROUP)

TERMS AND CONDITIONS FOR INDIGENOUS TENDER ENQUIRY

This Format is to be submitted in original duly signed by bidder. Deviation, if any, is to be brought out clearly in Schedule of Commercial Deviation giving clause-wise deviation. Any condition / clarification / deviation mentioned elsewhere may not be accepted.

Sr. No.	Standard Terms & Conditions Enquiry No.- 254E017 REV 01 Dated 15.01.15
1.	**INSTRUCTION TO BIDDERS:** a) Sealed quotations are invited for the items mentioned in the enquiry. Quotations should be typed and free from over writing and erasures. Corrections or additions must be clearly written both in words and figures and attested, otherwise offer shall be liable for rejection. b) Bidder must ensure that their quotation is received / dropped in the tender box on or before 14:00 Hrs of the due date of opening. ***Material Management Division*** ***Transmission Business Group*** ***Tower A, 5th Floor, BHEL, Advant Navis IT Business Park*** ***Plot No 7, Sector - 142, Express way Noida*** ***Noida -201305*** ***DISTT- GAUTAM BUDH NAGAR, UP*** c) The same shall be opened at 14:30 Hrs. on the same day. Tenders received late may be rejected. Bidders sending tenders by courier or post, to ensure that it is delivered one day before as same day delivery may not reach above office by due time. d) Bids are to be submitted in Two parts: i) Techno-commercial bid (Part-I): To be submitted in duplicate. A copy of price bid (Part-II) "without prices" is also to be enclosed in Part-I bid. ii) Bidder to strictly ensure submitting the price bids in BHEL format of Rate Contract or as per project requirement. iii) Price bid (Part-II): To be submitted only in one copy in a separate sealed envelope. This should not contain any Technical or Commercial Terms. The rates should be quoted both in figures and words. In case of any difference between figures and words, the quoted rate in words shall prevail over figure. Futher in case of difference between unit rate & total price, unit rate in words shall prevail over total price. Both Part-I and Part-II bids are to be sealed in separate envelope and both envelopes to be kept in another common envelope. Each envelope should be sealed and superscribed with enquiry no., item / package name, project name (if any) and due date of opening. e) For any technical clarification please contact :

Shri ALI ABBAS, Sr. Engineer (TBEM)
BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP
TOWER A, 5TH FLOOR, ADVANT NAVIS IT BUSINESS PARK,
PLOT NO-7, SECTOR-142, EXPRESSWAY NOIDA,
NOIDA-201305,
DISTT- GAUTAM BUDH NAGAR, UP, INDIA
Phone : 0120 – 6748546
E-mail : aliabbas@bhel.in; plkadhala@bhel.in

For any Commercial clarification, please contact:

SH. S.C. SHIVHARE, SR. MGR.(TBMM)
BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP
TOWER A, 5TH FLOOR, ADVANT NAVIS IT BUSINESS PARK,
PLOT NO-7, SECTOR-142, EXPRESSWAY NOIDA,
NOIDA-201305,
DISTT- GAUTAM BUDH NAGAR, UP, INDIA
Phone : 0120-6748473 / 0120-6748471
Email: shashirai@bhel.in / scshivhare@bhel.in / a.kumar@bhel.in

f) Price bid should contain only rates / prices, otherwise bid shall be liable for rejection.

g) Price bid submitted along with the bid shall remain valid up to validity of offer. Unsolicited Supplementary / Revised price bid submitted during validity period of offer, unless asked by BHEL, shall not be considered. Withdrawal of quotation by the bidder, at any stage after its opening, may entail blacklisting of vendor.

h) Enquiry condition for where the scope against this tender includes Installation and Commissioning of the equipment / material:

There will be separate contract awarded for Supply portion and Site execution portion. For Supply portion Commercial Terms and Conditions mentioned herein shall be applicable & for Site execution portion Terms and Conditions for Installation services shall be applicable. However, any breach in either of the contracts shall be deemed as the breach of other contract also.

2. PRICES:

A. The prices to be quoted are with PVC with following formula :

PVC as per IEEMA as applicable as on date of dispatch. Present PVC formula as per Annexure – II.

The base indices in the formula shall be of first notification of IEEMA of the month one Month prior to Scheduled Techno – Commercial Bid opening. The date of delivery shall be P. O. Delivery Date or Date of Actual Dispatch, whichever is earlier.

B. The prices shall be quoted by the vendors considering below:

Mega Power project. Deemed Export benefits are available as per Foreign Trade Policy of Govt. of India.

C. The prices are to be quoted on Ex-works basis. The break-up of prices shall be as under : -

a) **Ex-works Price**: Ex-Works price including packing & forwarding Charges.

b) **Excise Duty**: Exempted .PAC/ Exemption certificate for BOIs shall be issued by Customer (NPGC) .

c) **Sales Tax**: ST / VAT / CST (against C form) as applicable to be quoted extra as percentage in un-priced and price bid. In case of inter-state sale-in-transit supplier/vendor will have to provide E1/E2 form.

d) **Entry tax / Octroi Charges**: Any Entry tax / Octroi applicable at destination / destination state shall be paid extra on proof of such payment.

e) **Freight & Insurance**: Freight and Transit Insurance for door delivery up to destination/site is to be quoted.

Note: The purchase order shall be placed on Ex-works basis.

"BHEL reserves the right to go for Reverse Auction (RA) instead of opening the sealed envelope price bid, submitted by the bidder. This will be decided after techno-commercial evaluation. All bidders to give their acceptance for participation in RA. Non-acceptance to participate in RA may result in non-consideration of their bids, in case BHEL decides to go for RA.

In case BHEL decides to go for Reverse Auction, only those bidders who have given their acceptance to participate in RA will be allowed to participate in the Reverse Auction. Those bidders who have given their acceptance to participate in Reverse Auction will have to necessarily submit 'online sealed bid' in the Reverse Auction. Non-submission of 'online sealed bid' by the bidder will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines in vogue."

Further to above clause, please refer attached Annexure I for Terms & Conditions Of Reverse Auction Page 1 & 2)

3. **a) TERMS OF PAYMENT FOR BOIs:**

100% payment along with taxes, duties, Freight & Insurance within 60 days (45 days for MSE Vendor) from the date of receipt of complete invoice **in TBG, BHEL** with following documents in 3 sets (Original + 2 copies).

- LR duly endorsed in the name of Customer by BHEL-Site
- Material Receipt certificate issued by Site as per attached format
- Excise invoice (where ED re-imbursement is required)
- Packing List (Case-wise)
- Copy of Performance Bank Guarantee
- Transit insurance Certificate from insurance Comp or intimation of Transit Insurance duly endorsed by insurance Comp.
- MICC issued by BHEL
- Guarantee Certificate

Sr. No.	Standard Terms & Conditions Enquiry No.- 254E017 REV 01 Dated 15.01.15
	b) Terms of payment for Type test charges: 100% payment with taxes and duties on acceptance of test reports by BHEL on certification by BHEL engineering within 60 days from the date of receipt of clear invoice.
4.	**INTEREST LIABILITY:** In case of any delay in payment due to any reason, BHEL shall not pay any interest on delayed payment.
5.	**GUARANTEE:** The equipment / material shall be guaranteed for 18 months from the date of delivery or 12 months from the date of commissioning, whichever is earlier. The defective material / component shall be replaced free of cost at site.
6.	**PERFORMANCE BANK GUARANTEE:** Supplier shall submit BG within 30 Days of P.O. placement for a value of 2% of Ex-works value of Purchase Order Rev-0 and valid for a period of 18 months + 3 months claim period (i.e. Total 21 months) from the date of last delivery. Further BG shall be released only after ensuring submission of documents as per clause 3.5 of Technical specification (Final Engineering Documentation).
7.	**FINAL ENGINEERING DOCUMENTATION:** Final Engineering Documetation as called in the specification is to be submitted within 3 months from the date of dispatch of material. Bank Guarantee pertaining to Purchase Order shall be released only after certification of documents submission as per Clause No. 3.5 of Tech Spec No. TB XXX 618-006 Rev 00.
8.	**INSPECTION:** BHEL / customer / Third party shall inspect equipment / material before despatch. Stage inspection during manufacturing may also be carried out. Material to be despatched only after getting Despatch Clearance from BHEL. Supplier shall send inspection call on prescribed format only, with an advance notice of 15 days. Vendor shall forward all inspection and test reports for issue of MICC by BHEL. Road Permit Form request should also be given along with Inspection call.
9.	**DESPATCH DOCUMENTS:** Following despatch documents are to be immediately sent to purchaser on despatch: • Copy of LR • Packing List (Case-wise) • Insurance Certificate • Guarantee Certificate

Sr. No.	Standard Terms & Conditions Enquiry No.- 254E017 REV 01 Dated 15.01.15
10.	**DELIVERY PERIOD:** Bidder to specify the delivery period in weeks from the date of LOI / PO in the Activity Schedule Format enclosed with enquiry. Time for conduction of type test, if required, is to be separately indicated. Note: LR date or Invoice date whichever is later shall be considered as delivery date.
11.	**DELAYED DELIVERY:** In case of delay in execution of order beyond the lot wise contractual delivery, an amount of ½ % of total Ex-Works Value of Delayed Lot per week or part there-of subject to maximum of 10% Ex-Works Value of Delayed Lot will be withheld.
12.	**VALIDITY:** The offer shall be valid for 120 days from the due date of opening.
13.	**QUANTITY VARIATION:** **As per Technical Specification TB XXX 618-006 Rev 00**.
14.	**ACCEPTANCE / REJECTION OF TENDER:** BHEL reserves the right to reject in full or part, any or all tender without assigning any reason thereof. BHEL also reserves right to vary the quantities mentioned in the tender.
15.	**EVALUATION:** Comparative statement shall be prepared based on total quantity basis unless otherwise indicated in the enquiry. Evaluation of offers shall be done on the basis of delivered cost to BHEL.
16.	**DEVIATION:** The bids having deviation(s) w.r.t. tender are liable for rejection. However, BHEL, at its discretion, may load the prices for evaluation of offer as per Loading Criteria for identified deviations mentioned in clause No. 25.
17.	**ARBITRATION:** All cases of disputes emanating from and relating to this contract shall be referred to the sole arbitration of Unit Head / GM, BHEL or any other person nominated by him(including an employee of BHEL, even though he had to deal with the matter relating to this contract in any manner) to act as sole arbitrator. The arbitration shall be in accordance with 'The Arbitration and Conciliation Act 1996' and the rules there under as amended from time to time. The arbitrator shall give a reasoned award. The decision of the arbitrator shall be final & binding upon both the parties. The venue of arbitration shall be Delhi.
18.	**LEGAL SETTLEMENT:** Subject to clause 17 hereinabove this contract shall be subject to exclusive jurisdiction of courts at Delhi.

Sr. No.	Standard Terms & Conditions Enquiry No.- 254E017 REV 01 Dated 15.01.15
19.	**SUBCONTRACTING :** In case further subcontracting of BHEL order or part thereof is envisaged by supplier, the same can be done after written permission is obtained from BHEL. However it shall not absolve the supplier of the responsibility of fulfilling BHEL purchase order requirements.
20.	**RISK PURCHASE :** In case the successful bidder fails to supply or fails to comply with the terms & conditions of the purchase order, BHEL reserves the right to source such material/ component / equipment/ system from any other agency at the risk and cost of the successful bidder.
21.	**ADJUSTMENT OF RECOVERY :** Any amount payable by the supplier under any of the condition of this contract shall be liable to be adjusted against any amount payable to the supplier under any other works / contract awarded to him by any BHEL unit. This is without prejudice to any other action as may be deemed fit by BHEL.
22.	**FORCE MAJEURE CONDITION :** If by reason of war, civil commotion, act of god, Government restrictions, strike, lockout which are not in control of supplier the deliveries are delayed, supplier shall not be held responsible.
23.	**TECHNICAL SPECIFICATION :** **TB- XXX 618 006 REV 00**
24.	**QUALITY PLAN :** The standard QAP of G.I. Lattice Structures of NTPC would be applicable.
25	**LOADING CRITERIA FOR DEVIATIONS TAKEN BY BIDDER ON:** **25.1.TERMS OF PAYMENT**: If a bidder asks for payment within specified no. of days from the date of receipt of invoice with complete documents as per "Terms of Payment" at sr. No. 3 above, loading to be done as follows: a) Base rate of SBI (as applicable on the date of techno commercial bid opening) + 6 % shall be considered for loading for the period of relaxation sought by the bidder. b) 60 days - No loading **25.2. DELAYED DELIVERY / PENALITY DUE TO DELAYED DELIVERY**: Loading for not accepting this clause / accepting only on un delivered portion shall be the maximum amount specified in this clause. **25.3 GUARANTEE**: Normally BHEL will not accept deviation against this clause and offer may be ignored on this deviation, however If the offered guarantee period is less than the tender guarantee period the ex- works prices shall be loaded for the difference in the period (higher of the difference with respect to guarantee required from date of delivery and date of commissioning) @ 2.5 % per year for number of months(fractional months to be rounded off to next higher)
26	**"**MSE suppliers can avail the intended benefit only if they submit along with offer, attested copies of either EM II certificate having deemed validity (Two years from the date of issue of acknowledgement in EM II) or valid NSIC certificate or EM II certificate along with CA certificate (Format enclosed as per Annexure - 1) applicable for the year, certifying quantum of investment in plant and machinery within the permissible limit as per the act for

Sr. No.	Standard Terms & Conditions Enquiry No.- 254E017 REV 01 Dated 15.01.15
	relevant status (Micro or Small) where the deemed validity of EM II is over. Date to be reckoned for determining the deemed validity will be the last date of technical bid submission. Non submission of such documents will lead to consideration of their bid at par with other bidders and MSE status of such suppliers shall be shifted to Non MSE supplier till the supplier submits these documents".
27	**Pre- Qualification Criteria:** A. Bidder should have fabricated and successfully type tested at least one project of 400kV or higher kV transmission lines. B. Bidder should be approved vendor of NTPC for 400kV or higher kV transmission lines tower structure. Relevant documents (like order copies /completion certificates for projects) of bidders and its agency(s) should be submitted with the bid.

