

**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	Enquiry No. 284E270 Dated 27/03/2015 Due on 21/04/2015
1.	<p>1. 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 or otherwise offer may be rejected.</p> <p>2. Bidder must ensure that their quotation is received / dropped in the tender box on or before 2.00 PM of the due date of opening in</p> <p><b>BHEL, Tower A, 5<sup>th</sup> Floor, Advant Navis IT Business Park, Plot No. 7, Sector-142, Expressway, Noida Distt. Gautam Buddha Nagar, U.P-201305</b></p> <p>3. The same shall be opened at 2.30 PM 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.</p> <p>4. 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) 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 will prevail over figure.</p> <p>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 super scribed with enquiry no., item / package name, project name and due date of opening.</p> <p>5. For any Technical clarification, please contact</p> <p>Ms Muneet Mehta (Manager – Engineering) BHEL, Tower A, 5<sup>th</sup> Floor, Advant Navis IT Business Park, Plot No. 7, Sector-142, Expressway, Noida, Distt. Gautam Buddha Nagar, U.P-201305 e-mail : muneet@bhel.in Phone: 0120-6748519</p> <p>For any commercial clarification please contact person issuing enquiry.</p>

Sr. No	Enquiry No. 284E270 Dated 27/03/2015 Due on 21/04/2015
	<p>6. Price bid should not contain any information / description / terms &amp; condition other than given in Part-I of the bid except prices, otherwise bid is liable for rejection.</p> <p><b>7. 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. With-drawal of quotation by the bidder, at any stage after its opening, may entail blacklisting of vendor.</b></p> <p><b>8. Enquiry condition for where the scope against this tender includes Installation and Commissioning of the equipment / material – N A</b></p>
2.	<p><b>PRICES:</b></p> <p><b>A.</b> The prices shall be Firm</p> <p><b>B</b> The prices shall be quoted by the vendors considering following.</p> <p><b>B.1</b>This is a <b>Mega Power Project where deemed export benefits is available as per foreign trade policy of Govt. of India. Hence,</b></p> <p><b>B.1 (A) Excise Duty – Exempted. Requisite certificates i.e. Project Authority Certificates shall be issued by BHEL customer (NPGC).</b></p> <p><b>B.1 (B) Vendor shall be solely responsible for obtaining deemed export benefits from the concerned authorities and in case of failure to receive such benefits, BHEL will not compensate them in any manner, whatsoever.</b></p> <p><b>C.</b> The prices are to be quoted on FOR (Destination) basis. The break-up of price shall be as under:-</p> <p><b>a) Ex-works Price:</b> Ex- works price including packing &amp; forwarding charges.</p> <p><b>b) Excise duty:</b> Exempted against PAC.</p> <p><b>c) Sales Tax:</b> ST / VAT /CST (against C-form) to be quoted as percentage in un-price and price bid. In case of interstate sale-in-transit supplier have to provide E1/E2 form.</p> <p><b>e) Entry tax / Octroi Charges:</b> Any Entry tax / Octroi applicable at destination / destination state shall be paid extra on proof of such payment.</p> <p><b>f) Freight &amp; Insurance:</b> Freight and Transit Insurance for door delivery up to destination/store is to be quoted.</p> <p><b>g) Type Test charges:</b> If asked in the technical specification, is to be quoted separately for each Test along with taxes and duties applicable on them.</p> <p><b>h) Erection / Commissioning supervision charges:</b> If asked in the technical specification, to be quoted separately along with taxes and duties applicable on them.</p> <p>Note: The purchase order shall be placed on Ex-works basis</p>

<b>Sr. No</b>	<b>Enquiry No. 284E270 Dated 27/03/2015 Due on 21/04/2015</b>
<b>3.</b>	<p><b>TERMS OF PAYMENT :</b>  100% payment along with taxes, duties, Freight &amp; Insurance within 60 days from the date of receipt of invoice. The invoice must contain following documents in 3 sets (Original + 2 copies).</p> <ul style="list-style-type: none"> <li>- Receipted LR/ Material Receipt Certificate or proof of delivery of material at site</li> <li>- Excise invoice (where ED re-imburement is required)</li> <li>- Delivery Challan / Packing list (case wise)</li> <li>- Transit insurance certificate from insurance co. or Intimation of Transit Insurance duly endorsed by insurance co.</li> <li>- MICC issued by BHEL</li> <li>- Guarantee certificate</li> <li>- Copy of Bank Guarantee</li> </ul>
<b>4.</b>	<p><b>INTEREST LIABILITY</b>  In case of any delay in payment due to any reason, BHEL shall not pay any interest on delayed payment.</p>
<b>5.</b>	<p><b>GUARANTEE :</b>  The equipment / material shall be guaranteed for 18 months from the date of delivery or 12 months from the date of commissioning, which ever is earlier. The defective material / component shall be replaced free of cost at site.</p>
<b>6.</b>	<p><b>PERFORMANCE BANK GUARANTEE :</b>  Bidder shall furnish along with first invoice Performance BG / deposit as per one of following 3 options.</p> <p><u>Option A</u>  A single rolling Bank Guarantee of Rs 20 lakhs initially valid for one year for all the orders being executed for Transmission Business Group, BHEL.</p> <p><u>Option B</u>  BG for 10% of the total Ex-works PO value, valid for 24 months from the date of first delivery. PO value at the time of first invoice for the particular order shall be considered for calculation of BG amount.</p> <p><u>Option C</u>  Retention of 10% of the total Ex-works PO value by BHEL from the first bill in lieu of Performance Bank Guarantee, to be released after expiry of 24 months from the date of first delivery.</p> <p>The Bank guarantee shall be from State Bank of India / State bank of Hyderabad / State Bank of Travancore / State Bank of Mysore / Canara Bank / Bank of Baroda / Punjab National Bank / Deutsche Bank / HDFC Bank / Standard Chartered Bank / CITI Bank / ICICI Bank / IDBI Bank / HSBC / any other Nationalised Bank. The original BG should be sent by issuing Bank directly to AGM (Finance), TBG, BHEL</p>
<b>7.</b>	<p><b>FINAL ENGINEERING DOCUMENTATION:</b>  Final documentation as called in the specification is to be submitted within 3 months from the date of despatch of material.</p>
<b>8.</b>	<p><b>INSPECTION :</b>  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.</p> <p>Supplier shall send inspection call on prescribed format (web site) only, with an advance notice of 15 days.</p>

<b>Sr. No</b>	<b>Enquiry No. 284E270 Dated 27/03/2015 Due on 21/04/2015</b>
<b>9.</b>	<p><b>DESPATCH DOCUMENTS :</b> Following despatch documents are to be immediately sent to purchaser on despatch.</p> <ul style="list-style-type: none"> <li>- Copy of LR</li> <li>- Copy of delivery challan / packing list</li> <li>- Insurance certificate</li> <li>- Copy of Invoice</li> </ul>
<b>10.</b>	<p><b>DELIVERY PERIOD:</b> Bidder to specify delivery period in weeks from the date of LOI / PO.</p> <p><u>Note:</u> LR date or Invoice date whichever is later shall be considered as delivery date.</p>
<b>11.</b>	<p><b>DELAYED DELIVERY:</b> In case of delay in execution of order beyond the lot wise contractual delivery, an amount of ½ % of total Ex-Works Value per week or part there-of subject to maximum of 10% of total Ex-Works value of P.O. will be levied.</p>
<b>12.</b>	<p><b>VALIDITY :</b> The offer shall be valid for 120 days from the due date of opening.</p>
<b>13.</b>	<p><b>ACCEPTANCE / REJECTION OF TENDER :</b> BHEL reserves the right to reject in full or part, any or all tender without assigning any reason thereof.</p> <p>BHEL also reserves right to vary the quantities mentioned in the tender.</p>
<b>14.</b>	<p><b>EVALUATION :</b> Comparative statement shall be prepared based on overall quantity basis unless otherwise indicated in the enquiry. Evaluation of offers shall be done on the basis of delivered cost to BHEL.</p>
<b>15.</b>	<p><b>DEVIATION :</b> The bids having deviation(s) w.r.to tender are liable for rejection. However, BHEL, at its discretion, may load the prices for evaluation of offer with prior intimation to bidder.</p>
<b>16.</b>	<p><b>ARBITRATION :</b> All cases of disputes emanating from and relating to this contract, the matter shall be referred to the sole arbitration of Unit Head / GM, BHEL or any other person (including an employee of BHEL, even though he had to deal with the matter relating to this contract in any manner) nominated by him to act as sole arbitrator. The arbitration shall be under 'The arbitration and contract act 1996' and the rules there under as amended from time to time. The arbitrator may from time to time with the consent of the parties enlarge the time for making and publishing the award. The venue of arbitration shall be any Indian city as decided by BHEL.</p>
<b>17.</b>	<p><b>LEGAL SETTLEMENT :</b> All suits/claims in respect of this contract shall be in the courts having jurisdiction at New Delhi</p>
<b>18.</b>	<p><b>SUBCONTRACTING :</b> 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.</p>
<b>19.</b>	<p><b>RISK PURCHASE :</b> In case the successful bidder fails to supply or fails to comply with the terms &amp; conditions of the purchase order, BHEL reserves the right to source such material/</p>