SCHEDULE OF PRICE

PROJECT :- NPGCPL NABHINAGAR STPP **Enquiry No .254E017 REV 01 Date:- 15.01.15**

ITEM:- LATTICE STRUCTURE (TRANSMISSION LINE)

SL. NO.	DESCRIPTION OF ITEM (As per Tech Spec. TB XXX 618 006 Rev -00)	UNIT	QUANTITY	UNIT PRICE EX. WORKS (Rs.)	TOTAL EX. WORKS (Rs.)	UNIT FREIGHT & INSURANCE UP TO SITE (Rs.)	TOTAL FREIGHT & INSURANCE UP TO SITE (Rs.)	ED (EXEMPTED/ NOT APPLICABLE) (Rs.)	CST/VAT/ST @.....% OF COL 6 (Rs.) AGAINST FORM "C"	F.O.R. DESTINATION PRICE (Rs.) COL (6+8+10)
1	2	3	4	5	6	7	8	9	10	11
1	Preparation of shop drawings based on fabrication drawings (Line diagram) provided by BHEL, fabrication and supply of 400 kV line towers (mild steel and HT steel as required) , submission of proto corrected drawings/BOMs, mass fabrication, galvanising, inspection and supply of lattice, type galvanized steel structures including stub assembly. (Zinc coating 610 gms/sq.m)	-	-							
a	Mild steel	MT	350					EXEMPTED		
b	HT (High Tensile) steel	MT	500					EXEMPTED		
2	Destructive testing of one no. , 400 kV transmission line tower (DD Type) including supply of all materials required for tower to be tested. All necessary arrangements (proto assembly, transportation etc) complete in all respect for conducting the tests are included in the scope of vendor. All tower materials after testing shall be property of bidder.	Lot	1					NOT APPLICABLE		
3	Destructive testing of one no. , 400 kV transmission line tower (DA Type) including supply of all materials required for tower to be tested. All necessary arrangements (proto assembly,transportation etc.)complete in all respect for conducting the tests are included in the scope of vendor. All tower materials after testing shall be property of bidder.	Lot	1					NOT APPLICABLE		
4	Preparation of shop drawings based on fabrication drawings (Line diagram) provided by BHEL, fabrication and supply of 33 kV line towers (mild steel as required) , submission of proto corrected drawings/BOMs, mass fabrication, galvanising, inspection and supply of lattice type galvanized steel structures including stub assembly. (Zinc coating 610 gms/sq.m).	-								
a	Mild Steel	MT	110					EXEMPTED		
5	Destructive testing of one no. , 33 kV transmission line tower (A Type) including supply of all materials required for tower to be tested. All necessary arrangements(proto assembly, transportation etc.) complete in all respect for conducting the tests are included in the scope of vendor. All tower materials after testing shall be property of bidder	Lot	1					NOT APPLICABLE		
6	Destructive testing one no. , of 33 kV transmission line tower (C Type) including supply of all materials required for tower to be tested. All necessary arrangements (proto assembly, transportation etc.) complete in all respect for conducting the tests are included in the scope of vendor. All tower materials after testing shall be property of bidder	Lot	1					NOT APPLICABLE		
7	Supply of MS stub templates made of channels,angles etc	MT	6					EXEMPTED		
	TOTAL COST TO BHEL							EXEMPTED / NOT APPLICABLE		

NOTE:

1. PLEASE NOTE THAT UNPRICED COPY OF PRICE BID (i.e. WITH ALL PRICES BLANKED) SHALL BE FURNISHED ALONG WITH TECHNO-COMMERCIAL BID.
2. REQUIRED COPIES OF FORMAT BE MADE & DETAILS MAY BE ANNEXED.
3. THE PRICES MUST BE QUOTED IN THE PRESCRIBED UNIT ONLY.
4. SALES TAX RATE AS APPLICABLE FOR SPECIFIED DESTINATION SHALL BE QUOTED. IN CASE OF CST, RATE AGAINST "C" FORM SHALL BE QUOTED.
5. IN CASE OF VARIED ED SLAB RATES, CONFIRM YOUR OPTION FOR "X" OR "Y". (STRIKE OFF WHICH IS NOT APPLICABLE) IF NO OPTION IS MENTIONED "X" SHALL BE TAKEN.
6. THE VENDORS MUST INDICATE THE APPLICABLE TARIFF NOS. UNDER WHICH ED AND / OR CST WOULD BE PAID BY THEM TO THE TAX AUTHORITIES.
7. IF A VENDOR SUBMITS AN OFFER WITH REDUCED ED AND OR CST APPLICABLE THAN NORMALLY PAID ON SUCH ITEMS, THEY SHOULD SUBMIT NECESSARY DOCUMENTARY PROOF FOR THE SAME.

"X" THE MAXIMUM ED SLAB RATE BE CONSIDERED FOR PRICE COMPARISON. IN THE EVENT OF ORDER ED AT ACTUAL BE PAID.

"Y" THE QUOTED ED RATE BE CONSIDERED FOR PRICE COMPARISON. IN THE EVENT OF ORDER ED AT ACTUAL RATE LIMITED TO QUOTED RATE BE PAID.

SIGNATURE & SEAL OF TENDERER

SCHEDULE OF TECHNICAL DEVIATION

Ref: TBMM/GILS / NABHINAGAR ENQUIRY NO. 254E017 REV.01 DATED 15.01.15

This Format is to be submitted in original duly signed by bidder.

The following are the devitions/variations/exceptions from the Terms and Conditions :-

SL. NO.	CLAUSE NO. OF TERMS AND CONDITIONS	STATEMENT OF DEVIATION

In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract is deemed to be in compliance with the Terms and Conditions.

If there is NIL deviation,even then the format to be filled as NIL DEVIATION.

Note : Continuation Sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Signature of the authorised representative of

Place : ……

Date : ……

Bidder's name :……

Designation:……..

Company Seal:……

SCHEDULE OF COMMERCIAL DEVIATION

Ref: TBMM/GILS / NABHINAGAR ENQUIRY NO. 254E017 REV.01 DATED 15.01.15

This Format is to be submitted in original duly signed by bidder.

The following are the devitions/variations/exceptions from the Terms and Conditions :-

SL. NO.	CLAUSE NO. OF TERMS AND CONDITIONS	STATEMENT OF DEVIATION

In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract is deemed to be in compliance with the Terms and Conditions.

If there is NIL deviation,even then the format to be filled as NIL DEVIATION.

Note : Continuation Sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Signature of the authorised representative of

Place : ……..

Date : ……..

Bidder's name :……

Designation:……..

Company Seal:……

Annexure – II

ieema
your link to electricity

501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumbai 400 018
India

P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA/PVC/TLT/2010 (R-1) **Effective from: 1st April 2014**

PRICE VARIATION CLAUSE FOR TRANSMISSION LINE TOWERS

The price quoted/confirmed is based on the input cost of raw materials/components and labour cost as on the date of quotation and the same is deemed to be related to prices of raw materials and all India average consumer price index number for industrial workers as specified in the price variation clause given below. In case of any variation in these prices and index numbers, the price payable shall be subject to adjustment, up or down in accordance with the following formula:

(A) Transmission Line Tower with both Heavy and Light angles

$$P = \frac{P_0}{100}\left(11 + 32\,\frac{SBLR}{SBLR_0} + 25\,\frac{SBIR}{SBIR_0} + 09\,\frac{Zn}{Zn_0} + 23\,\frac{W}{W_0}\right)$$

(B) Transmission Line Tower with only Heavy angles

$$P = \frac{P_0}{100}\left(11 + 57\,\frac{SBLR}{SBLR_0} + 09\,\frac{Zn}{Zn_0} + 23\,\frac{W}{W_0}\right)$$

(C) Transmission Line Tower with only Light angles

$$P = \frac{P_0}{100}\left(11 + 57\,\frac{SBIR}{SBIR_0} + 09\,\frac{Zn}{Zn_0} + 23\,\frac{W}{W_0}\right)$$

Wherein,

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

P_0 = Price quoted/confirmed.

$SBLR_0$ = Price of Steel Blooms- Retail (refer notes)
This price is as applicable on the 1st working day of the month, one month prior to the date of tendering.

$SBIR_0$ = Price of Steel Billets- Retail (refer notes)
This price is as applicable on the 1st working day of the month, one month prior to the date of tendering.

Delhi
Rishyamook Building, First Floor
85 A, Panchkuian Road
New Delhi 110001
P +91 11 2336 3013 / 14
F +91 11 2336 3015
E delhi@ieema.org
W www.ieema.org

Bangalore
204, Swiss Complex
33, Race Course Road
Bangalore 560001, India
P +91 80 2220 1316/18
F +91 80 2220 1317
E bangalore@ieema.org
W www.ieema.org

Kolkata
503 A, Oswal Chambers
2, Church Lane
Kolkata 700001, India
P +91 33 6510 7855
F +91 33 2213 1326
E kolkata@ieema.org
W www.ieema.org

Indian Electrical & Electronics Manufacturer's Association

Zn_0 = Price of Electrolytic high grade zinc (refer notes)
This price is as applicable on the 1st working day of the month, one month prior to the date of tendering.

W_0 = 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) (Refer notes)
This index number is as applicable on the first working day of the month, three months prior to the date of tendering.

For example, if date of tendering falls in May 2014, the applicable prices of Steel Bloom-Retail ($SBLR_0$), Steel Billets-Retail ($SBIR_0$) and Zinc (Zn_0) should be for the month April 2014 and all India average consumer price index number (W_0) should be for the month of February 2014.

The above prices and indices are as published by IEEMA vide circular reference number IEEMA (PVC)/TLT-2014/_/_ one month prior to the date of tendering.

SBLR = Price of Steel Bloom-Retail (refer notes)
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 (refer notes)
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 (refer notes)
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) (refer notes)
This index number is as applicable on the first working day of the month, four months prior to the date of delivery.

For example, if date of delivery falls in December 2014, the applicable prices of Steel Bloom-Retail (SBLR), Steel Billets-Retail (SBIR) and Zinc (Zn) should be for the month October 2014 and all India average consumer price index number (W) should be for the month of August 2014.

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) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

Notes: (a) All prices of raw materials are exclusive of modvatable excise/CV duty amount and exclusive of any other central, state or local taxes; octroi etc.
(b) All prices are as on first working day of the month.
(c) The details of prices are as under:

1. The prices of Steel Bloom-Retail are the average Retail price of Blooms of size 150 x 150 mm of all cities in Rs/MT; as published by Joint Plant Committee (JPC), Kolkata. **Heavy angles of size above 110mm x 110mm are deemed to be related to this price.**

2. The prices of Steel Billet-Retail are the average Retail price of Billets of size 100 mm of all cities in Rs/MT; as published by Joint Plant Committee (JPC), Kolkata. **Light angles of size below & including 110mm x 110mm are deemed to be related to this price.**

3. The price of Electrolytic high grade zinc (in Rs/MT) is ex-works price as quoted by a primary producer.

4. Cost weightage of re-rolling/conversion charges is included in Labour cost weightage (W)

Deputy Director General

Terms & Conditions of Reverse Auction

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

1. For the proposed reverse auction, technically and commercially acceptable bidders only shall be eligible to participate.

2. Those bidders who have given their acceptance for Reverse Auction (quoted against this tender enquiry) will have to necessarily submit 'online sealed bid' in the Reverse Auction. Non-submission of 'online sealed bid' by the bidder for any of the eligible items for which techno-commercially qualified, will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines in vogue.

3. BHEL will engage the services of a service provider who will provide all necessary training and assistance before commencement of on line bidding on internet.

4. In case of reverse auction, BHEL will inform the bidders the details of Service Provider to enable them to contact & get trained.

5. Business rules like event date, time, bid decrement, extension etc. also will be communicated through service provider for compliance.

6. Bidders have to fax the Compliance form (annexure IV) before start of Reverse auction. Without this, the bidder will not be eligible to participate in the event.

7. In line with the NIT terms, BHEL will provide the calculation sheet (e.g., EXCEL sheet) which will help to arrive at "Total Cost to BHEL" like Packing & forwarding charges, Taxes and Duties, Freight charges, Insurance, Service Tax for Services and loading factors (for non-compliance to BHEL standard Commercial terms & conditions) for each of the bidder to enable them to fill-in the price and keep it ready for keying in during the Auction.

8. Reverse auction will be conducted on scheduled date & time.

9. At the end of Reverse Auction event, the lowest bidder value will be known on auction portal.

10. The lowest bidder has to fax/e-mail the duly signed and filled-in prescribed format for price breakup including that of line items, if required, (Annexure VII) as provided on case-to-case basis to Service provider within two working days of Auction without fail.

11. In case BHEL decides not to go for Reverse Auction procedure for this tender enquiry, the Price bids and price impacts, if any, already submitted and available with BHEL shall be opened as per BHEL's standard practice.

12. Bidders shall be required to read the "Terms and Conditions" section of the auctions site of Service provider, using the Login IDs and passwords given to them by the service provider before reverse auction event. Bidders should acquaint themselves of the 'Business Rules of Reverse Auction', which will be communicated before the Reverse Auction.

13. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action *as per extant BHEL guidelines*, shall be initiated by BHEL and the results of the RA scrapped/ aborted.

14. The Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party.

15. In case BHEL decides to go for reverse auction, the H1 bidder (whose quote is highest in online sealed bid) may not be allowed to participate in further RA process.

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

DOCUMENT No.	**TB xxx 618 006**	Rev 00	Prepared	Checked	Approved
TYPE OF DOC.	**TECHNICAL SPECFICATION**	NAME	**AA**	**PLK**	**SS / DKM**
TITLE		SIGN			
G I LATTICE STRUCTURES FOR TRANSMISSION LINE		DATE			
		GROUP	**TBEM**		
		W.O. No			
CUSTOMER/ CONSULTANT	NABINAGAR POWER GENERATION CO. LTD.				
PROJECT	400/132/33 kV s/s at Nabinagar STPP (3x660 MW)				

Contents:

Rev	Date	Altered	Checked	Approved				
Distribution				To				
				Copies				

SECTION - 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

1.1 SCOPE

The scope of this specification is to specify all details required by a supplier for preparation detailed fabrication drawings (structure assembly drawings), fabrication, destructive testing, proto assembly, galvanising and supply of galvanized steel structures for projects being executed by BHEL on turnkey basis for NTPC.

The detailed scope of work is preparation, submission and approval of detailed fabrication drawings (structure assembly drawings), fabrication, galvanizing and supply of all type of transmission line towers including stub assembly and stub templates made of channels, angles, etc. ,base plates, stiffener plates and other such items required to complete the job excluding all fixtures, such as nuts, bolts, step bolts and washers. However, detailed and accurate bill of quantities for nuts, bolts, step bolts and washers shall be given by the supplier in the drawings submitted by him. The detailed structure assembly drawing shall be prepared based on input/line sketches provided by BHEL.

Design drawings and type test reports of the type tested towers shall be copy right of BHEL.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

The specific technical requirements shall be as per Standard Technical Specification (Refer Section 2).

1.3 QUANTITIES

The quantities indicated are tentative & it may change to any extent during detailed engineering at contract stage.

Sl.No.	Description	Quantity
1	Preparation of shop drawings based on fabrication drawings (Line diagram) provided by BHEL, fabrication and supply of 400 kV line towers (mild steel and HT steel as required) , submission of proto corrected drawings/BOMs, mass fabrication, galvanising, inspection and supply of lattice type galvanized steel structures including stub assembly. (Zinc coating 610 gms/sq.m)	
a	Mild steel	350 MT
b	HT (High Tensile) steel	500 MT
2	Destructive testing of one no. , 400 kV transmission line tower (DD Type) including supply of all materials required for tower to be tested. All necessary arrangements (proto assembly, transportation etc) complete in all respect for conducting the tests are included in the scope of vendor. All tower materials after testing shall be	1 Lot

	property of bidder.	
3	Destructive testing of one no. , 400 kV transmission line tower (DA Type) including supply of all materials required for tower to be tested. All necessary arrangements (proto assembly,transportation etc.)complete in all respect for conducting the tests are included in the scope of vendor. All tower materials after testing shall be property of bidder.	1 Lot
4	Preparation of shop drawings based on fabrication drawings (Line diagram) provided by BHEL, fabrication and supply of 33 kV line towers (mild steel as required) , submission of proto corrected drawings/BOMs, mass fabrication, galvanising, inspection and supply of lattice type galvanized steel structures including stub assembly. (Zinc coating 610 gms/sq.m)	
a	Mild Steel	110 MT
5	Destructive testing of one no. , 33 kV transmission line tower (A Type) including supply of all materials required for tower to be tested. All necessary arrangements(proto assembly, transportation etc.) complete in all respect for conducting the tests are included in the scope of vendor. All tower materials after testing shall be property of bidder.	1 Lot
6	Destructive testing one no. , of 33 kV transmission line tower (C Type) including supply of all materials required for tower to be tested. All necessary arrangements (proto assembly, transportation etc.) complete in all respect for conducting the tests are included in the scope of vendor. All tower materials after testing shall be property of bidder.	1 Lot
7	Supply of MS stub templates made of channels,angles etc.	6MT.

SECTION - 2

2.0 GENERAL

This section covers the standard technical specification for GI Structures.

(In case any variance in Section-2 , NTPC specification shall prevail.)

2.1 STEEL MATERIAL

Mild Steel (MS) materials shall be tested quality and shall conform to IS:2062 and High Tensile (HT) Steel shall be tested quality and shall conform to IS: 8500. Steel material (Both HT and MS)should be procured from NTPC approved source.

Steel shall not be pitted and should be free from scales and rust. If the rolled section and plates are bent or distorted, bend or distortion shall normally be removed by the cold treatment. Straightening under hot stage shall be resorted to only under specific permission from BHEL. If any rolling defects viz., laminations, cracks etc. are discovered in the steel during the processing, it is to be rejected.

TOLERANCE:

The dimensional and weight tolerances for rolled shapes shall be in accordance with IS:1852-1985.

No rolled or fabricated member shall deviate from straightness by more than 1/1000 of the axial length or 10mm which ever is smaller.

2.2 FABRICATION

GENERAL:

All the workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined true and square where so specified. All holes and edges shall be free of burrs. Shearing and cropping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Material at the shops shall be kept clean and protected from weather.

The fabrication of galvanized steel structures shall be carried out generally in accordance with IS:802 part. II, IS:800-1984. All materials shall be completely shop fabricated. Normally, butt splices shall be used. The components constituting the joint shall have a total strength greater than the heavier of the members connected. Lap splices may be used for connecting members of unequal sizes. The inside angle of lap splice shall be grounded at the heel to fit the fillet of the outside angle. The splices shall develop full strength of the members connected through bolts. Butt as well as lap splices shall be made as close to the main panel points as possible.

Joints shall be so designed and detailed as to avoid eccentricity as far as possible. However, where joints are such that the elimination of gusset plates would result into eccentric joints, gusset plates and spacer plates may be used in conformity with modern practices.
The use of filler in the connections shall be avoided as far as possible. The diagonal members in tension may be connected entirely to the gusset plate where necessary to avoid the use of fillers. Each diagonal shall be in one piece without splices or center gussets, and it shall be connected at the point of intersection by one or more bolts.

The gap between the ends of two connected members in butt joints shall not be more than 6 mm and less than 4mm.

The tower structure members shall be accurately fabricated to bolt together easily at site without any undue strain on them or the bolts.

Drain holes shall be provided at all points where pockets or depressions are likely to hold water.

For designing of towers , preferably rationalized steel sections shall be used. During execution of the project, if any particular section is not available same shall be substituted by higher section at no extra cost to owner and the same shall be borne by the bidder. However design approval for such substitution shall be obtained from owner before substation.

STRAIGHTENING:

For rolled steel material, if straightening or flattening is necessary, it shall be done by methods that will not injure the materials.

CUTTING:

Cutting may be effected by chopping, cropping, sawing or machine flame cutting. Sheared or cropped edges shall be dressed to a neat workmanlike finish and shall be free from distortion and burrs.

PUNCHING AND DRILLING:

Holes in members may be punched full size through material not over 12mm thick. Holes must be cleaned of burrs and ragged edges. Drilled holes shall be preferred. Holes made by drilling shall also be cleaned of burrs and ragged edges. Where several parts are to be drilled, they shall be first assembled, tightly clamped together and drilled through.

Punched holes must be square with plates and the walls of the holes shall be parallel. The following maximum allowance in accuracy of punched holes is permissible:

i) Holes must be perfectly circular and no tolerance in this respect is permissible.

ii) The maximum allowable difference in diameter of the holes on the two sides of plates or angle is 0.8 mm, i.e. the allowable taper in punched holes should not exceed 0.8 mm in diameter.

iii) Holes must be square with the plates. Holes at angle or slant shall not be permitted.

The minimum spacing of bolts and edge distances shall be as given below:

Bolt Diameter	Minimum Bolt Spacing	Maximum edge distance	
		Hole center To rolled Edge	Hole center to cut/ flame edge
(mm)	(mm)	(mm)	(mm)
16	40	20	23

WELDING:

The work shall be done as per approved fabrication drawings, qualified welding procedure specifications (WPS) and by qualified welders. Procedure qualification records (PQR) shall be maintained. Electrodes for shielded arc manual welds shall comply with the requirements of IS:814 - 1991. All welds shall be free from defects like blow holes, slag inclusions, lack of penetration, under cutting, cracks etc. All welds shall be cleaned of all slag or flux before galvanizing.

MARKING OF MEMBERS FOR IDENTIFICATION.

All members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on. The erection mark shall be stamped with a metal dye with figures at least 16 mm high and to such optimum depth as to be clearly visible, even after a member is galvanized. All erection marks shall be on outer surface of all sections and near one end, but clear of bolt holes. Marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be encircled boldly by a distinguishable paint to facilitate easy location.

Erection marks on like pieces shall be in identical locations. Members having lengths of 3.0 M or more shall have the erection mark at both ends.

PROTOTYPE ASSEMBLY:

Towers shall be trial assembled at shop before galvanizing i.e. prototype assembly keeping in view the actual site condition prior to dispatch to testing station/erection sites. The prototype assembly of each structure shall be got approved from BHEL/Customer as directed. Necessary match marks shall be made on each cornponents before dismantling the prototype assembly and galvanizing. Any error shall be rectified at the expense of the contractor.

No extra charge on account of erecting the assemblies or getting them inspected will be permissible. It is however to be mentioned that the responsibility for proper fitting of various members for the erection of the structure in the field will rest with the supplier and any discrepancy found at the time of erection will have to be rectified by the contractor at his cost.

2.3 GALVANISING:

All structural steel works shall be hot dip galvanized after fabrication. Galvanizing of each members shall be carried out in one complete immersion and double dipping shall not be permitted.

Zinc required for galvanizing will have to be arranged for by the Contractor. Purity of zinc to be used for galvanizing shall be 99.5% as per IS:209-1992.

All burrs and irregular edges shall be ground smooth before galvanizing.

After all shop work is complete, all structural materials shall be punched with the Erection Mark and be hot dip galvanized. Before galvanizing the steel section shall thoroughly be cleaned of any paint, grease, rust, scale, acid/ alkali or such other foreign matters as are likely to interfere with the galvanizing process or with the quality and durability of the zinc coating. Pickling shall be carefully done and shall be proper.

Minimum weight of zinc coating shall be 610gms/sqm. However, higher coating may be provided as per requirement.

The galvanized surface shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel, globules, spiky deposits, blistered surface flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per IS: 2633 - 1986.

When the steel section is removed from the galvanizing kettle excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose.

Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specification, or lack of quality control in any manner in the galvanizing plant shall render the entire production in the relevant shift liable to rejection.

All the galvanized structural steel members and accessories shall be treated with sodium dichromate or an approved equivalent solution after galvanizing, so as to prevent white storage stains.

If the galvanizing of any member is damaged, BHEL shall be shown of the extent of damage and if so directed the galvanizing may have to be redone in the similar manner as stated above at no extra cost.

Contractor shall also furnish sufficient quantity of appropriate paint, free of cost, for repairing galvanized surfaces damaged in transit, and minor modifications done at site during erection.

Galvanizing tests shall be made from time to time on as many samples as may be considered necessary. The supplier shall supply all samples and equipment and carry out the tests without any extra cost.

2.4 INSPECTION OF MATERIALS

GENERAL:

Contractor shall give notice to BHEL/ Customer in advance for inspection of materials. All rejected material shall be promptly removed from the shop and replaced with new material for BHEL/ Customer approval/ inspection. The fact that certain material has been accepted at Contractor's shop shall not invalidate final rejection at site by BHEL/ Customer if it fails to be in proper condition or has fabrication inaccuracies which prevent proper assembly. No materials shall be painted, galvanized or dispatched to site without the inspection and approval by BHEL/ Customer unless such inspection is waived off in writing by BHEL/ Customer.

Shop inspection by BHEL/ Customer, for submission of test certificates and acceptance there of by BHEL// Customer shall not relieve contractor from the responsibility of furnishing material conforming to the requirements of these specifications, nor shall it invalidate any claim which BHEL/ Customer may make because of defective or unsatisfactory material and workmanship.