<b>Sr. No</b>	<b>Enquiry No. 284E270 Dated 27/03/2015 Due on 21/04/2015</b>
	component / equipment/ system from any other agency at the risk and cost of the successful bidder.
<b>20.</b>	<b>ADJUSTMENT OF RECOVERY:</b> 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.
<b>21.</b>	<b>FORCE MAJEURE CONDITION:</b> 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.
<b>22</b>	<b>INTENDED BENEFITS FOR MSE SUPPLIERS:</b> MSE suppliers can avail the intended benefits 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 I) applicable for the year, certifying quantum of investment in plant & machinery within the permissible limit as per the act for 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 bids at par with other bidders and MSE status of such suppliers shall be shifted to Non MSE supplier till the supplier submits these documents.
<b>23.</b>	<b>LOADING CRITERIA FOR DEVIATIONS TAKEN BY BIDDER ON:</b> 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. 60 days - No loading <b>22.2 : DELAYED DELIVERY / PENALTY DUE TO DELAYED DELIVERY:</b> Loading for not accepting this clause / accepting only on undelivered portion shall be the maximum amount specified in this clause. <b>22.3 GUARANTEE:</b> Normally BHEL may 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).
<b>24</b>	<b>Quantity Variation:</b> Final quantity may vary upto +/- 20 % during order execution.
<b>25</b>	<b>Final acceptance of bidder's offer is subjected to BHEL/Customer approval of bidder for respective Project. This will be done prior to Price Bid opening / RA and the Vendors will be intimated regarding their qualification for the Projects along with intimation for Price Bid opening / RA.</b>  <b>To obtain approval bidder has to submit complete credentials along with offer.</b>
<b>26</b>	<b>TECHNICAL SPECIFICATIONS:</b> <b>Technical Specification TB-350-316-028</b>

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<b>27</b>	<b>PRE QUALIFYING CRITERIA FOR BIDDERS :</b>  <b>A) The bidder must be an original equipment manufacturer (OEM) of transmission line accessories (of voltage class offered) and should have valid type test reports as per Technical Specification.</b>  <b>And</b>  <b>B) Vendor must have supplied the Transmission Line accessories for 33kV or above voltage rating lines in last five years.</b>

Signature of Bidder  
Seal

**SCHEDULE OF PRICE**

Enquiry No 284E270 Date: 27/03/15  
(BIDDERS TO STRICTLY ENSURE SUBMITTING THE PRICE BIDS IN THIS FORMAT)

NPGCL Nabhinagar STPP

SL. NO.	DESCRIPTION OF ITEM (AS PER TECHNICAL SPECIFICATION NO. TB-350-316-028 )	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.)	Excise Duty ....NIL..... OF COL 6 (Rs.)	CST/VAT/ST @.....% OF COL 6 +9 (Rs.) AGAINST FORM "C"	F.O.R. DESTINATION PRICE (Rs.) COL (6+8+9+10)
1	2	3	4	5	6	7	8	9	10	11
1	Mid span compression joint for ACSR Moose conductor	Nos	110.000					Exempted against PAC		
2	Mid span compression joint for AAAC conductor (100 sqmm, 12.78 mm OD)	Nos	22.000							
3	Mid span compression joint for GS earthwire	Nos	20.000							
4	Repair Sleeve for ACSR Moose Conductor	Nos	11.000							
5	Repair Sleeve for AAAC ,100 sqmm Conductor	Nos	11.000							
6	Flexible Copper Bond for GS Earthwire	Nos	106.000							
7	Vibration Damper for 7/3.66mm GS Earthwire	Nos	183.000							
8	Bundle Spacer for Conductor	Nos	1320.000							
9	Earthwire Suspension Clamp - 400 kV	Nos	21.000							
10	Earthwire Suspension Clamp -33 kV	Nos	31.000							
11	Earthwire Tension Clamp - 400kV	Nos	36.000							
12	Earthwire Tension Clamp -33 kV	Nos	53.000							
13	Vibration dampers for ACSR conductor	Nos	1690.000							
14	Vibration dampers for AAAC conductor (100 sqmm, 12.78 mm OD)	Nos	1100.000							
15	Rigid Spacer for Conductor (on jumpers)	Nos	429.000							
	<b>Total</b>									

NOTE:

- PLEASE NOTE THAT UNPRICED COPY OF PRICE BID (i.e. WITH ALL PRICES BLANKED) SHALL BE FURNISHED ALONG WITH TECHNO-COMMERCIAL BID.
- REQUIRED COPIES OF FORMAT BE MADE & DETAILS MAY BE ANNEXED.
- THE PRICES MUST BE QUOTED IN THE PRESCRIBED UNIT ONLY.
- SALES TAX RATE AS APPLICABLE FOR SPECIFIED DESTINATION SHALL BE QUOTED. IN CASE OF CST, RATE AGAINST "C" FORM SHALL BE QUOTED.
- 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.
- For any variation in Item description/quantity given in Tech. Spec shall be final.

- THE VENDORS MUST INDICATE THE APPLICABLE TARIFF NOS. UNDER WHICH ED AND / OR CST WOULD BE PAID BY THEM TO THE TAX AUTHORITIES.
- 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



TENDER ENQUIRY NO. 284E270

DATE : 27/03/2015

**SCHEDULE OF COMMERCIAL DEVIATION**

The following are the deviations/ variations exception from the General Terms and Conditions:

SL. NO.	CLAUSE NO. OF GENERAL TERMS AND CONDITION	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 General 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 scheduled.

Place: - .....

Date: - .....

Signature of the authorized representative of

Bidder's name:.....

Designation.....

Company Seal:.....



**SCHEDULE OF TECHNICAL DEVIATION**

The following are the deviations/ variations exception from the Specification:

SECTION	CLAUSE NO. / PAGE NO.	STATEMENT OF DEVIATION/ VARIATIONS/EXCEPTIONS

- **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 General 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 scheduled.

Place: - .....

Date: - .....

Signature of the authorized representative of

Bidder's Name:.....

Designation:.....

Company Seal:.....

**ACTIVITY SCHEDULE**

Sl. NO.	ACTIVITY	ACTIVITY TIME IN WEEKS	CUMULATIVE TIME IN WEEKS FROM LOI / PO DATE	REMARKS IF ANY
1.	Submission of Documents necessary for getting manufacturing clearance like Drawings, Date sheet etc.			
2.	Approval of documents from BHEL / Customer *			
3.	Manufacturing time			
4.	Inspection call			
5.	Customer Inspection & Dispatch Clearance			
6.	Dispatch			
7.	<del>Erection Testing &amp; Commissioning (ETC)</del>			

- Note: 1) \* Supplier must ensure the completeness and correctness of the requisite documents before submission for approval. Delay in approval on account of incomplete/inadequate information shall be the responsibility of supplier.
- 2) Inspection call should be given in the prescribed format only. Inspection calls not in the prescribed format shall not be entertained.
- 3) Qty. to be offered for Inspection should be in accordance within Delivery- schedule - lot BHEL reserves the right not to entertain multiple inspection calls for a Delivery- lot and delay on this account shall be the responsibility of Supplier.

Signature of Supplier

Date:



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

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BHEL Document No.		Rev 00	Name	<b>Prepared by</b>	<b>Checked by</b>	<b>Approved by</b>
TB-350-316-028				MM	DKM	RS
Type of Document	<b>TECHNICAL SPECIFICATION</b>		Sign	-sd-	-sd-	-sd-
Title	<b>Transmission Line Accessories</b>		Date			
			Group	<b>TBEM</b>		
Customer	<b>NABINAGAR POWER GENERATION CO. LTD.</b>					
Projects	400/132/33 kV s/s at Nabinagar STPP (3x660 MW)					

CONTENTS		
SECTION	TITLE	PAGES
1	Scope, specific Tech requirements and Quantities	1+2
2	Equipment Specification	1+14+21+5
3	Project Details and General Specification	20+3
4	Guaranteed Technical Particulars (To be filled at contract stage only)	1+2
5	Quality Plan	1+2

**Note: Offers without checklist will not be considered**

01	06.02.15	MM	AS	AS	BOQ in section 1 revised
Rev No.	Date	Altered	Checked	Approved	
<b>Distribution</b>					

<b>PROJECT: 400/132kV Switchyard at Nabinagar STPP</b>	
<b>CUSTOMER: Nabinagar Power Generating Company Ltd.</b>	
<b>Technical Specification of Transmission Line Accessories</b>	<b>TB-350-316-028</b>
<b>Section-1: Scope, Specific Technical Requirements &amp; Quantities</b>	<b>REV.00</b>

## SECTION 1

### 1.0 SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.

#### 1.1 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of transmission line accessories for 400kV & 33 kV transmission lines complete with hardware.

The Transmission Line Accessories are required for the following Project

**Name of Customer :** Nabinagar Power Generation Co. Pvt. Ltd. (JV between NTPC and Bihar State electricity Board)

**Name of Project :** 400/132 kV Switchyard at Nabinagar STPP and extn. at 400 kV Nabinagar TPP (BRBCL)

#### 1.2 TECHNICAL PARTICULARS

The Technical Particulars of Transmission line Accessories shall be as per NTPC's Specification enclosed in section 2.

Conductor for 400 kV Double circuit line (10.5km) - Twin ACSR Moose Conductor  
Conductor for 33kV Double /Single Circuit Line (3km each)- Single AAAC Conductor ,100sqmm

#### 1.3 Quantities

As per Annexure-I

#### 1.4 Type tests

The post insulators to be supplied shall be of type tested design. During detail engineering, the Bidder / Contractor shall furnish for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. Date of bid opening is 29.06.2011. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

However if contractor is not able to submit report of type test(s) conducted in last ten years from the date of bid opening, or in case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.