Contractor shall provide all the testing and inspection services and facilities for shop work. For fabrication work carried out in the field the standard of supervision and quality control shall be maintained as in shop fabricated work. The inspection and testing shall be conducted in a manner satisfactory to BHEL/ Customer.

The supplier shall submit QP (Quality Plan) detailing each stage of manufacturing i.e. raw-material , in process and final inspection for approval by BHEL/Customer in the prescribed format of NTPC. The final Quality plan shall approved by BHEL/ Customer

MATERIAL TESTING

If mill test reports are not available for any steel materials the same shall be got tested by the contractor and demonstrate conformity with the relevant specification to the full satisfaction of BHEL/ Customer. The cost of such tests shall be borne by the contractor.

DIMENSIONS AND WORKMANSHIP:

The Structural Steel members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment and surface finish, are in accordance with the requirements shown in Contractor's approved shop drawings.

INSPECTION OF TEST FAILURE:

In the event of any failure of structural steel members to meet an inspection or test requirement, contractor shall inform BHEL/ Customer and must obtain permission from the BHEL/ Customer before repair is undertaken. The quality control procedures to be allowed to ensure satisfactory repair shall be subject to approval by BHE/ Customer L.

2.5 PACKING TRANSPORTATION AND DELIVERY

After completion of final inspection and marking, the fabricated galvanized structural items shall be packed and loaded for transportation.

Packing must be adequate to protect items against bending and any mechanical injuries and damage to galvanized film during loading and unloading. As far as possible, like member should be bundled together and tied.

Proper lifting devices shall be used for loading at shop and unloading at site in order to protect items against bending, mechanical injuries and damage to galvanized film.

Loading, transporting and unloading shall be done in compliance with transportation rules.

Slender and projected parts shall be braced properly with additional spacer steel bars, spacer wood etc, before loading for transportation, to protect against bending or any other damages during transportation.

If certain parts cannot be transported in the lengths stipulated in the design drawing, the position and type of additional splice joints shall be got approved from BHEL/ Customer.

Items must be carefully loaded and tied up properly to prevent bending, falling etc. during transportation.

The small parts such as plates, gussets, cleats etc. shall be securely tied with the wire, and packed in wooden boxes and properly identified.

As far as possible the delivery of fabricated galvanized structural steel shall be as per the order stipulated by BHEL/ Customer and to suit the erection sequence.

Contractor shall make good/ replace at his own cost any damage occurred during loading, transporting, unloading and stacking of fabricated galvanized

steel structures as directed by BHEL/ Customer. No extra payment on this account shall be entertained under any circumstances.

2.6 APPLICABLE STANDARDS

Unless otherwise specified, materials, and workmanship shall conform to the following standards of their latest editions:

1.	IS : 209	-	Zinc Ingot.
2.	IS : 228	-	Method of chemical analysis of pig iron, cast iron, plain carbon and low alloy steel.
3.	IS : 406	-	Methods of analysis of zinc (Spelter).
4.	IS : 800	-	Code of practice for general construction.
5.	IS : 802 - Part1 - Part1/Sec.2 - Part 2 - Part 3	- -	Code of Practice for use of structural in over head Transmission line towers.
6.	IS : 806	-	Code of practice for use of steel tubes in general building construction.
7.	IS : 808	-	Dimensions for hot rolled steel beam, column, channel and angle sections.
8.	IS : 814	-	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel.
9.	IS : 816	-	Code of Practice for use of metal arc welding for general construction in mild steel.
10.	IS : 817	-	Code of practice for training & testing of Metal Arc welders.
11.	IS : 1161	-	Steel tubes for structural purposes.
12.	IS : 1599	-	Method of bend test
13.	IS : 1608	-	Method of tensile testing of steel

products.

14.	IS : 1852	-	Rolling and cutting tolerances for hot rolled steel products.
15.	IS : 1978	-	Line pipe
16.	IS : 2062	-	Steel for general structural purposes.
17.	IS : 2074	-	Ready Mixed Paint, air drying red oxide zinc, chrome, priming.
18.	IS : 2629	-	Recommended practice for hot dipped galvanising on Iron & Steel.
19	IS : 2633	-	Methods for testing uniformity of coating on zinc coated articles.
20.	IS : 3502	-	Steel chequered plates.
21.	IS : 4759	-	Hot dip zinc coating on structural steel and other allied products.
22.	IS : 6745	-	Method for determination of mass of zinc coating on zinc coated iron and steel articles
23.	IS : 8500	-	Specification for micro-alloyed structural steel

NTPC SPECIFICATION FOR TRANSMISSION LINE TOWER MATERIAL.

(In case of any variance in Section -2 , NTPC specification shall prevail.)

PART- III

TECHNICAL SPECIFICATION
CHAPTER – T1

TRANSMISSION LINES TOWERS

(For 400KV Transmission lines)

PART- III

TECHNICAL SPECIFICATION
CHAPTER – T1

TRANSMISSION LINES TOWERS

SECTION – T1: TRANSMISSION LINE TOWERS

1.00.00 GENERAL DESCRIPTION OF TOWERS

1.01.00 **Types of Towers**

1.01.01 **400 KV Towers**

The towers shall be of self supporting lattice steel type, designed to carry the line conductors with necessary insulators, earth wires and all fittings under all loading conditions.

1.01.02 The tower shall be of a fully galvanised structure, using structural mild steel sections for members. Bolts and nuts with spring washers shall be used for connections.

1.01.03 Bidders can also use high tensile steel and cold formed steel for fabrication of towers provided they furnish the justification for use of such steel with reference to national or international standards. However, the factors of safety, limitation on member length, requirement of fasteners and galvanisation shall be as specified in this specification.

The towers shall be classified as given in Table 1-1

Table T1-1

Type of Tower	Deviation limit	Typical use
DA	0 to 2	To be used as tangent tower
DB	0 to 15	a) Angle towers with tension insulator string b) Tension tower for uplift forces resulting from an uplift span upto 200 metres under broken wire conditon. c) Also to be designed for unblanced tension resulting from unequal ruling span of 305 m and 150 m on each side of the tower.
DB	0	d) to be used as section tower
DC	15 to 30 degree.	a) Angle tower with tension insulator string b) Tension tower for uplift forces resulting from

			an uplift span upto 200 meters under broken wire condition. c) Also to be designed for unblanced tension resulting from unequal ruling span of 305 m and 150 m on each side of the tower.
	D* and DD	30 deg. To 60 deg.	a) Angle tower with tension insulator string. b) Tension tower for uplift forces resulting from an uplift span upto 200 metres under broken wire condition. c) Also to be designed for the unbalanced tension resulting from unequal ruling span of 305m (*400 m) 150 m (*200 m) on each side of the tower (* For 400 KV towers) d) Dead end with 0 deg. to 15 deg deviation both on line and sub- station side (slack span).
	D* and DD	0deg.	e) complete dead end.
	D* and DD	90deg.	f) to be used near switchyard with Reduced design and span

NOTE: The above towers may also be used for longer span with smaller angle of deviation.
* Indicates Single circuit tower.

1.03.00 **Extension**

The single and double circuit tower shall be designed so as to be suitable for adding 3M, 6M and 9M body extension for maintaining adequate ground clearance without reducing the specified factor of safety in any manner.

For power line crossing 25 metre extensions with DD type towers are required. Bidders shall state in relevant clause of volume II-A the maximum reduced span for which type tower with 25 metre extension can be used with the stipulated factor of safety.

The 25 metre extension should be designed in such a manner the same can also be used as 18.0 metre estension to normal tower after removal of bottom panels.

For under line crossing of EHV transmission lines the bidder shall have to design minus-three metres and minus six metre extensions to D type tower.

D/DD type towers shall be designed to cater for 90deg. deviation with auxiliary cross arm and reduced tension/span.

1.04.00 **Stub Setting templates.**

Stub templates shall be designed and arranged by the contractor at his own cost for all types of tower with or without extension and also for leg extension. Stub templates for standard towers and tower with extension shall be of adjustable type. The stub templates shall be painted. The number of such templates of each type proposed to be supplied shall be stated by the Bidder. One set of each type of stub setting template for single and double circuit tower shall be supplied to the Owner, on completion of the project, at no extra cost.

2.00.00 **SPANS AND CLEARANCES**

2.01.00 **Normal Span**

The normal ruling span of the line shall be 400 meters for 400 KV towers..

2.02.00 **Wind Span**

The wind span is the sum of the two half spans adjacent to the support under consideration. For normal horizontal spans this equals to normal span.

2.03.00 **Weight Span**

The weight span is the horizontal distance between lowest point of the conductors on the two spans adjacent to the tower. For design of structures, the span limits given below shall prevail.

Tower type	Normal Condition		Broken Wire Condition	
	Max. (m)	Min. (m)	Max. (m)	Min. (m)
DA, DB, DC & DD (400 KV)	600	-200	360	-200

2.04.00 Electrical Clearance

2.04.01 Ground clearance

The minimum ground clearance from the bottom conductor shall not be less than 8.84 meters for 400 KV lines at the maximum sag conditions i.e. at maximum temperature and still air. However, to achieve the above clearance the height of tower shall be increased in the following manner:

a) Allowance of 150 mm shall be provided to account for errors in stringing.

b) Conductor creep shall be compensated by over tensioning the conductor at a temperature lower than the ambient temperature. The creep correction temperature along with calculations shall be furnished by the Contractor.

c) Minimum spacing
The minimum electrical clearance between conductors shall be as follows:
Vertical : 9.0 mtr.
Horizontal : 11.0 mtr.

2.04.02 **Rail Crossing**

In case of rail crossing the min. height above rail level of the lowest portion of any conductor under condition of max. sag, in accordance with the regulations for Electrical Crossing of Railway tracks as prevailing at the time of construction of line shall be applicable. However, as per present regulations (revised in 1987) the minimum clearance is stipulated as 18.6 meters for 400 KV towers.

2.04.03 **Power Line Crossing**

Minimum clearance between power line to power line crossing should be 4580 mm for 220 kV and 6300mm for 400 kV lines.

2.04.04 **Live Metal Clearance**

The minimum live metal clearance to the provided between the live parts and steel work of super-structure shall conform to IS-5613- 1985/ IS- 5613 Part as follows :

	Type of Insulator String	Swing In Degrees	Min. Clearance (mm)
a)	Single suspension string	NIL	3050
		22	3050
		44	1860
b)	Tension string (Single/Double)	NIL	3050
c)	Jumper	NIL	3050
		20	3050

d) Bidder shall adopt same cross arm design where jumper is projecting outside of cross-arm for `DD' type tower to be used as dead end and angle tower.

The design of the tower shall be such that it should satisfy all the above conditions when clearances are measured from any live point of the strings.

2.04.05 Angle of Shielding

2.04.06 The angle of shielding is defined as the angle formed by the line joining the center lines of the earthwire and outer power conductor, in still air, at tower supports, to the vertical line through the center line of the earthwire. Bidders shall design the tower in such a way that the angle of shielding does not exceed 20 deg for 400 KV towers. The drop of the earthwire clamp, which is in the scope of contractor supplied items, should be considered while calculating the minimum angle of protection. For estimating the minimum angle of protection the drop of earth wire suspension clamp alongwith shackle shall be taken as 150mm.

2.04.07 Mid Span Clearance

	The minimum vertical mid span clearance between the earthwire and the nearest power conductor shall not be less than 6.1 meters, which shall mean the vertical clearance between earthwire and the nearest conductor under all temperatures and still air condition in the normal ruling span. Further, the tensions of the earthwires and power conductors, shall be so co-ordinated that the sag of earthwires shall be at least 10% less than that of power conductors under all temperature loading conditions.
3.00.00	**LOADING CONDITIONS**
3.01.00	**Loads at Conductor And Earthwire Points**
	Owner has calculated the ultimate external loadings at conductor and earthwire points and enclosed alongwith the Specification. The Contractor shall develop the tower designs considering loadings given by the Owner. These loads have been computed based on IS 802/Part - I, 1995and towers are to be designed to cater for the following loads:
a)	Reliability Loads (Normal condition)
b)	Security Loads (Broken wire condition)
c)	Safety Loads (Construction & Maintenance loads)
	Suspension towers shall be designed for full wind load under security condition
3.02.00	**Wind Loads on Tower Body**
	The wind load on tower body shall be calculated by the Contractor as per IS:802, Part-I, 1995.
3.03.00	**Maximum Tension**
	Maximum tension shall be based on either of the following (whichever is more stringent):
a)	at 0 deg C with 36% full wind pressure., or
b)	at 32 deg C with full wind pressure
	The value of drag co-efficient (Cd) shall be 1.2 for conductor/earthwire if the diameter of the conductor/earth is 15mm or less.
3.04.00	Sag tension calculation for design purpose shall be calculated considering normal span of 400 meter.
3.04.05	The initial conductor and earthwire tension at 32 degree C and without wind shall be 22% of the ultimate tensile strength of the conductor and 20% of the ultimate tensile strength of the Earthwire.
3.06.00	Limiting Tensions of conductor & Earthwire
	The ultimate tension of conductor and ground wire shall not exceed 70 per cent of the ultimate tensile strengths.

3.07.00 **Broken Wire Condition**

3.07.01 **Suspension Tower Type DA**

Breaking of conductor in one phase only, resulting in instantaneous unbalanced tension of maximum working conductor tension or breaking of one earthwire resulting in an unbalance tension equal to the maximum tension of the earthwire whichever is more stringent is to be considered.

3.07.02 **Tower Type DB& DC**

Breaking conductor is any two phase only or breaking of earthwire and any one phase on the same side and same span resulting is instantaneous unbalanced tension on the tower is to be considered. The unbalanced tension shall be taken as the maximum tension.

3.07.03 **Tower Type DD**

Breakage of all the three phases on the same side and on the same span or breakage of two phases and any one earthwire on the same side and one he same span, whichever combination is more stringent for a particular member.

3.08.00 **Design Loads**

3.08.01 Owner's requirement for most stringent design longitudinal and transverse loads is summerized in Table T1-2.

3.08.02 The Bidder shall furnish the details of design loads proposed to be adopted in the tower design in accordance with this specification. The same design load data be filled in the Data Requirement Sheet.

4.00.00 **DESIGN OF TOWERS**

4.01.00 **Design Criteria**

Towers shall be designed based on spans and clearances, and loading conditions as detailed above.

4.02.00 **Design Temperatures**

The following temperature range for the conductors and ground wires shall be adopted for line design:

a)	Minimum temperature	:	0 deg.C
b)	Everyday temperature of conductor	:	32 deg.C
c)	Max. temperature of Conductor	:	75 deg.C
d)	Max. temperature of Earthwire exposed to sun	:	53 deg.C

4.03.00 **Redundant Design**

All redundants in the towers are to be triangulated. Redundants, having an angle of 15 deg or less with horizontal are to be designed for a concentric vertical ultimate load of 1.5 KN acting at center of the unsupported length. The Contractor has to furnish the calculation for the same. The redundants shall also be designed for 2.5% of max. axial load of connecting members (i.e. leg members, bracing members etc.).

4.04.00 **Steel Sections**

For designing of towers, preferably rationalised steel sections shall be used. During execution of the project, if any particular section is not available same shall be substituted by higher section at no extra cost to Owner and the same shall be borne by the Contractor. However, design approval for such substitution shall be obtained from the Owner before any substitution.

4.05.00 **Thickness of Members**

The minimum thickness of angle sections used in the design of tower, unless otherwise specified elsewhere in this Specification, shall be kept not less than the following values:

a) Main corner leg members including the groundwire peak and main cross arm : 5 mm
b) For all other members : 4 mm

4.06.01 **Bolts & Nuts**

4.06.02 The minimum bolt spacing and rolled edge distance and sheared edge distance from the centers of the bolt holes to be maintained are given below:

a)	Diameter of bolts	16 mm
b)	Hole diameter	17.5 mm
c)	Min. bolt spacing	40 mm
d)	Min. rolled distance	20 mm
e)	Min. sheared edge distance	23 mm

4.07.00 Bolts sizes mentioned above shall only be used. The minimum width of the flanges without bolt holes shall be 30mm.

4.07.01 For the purpose of calculating shearing stress and bearing stress for bolts, IS:802-Part-II-1993 may be referred.

4.07.02 **Slenderness Ratio**

4.08.00 Slenderness ratio for members shall be computed in accordance with IS:802, Part-II, 1993. Slenderness ratio for compression and tension members shall not exceed the values specified therein.

4.09.00	The following maximum limit of the slenderness ratio i.e. the ratio of unsupported length of the section in any plane to the appropriate radius of gyration will be adopted:	
a)	For main corner leg members including the corner members of earthwire peak and the lower corner members of the cross-arms	120
b)	For other members having calculated stresses	200
c)	For redundant members	250
d)	For members having tensile stress only	375
4.10.00	The bracing pattern, including that of secondary bracings (redundants) shall be identical on transverse and longitudinal faces of the tower, i.e. staggering of primary and secondary bracings are not permitted. Primary bracings and redundants shall be properly triangulated, i.e. the overall pattern of bracing on tower body and cross arms shall be triangular only.	
4.11.00	**Erection Stress** Where erection stress combined with other permissible co-existent stresses could produce a working stress in any member appreciably above the specified working stress, such other provisions are to be made as may be necessary to bring the working stress within the specified limit.	
5.00.00	**TOWER MATERIALS**	
5.01.00	**Tower Steel Sections** IS steel sections of tested quality in conformity with IS:226-1975 or IS:2062-1980 are to be used in towers, extensions and stub setting templates. No individual member shall be longer than 6000mm. The Bidder can also use most efficient grades of structural steel angle sections and plates conforming to latest international standards. However, the Bidders are permitted to opt for not more than two (2) grades of steel for any particular package.	
5.02.00	**Fasteners : Bolts, Nuts and Washers**	
5.02.01	All bolts and nuts shall conform to IS:6639-1972. All bolts and nuts shall be galvanised and 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.	
5.02.02	The bolt shall be of 16 mm dia and of property class 5.6 as specified in IS:1367 (Part-III) 1979 and matching nut of property class as specified in IS:1367 (Part-VI) 1980.	
5.02.03	Bolts upto M16 and having length upto 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 bolts for 5.6 grade should be 310 MP a minimum as per IS:12427. Bolts should be provided with washer face in accordance with IS:1363 Part-I to ensure proper bearing.	

5.02.04	To ensure uniformity of galvanizing, bolts and nuts should be galvanised by high temperature hot-dip galvanizing, at a minimum temperature of 530 deg.C . The temperature should be recorded continuously in the form of a continuous chart. The galvanised coating should be uniform and its value should be between 50 micron to 115 micron to be checked on random sampling basis, on the threaded portion as well. The facility to check the galvanised coating should be by metallographic method.
5.02.05	Nuts should be double chamfered as per the requirement of IS:1363 Part-III, 1984. It should be ensured by the manufacturer that nuts should not be overtapped beyond 0.4 MM oversize on effective diameter for size upto M16.
5.02.06	Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion will not extend into the place of contact of the members.
5.02.07	All bolts shall be threaded to take the full depth of the nuts and threaded 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 8mm when fully tightened. All nuts shall fit and tight to the point where the shank of the bolt connects to the head.
5.02.08	Flat and tapered washers shall be provided wherever necessary. Spring washers shall be provided for insertion under all nuts. These washers shall be of steel electro-galvanised, positive lock type and 3.5mm in thickness for 16mm dia.
5.02.09	The Bidder shall furnish bolt schedules giving thickness of members connected, the nut and the washer and the length of shank and the threaded portion bolts and sizes of holes and any other special details of this nature.
5.02.10	To obviate bending stress in bolts or to reduce to minimum, no bolt shall connect aggregate thickness of more than three (3) times its diameter.
5.02.11	The bolt positions is assembled towers shall be as per IS:5613 (Part-II/Section-2)-1976.
5.02.12	Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.
5.03.00	**Tower Accessories**
5.03.01	**Step Bolts & ladders** Each tower shall he provided with step bolts of not less than 16mm diameter and 175 mm long, spaced not more than 450mm apart and extending from about 3.5 meters above the ground level to the top of the tower. 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 structures, where the height of the super structure exceeds 50 meters, ladders along with protection rings as per the Owner 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 railing for access from step bolts to the ladder and from

	the ladder to each crossarm tip and the groundwire support shall be fixed on tower by using countersunk bolts.
5.03.02	**Insulator Strings and Earthwire Clamps Attachments**
a)	For the attachment of suspension insulator string a suitable dimensioned swinging hanger on the tower shall be provided so as to obtain requisite clearance under extreme swinging conditionings and free from swinging of the string. The hanger shall be designed to withstand an UTS equivalent to that of insulators. The supply of design & supply of hanger is in the scope of the Contractor.
b)	At tension towers strain plates of suitable dimensions on the underside of each cross-arm tip and at the top of earthwire peak, suitable plate should be provided for taking the hooks or D-Shackle of the tension insulator strings or earthwire tension clamps, as the case may be. Full details of the attachments shall be submitted by the bidder for Owner's approval before starting the mass fabrication.
5.03.03	Earthwire peaks/crossarms are to be suitably designed to accommodate the shackle of the suspension clamp/tension clamps.
5.03.04	**Anti-climbing Device**
	Barbed wire type anti-climbing device, as per enclosed drawing shall be provided and installed by the Contractor for all towers. The height of the anti-climbing device should be provided approximately 3m above ground level. The barbed wire shall conform to IS-278-1978. The barbed wires shall be given chromating dip as per procedure laid down in IS:1340-1959.
5.03.05	Danger plate, Number plates, Circuit Plate, Phase plate & Bird Guards.
	Danger, Number Plates, Phase Plates & Bird Guards shall be provided and installed by the Contractor:
a)	Each tower shall be fitted with a number plate, and danger plate. Each tension tower shall be provided with a set of phase plates also. The arrangement for fixing these accessories shall not be more than 4.5m above the ground level.
b)	The letters, figures and the conventional skull and bones of data plates shall conform to IS:2551-1963 and shall be in a single red on the front of the plate.
c)	The corners of the number and danger plate shall be rounded off to remove sharp edges.
d)	To prevent birds from perching immediately above the suspension insulator strings and thus fouling it with droppings suitable birdguards shall be provided at cross arm tips of all suspension towers. The arrangement shall conform to IS:5613 part-2/Sec.I.
6.00.00	**TOWER FABRICATION**
6.01.00	Except where hereinafter modified, details of fabrication shall conform to IS:802 (Part-II) 1993 or the relevant international standards.

6.02.00	Butt splices shall be used and the inside Angle and outside plate shall be designed to transmit the load and inside cleat angle, shall not be less than half the thickness of the heavier member connected plus 2mm. Lap splice may be used for connecting members of unequal size and the inside angle of lap splice shall be rounded at the heel to fit the fillet of the outside angle. All splices shall develop full stress in the member connected through bolts. Butt as well as lap splice shall be made as above and as close to the main panel point as possible.
6.03.00	Joints shall be so designed as to avoid eccentricity as far as possible. The use of gusset plates for joining tower members shall be avoided as far as possible. However, where the connections are such that the elimination of the gusset plates would result in eccentric joints, gussets plates and spacer plates may be used in conformity with modern practices. The thickness of the gusset plates required to transmit stress shall not be less than that of members connected.
6.04.00	The use of filler in connection shall be avoided as far as possible. The diagonal web members in tension may be connected entirely to the gusset plate wherever necessary to avoid the use of filler and it shall be connected at the point of intersection by one or more bolts.
6.05.00	The tower structures shall be accurately fabricated to connect together easily at site without any undue strain on the bolts.
6.06.00	No angle member shall have the two leg flanges brought together by closing angle.
6.07.00	The diameter of the hole shall be equal to the diameter of bolt plus 1.5mm.
6.08.00	The structure shall be designed so that all parts shall be accessible for inspection and cleaning. Drain holes shall be provided at all points where pockets depression are likely to hold water.
6.09.00	All similar parts shall be made strictly inter-changeable. All steel sections before any work is done on them, shall be carefully leveled, 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 through out. No rough edges shall be permitted in the entire structure.
6.10.00	**Drilling and Punching**
6.10.01	Before any cutting work is started all steel sections shall be carefully straightened and trued by pressure and not by hammering. They shall again be trued after being punched and drilled.
6.10.02	Holes for bolts shall be drilled on punched with a jig but drilled holes shall be preferred. The following maximum tolerance of accuracy of punched holes is permissible.
a)	Holes must be perfectly circular and no tolerance in this respect permissible.
b)	The max. allowable difference in diameter of the holes on the two sides of plates or angle is 0.8mm. i.e. the allowable taper in a punched holes should not exceed 0.8mm on diameter.
c)	Holes must be square with the plates or angles and have their walls parallel.

6.10.03	All burrs left by drills or punch shall be removed completely. When the tower members are in position the holes shall be truly opposite to each other. Drilling or reaming to enlarge holes shall not be permitted.
6.11.00	**Erection mark**
6.11.01	Each individual member shall have erection mark conforming to the component number given to it in the fabrication drawings. This mark shall be marked with marking dies of 16mm size before galvanising and shall be legible after galvanising.
6.11.02	Erection Mark shall be "A - BB- CC – DDD", where A = Owner's code assigned to the Contractor Alphabet. BB = Contractor's Mark-Numerical CC = Tower Type-Alphabet DDD = Number mark to be assigned by Contractor.
6.12.00	**Quantities and Weights**
6.12.01	The estimated unit weight of each type of tower, stubs and extensions shall be furnished by the bidder. The final quantity of all the items associated with these lines shall be determined by the contractor after completion of the detailed route survey for which the rate quoted by the bidder shall be valid. The weight of tower shall mean the weight of tower calculated by using the black sectional (i.e. un-galvanised) weight of steel members of the size indicated in the approved fabrication drawings and bills of materials, without taking into consideration the reduction in weights, holes, notches and bevel cuts etc, but taking into consideration the weight of the fasteners, anti-climbing devices etc.
6.13.00	**Galvanising** Fully galvanised towers and stub shall be used for the line. Galvanising of the member of the towers shall conform to IS:2629-1985 and IS:4759-1968. All galvanised shall conform 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 Grade 4 of IS:1573-1970.
7.00.00	**TOWER EARTHING** The footing resistance of all towers shall be measured by the Contractor in dry weather after tower erection but before the stringing of earthwire. All the tower are to be earthed. In no case tower footing resistance shall exceed 10 ohms. Pipe type earthing and counterpoise type earthing wherever required shall be provided in accordance with the stipulations made in IS:3043-1987 and IS:5613 (part-II/Section-2) 1985. The details for pipe and counterpoise type earthing are given in drawing enclosed with the specification.