All acceptance and routine tests as per specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

## BOQ for Transmission Line Accessories for 400 kV &amp; 33 kV Transmission Lines


Sl. No	Item Description	Unit	Quantity						
			400 kV D/C Line	33 kV D/C Line	33kV S/C Line	Total without spare	spare	Total with Spare	
<b>A</b>	<b>Accessories for Conductor &amp; Earthwire</b>								0
1	Mid span compression joint for ACSR Moose conductor	Nos	100	0	0	100		10	110
2	Mid span compression joint for AAAC conductor (100 sqmm, 12.78 mm OD)	Nos	0	10	10	20		2	22
3	Mid span compression joint for GS earthwire	Nos	10	4	4	18		2	20
4	Repair Sleeve for ACSR Moose Conductor	Nos	10		0	10		1	11
5	Repair Sleeve for AAAC, 100 sqmm Conductor	Nos		5	5	10		1	11
6	Flexible Copper Bond for GS Earthwire	Nos	38	29	29	96		10	106
7	Vibration Damper for 7/3.66mm GS Earthwire	Nos	62	52	52	166		17	183
8	Bundle Spacer for Conductor	Nos	1200	0	0	1200		120	1320
9	Earthwire Suspension Clamp - 400 kV	Nos	19			19		2	21
10	Earthwire Suspension Clamp - 33 kV	Nos		14	14	28		3	31
11	Earthwire Tension Clamp - 400kV	Nos	32			32		4	36
12	Earthwire Tension Clamp - 33 kV	Nos		24	24	48		5	53
13	Vibration dampers for ACSR conductor	Nos	1536	0	0	1536		154	1690
14	Vibration dampers for AAAC conductor (100 sqmm, 12.78 mm OD)	Nos	0	500	500	1000		100	1100
15	Rigid Spacer for Conductor (on jumpers)	Nos	390	0	0	390		39	429


## **SECTION 2**


### **EQUIPMENT SPECIFICATION**


The Technical Particulars of Transmission line Accessories shall be as per following enclosed specification:


1. NTPC Specification SECTION – T4: 400 KV TL. LINE MATERIAL , PART-III, SECTION-VI (14 pages)
2. NTPC Specification CHAPTER – T5 : TESTS FOR 400KV TL. LINE MATERIAL, PART-III, SECTION-VI (21 pages)
3. For 33 kV Line Material, NTPC Specification CHAPTER – T4 : LINE MATERIAL, PART-III, SECTION-VI (5 pages)


Clause No.	<b>TECHNICAL REQUIREMENTS</b> 																	
<b>SECTION - T4: 400 KV TL. LINE MATERIAL</b>																		
1.00.00	<b>GENERAL</b>																	
1.01.00	All the equipment shall be of the latest design and conform to the best modern practice adopted in the extra high voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 400 kV AC transmission with twin conductor and will give continued good performance.																	
1.02.00	The design, manufacturing process and quality control of all the materials shall be such as to give maximum factor of safety, maximum possible working load, highest mobility, elimination of sharp edges and a good finish.																	
1.03.00	All ferrous parts shall be hot dip galvanised, after all machining has been completed, nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electrogalvanised. The bolt threads shall be under cut to take care of increase in diameter due to galvanising . Galvanising shall be done in accordance with IS:2629-1972. Fasteners shall withstand four dips while spring washers shall withstand three dips. Other galvanised materials shall be guaranteed to withstand at least six dips each lasting one minute under the standard preece tests for galvanising.																	
1.04.00	The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continues and free from imperfection such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanising shall be of grade Zn. 99.95 as per IS:209-1966.																	
1.05.00	Electrical System Data for 400 kV Lines <table border="0" style="width: 100%; margin-top: 10px;"> <tr> <td style="width: 60%;">Nominal voltage</td> <td style="text-align: right;">400kV</td> </tr> <tr> <td>Maximum voltage</td> <td style="text-align: right;">420 kV</td> </tr> <tr> <td>BIL(Impulse)</td> <td style="text-align: right;">1550 kV(peak)</td> </tr> <tr> <td>Power Frequency Withstand Voltage (Wet)</td> <td style="text-align: right;">680 kV(rms)</td> </tr> <tr> <td>Switching surge withstand voltage (Wet)</td> <td style="text-align: right;">1050 kV(rms)</td> </tr> <tr> <td>Minimum Corona extinction Voltage at 50Hz AC system Under dry condition.</td> <td style="text-align: right;">320kV Min(rms) phase to earth</td> </tr> <tr> <td>Radio interference voltage at One MHz for phase to earth Voltage of 305kV under dry Condition.</td> <td style="text-align: right;">1000 Micro Volts Max.</td> </tr> </table>				Nominal voltage	400kV	Maximum voltage	420 kV	BIL(Impulse)	1550 kV(peak)	Power Frequency Withstand Voltage (Wet)	680 kV(rms)	Switching surge withstand voltage (Wet)	1050 kV(rms)	Minimum Corona extinction Voltage at 50Hz AC system Under dry condition.	320kV Min(rms) phase to earth	Radio interference voltage at One MHz for phase to earth Voltage of 305kV under dry Condition.	1000 Micro Volts Max.
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<b>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</b>	<b>Bid Doc. No.:</b> CS-0370-572-2	<b>TECHNICAL SPECIFICATIONS</b>	<b>PART-III SECTION-VI</b>	<b>Page</b> T4-1/14														


Clause No.	TECHNICAL REQUIREMENTS			
2.00.00	<b>EARTHWIRE</b>			
2.01.00	The galvanised steel earthwire shall generally conform to the specification of ACSR core wire as mentioned in IS 398 (Part-II)-1976 except where otherwise specified herein.			
2.02.00	Parameters of the earthwire  Refer Chapter-E12, clause 7.00.00 of Switchyard Technical Specification.			
2.03.00	The earthwire shall be pre-formed and post-formed to avoid opening of strands at the time of cutting or joining. The finished material shall have minimum brittleness, as it will be subject to appreciable vibration while in use. It shall withstand 3 and ½ number of one minute dips in the standard preece test.			
2.04.00	There shall be no joint of any kind in the finished steel wire strand entering into the manufacture of the earthwire. There shall be no strand joints or strand splicer in any length of the completed stranded earthwire.			
2.05.00	Standard length and random length shall be as per clause 3.05.00 below. Bidder may offer two lengths in one drum.			
3.00.00	<b>CONDUCTOR</b>			
3.01.00	The conductor shall be Aluminium Core Steel Reinforced (ACSR) type. The conductor shall confirm to IS:398 (Part-II) except where otherwise specified herein.			
3.02.00	Parameters of the conductor  Refer Chapter-E12, clause 2.00.00 of Switchyard Technical Specification.			
3.03.00	The steel strands shall generally comply with the requirements stipulated for earthwire at clause 2.00.00 above.			
3.04.00	Joints shall be permitted in the individual Aluminium wires in all layers except the outer most layer of the finished conductor. These joints shall be made by cold pressure butt-welding and shall be such that no two such joints are within 15 metres of each other in the complete stranded conductor.			
3.05.00	The standard length of the conductor shall be 1600 meters for conductor and 2x2000 metres for earth wire. A tolerance of ± 5% on the standard length offered by the bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths. Random lengths will be accepted provided no length is less than 70% of the standard length and the total quantity of random lengths shall not be more than 10% of the total quantity ordered.			
4.00.00	<b>CONDUCTOR ACCESSORIES</b>			
4.01.00	<b>Mid Span Compression Joint for Conductor</b>			
4.01.01	As per details given in IS:2121 Part-2..			
4.02.00	<b>Repair Sleeve</b>			
NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE	Bid Doc. No.: CS-0370-572-2	TECHNICAL SPECIFICATIONS	PART-III SECTION-VI	Page T4-2/14


Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 																																														
<p>4.03.00</p>	<p>Repair Sleeve of compression type shall be used to repair conductor with not more than two strands broken in the outer layer. The sleeve shall be manufactured from 99.5% pure aluminium and shall have a smooth surface. The repair sleeve shall comprise of two pieces with a provision of seat for sliding of the keeper piece. The edges of the seat as well as the keeper piece shall be of rounded that the conductor strands are not damaged during installation.</p> <p>The Bidder shall clearly specify the before and after compression dimensions of the mid span compression joint and repair sleeve. The compression pressure shall also be indicated by the Bidder. The dimensions and dimensional tolerances for Mid Span Compression Joint and Repair Sleeves for ACSR 'MOOSE' conductor shall be as follows:</p> <table border="1" data-bbox="363 734 1332 1346"> <thead> <tr> <th rowspan="2">Item</th> <th colspan="2">Dimensions before compression</th> <th rowspan="2">Length</th> <th colspan="2">Dimension after compression</th> </tr> <tr> <th>Inner Dia.</th> <th>Outer Dia.</th> <th>Corner to Corner width</th> <th>Face to face width</th> </tr> <tr> <th></th> <th>(mm)</th> <th>(mm)</th> <th>(mm)</th> <th>(mm)</th> <th>(mm)</th> </tr> </thead> <tbody> <tr> <td>a) <b>Al.Sleeve</b></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Mid Span Compression Joint</td> <td>34±0.5</td> <td>54±1</td> <td>735±5</td> <td>53±0.5</td> <td>34±0.5</td> </tr> <tr> <td>Repair Sleeve</td> <td>34±0.5</td> <td>54±1</td> <td>300±5</td> <td>53±0.5</td> <td>46±0.5</td> </tr> <tr> <td>b) <b>Steel Sleeve</b></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Mid Span Compression Joint</td> <td>11.1±0.2</td> <td>21±0.5</td> <td>250±5</td> <td>20.2±0.5</td> <td>17.5±0.5</td> </tr> </tbody> </table>	Item	Dimensions before compression		Length	Dimension after compression		Inner Dia.	Outer Dia.	Corner to Corner width	Face to face width		(mm)	(mm)	(mm)	(mm)	(mm)	a) <b>Al.Sleeve</b>						Mid Span Compression Joint	34±0.5	54±1	735±5	53±0.5	34±0.5	Repair Sleeve	34±0.5	54±1	300±5	53±0.5	46±0.5	b) <b>Steel Sleeve</b>						Mid Span Compression Joint	11.1±0.2	21±0.5	250±5	20.2±0.5	17.5±0.5
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<p>4.04.00</p>	<p><b>Vibration Damper for conductor and Earthwire</b></p>																																														
<p>4.04.01</p>	<p>Vibration dampers of 4 R-Stock bridge type with four (4) different resonance spread within the specified aeolian frequency bandwidth shall be used at all suspension and tension points on each span to damp out the Aeolian vibrations of the conductors to the specified level as mentioned hereinafter. Two dampers minimum on each side per conductor/earthwire shall be used at tension points and one damper minimum on each side per conductor at suspension points for ruling design span.</p>																																														
<p>4.04.02</p>	<p>The clamp of the vibration damper shall be made of high strength aluminium alloy of type LM-6 or equivalent.</p>																																														
<p>4.04.03</p>	<p>The messenger cable shall be made of high strength galvanised steel/stainless steel with a minimum strength of 135 kg/mm<sup>2</sup>. It shall be of pre-formed and post-formed quality in order to prevent</p>																																														
<p>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</p>	<p>Bid Doc. No.: CS-0370-572-2</p>	<p>TECHNICAL SPECIFICATIONS</p>	<p>PART-III SECTION-VI</p>	<p>Page T4-3/14</p>																																											


Clause No.	TECHNICAL REQUIREMENTS																			
	<p>subsequent droop of weight and to maintain consistent flexural stiffness of the cable in service. The number of strands in messenger cable shall be 19. The messenger cable other than stainless steel shall be hot dip galvanised in accordance with the recommendations of IS:4826-1979 for heavily coated wires.</p> <p>4.04.04 The manufacturer must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5 KN and 5KN. The clamp when installed on the conductor shall not cause excessive stress concentration on the conductor leading to permanent deformation of the conductor strands and premature fatigue failure in operation.</p> <p>4.04.05 The vibration damper for conductor shall not have magnetic power loss more than 1 watt at 600 amps at 50 Hz alternating current.</p> <p>4.04.06 The vibration analysis of the system, with and without damper and dynamic characteristics of the damper as detailed under Chapter-T5 shall have to be submitted by the Bidder along with his bid. The technical particulars for vibration analysis and damping design of the systems area follows:</p> <table border="0" data-bbox="453 875 1262 1171"> <tr> <td>Configuration</td> <td>Twin conductor per phase / earth wire on peak</td> </tr> <tr> <td>Span length</td> <td></td> </tr> <tr> <td>i) Ruling design span</td> <td>400 meters</td> </tr> <tr> <td>ii) Maximum Span</td> <td>1100 meters</td> </tr> <tr> <td>iii) Minimum Span</td> <td>100 meters</td> </tr> <tr> <td>Tensile load in Conductor /earthwire</td> <td>4144 Kg/1340 Kg</td> </tr> <tr> <td>Armour rods used</td> <td>Standard preformed armour rods/AGS</td> </tr> <tr> <td>Max. Velocity of wind</td> <td>30 kms per hour</td> </tr> <tr> <td>Maximum permissible dynamic strains</td> <td>150 micro strains</td> </tr> </table> <p>4.04.07 The damper placement chart for spans ranging from 50 m to 600 m shall be submitted by the Bidder. All the placement charts should be duly supported by relevant technical documents and sample calculations.</p> <p>4.04.08 The damper placement charts shall include the following:</p> <ol data-bbox="411 1339 1426 1570" style="list-style-type: none"> <li>Location of the dampers for various combinations of spans and line tensions clearly indicating the number of dampers to be installed per conductor/earthwire per span.</li> <li>Placement distances clearly identifying the extremities between which the distances are to be measured.</li> <li>Placement recommendation depending upon type of suspension clamp (viz Free centre type, Armour grip type, etc.)</li> <li>The influence of mid span compression joints, repair sleeves and armour rods (standard and AGS) in the placement of dampers.</li> </ol> <p>4.05.00 <b>Bundle Spacers</b></p> <p>4.05.01 Armour grip bundle spacers shall be used to maintain the spacing of 450mm between the two sub-conductors or each bundle under all normal working conditions.</p> <p>4.05.02 Spacers offering equivalent or better performance shall also be accepted provided offer meets the qualifying requirements stipulated in the specification.</p>	Configuration	Twin conductor per phase / earth wire on peak	Span length		i) Ruling design span	400 meters	ii) Maximum Span	1100 meters	iii) Minimum Span	100 meters	Tensile load in Conductor /earthwire	4144 Kg/1340 Kg	Armour rods used	Standard preformed armour rods/AGS	Max. Velocity of wind	30 kms per hour	Maximum permissible dynamic strains	150 micro strains	
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<p>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</p>	<p>Bid Doc. No.: CS-0370-572-2</p>	<p>TECHNICAL SPECIFICATIONS</p>	<p>PART-III SECTION-VI</p>	<p>Page T4-4/14</p>																


Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
4.05.03	The offer shall include placement charts recommending the number of spacers per phase per span and the sub span lengths to be maintained between the spacers while installing on the twin bundle conductors.			
4.05.04	The placement of spacers shall be in such a way that adjacent sub spans are sufficiently detuned and the critical wind velocity of each sub span shall be kept more than 30 km/hr and to avoid clashing of sub conductors. The placement shall ensure bundle stability under all operation conditions.			
4.05.05	The placement chart shall be provided for spans ranging from 100 m to 1100 m. The number of spacers recommended for a ruling design span of 400 m shall however be seven with no sub-span greater than 70m and no end sub-span longer than 40 m.			
4.05.06	The Bidder may offer more number of spacers per ruling design span than the specified. However, in such case, suitable price compensation shall be considered for evaluation. For the purpose of price compensation, all the spans shall be assumed to be ruling design spans.			
4.05.07	The Bidder shall also furnish all the relevant technical documents in support of their placement charts along with the bid.			
4.05.08	Jumpers at tension points shall also be fitted with spacers so as to limit the length of free conductor to 3.65 m and to maintain the sub conductor spacing of 450 mm. Bidder shall quote for rigid spacer for jumper. It shall meet all the requirements of spacer used in line except for its vibration performance. Spacers requiring retaining rods shall not be quoted for jumpers.			
4.05.09	The spacers offered by the Bidder shall satisfy the following requirements.			
4.05.10	Spacers shall restore normal spacing of the sub conductors after displacement by wind, electromagnetic and the electrostatic forces under all operating conditions including the specified short circuit level without permanent deformation damage either to conductor or to the assembly itself. They shall have uniform grip on the conductor.			
4.05.11	For spacer requiring retaining rods, the retaining rods shall be designed for the specified conductor size. The preformed rods shall be made of high strength, special aluminum alloy of type 6061/65032 and shall have minimum tensile strength of 35 kg/sq.mm. The ends of retaining rods should be ball ended. The rods shall be heat-treated to achieve specified mechanical properties and give proper resilience and retain the same during service.			
4.05.12	Four numbers of rods shall be applied on each clamps to hold the clamp in position. The minimum diameter of the rods shall be $7.87 \pm 0.1$ mm and the length of the rods shall not be less than 1100 mm.			
4.05.13	Where elastomer surfaced clamp grooves are used, the elastomer shall be firmly fixed to the clamp. The insert should be forged from aluminium alloy of type 6061/65032. The insert shall be duly heat treated and aged to retain its consistent characteristics during service.			
4.05.14	Any nuts used shall be locked in a approved manner to prevent vibration loosening. The ends of bolts and nuts shall be properly rounded for specified corona performance or suitably shielded.			
4.05.15	Clamp with cap shall be designed to prevent its cap from slipping out of position when being tightened.			
<p style="text-align: center;">NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</p>	<p style="text-align: center;">Bid Doc. No.: CS-0370-572-2</p>	<p style="text-align: center;">TECHNICAL SPECIFICATIONS</p>	<p style="text-align: center;">PART-III SECTION-VI</p>	<p style="text-align: center;">Page T4-5/14</p>


Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
4.05.16	The clam grooves shall be in uniform contact with the conductor over the entire surface, except for rounded edges. The groove of the clamp body and clamp cap shall be smooth and free of projections, grit or other material which cause damage to the conductor when the clamp is installed.			
4.05.17	For the spacer involving bolted clamps, the manufacturer must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5 kN and 5 kN. The clamp when installed on the conductor shall not cause excessive stress concentration on the conductor leading to permanent deformation of the conductor strands and premature fatigue failure in operation.			
4.05.18	Universal type bolted clamps covering a range of conductor sizes, will not be permitted.			
4.05.19	No rubbing other than that of conductor clamps hinges or clamp swing bolts, shall take place between any parts of the spacer. Joint incorporating a flexible medium shall be such that there is no relative slip between them.			
4.05.20	The spacer shall be suitable designed to avoid distortion or damage to the conductor or to themselves during service.			
4.05.21	Rigid spacers shall be acceptable only for jumpers.			
4.05.22	The spacers shall not damage or chafe the conductor in any way which might affect its mechanical and fatigue strength or corona performance.			
4.05.23	The clamping system shall be designed to compensate for any reduction in diameter of conductor due to creep.			
4.05.24	The spacer assembly shall not have any projection, cuts, abrasions, etc. or chattering parts which might cause corona or RIV.			
4.05.25	The spacer tube shall be made of aluminium alloy of type 6061/65032. If fasteners of ferrous material are used, they shall conform to an be galvanized conforming to relevant Indian Standards. The spacer involving ferrous fasteners shall not have magnetic power loss more than one watt at 600 amps 50 Hz alternating current per sub conductor.			
4.05.26	Elastomer, if used, shall be resistant to the effects of temperature up to 75 deg.,C, ultraviolet radiation and other atmospheric contaminants likely to be encountered in service. It shall have good fatigue characters. The physical properties of the elastomer shall be of approved standard..			
4.05.27	The spacer assembly shall have electrical continuity. The electrical resistance between the sub-conductor across the assembly in case of spacer having elastomer clamp grooves shall be suitably selected by the manufacturers to ensure satisfactory electrical performance and to avoid deterioration of elastomer under all service conditions.			
4.05.28	The spacer assembly shall have complete ease of installation and shall be capable of removal/reinstallation without any damage.			
4.05.29	The spacer assembly shall be capable of being installed and removed from the energized line by means of hot line technique.			
<p style="text-align: center;">NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</p>	<p style="text-align: center;">Bid Doc. No.: CS-0370-572-2</p>	<p style="text-align: center;">TECHNICAL SPECIFICATIONS</p>	<p style="text-align: center;">PART-III SECTION-VI</p>	<p style="text-align: center;">Page T4-6/14</p>


Clause No.	TECHNICAL REQUIREMENTS 																					
5.00.00	<b>EARTHWIRE ACCESSORIES</b>																					
5.01.00	<p>Mid Span Compression Joint for Earthwire</p> <p>It shall be used for joining two lengths of earthwire. The joint shall be made of mild steel. The steel sleeve should not crack or fail during compression in it or service period. The Brinell Hardness of steel should not exceed 200. the steel sleeve shall be hot dip galvanised. The joints shall not permit slipping off, damage to , of failure of the complete earthwire or any part thereof at a load not less than 95% of the ultimate tensile strength of the earthwire. The joint shall have resistivity less than 75% of resistivity of equivalent length of earthwire. The dimensions and the dimensional tolerance of the joint shall be as given below:</p> <table border="1" data-bbox="367 757 1327 1003"> <thead> <tr> <th rowspan="2">Item</th> <th colspan="3">Dimensions before compression</th> <th colspan="2">Dimension after compression</th> </tr> <tr> <th>Inner Dia. (mm)</th> <th>Outer Dia. (mm)</th> <th>Length (mm)</th> <th>Corner to Corner width (mm)</th> <th>Face to face width (mm)</th> </tr> </thead> <tbody> <tr> <td>Steel Dead-end</td> <td>11.1±0.2</td> <td>21±0.5</td> <td>250±5</td> <td>20.2±0.5</td> <td>17.5±0.5</td> </tr> </tbody> </table>					Item	Dimensions before compression			Dimension after compression		Inner Dia. (mm)	Outer Dia. (mm)	Length (mm)	Corner to Corner width (mm)	Face to face width (mm)	Steel Dead-end	11.1±0.2	21±0.5	250±5	20.2±0.5	17.5±0.5
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5.02.00	<b>Vibration Damper For Earthwire</b>																					
5.02.01	Refer Clause 4.04.00 detailed above.																					
5.03.00	<p><b>Flexible Copper Bond:</b> As detailed in is:2121 part3. the flexible copper bond shall be fitted with 2 nos. tinned copper connecting lugs which will be pressed jointed to either ends of the bond. One lug shall be suitable for 12 mm dia bolt and other for 16 mm dia bolt. The complete assembly shall also include one 16 mm dia 40 mm lug HRH MS bolt hot dip galvanised with nut and lock washer.</p>																					
5.04.00	Suspension Clamp for Earthwire : As Detailed in IS:2121 Part3																					
5.04.01	At all suspension towers, suitable suspension clamp shall be used to support the earthwire of 7/3.66 mm size, the clamp shall be of either free-centre type or trunion type and shall provide adequate area of support to the earthwire.																					
5.04.02	The total drop of the suspension assembly from the center point of the attachment to the centre point of the Earthwire shall not exceed 150 mm. The complete assembly shall be guaranteed for slip strength of not less than 12 kN and not more than 17 kN. The breaking strength of the assembly shall not be less than 25 kN.																					
5.04.03	The clamping piece and the clamp body shall be clamped by at least two U-bolts of size not less than 10 mm diameter having one nut and 3 mm thick lock nut with washer on each of its limbs. Suspension clamps shall be provided with inverted type U-bolts. One limb of the U-bolt shall be long enough to accommodate the lug of the flexible copper bond.																					
NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE	Bid Doc. No.: CS-0370-572-2	TECHNICAL SPECIFICATIONS	PART-III SECTION-VI	Page T4-7/14																		


Clause No.	TECHNICAL REQUIREMENTS			
5.05.00	<b>Tension Clamp for Earthwire</b>			
5.01.00	The details shall be as per IS:2121 part-3. Only Compression type tension clamp shall be used to hold 7/3.66 mm galvanised steel earthwire. Anchor shackle shall be supplied which shall be suitable for attaching the tension clamp to strain plates. The strain plates supplied with the towers will have a minimum thickness of 8 mm with a hole of 17.5 mm diameter. Suitable lugs for jumper connection shall also be supplied alongwith necessary bolts and nuts.			
6.00.00	<b>HARDWARE FITTINGS</b>			
6.01.00	The hardware fittings shall be as per the specification for hardware fittings along with its component for the following insulator strings:			
	<ul style="list-style-type: none"> <li>a) Single – 'I' suspension insulator string.</li> <li>b) Single Suspension –I string with Pilot Clamp</li> <li>c) Double suspension insulator string.</li> <li>d) Double tension insulator string.</li> </ul>			
6.02.00	Each hardware fittings shall be supplied complete in all respects and include the following hardware parts:			
	<ul style="list-style-type: none"> <li>a) Ball hook for suspension hardware fittings suitable for attaching to V-hanger of the tower. Anchor shackle shall be supplied which shall be suitable for attaching the tension hardware fittings to 16 mm thick strain plate having 22 mm dia hole, of the tower.</li> <li>b) Suitable yoke plates for double suspension and double tension hardware fittings for the twin conductor arrangement complying with the specifications given hereinafter.</li> <li>c) Suspension and dead end assembly to suit conductor size.</li> <li>d) Other necessary fittings such as eye links, ball clevis, socket clevis, clevis eye, U-clevis, ball link, arcing horn etc. to make the hardware fittings complete.</li> <li>e) 2.5% extra fasteners shall be supplied along with the hardware fittings.</li> <li>f) Socket fittings shall be provided with only R-shaped security clip in accordance with IS-2486 (part-II).</li> </ul>			
6.03.00	<b>Suspension Assembly for Conductor</b>			
6.03.01	The suspension assembly shall include AGS type suspension clamps alongwith standard performed armour rods set suitable for ACSR 'MOOSE' conductor. The elastomer used for AGS clamp shall be neoprene rubber with insert. This shall be suitable to withstand upto 75deg. Centigrade temperature and atmospheric ozone.			
6.03.02	The suspension clamp assembly alongwith standard armour rods shall have a slip strength between 20 to 29 KN.			
6.03.03	Suspension assemblies with magnetic power loss more than 4 watts at a sub conductor current of 600 amp. Shall be rejected. The Bidders are requested to enclose test certificates for magnetic power loss test alongwith the bid.			
<b>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</b>	<b>Bid Doc. No.:</b> CS-0370-572-2	<b>TECHNICAL SPECIFICATIONS</b>	<b>PART-III SECTION-VI</b>	<b>Page</b> T4-8/14