8.00.00	**INSPECTION AND TESTS**
8.01.00	All standard tests, including quality control tests, in accordance with appropriate Indian/International standard, shall be carried out unless otherwise specified herein.
8.02.00	**Inspection** In addition to the provisions contained in Vol. I of tenders documents, the following shall also apply:
8.02.01	The Contractor shall keep the Owner informed in advance about the time of starting and the progress of manufacture and fabrication of various tower parts at various stages, so that arrangements could be made for inspection.
8.02.02	The acceptance of any part of items shall in no way relieve the Contractor of any part of his responsibility for meeting all the requirements of the Specification.
8.02.03	The Owner or his representative shall have free access at all reasonable times to those parts of the Contractor's works which are concerned with the fabrication of the Owner's material for satisfying himself that the fabrication is being done in accordance with the provisions of the specifications.
8.02.04	Unless specified otherwise inspection shall be made at the place of manufacture prior to dispatch and shall be conducted so as not to interfere unnecessarily with the operation of the work.
8.02.05	Should any member of the structure be found not to comply with the approved design, it shall be liable to rejection. No member once rejected shall be resubmitted for inspection, except in cases where the Owner or his authorised representative considers that the defects can be rectified.
8.02.06	Defect which may appear during fabrication shall be made good with the consent of, and according to the procedure proposed by the Contractor and approved by the Owner.
8.02.07	All gauges and templates necessary to satisfy the Owner shall be supplied by the manufacturer.
8.02.08	The correct grade and quality of steel shall be used by the Contractor. To ascertain the quality of steel used the inspector may at his discretion get the material tested at an approved laboratory.
8.03.00	**Tower Load Tests**
8.03.01	The Contractor shall submit one set of shop drawings alongwith the bill of materials after award of Contract. Further, Contractor shall submit one copy of test reports and final tracings of shop drawings and Bill of materials for Owner's reference and record.
8.03.02	The Contractor shall ensure that the specification of materials and workmanship of all towers actually supplied conform strictly to the towers which have successfully under gone the tests. In case any deviation is detected, the Contractor shall replace such defective towers free of cost to the Owner. All expenditure incurred in erection, to and fro transportation and any other expenditure or losses incurred

by the Owner on this account shall be fully borne by the Contractor. No extension in delivery time shall be allowed on this account.

8.04.00 **Tower Testing Procedure**

All type of tower offered should be tested type as per the procedure described below:

8.04.01 **Bolt Slip Test**

8.04.02 In the bolt slip test, the test loads shall be gradually applied up to the 50% of design loads under normal condition and held for two (2) minutes at that loads and then released gradually.

The initial and final readings on the scales (for measurement of defection) before application and after the release of Loads respectively shall be taken with the help of theodolite. The difference between these readings gives the values of the bolt slip.

8.04.03 **Normal/Broken Wire Load Tests**

All the loads, for a particular load-combination test shall be applied gradually upto the full design loads in the following steps and shall also be released in the similar manner:

25 percent
50 percent
75 percent
90 percent
95 percent
100 percent

8.04.04 **Observation Periods**

a) Under normal and broken wire load tests, the tower shall be kept under observation for sign of any failure for two minutes (excluding the time for adjustment of loads) for all intermediate steps of loading upto and including 95 per cent of full design loads.

b) For normal, as well as broken wire tests, the tower shall be kept under observation for five (5) minutes (excluding the time for adjustment of loads) after it is loaded upto 100 percent of full design loads.

c) While the loading operation are in progress, the tower shall be constantly watched, and if it shows any tendency of failure anywhere, the loading shall be immediately stopped, released and then entire tower shall be inspected. The reloading shall be started only after the corrective measures are taken.

d) The structure shall be considered to be satisfactory, if it is able to support the specified full design loads for five (5) minutes, with no visible local deformation after unloading (such as bowing, buckling etc.) and no breakage of elements or constituent parts.

e) Ovalization of holes and permanent deformation of bolts shall not be considered as failure.

8.04.05	**Recording** The deflection of the tower shall be recorded at each intermediate and final stage of normal load and broken wire load tests by means of a theodolite and graduated scale. The scale shall be of about one meter long with marking upto 5 mm accuracy.
8.04.06	**Destruction Test**
a)	The destruction test shall be carried out under normal condition or broken wire condition. The Owner at the time of approval of rigging chart/test data sheet shall intimate the contractor. Under which load condition the destruction test is to be carried out.
b)	The procedure for application of load for normal/broken wire test shall also be applicable for destruction test. However, the load shall be increased in steps of five (5) percent after the full design loads have been reached.
9.00.00	**PACKING**
9.01.00	Angle section shall be wire bundled.
9.02.00	Cleat angles, gusset plates, brackets, fillet plate, hanger and similar loose pieces shall be tested and bolted together in multiples or securely wired through holes.
9.03.00	Bolts, nuts, washers and other attachments shall be packed in double gunny bags accurately tagged in accordance with the contents.
9.04.00	The packings shall be properly done to avoid losses/damages during transit. Each bundle or package shall be appropriately marked.
10,00,00	**DESIGN CALCULATION AND DRAWINGS**
10.01.00	The following design calculation and drawings are required to be furnished during detailed engineering.
a)	Computation of wind load
b)	Sag-tension calculation
c)	Tower loading
d)	Single line diagram of towers slowing electrical clearances and steel sections.
e)	Sketches of foundation showing dimensions.
10.02.00	The Contractor shall furnish following to the owner:
a)	Detailed design calculation and drawing for towers and foundations.
b)	Detailed structural drawings indicating section size, length of members sizes of plate along with hole to hole distance, joint details etc.
c)	Bill of materials, indicating cutting and bending details against each member.
d)	Shop drawings showing all details relevant to fabrication.

e) All the drawings for the tower accessories.

TABLE-T1-2
DESIGN LOADS

S.No	Tower Type	Longitudinal Loads		Transverse Loads	
		Reliability Condition	Security Condition	Reliability Condition	Security Condition
1	2	3	4	5	6
a.	DA	0.0	0.5 x MT For Conductor). 1.0 x MT (For Earth Wire)	WC + WI + DY	0.6 WC + WI +0.25 DY (For Conductor) 0.6 WC + 0.5 DY (For Earth Wire)
b.	DB (Section Tower- 0° Deviation)	MT1	1.0 x MT	WC + WI + DY	0.6 WC + WI +0.5 DY
c.	D B (15° Deviation)	MT1	1.0 x MT x Cos Φ/2	WC + WI + DY	0.6 WC + WI +0.5 DY
d.	DC (Section Tower- 0° Deviation)	MT1	1.0 x MT	WC + WI + DY	0.6 WC + WI +0.5 DY
e.	DC (30° Deviation)	MT1	1.0 x MT x Cos Φ/2	WC + WI + DY	0.6 WC + WI +0.5 DY
f.	D/DD (60° Deviation)	MT1	1.0 x MT x Cos Φ/2	WC + WI + DY	0.6 WC + WI +0.5 DY
g.	D/ DD (Dead End with slack span of 100 Mtrs. Max.)	0.7 MT	1.0 x MT	WC + WI + (0.3 MT x Sin 15°)	0.6 WC + WI
h.	D/ DD Complete Dead End	MT	1.0 x MT	WC + WI	0.1 WC + WI

DESCRIPTION	SYMBOL	REMARKS
Maximum Tension Of Conductor/ Earth Wire under everyday temperature & full wind condition or minimum temperature & 36% 0f max. wind which ever is more stringent	MT	For 400 KV Towers, twin bundle conductors shall be considered. Wind Span shall be the normal ruling span.
Wind On Conductor	WC	
Wind On Insulator	WI	In case of Double String Insulators, both their strings shall be considered
Angle Of Deviation (Degrees)	Φ	
Load Due To Deviation Of Tower	DY= 2 x MT x Sin Φ/2	
Difference In Tension For Equivalent Spans Of 400 M & 200 M (For 400 KV Towers)	MT1	

Note:

1. Vertical loads shall conform to IS 802 – Part I, 1995. Weight spans as furnished under Clause 2.03.00 shall be considered for computation of vertical loads.

2. Safety loads and Anti-cascade loads as specified in IS 802- Part I, 1995 shall also be considered for design of Towers.

3. Wind loads on the towers shall be considered in transverse loads as per clause 11, 12 and 13 of IS: 802 (Part-I/ Sec. I)- 1995.

4. Any additional loads apart from the loads mentioned above, as required as per IS: 802- 1995 shall be considered for design purpose.

PART- III

TECHNICAL SPECIFICATION
CHAPTER – T0

TRANSMISSION LINES – GENERAL

(For 33KV Lines)

PART- III

33kV TRANSMISSION LINES

CHAPTER – T1 : TRANSMISSION LINE TOWERS

1.00.00 GENERAL DESCRIPTION OF TOWERS

1.01.00 The double circuit towers are self supporting lattice steel type and square, designed to carry the line conductors with necessary insulators, earthwires and all fittings under all loading conditions. The tower shall be fully galvanised structure. The types and grade of steel shall conform to latest applicable standards. However, the Bidders are permitted to opt for not more than two grades of steel.

1.02.00 **Types of Towers**

Type of Tower	Deviation Limit	Typical Use
A	0 deg. – 2 deg.	To be used as tangent tower
B	0 deg. – 30 deg.	a) Angle towers with tension insulator string b) Also to be designed for anti-cascading condition.
B	0 deg.	To be used as section tower
C	30 deg. – 60 deg.	a) Angle towers with tension insulator string b) Dead end with 0 deg. to 15 deg. deviation both on line and substation side (slack span)
C	0 deg.	a) Complete dead end d) For crossing/anchoring with longer wind span with 0 deg. deviation on crossing span side and 0 deg. to 30 deg. deviation on other sides.

Note: The above towers can be used for longer span with smaller angle of deviations.

1.03.00 **Extensions**

The single circuit towers shall be designed so as to be suitable for adding 3m, 6m, 9m and 12m body extensions for maintaining adequate ground clearance without reducing the specified factor of safety in any manner. All above extension provisions to normal tower shall be treated as part of normal tower body.

2.00.00 SPANS AND CLEARANCES

2.01.00 Normal Span

The normal ruling span of the line shall be 150 meters.

2.02.00 Wind Span

The wind span is the sum of the two half spans adjacent to the support under consideration. For normal horizontal spans this equals to normal span.

2.03.00 Weight Span

The weight span is the horizontal distance between lowest point of the conductors on the two spans adjacent to the tower. For design of structures, the span limits given below shall prevail.

Tower type	Normal Condition		Broken Wire Condition	
	Max. (m)	Min. (m)	Max. (m)	Min. (m)
A	225	120	135	72
B & C	225	160	135	-160

2.04.00 Electrical Clearance

2.04.01 Ground clearance

The minimum ground clearance from the bottom conductor shall not be less than 5.2 meters at the maximum sag conditions i.e. at maximum temperature and still air. However, to achieve the above clearance the height of tower shall be increased in the following manner:

a) Allowance of 150 mm shall be provided to account for errors in stringing.

b) Conductor creep shall be compensated by over tensioning the conductor at a temperature lower than the ambient temperature. The creep correction temperature along with calculations shall be furnished by the Contractor.

2.04.02 Rail Crossing

In case of rail crossing the min. height above rail level of the lowest portion of any conductor under condition of max. sag, in accordance with the regulations for Electrical Crossing of Railway tracks as prevailing at the time of construction of line shall be applicable. However, as per present regulations (revised in 1987) the minimum clearance is stipulated as 14.1 meters.

2.04.03 Power Line Crossing

a) Minimum clearance between power line to power line crossing should be 4580 mm for 220 kV and 6300mm for 400 kV lines.

b) For power line crossing, suitable gantries/Rail Pole structures may be used.

2.04.04 Live Metal Clearance

The minimum live metal clearance to the provided between the live parts and steel work of super-structure shall conform to IS-5613 (Part-2/Sec-1) - 1985.

	Type of Insulator String	Swing in Degrees	Min. Clearance (mm)
a)	Pin Insulator	NIL	330
b)	Tension string (Single/Double)	NIL	330
c)	Jumper	10°	330
		20°	330
		30°	330
d)	Single suspension string	Nil	330
		15°	330
		30°	330
		45°	330
		60°	330
e)	Double suspension string	30°	330

2.04.05 Bidder shall adopt same cross arm design where jumper is projecting outside of cross-arm for `C' type tower to be used as dead end and angle tower.

2.04.06 The design of the tower shall be such that it should satisfy all the above conditions when clearances are measured from any live point of the strings.

2.04.07 Angle of Shielding

The angle of shielding is defined as the angle formed by the line joining the center lines of the earthwire and outer power conductor, in still air, at tower supports, to the vertical line through the center line of the earthwire. Bidders shall design the tower in such a way that the angle of shielding does not exceed 30 deg for double circuit towers. The drop of the earthwire clamp, which is in the scope of contractor supplied items, should be considered while calculating the minimum angle of protection. For estimating the minimum angle of protection the drop of earth wire suspension clamp alongwith shackle shall be taken as 150mm.

2.04.08 Mid Span Clearance

The minimum vertical mid span clearance between the earthwire and the nearest power conductor shall not be less than 1.5 meters, which shall mean the vertical clearance between earthwire and the nearest conductor under all temperatures and still air condition in the normal ruling span. Further, the tensions of the earthwires and power conductors, shall be so co-ordinated that the sag of earthwires shall be at least 10% less than that of power conductors under all temperature loading conditions.

3.00.00 **LOADING CONDITIONS**

3.01.00 Loads at Conductor And Earthwire Points

Owner has calculated the ultimate external loadings at conductor and earthwire points and enclosed alongwith the Specification. The Contractor shall develop the tower designs considering loadings given by the Owner. These loads have been computed based on IS 802/Part - I, 1996 and towers are to be designed to cater for the following

	loads:
a)	Reliability Loads (Normal condition)
b)	Security Loads (Broken wire condition)
c)	Safety Loads (Construction & Maintenance loads)
3.02.00	Wind Loads on Tower Body The wind load on tower body shall be calculated by the Contractor as per IS: 802, Part-I, 1996.
3.03.00	Maximum Tension Maximum tension shall be based on either of the following (whichever is more stringent):
a)	at 0 deg C with 36% full wind pressure., or
b)	at 32 deg C with full wind pressure
3.04.00	Sag tension calculation for design purpose shall be calculated considering normal span of 200 meter.
3.05.00	The initial conductor and earthwire tension at 32 degree C and without wind shall be 22% of the ultimate tensile strength of the conductor and 20% of the ultimate tensile strength of the Earthwire.
3.06.00	Limiting Tensions of conductor & Earthwire The ultimate tension of conductor and ground wire shall not exceed 70 per cent of the ultimate tensile strengths.
3.07.00	Broken Wire condition(Security Condition) All tower under this condition shall be designed for maximum wind condition
3.07.01	Suspension Tower Type A Any one phase or earthwire broken: whichever is more stringent for a particular member. The design longitudinal load under this conditions shall be 100% of maximum tension for earthwire and 50% of maximum tension for conductors.
3.07.02	Tension Tower Type B Any two phases broken on the same side and same span or any one phase and ground wire broken : whichever is more stringent for a particular member.
3.07.03	Tension tower type C Any three phases broken on the same side and same span or groundwire and any two phases on the same span and same side broken whichever is more stringent for a particular member.

4.00.00	**DESIGN OF TOWERS**
4.01.00	Design Criteria Towers shall be designed based on spans and clearances, and loading conditions as detailed above.
4.02.00	Design Temperatures The following temperature range for the conductors and ground wires shall be adopted for line design: a) Minimum temperature : 0 deg.C b) Everyday temperature of conductor : 32 deg.C c) Max. temperature of Conductor : 75 deg.C d) Max. temperature of Earthwire exposed to sun : 53 deg.C
4.03.00	Redundant Design All redundants in the towers are to be triangulated. Redundants, having an angle of 15 deg or less with horizontal are to be designed for a concentric vertical ultimate load of 1.5 KN acting at center of the unsupported length. The Contractor has to furnish the calculation for the same. The redundants shall also be designed for 2.5% of max. axial load of connecting members (i.e. leg members, bracing members etc.).
4.04.00	Steel Sections For designing of towers, preferably rationalised steel sections shall be used. During execution of the project, if any particular section is not available same shall be substituted by higher section at no extra cost to Owner and the same shall be borne by the Contractor. However, design approval for such substitution shall be obtained from the Owner before any substitution.
4.05.00	Thickness of Members The minimum thickness of angle sections used in the design of tower, unless otherwise specified elsewhere in this Specification, shall be kept not less than the following values: a) Main corner leg members including the groundwire peak and main cross arm : 5 mm b) For all other members : 4 mm
4.06.00	Bolts & Nuts
4.06.01	The minimum bolt spacing and rolled edge distance and sheared edge distance from the centers of the bolt holes to be maintained are given below: a) Diameter of bolts 16 mm b) Hole diameter 17.5 mm c) Min. bolt spacing 40 mm d) Min. rolled distance 20 mm e) Min. sheared edge distance 23 mm

4.06.02	Bolts sizes mentioned above shall only be used. The minimum width of the flanges without bolt holes shall be 30mm.
4.06.03	For the purpose of calculating shearing stress and bearing stress for bolts, IS:802-Part-II-1973 may be referred.
4.07.00	Slenderness Ratio
4.07.01	Slenderness ratio for members shall be computed in accordance with IS:802, Part-II, 1993. Slenderness ratio for compression and tension members shall not exceed the values specified therein.
4.07.02	The following maximum limit of the slenderness ratio i.e. the ratio of unsupported length of the section in any plane to the appropriate radius of gyration will be adopted:
a)	For main corner leg members including the corner members of earthwire peak and the lower corner members of the cross-arms 120
b)	For other members having calculated stresses 200
c)	For redundant members 250
d)	For members having tensile stress only 375
4.08.00	The bracing pattern, including that of secondary bracings (redundants) shall be identical on transverse and longitudinal faces of the tower, i.e. staggering of primary and secondary bracings are not permitted. Primary bracings and redundants shall be properly triangulated, i.e. the overall pattern of bracing on tower body and cross arms shall be triangular only.
4.09.00	Erection Stress Where erection stress combined with other permissible co-existent stresses could produce a working stress in any member appreciably above the specified working stress, such other provisions are to be made as may be necessary to bring the working stress within the specified limit.
5.00.00	**TOWER MATERIALS**
5.01.00	Tower Steel Sections IS steel sections of tested quality in conformity with IS:226-1975 or IS:2062-1980 are to be used in towers, extensions and stub setting templates. No individual member shall be longer than 6000mm. The Bidder can also use most efficient grades of structural steel angle sections and plates conforming to latest international standards. However, the Bidders are permitted to opt for not more than two (2) grades of steel for any particular package.
5.02.00	Fasteners : Bolts, Nuts and Washers
5.02.01	All bolts and nuts shall conform to IS:6639-1972. All bolts and nuts shall be galvanised and 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.

5.02.02	The bolt shall be of 16 mm dia and of property class 5.6 as specified in IS:1367 (Part-III) 1979 and matching nut of property class as specified in IS:1367 (Part-VI) 1980.
5.02.03	Bolts upto M16 and having length upto 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 bolts for 5.6 grade should be 310 MP a minimum as per IS:12427. Bolts should be provided with washer face in accordance with IS:1363 Part-I to ensure proper bearing.
5.02.04	To ensure uniformity of galvanizing, bolts and nuts should be galvanised by high temperature hot-dip galvanizing, at a minimum temperature of 530 deg.C . The temperature should be recorded continuously in the form of a continuous chart. The galvanised coating should be uniform and its value should be between 50 micron to 115 micron to be checked on random sampling basis, on the threaded portion as well. The facility to check the galvanised coating should be by metallographic method.
5.02.05	Nuts should be double chamfered as per the requirement of IS:1363 Part-III, 1984. It should be ensured by the manufacturer that nuts should not be overtapped beyond 0.4 MM oversize on effective diameter for size upto M16.
5.02.06	Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion will not extend into the place of contact of the members.
5.02.07	All bolts shall be threaded to take the full depth of the nuts and threaded 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 8mm when fully tightened. All nuts shall fit and tight to the point where the shank of the bolt connects to the head.
5.02.08	Flat and tapered washers shall be provided wherever necessary. Spring washers shall be provided for insertion under all nuts. These washers shall be of steel electro-galvanised, positive lock type and 3.5mm in thickness for 16mm dia.
5.02.09	The Bidder shall furnish bolt schedules giving thickness of members connected, the nut and the washer and the length of shank and the threaded portion bolts and sizes of holes and any other special details of this nature.
5.02.10	To obviate bending stress in bolts or to reduce to minimum, no bolt shall connect aggregate thickness of more than three (3) times its diameter.
5.02.11	The bolt positions is assembled towers shall be as per IS:5613 (Part-II/Section-2)-1976.
5.02.12	Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.
5.03.00	Tower Accessories
5.03.01	Step Bolts & ladders
	Each tower shall he provided with step bolts of not less than 16mm diameter and 175 mm long, spaced not more than 450mm apart and extending from about 3.5 meters above the ground level to the top of the tower. 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 structures, where the height of the super structure exceeds 50 meters, ladders along with protection rings as per the Owner 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 railing for access from step bolts to the ladder and from the ladder to each crossarm tip and the groundwire support shall be fixed on tower by using Countersunk bolts.
5.03.02	Insulator Strings and Earthwire Clamps Attachments
a)	For the attachment of suspension insulator string a suitable dimensioned swinging hanger on the tower shall be provided so as to obtain requisite clearance under extreme swinging conditionings and free from swinging of the string. The hanger shall be designed to withstand an UTS equivalent to that of insulators. The supply of design & supply of hanger is in the scope of the Contractor.
b)	At tension towers strain plates of suitable dimensions on the underside of each cross-arm tip and at the top of earthwire peak, suitable plate should be provided for taking the hooks or D-Shackle of the tension insulator strings or earthwire tension clamps, as the case may be. Full details of the attachments shall be submitted by the bidder for Owner's approval before starting the mass fabrication.
5.03.03	Earthwire peaks/crossarms are to be suitably designed to accommodate the shackle of the suspension clamp/tension clamps.
5.03.04	Anti-climbing Device Barbed wire type anti-climbing device, as per enclosed drawing shall be provided and installed by the Contractor for all towers. The height of the anti-climbing device should be provided approximately 3m above ground level. The barbed wire shall conform to IS-278-1978. The barbed wires shall be given chromating dip as per procedure laid down in IS:1340-1959.
5.03.05	Danger plate, Number plates, Circuit Plate, Phase plate & Bird Guards. Danger, Number Plates, Phase Plates & Bird Guards shall be provided and installed by the Contractor:
a)	Each tower shall be fitted with a number plate, and danger plate. Each tension tower shall be provided with a set of phase plates also. The arrangement for fixing these accessories shall not be more than 4.5m above the ground level.
b)	The letters, figures and the conventional skull and bones of data plates shall conform to IS:2551-1963 and shall be in a single red on the front of the plate.
c)	The corners of the number and danger plate shall be rounded off to remove sharp edges.
d)	To prevent birds from perching immediately above the suspension insulator strings and thus fouling it with droppings suitable birdguards shall be provided at cross arm tips of all suspension towers. The arrangement shall conform to IS:5613 part-2/Sec.I.
6.00.00	**TOWER FABRICATION**
6.01.00	Except where hereinafter modified, details of fabrication shall conform to IS:802 (Part-II) 1993 or the relevant international standards.

6.02.00	Butt splices shall be used and the inside Angle and outside plate shall be designed to transmit the load and inside cleat angle, shall not be less than half the thickness of the heavier member connected plus 2mm. Lap splice may be used for connecting members of unequal size and the inside angle of lap splice shall be rounded at the heel to fit the fillet of the outside angle. All splices shall develop full stress in the member connected through bolts. Butt as well as lap splice shall be made as above and as close to the main panel point as possible.
6.03.00	Joints shall be so designed as to avoid eccentricity as far as possible. The use of gusset plates for joining tower members shall be avoided as far as possible. However, where the connections are such that the elimination of the gusset plates would result in eccentric joints, gussets plates and spacer plates may be used in conformity with modern practices. The thickness of the gusset plates required to transmit stress shall not be less than that of members connected.
6.04.00	The use of filler in connection shall be avoided as far as possible. The diagonal web members in tension may be connected entirely to the gusset plate wherever necessary to avoid the use of filler and it shall be connected at the point of intersection by one or more bolts.
6.05.00	The tower structures shall be accurately fabricated to connect together easily at site without any undue strain on the bolts.
6.06.00	No angle member shall have the two leg flanges brought together by closing angle.
6.07.00	The diameter of the hole shall be equal to the diameter of bolt plus 1.5mm.
6.08.00	The structure shall be designed so that all parts shall be accessible for inspection and cleaning. Drain holes shall be provided at all points where pockets depression are likely to hold water.
6.09.00	All similar parts shall be made strictly inter-changeable. All steel sections before any work is done on them, shall be carefully leveled, 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 through out. No rough edges shall be permitted in the entire structure.
6.10.00	Drilling and Punching
6.10.01	Before any cutting work is started all steel sections shall be carefully straightened and trued by pressure and not by hammering. They shall again be trued after being punched and drilled.
6.10.02	Holes for bolts shall be drilled on punched with a jig but drilled holes shall be preferred. The following maximum tolerance of accuracy of punched holes is permissible.
a)	Holes must be perfectly circular and no tolerance in this respect permissible.
b)	The max. allowable difference in diameter of the holes on the two sides of plates or angle is 0.8mm. i.e. the allowable taper in a punched holes should not exceed 0.8mm on diameter.
c)	Holes must be square with the plates or angles and have their walls parallel.