Clause No.	TECHNICAL REQUIREMENTS																							
6.03.04	<p>The length and diameter of each rod shall be 2540±25 mm and 9.27±0.10mm respectively. The tolerance in length of the rods in completed set should be within 13 mm between the longest and shortest rod. The ends of armour rod shall be parrot billed or ball ended.</p>																							
6.03.05	<p>The number of armour rods in each set shall be eleven. Each rod shall be marked in the middle with paint for easy applications on the line.</p>																							
6.03.06	<p>The armour rod shall not loose, their resilience even after five applications. The conductivity of each rod of the set shall not be less than 40% of the conductivity of the International Annealed Copper Standard (IACS). The armour rods shall be made of aluminium alloy of type 6061 or equivalent. The alloy shall have a minimum tensile strength of 35 kg / mm<sup>2</sup>.</p>																							
6.04.00	<p><b>Dead End Assembly</b></p> <p>The dead end assembly shall be complete with jumper cone etc.</p>																							
6.04.01	<p>The bidder shall clearly specify the before and after compression dimensions of the dead-end clamp. The compression pressure shall also be indicated by the bidder. The dimensions and dimensional tolerances of the cross section of aluminium dead-end for conductor shall be as given below:</p> <table border="1" data-bbox="368 1010 1193 1339"> <thead> <tr> <th rowspan="2">Item</th> <th colspan="2">Dimensions before compression</th> <th colspan="2">Dimension after compression</th> </tr> <tr> <th>Inner Dia. (mm)</th> <th>Outer Dia. (mm)</th> <th>Corner to corner width (mm)</th> <th>Face to face width (mm)</th> </tr> </thead> <tbody> <tr> <td>Alum. Dead-end</td> <td>34±0.5</td> <td>54±1</td> <td>53±0.5</td> <td>46±0.5</td> </tr> <tr> <td>Steel Dead-end</td> <td>11.1±0.2</td> <td>21±0.5</td> <td>20.2±0.5</td> <td>17.5±0.5</td> </tr> </tbody> </table>				Item	Dimensions before compression		Dimension after compression		Inner Dia. (mm)	Outer Dia. (mm)	Corner to corner width (mm)	Face to face width (mm)	Alum. Dead-end	34±0.5	54±1	53±0.5	46±0.5	Steel Dead-end	11.1±0.2	21±0.5	20.2±0.5	17.5±0.5	
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6.05.00	<p><b>Yoke Plates</b></p> <p>The strength of yoke plates shall be adequate to withstand the minimum ultimate tensile strength, as specified in clause 7.01.00</p> <p>The Plates shall be either triangular or rectangular in shape as may be necessary. The design of yoke plate shall take into account the most unfavourable loading conditions likely to be experienced as a result of dimensional tolerances for disc insulators as well as components of hardware fittings within the specified range. The plates shall have suitable holes for fixing arcing horn. All the corners and edges should be rounded off with a radius of atleast 3 mm. Design calculations, i.e. for bearing &amp; tensile strength, for deciding the dimensions of yoke plate shall be furnished by the bidder. The holes provided for bolts in the yoke plate should satisfy shear edge condition as per Clause No. 8.10 of IS:800-1984.</p>																							
<p>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</p>		<p>Bid Doc. No.: CS-0370-572-2</p>	<p>TECHNICAL SPECIFICATIONS</p>	<p>PART-III SECTION-VI</p>	<p>Page T4-9/14</p>																			


Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 																				
7.00.00	<b>INSULATOR</b>																				
7.01.00	<p>The size of disc insulator, the number to be used in different type of strings, their electromechanical strength and minimum creepage distance shall be as follows :</p>																				
	<table border="1"> <thead> <tr> <th data-bbox="443 568 635 658">Type of String</th> <th data-bbox="651 568 826 658">Size of disc insulator (mm)</th> <th data-bbox="842 568 986 658">Min. creepage distance of each disc (mm)</th> <th data-bbox="1002 568 1114 658">No. of standard discs</th> <th data-bbox="1129 568 1417 658">Electro-mechanical strength of insulator string (kN)</th> </tr> </thead> <tbody> <tr> <td data-bbox="443 663 635 725">Single –I Suspension</td> <td data-bbox="651 663 826 685">255/280 x 145</td> <td data-bbox="842 663 986 685">320</td> <td data-bbox="1002 663 1114 685">1x 23</td> <td data-bbox="1129 663 1417 685">120</td> </tr> <tr> <td data-bbox="443 748 635 810">Double Suspension</td> <td data-bbox="651 748 826 770">-do-</td> <td data-bbox="842 748 986 770">-do-</td> <td data-bbox="1002 748 1114 770">2x 23</td> <td data-bbox="1129 748 1417 770">2 x 120</td> </tr> <tr> <td data-bbox="443 833 635 855">Double tension</td> <td data-bbox="651 833 826 855">255/280x170</td> <td data-bbox="842 833 986 855">-do-</td> <td data-bbox="1002 833 1114 855">2x 23</td> <td data-bbox="1129 833 1417 855">2 x 160</td> </tr> </tbody> </table>	Type of String	Size of disc insulator (mm)	Min. creepage distance of each disc (mm)	No. of standard discs	Electro-mechanical strength of insulator string (kN)	Single –I Suspension	255/280 x 145	320	1x 23	120	Double Suspension	-do-	-do-	2x 23	2 x 120	Double tension	255/280x170	-do-	2x 23	2 x 160
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	<p>Note: Single Suspension (Pilot) string will be used for jumpers of tension DD type towers. It will be similar to single suspension type except the clamp of the conductor.</p>																				
7.01.01	<p>Disc Insulator: The insulator shall be pin and cap ; ball and socket type. The disc insulator shall conform to IS:731.</p>																				
7.01.02	<p>Ball and Socket Designation</p> <p>The dimensions of the balls and sockets shall be of 20 mm designation, for 120KN/160KN disc insulator in accordance with the standard dimensions stated in IS:2486-(Part-II)/IEC:120.</p>																				
7.02.00	<b>Materials</b>																				
7.02.01	<p>Porcelain : The porcelain used in the manufacture of shells shall be sound, free from defects thoroughly vitrified and smoothly glazed.</p>																				
7.02.02	<p>Glaze: The finished porcelain shall be glazed in brown colour. The glaze shall cover all exposed parts of he insulator and shall have a good lustre, smooth, surface and good performance under the extreme weather conditions of a tropical climate. It shall not be cracked or chipped by ageing under the normal service conditions. The glaze shall have the same co-efficient of expansion as of the porcelain body throughout the working temperature range.</p>																				
7.02.03	<p>Toughened Glass: In case of glass insulator, the glass used for the shells shall be sound, free from defects such as flows, bubbles, inclusions etc. and be of uniform toughness over its entire surface. All exposed glass surfaces shall be smooth.</p>																				
7.02.04	<p>Cement: Cement used in the manufacture of the insulator shall not cause fracture by expansion or loosening by contraction. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as small and uniform as possible. Proper care shall be taken to correctly centre and locate individual parts during cementing.</p>																				
<p>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</p>	<p>Bid Doc. No.: CS-0370-572-2</p>	<p>TECHNICAL SPECIFICATIONS</p>	<p>PART-III SECTION-VI</p>	<p>Page T4-10/14</p>																	


Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 																				
7.02.05	<p><b>Pins and Caps:</b> Pins and Caps shall be made of drop forged steel and malleable cast iron/spheroidal graphite iron/drop forged steel respectively, duly hot dip galvanised and shall not be made by jointing, welding, shrink fitting or any other process from more than one piece of material.</p>																				
7.02.06	<p><b>Security Clips:</b> Security clips shall be made of good quality stainless steel or phosphor bronze as per IS:1385-1968 2.5% extra Security clip shall be provided.</p>																				
7.03.00	<p><b>Hot Line Maintenance</b></p> <p>The insulators offered shall be suitable for employment of hot line maintenance technique so that the usual hot line operations can be carried out with ease, speed and safety.</p> <p>Bidders shall indicate the methods generally used in the routine hot and dead line maintenance of HV lines for which similar insulator have been supplied by them. Bidders shall also indicate the recommended periodicity of such maintenance.</p>																				
7.04.000	<p><b>PGW and its accessories</b></p>																				
7.04.01	<p><b>General</b></p> <p>This specification covers the provision of one peak of 400 kV tower with Optical Fiber (OPGW). This optical fiber cable will be connected to suitable optical line terminal and multiplex equipment to form part of the Plant's overall communications transmission system. Any expected variation shall be clearly identified in the Bidder's Proposal.</p>																				
7.04.02	<p><b>Construction</b></p> <p>The OPGW shall be composed of a layer of aluminum-clad steel wires around a seamless aluminum tube or stainless steel tube. The Optical core, in order to protect the fibers from external forces, shall be laid loose inside buffer tubes.</p> <p>The optical core shall be filled with hydrogen absorbent and water blocking filling compound. The optical fiber itself shall be manufactured by using high grade silica to provide the required performance.</p>																				
7.04.03	<p><b>Optical Fiber Characteristics</b></p> <p>Optical fiber shall be supplied in accordance with ITU - T Recommendation G.652 with the following requirements.</p> <table border="0" data-bbox="363 1467 1157 1765"> <tr> <td>Profile of Optical Fiber:</td> <td>Single mode stepped index</td> </tr> <tr> <td>Average Transmission Loss:</td> <td></td> </tr> <tr> <td>At wavelength 1310 nm</td> <td>0.38 dB per km maximum</td> </tr> <tr> <td>At Wavelength 1550 nm</td> <td>0.25 dB per km maximum</td> </tr> <tr> <td>Number of Fiber</td> <td>12</td> </tr> <tr> <td>Average splicing loss:</td> <td>0.05db per joint</td> </tr> <tr> <td>Maximum splicing loss:</td> <td>0.10 dB per joint</td> </tr> <tr> <td>Mode field diameter (MFD):</td> <td>9.0µm ± 1.0µm</td> </tr> <tr> <td>Cladding diameter:</td> <td>125 ± 2 µm</td> </tr> <tr> <td>Core / Cladding</td> <td></td> </tr> </table>	Profile of Optical Fiber:	Single mode stepped index	Average Transmission Loss:		At wavelength 1310 nm	0.38 dB per km maximum	At Wavelength 1550 nm	0.25 dB per km maximum	Number of Fiber	12	Average splicing loss:	0.05db per joint	Maximum splicing loss:	0.10 dB per joint	Mode field diameter (MFD):	9.0µm ± 1.0µm	Cladding diameter:	125 ± 2 µm	Core / Cladding	
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<p>7.04.04</p>	<p>Mode field concentricity error: 1µm  Chromatic – dispersion coefficient @ 1310 nm 3.5 ps / nm km. Maximum  Chromatic – dispersion coefficient @ 1550 nm 20 ps / nm km. Maximum  Fiber Identification: each fiber shall be uniquely identifiable throughout the Length of the wire.  Operating Temperature: 0°C to 80°C continuously</p> <p>OPGW Characteristics</p> <table border="0"> <tr> <td>Ultimate tensile strength</td> <td>(kg)</td> <td>≥</td> <td>7,500</td> </tr> <tr> <td>Outside diameter</td> <td>(mm)</td> <td>≤</td> <td>14</td> </tr> <tr> <td>Cross sectional area of Conduct</td> <td>(mm<sup>2</sup>)</td> <td>≥</td> <td>80</td> </tr> <tr> <td>D.C. Resistance @ 20 °C</td> <td>(Ω/km) ≤</td> <td></td> <td>0.76</td> </tr> <tr> <td>Length per reel</td> <td>(m)</td> <td></td> <td>3000 Approx.</td> </tr> <tr> <td>Modulus of elasticity</td> <td>(kg/mm<sup>2</sup>)</td> <td>≥</td> <td>10,000</td> </tr> <tr> <td>Coefficient of linear expansion</td> <td>(/°C)</td> <td>≤</td> <td>15.0 x 10<sup>-6</sup></td> </tr> <tr> <td>Capacity fault current (KA)<sup>2</sup> sec.</td> <td></td> <td></td> <td>46</td> </tr> <tr> <td>Maximum allowable temp.</td> <td></td> <td></td> <td></td> </tr> <tr> <td>For optical fiber in loose type (°C)</td> <td></td> <td></td> <td>160</td> </tr> <tr> <td>Maximum Transmission Loss Change – Temperature Range 0°C to 150 °C</td> <td>(dB/km)</td> <td></td> <td>0.1</td> </tr> <tr> <td>Unit Weight</td> <td>(kg /km)</td> <td>≤</td> <td>600</td> </tr> </table> <p>The Bidder shall design the OPGW requirements to suit each span in the system, based on the applicable drawings and field surveys. The Bidder's proposal shall stipulate the characteristics of the OPGW required for each span in the system.</p> <p>7.04.05</p> <p>Assemblies and Line Accessories</p> <p>a. General</p> <p>The OPGW assemblies and line accessories shall consist of the hardware indicted herein. All hardware and accessories shall be made of aluminum, aluminum alloy, malleable iron, steel (metal mold of drop forging process), stainless steel, or non-ferrous metal, unless otherwise specified. In addition, all hardware and accessories shall have an ultimate tensile strength equal to or exceeding the rated ultimate tensile strength of the overhead ground wire. All metal shall be free from burrs, sharp edges, lumps and dross and shall be smooth so that interconnecting parts will fit properly, and so that the parts maybe assembled and readily.</p> <p>All bolts and other fasteners shall be installed according to manufacturer's recommendations. Materials not specifically covered herein by detailed specifications shall be of standard commercial quality suitable for the intended use. The Contractor shall determine the most suitable type of clamp to be used at each and every transmission tower location.</p> <p>b. Suspension Clamps</p>	Ultimate tensile strength	(kg)	≥	7,500	Outside diameter	(mm)	≤	14	Cross sectional area of Conduct	(mm <sup>2</sup> )	≥	80	D.C. Resistance @ 20 °C	(Ω/km) ≤		0.76	Length per reel	(m)		3000 Approx.	Modulus of elasticity	(kg/mm <sup>2</sup> )	≥	10,000	Coefficient of linear expansion	(/°C)	≤	15.0 x 10 <sup>-6</sup>	Capacity fault current (KA) <sup>2</sup> sec.			46	Maximum allowable temp.				For optical fiber in loose type (°C)			160	Maximum Transmission Loss Change – Temperature Range 0°C to 150 °C	(dB/km)		0.1	Unit Weight	(kg /km)	≤	600
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<p>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</p>	<p>Bid Doc. No.: CS-0370-572-2</p>	<p>TECHNICAL SPECIFICATIONS</p>	<p>PART-III SECTION-VI</p>	<p>Page T4-12/14</p>																																													


Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
	<p>The suspension clamps for the OPGW shall be of bolt or performed type. The bolt type suspension clamps shall be complete with bolts, keeper pieces, and other required parts. Each clamp shall be capable of holding the OPGW without slipping under an unbalanced tension of 25% of the ultimate tensile strength of the OPGW.</p> <p>c. Tension Clamps</p> <p>The tension clamps shall be of bolt or performed type, and cable of holding the OPGW without slipping or damaging the OPGW under a tension of 75% of the OPGW ultimate tensile strength. A suitable piece shall be of same material as the clamp body. Bolts, nuts and washers shall be hot-dipped galvanized malleable iron or steel.</p> <p>d. Grounding clamps and Parallel Groove Clamp</p> <p>Each clamp shall be capable holding the OPGW using bolts and nuts.</p> <p>e. Vibration dampers</p> <p>Stockbridge type vibration dampers, suitable for use on the OPGW shall be supplied. The dampers shall have an aluminum, clamping bolts, or other suitable device, on the galvanized wire between the weights, and be suitable for attachment to the OPGW. The damper clamp shall be designed to permit installation and removal using hot line tools. Each damper weight, subject to the accumulation of moisture, shall be provided with one drain hole positioned at the bottom of the weight when the damper is installed in the vertical plane. Damper weights shall be made of hot dip galvanized case iron or zinc.</p> <p>f. Armor rods</p> <p>The armor rods for the OPGW shall be of the preformed type. They shall be smooth and free from corrosion, splitting, cracking, or any other defects. They shall be designed to effectively protect the OPGW from fatigue caused by vibration.</p> <p>Armor rods may or may not be employed, as per OPGW manufacturer recommendations, however the use of armor rods is preferred by the Employer.</p> <p>g. The joint box shall be air-tight, water-proof. The cover shall be securely fastened to the case by non-loosening fasteners. Both the case and the cover shall be made of non-corrosive aluminum alloy or hot dip galvanized steel or approved materials. The joint box shall be sufficiently rugged and sturdy to withstand outdoor climatic and environmental conditions. The joint box shall accommodate sheath protected arc-fusion splices and up to 1.5 m of additional fiber on each side of the splice; guides shall be provided to keep the extra fiber well above the allowable bending radius of the fiber. The spliced parts of the optical fiber within the joint box shall be reinforced and free from tension after completion of the splicing.</p> <p>The contractor shall provide one set of terminating materials with every joint box for optical fiber connection.</p> <p>1. <b>Way Joint Box for OPGW</b></p>			
<p>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</p>	<p>Bid Doc. No.: CS-0370-572-2</p>	<p>TECHNICAL SPECIFICATIONS</p>	<p>PART-III SECTION-VI</p>	<p>Page T4-13/14</p>


Clause No.	TECHNICAL REQUIREMENTS 			
	<p>This type of joint box shall be used to straight joint OPGW to OPGW, or OPGW to approach cable. It shall be used at all locations requiring such a device except those specified otherwise in the text or drawings elsewhere in this specification.</p> <p>2. <b>Way Joint Box for OPGW and approach cable</b></p> <p>This type of joint box shall be used to spur joint all fibers contained in two OPGW cables to OPGW or one multi-core optical fiber cable at each terminal station, repeater station, or other location, as detailed in the text or drawings elsewhere in this specification.</p>			
NABINAGAR STPP (3X660MW) 400/132KV SWITCHYARD PACKAGE	Bid Doc. No.: CS-0370-572-2	TECHNICAL SPECIFICATIONS	PART-III SECTION-VI	Page T4-14/14


Clause No.	<b>TECHNICAL REQUIREMENTS</b> 			
<b>CHAPTER – T5 : TESTS FOR 400KV TL. LINE MATERIAL</b>				
1.00.00	<b>GENERAL REQUIREMENTS</b>			
1.01.00	The materials shall conform to all the type tests as per relevant standards. The following type, acceptance, routine tests and tests during manufacturer shall be carried out on the line material.			
1.02.00	The type tests shall be carried out on samples prior to commencement of commercial production against the specification.			
1.03.00	The standards and norms to which these tests will be carried out are listed against them. Where a particular test is a specific requirement of this specification, the norms and procedure of these shall be as specified in annexure to this section.			
1.04.00	For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Bidder in his bid or the acceptance value specified in the relevant standard, whichever is more stringent for that particular test.			
2.00.00	<b>TYPE TESTS</b>			
All the equipment shall conform to the type tests. As specified at clause elsewhere, Contractor shall submit reports of all the type tests as mentioned below as per the relevant standards for Owner's review. The type test reports shall be of the tests conducted in last 5 years prior to the date of bid opening. For the tests whose reports submitted are not acceptable or are not furnished, the same shall be conducted by the Contractor under this contract free of charge prior to the dispatch of the equipment/material.				
2.01.00	<b>Earthwire</b>			
a)	UTS test - As per specification enclosed			
b)	DC resistance test - As per specification enclosed			
2.02.00	<b>Conductor (specification of following tests enclosed at Annexure)</b>			
a)	UTS test on stranded conductor - As per specification enclosed			
b)	DC resistance test on stranded conductor - As per specification enclosed			
2.03.00	<b>Conductor and Earthwire Accessories</b>			
2.03.01	<b>Mid Span Compression Joint for Conductor and Earthwire</b>			
a)	Electrical Resistance Test – As per IS : 2121 - (Part-II) - 1981			
b)	Heating Cycle Test – As per IS:2486 (Part-I, 1971) (not applicable to mid span compression joint for earthwire).			
c)	Slip Strength Test - As per IS: 2486(part-I)-1971			
d)	Chemical analysis of material			
2.03.02	<b>Repair Sleeve for conductor</b>			
a)	Chemical analysis of material			
<b>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE.</b>	<b>Bid Doc. No.:</b> CS-0370-572-2	<b>TECHNICAL SPECIFICATIONS</b>	<b>PART-III SECTION-VI</b>	<b>Page</b> T5-1/21