6.10.03	All burrs left by drills or punch shall be removed completely. When the tower members are in position the holes shall be truly opposite to each other. Drilling or reaming to enlarge holes shall not be permitted.
6.11.00	Erection mark
6.11.01	Each individual member shall have erection mark conforming to the component number given to it in the fabrication drawings. This mark shall be marked with marking dies of 16mm size before galvanising and shall be legible after galvanising.
6.11.02	Erection Mark shall be "A - BB- CC – DDD", where A = Owner's code assigned to the Contractor Alphabet. BB = Contractor's Mark-Numerical CC = Tower Type-Alphabet DDD = Number mark to be assigned by Contractor.
6.12.00	Quantities and Weights
6.12.01	The provisional quantities required are mentioned in the respective Schedule of Prices. Final quantities shall be determined after completion and approval of the detailed route survey. The final quantities of tower shall be confirmed by the Owner based on the requirement of quantities of various towers furnished by the Contractor after completion of detailed survey. Hence it will be responsibility of the Contractor to intimate the exact requirements of all towers and various line materials required for line immediately after the survey. The Owner reserves the right to order the final quantities (including spare towers) for which the rates quoted in the Bid shall be valid.
6.12.02	The Owner shall/may purchase few towers as spare which shall be supplied at the rate quoted in the bid.
6.12.03	The estimated unit weight of each type of tower, stubs and extensions shall be furnished by the bidder. The weight of tower shall mean the weight of tower calculated by using the black sectional (i.e. un-galvanised) weight of steel members of the size indicated in the approved fabrication drawings and bills of materials, without taking into consideration the reduction in weights, holes, notches and bevel cuts etc, but taking into consideration the weight of the fasteners, anti-climbing devices etc.
6.13.00	Galvanising Fully galvanised towers and stub shall be used for the line. Galvanising of the member of the towers shall conform to IS:2629-1985 and IS:4759-1968. All galvanised shall conform 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 Grade 4 of IS:1573-1970.
7.00.00	**TOWER EARTHING** The footing resistance of all towers shall be measured by the Contractor in dry weather after tower erection but before the stringing of earthwire. All the tower are to be

	earthed. In no case tower footing resistance shall exceed 10 ohms. Pipe type earthing and counterpoise type earthing wherever required shall be provided in accordance with the stipulations made in IS:3043-1987 and IS:5613 (part-II/Section-2) 1985. The details for pipe and counterpoise type earthing are given in drawing enclosed with the specification.
8.00.00	**INSPECTION AND TESTS**
8.01.00	All standard tests, including quality control tests, in accordance with appropriate Indian/International standard, shall be carried out unless otherwise specified herein.
8.02.00	Inspection In addition to the provisions contained in Vol. I of tenders documents, the following shall also apply:
8.02.01	The Contractor shall keep the Owner informed in advance about the time of starting and the progress of manufacture and fabrication of various tower parts at various stages, so that arrangements could be made for inspection.
8.02.02	The acceptance of any part of items shall in no way relieve the Contractor of any part of his responsibility for meeting all the requirements of the Specification.
8.02.03	The Owner or his representative shall have free access at all reasonable times to those parts of the Contractor's works which are concerned with the fabrication of the Owner's material for satisfying himself that the fabrication is being done in accordance with the provisions of the specifications.
8.02.04	Unless specified otherwise inspection shall be made at the place of manufacture prior to dispatch and shall be conducted so as not to interfere unnecessarily with the operation of the work.
8.02.05	Should any member of the structure be found not to comply with the approved design, it shall be liable to rejection. No member once rejected shall be resubmitted for inspection, except in cases where the Owner or his authorised representative considers that the defects can be rectified.
8.02.06	Defect which may appear during fabrication shall be made good with the consent of, and according to the procedure proposed by the Contractor and approved by the Owner.
8.02.07	All gauges and templates necessary to satisfy the Owner shall be supplied by the manufacturer.
8.02.08	The correct grade and quality of steel shall be used by the Contractor. To ascertain the quality of steel used the inspector may at his discretion get the material tested at an approved laboratory.
8.03.00	Tower Load Tests
8.03.01	Testing of Tower Galvanised tower of each type complete with 6M extension shall be subjected to design and destruction tests by first applying test loads applied in a manner approved by the

	Owner. The tower shall withstand these tests without showing any sign of failure or permanent distortion in any part. Thereafter the tower shall be subjected to destruction by increasing the loads further in an approved manner till it fails. The tower shall be tested for all the conditions considered for the design of tower. The contractor shall submit to the Owner for approval, the detailed programme and proposal for testing the towers showing the methods of carrying out the tests and manner of applying the loads. After the Owner has approved the test procedures and programmes the Contractor will intimate the Owner about carrying out the tests at least 30 days in advance of the scheduled date of tests during which the Owner will arrange to depute his representative to be present at the time of carrying out the tests. Six copies of the test reports shall be submitted.
8.03.02	The Contractor shall submit one set of shop drawings alongwith the bill of materials at the time of prototype tower testing for checking the tower material. Further, at the time of submitting test report, the Contractor has to submit the final tracings of shop drawings and Bill of materials for Owner's reference and record. The type testing charges shall be released only after approval of test report, shop drawings, bill of material and structural drawings of tower.
8.03.03	In case of premature failure the tower shall be re-tested and steel already used in the earlier test shall not be used again. However, in case of minor failures, the Contractor can replace the members with higher section and carry out the testing. The Contractor shall provide facilities to the Owner or their representatives for inspection of materials during manufacturing stage and also during testing of the same.
8.03.04	In case of any premature failure even during waiting period, the tower is to be re-tested with rectified members. However, if the failures are major in nature and considerable portion of tower is to be re-erected, in such cases all the tests which has been carried out earlier are required to be conducted again in compliance with Specification.
8.03.05	No part of any tower subject to test shall be allowed to be used on the line. The price will be quoted after allowing rebate for the scrap value of the tower material which shall be retained by the Contractor.
8.03.06	The Contractor shall ensure that the specification of materials and workmanship of all towers actually supplied conform strictly to the towers which have successfully under gone the tests. In case any deviation is detected, the Contractor shall replace such defective towers free of cost to the Owner. All expenditure incurred in erection, to and fro transportation and any other expenditure or losses incurred by the Owner on this account shall be fully borne by the Contractor. No extension in delivery time shall be allowed on this account.
8.03.07	Each type of tower to be tested shall be a full scale prototype galvanised tower and shall be erected vertically on rigid foundation of the stub protruding above ground level as provided in the design/drawing between ground level and concrete level. This portion of the stub shall be kept unbraced while testing. The tower erected on test bed shall not be out of plumb by more than 1 in 360.
8.03.08	All the measuring instruments shall be calibrated in systematic/approved manner with the help of standard weight/device. Calibration shall be done before commencing the test of each tower upto the maximum anticipated loads to be applied during testing.
8.03.09	The sequence of testing shall be decided by the Owner at the time of approving the

	rigging chart/test data sheet.
8.03.10	The Owner may decide to carry out the tensile test, bend test etc. as per relevant IS on few members of the test tower after completion of the test or in case of any premature failure. The Contractor shall make suitable arrangement for the same without any extra cost of the Owner.
8.03.11	Prefix 'T' shall be marked on all members of test tower in addition to the mark number already provided.
8.04.00	Method of Load Application
8.04.01	Loads shall be applied according to the approved rigging arrangement through normal wire attachments angles on bent plates.
8.04.02	The various types of loads, transverse, vertical and longitudinal shall be applied in such a way that there is no impact loading on the tower due to jerks from the winches.
8.04.03	All the loads shall be measured through a suitable arrangement of strain devices or by using weights. Positioning of the strain devices shall be such that the effect of pulley friction is eliminated. In case the pulley friction cannot be avoided, the same will be measured by means of standard weights and accounted for in the test loads.
8.05.00	Tower Testing Procedure The procedure for conducting the tower test shall be as follows:
8.05.01	Bolt Slip Test
a)	In the bolt slip test, the test loads shall be gradually applied up to the 50% of design loads under normal condition and held for two (2) minutes at that loads and then released gradually.
b)	The initial and final readings on the scales (for measurement of defection) before application and after the release of Loads respectively shall be taken with the help of theodolite. The difference between these readings gives the values of the bolt slip.
8.05.02	Normal/Broken Wire Load Tests All the loads, for a particular load-combination test shall be applied gradually upto the full design loads in the following steps and shall also be released in the similar manner: 25 percent 50 percent 75 percent 90 percent 95 percent 100 percent
8.05.03	Observation Periods
a)	Under normal and broken wire load tests, the tower shall be kept under observation for sign of any failure for two minutes (excluding the time for adjustment of loads) for all

	intermediate steps of loading upto and including 95 per cent of full design loads.
b)	For normal, as well as broken wire tests, the tower shall be kept under observation for five (5) minutes (excluding the time for adjustment of loads) after it is loaded upto 100 percent of full design loads.
c)	While the loading operation are in progress, the tower shall be constantly watched, and if it shows any tendency of failure anywhere, the loading shall be immediately stopped, released and then entire tower shall be inspected. The reloading shall be started only after the corrective measures are taken.
d)	The structure shall be considered to be satisfactory, if it is able to support the specified full design loads for five (5) minutes, with no visible local deformation after unloading (such as bowing, buckling etc.) and no breakage of elements or constituent parts.
e)	Ovalization of holes and permanent deformation of bolts shall not be considered as failure.
8.05.04	Recording The deflection of the tower shall be recorded at each intermediate and final stage of normal load and broken wire load tests by means of a theodolite and graduated scale. The scale shall be of about one meter long with marking upto 5 mm accuracy.
8.05.05	Destruction Test
a)	The destruction test shall be carried out under normal condition or broken wire condition. The Owner at the time of approval of rigging chart/test data sheet shall intimate the contractor. Under which load condition the destruction test is to be carried out.
b)	The procedure for application of load for normal/broken wire test shall also be applicable for destruction test. However, the load shall be increased in steps of five (5) percent after the full design loads have been reached.
9.00.00	**PACKING**
9.01.00	Angle section shall be wire bundled.
9.02.00	Cleat angles, gusset plates, brackets, fillet plate, hanger and similar loose pieces shall be tested and bolted together in multiples or securely wired through holes.
9.03.00	Bolts, nuts, washers and other attachments shall be packed in double gunny bags accurately tagged in accordance with the contents.
9.04.00	The packings shall be properly done to avoid losses/damages during transit. Each bundle or package shall be appropriately marked.
10.00.00	**DESIGN CALCULATION AND DRAWINGS**
10.01.00	The following design calculation and drawings are required to be furnished alongwith

SECTION - 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

This section stipulates the General Technical Requirements under the contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections and is not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 QUALIFYING REQUIREMENT

The contractor shall have adequate galvanizing facilities to galvanize the longest single steel member of 6.5m length in one dip.

All structural assembly drawings shall be prepared in Auto Cad (Release 12 or better).

3.2 SITE INFORMATION

SL.NO.	DESCRIPTION	
3.2.1	**PROJECT INFORMATION**	
	a) Customer	
	b) Project	
	c) Project location	
	d) Transport facilities Nearest Railway Station/Gauge Distance from Railway Station	
	e) Access roads	

3.3 STANDARDS

All materials shall comply in all respect with the requirement of the latest edition of the relevant codes as listed in Section2.

3.4 UNIT

Metric (System International) units of measurements shall be used in all drawings.

3.5 DRAWINGS, BILL OF MATERIALS AND CDs

At each stage following set of fabrication drawings/Bill of materials shall be submitted.

i) Fabrication Drawings : 4 sets
ii) Bill of Materials : 4 sets

After final approval of proto –type assembly of structures, the drawings shall be updated as per proto and marked "PROTO CORRECTED". The following sets of fabrication drawings/shop drawings/bill of materials/CDs shall be submitted for distribution:

i)	Fabrication Drawings	: 1 set
ii)	Shop Drawings	: 1 set
ii)	Bill Of Materials	: 1 set
iii)	CDs	: 2 sets

3.6 CATEGORIES OF APPROVAL

CATEGORY I	This means that the documents/drawings is approved.
CATEGORY II	This means that the document/drawing is approved with comments i.e, some corrections are required but the contractor can go ahead with the manufacture after incorporating comments.
CATEGORY III	This means that the document/drawing is not approved i.e major revisions are required and the contractor can not proceed with the manufacture.

3.7 ERRORS

Any error in fabrication work preventing proper assembly and fitting up of parts in the field, shall be classified as defective workmanship. All changes incurred by BHEL either directly or indirectly because of this shall be deducted from the amount due to the contractor.

3.8 PURCHASE ORDER NUMBER

The P.O No. shall be mentioned on all documents and drawings.

SECTION – 5

MANUFACTURING QUALITY PLAN

5.1 Material shall be inspected in accordance to the QP duly approved by BHEL/Customer

SECTION-6

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER

RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:
BIDDER:OFFER REFERENCE:

6.1 Deviations Tick YES NO

If yes,

S.No.	Deviation	Clause No.
1		
2		
3		
4		

(Signature & Seal of Bidder)