Clause No.	TECHNICAL REQUIREMENTS			
2.03.03	Spacer for Line a) Chemical analysis of materials b) Clamp slip test c) Vibration tests i) Vertical vibration ii) Longitudinal vibration iii) Sub span oscillation d) Magnetic power loss test (if applicable) e) Tension – Compression test f) Corona extinction voltage test (dry) g) Radio interference voltage test (dry) h) Ozone test	As per specification enclosed		
2.03.04	Rigid Spacer for jumper (For Twin ACSR 'MOOSE') a) Chemical analysis of materials b) Clamp slip test c) Magnetic power loss test (if applicable) d) Tension – Compression test e) Corona extinction voltage test (dry) f) Radio interference voltage test (dry)			
2.03.05	Flexible Copper Bond. a) Slip strength test - As per specification enclosed			
2.03.06	Vibration Damper for Conductor and Earthwire. a) Dynamic characteristics test - As per specification enclosed b) Vibration Analysis - As per specification enclosed c) Clamp Slip Test - As per specification enclosed d) Fatigue Test - As per specification enclosed e) Chemical Analysis of Material			
2.03.07	Earthwire Suspension clamp Assembly a) Mechanical strength Test - As per specification enclosed b) Clamp Slip Strength vs Torque test for suspension assembly - As per specification enclosed.			
2.03.08	Earthwire Tension Clamp Assembly a) Mechanical strength test (excluding Clamp) - As per specification enclosed b) Slip strength test on tension assembly - As per specification enclosed c) Electrical resistance test on tension Clamp - As per specification enclosed			
2.04.00	Hardware Fittings			
2.04.01	On the complete insulator string with hardware fittings a) Power Frequency Voltage withstand test under wet condition - As per IS:731-1971 b) Impulse voltage withstand test under dry condition - As per IEC:383-1970. c) Switching surge voltage withstand test under wet condition – As per IEC:383.			
NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE	Bid Doc. No.: CS-0370-572-2	TECHNICAL SPECIFICATIONS	PART-III SECTION-VI	Page T5-2/21


Clause No.	TECHNICAL REQUIREMENTS			
	d) Impulse voltage Flashover test under dry condition - As per IEC:383-1970. e) Voltage distribution test- As per specification enclosed f) Mechanical strength test for complete string - As per specification enclosed g) Vibration test- As per specification enclosed  Notes: 1 All the type tests given above shall be conducted on single suspension and double tension insulator strings alongwith hardware fittings. 2. The mechanical strength test given above shall also be conducted on balance insulator strings alongwith hardware fittings.			
2.04.02	On suspension hardware fittings only a) Magnetic power loss test for suspension assembly - As per specification enclosed b) Clamp slip strength for clamp - As per specification enclosed c) Ozone test on Elastomer – As per specification enclosed			
2.04.03	On Tension Hardware Fittings only (As per IS : 2486 -Part-I) a) Electrical Resistance Test for dead end assembly b) Heating Cycle Test for dead end assembly c) Slip Strength Test for dead end assembly			
2.05.00	On disc insulators a) Verification of dimension – As per IS:731-1971 b) Thermal mechanical performance tests - As per IEC 575 c) Power frequency voltage withstand and Flashover test (wet) - As per IS:731-1971, d) Impulse voltage withstand and flashover test (dry) - As per IS:731-1971 e) Visible discharge test (dry) - As per IS:731 f) RIV test (dry) - As per IS:8263-1976			
3.00.00	ACCEPTANCE TESTS			
3.01.00	Earthwire a) Visual check on drum - As per specification enclosed b) Visual check for joint etc. - As per specification enclosed c) Dimensional check - As per specification enclosed d) Galvanising test - As per specification enclosed e) Lay length check - As per specification enclosed f) Torsion test - As per specification enclosed g) Elongation test - As per IS:398 (Part-II) h) Wrap test - As per IS:398 (Part-II) i) DC resistance test - As per IS:398 (Part-II) j) Breaking load test - As per IS:398 (Part-II) k) Chemical analysis of steel - As per IS:398 (Part-II)			
3.02.00	Conductor a) Visual and dimensional check on drum - As per specification enclosed			
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Clause No.	TECHNICAL REQUIREMENTS			
	b) Visual check for joint scratches and length of conductor - As per specification enclosed c) Dimensional check on individual strands - As per specification enclosed d) Check for lay-rations of various layers - As per specification enclosed e) Breaking load test on individual strands - As per IS:398 (Part IV) f) Wrap test on aluminium strands - As per IS:398 (Part-IV) g) DC resistance test on individual strands - As per IS:398 (Part IV) h) Elongation test - As per IS:398 (Part IV) i) Breaking load test on welded Aluminium strand - As per specification enclosed  Note: All the above tests shall be carried out on aluminium strands after stranding only.			
3.03.00	Conductor and Earthwire Accessories			
3.03.01	Mid Span Compression Joint for Conductor and Earthwire a) Visual examination & dimensional verification - IS:2121 (Part-II) b) Galvanising Test - As per IS : 2121 (Part-II) c) Hardness Test - As per specification enclosed			
3.03.02	Repair Sleeve for conductor a) Visual examination and dimensional verification – As per IS:2121 (Part-II)			
3.03.03	Vibration Damper for Conductor and Earthwire. a) Visual examination and dimensional verification – As per IS:2121 (Part-II) b) Galvanising Test on i) Damper mass ii) Messenger Cable c) Verification of Resonance Frequencies - As per specification enclosed d) Clamp Slip vs torque Test - As per specification enclosed e) Clamp Bolt Torque Test - As per specification enclosed f) Strength of the Messenger Cable - As per specification enclosed g) Mass Pull Off Test - As per specification enclosed			
3.03.04	Spacer for Conductor/Spacer for jumper  a) Visual examination and dimensional verification - As per IS : 2121 (Part-II) b) Galvanising test c) Movement test (except for spacers for jumpers) d) Clamp slip test e) Clamp bolt torque test f) Compressive and tensile test g) Assembly torque test h) Hardness test for elastomer (if applicable)			
3.03.05	Earth wire Suspension Clamp Assembly a) Visual examination and dimensional verification – As per IS : 2121 (Part-II) b) Galvanising test - As per IS:2121 (Part-II)			
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Clause No.	TECHNICAL REQUIREMENTS			
c) d)	Clamp slip strength Vs Torque test - As per specification enclosed Mechanical strength of each component.			
3.03.06	Earth wire Tension Clamp Assembly a) Visual examination and dimensional verification - As per IS : 2121 (Part-II) b) Galvanising test (excluding clamp) - As per IS : 2121 (Part-II) c) Hardness test - As per specification enclosed d) Mechanical strength test on each component (excluding clamp) e) Slip strength test on tension clamp - As per specification enclosed			
3.04.00	Hardware Fittings			
3.04.01	On both suspension and tension hardware fittings a) Visual Examination - As per IS : 2486 - (Part-I) - 1971 b) Verification of dimension - As per IS : 2486 - (Part-I) - 1971 c) Galvanising/Electroplating - As per specification enclosed d) Mechanical strength test of welded joint - As per specification enclosed e) Mechanical strength test of each component - As per specification enclosed f) Test on locking devices for ball and socket coupling – As per IEC:372(2)-1976 g) Chemical analysis, hardness test, grain size, inclusion rating and magnetic particle inspection for forging /casting- As i)per specification enclosed			
3.04.02	On suspension Hardware fittings only a) Clamp slip strength vs Torque test for suspension clamp - As per specn. enclosed b) Shore hardness test of elastomer cushion for AG suspension clamp c) Bend test for armour rod set - As per IS:2121-(Part-I)1981 d) Resilience test for armour rods set - As per IS:2121 e) Conductivity test for armour rods set. - As per IS:2121			
3.04.03	On Tension Hardware Fittings only a) Slip strength test for dead end assembly : As per IS:2486-(Part-I)1971			
3.05.00	Disc insulator a) Visual Examination - As per IS:731-1971 b) Verification of dimensions - As per IS:731-1971 c) Temperature cycle test - As per IS:731-1971 d) Galvanising test - As per IS:731-1971 e) Mechanical performance test – As per IEC:575-1977 f) Tests on locking device for ball and socket coupling – As per IEC:372(2) -1976 g) Eccentricity test - As per specification enclosed h) Electro-mechanical failing load - As per IEC:383-1993 i) Puncture test - As per IS:731-1971 j) Porosity test - As per IS:731-1971			
4.00.00	<b>ROUTINE TESTS</b>			
4.01.00	Earthwire			
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Clause No.	TECHNICAL REQUIREMENTS			
	a) Check that there are no cuts, fins etc. on the strands b) Check for correctness of stranding. c) Check that drums are as per specification.			
4.02.00	Conductor a) Check to ensure that the joints are assembly per specification b) Check that there are no cuts, fins etc. on the strands c) Check that drums are as per specification. d) All acceptance test as mentioned in clause 3.02.00 above to be carried out on each coil.			
4.03.00	Conductor and Earthwire Accessories a) Visual Examination and Dimensional Verification - As per IS : 2121 - (Part-II) - 1981			
4.04.00	Hardware Fittings a) Visual Examination – As per IS:2486 (Part-I) 1971 b) Proof Load Test - As per specification enclosed			
4.05.00	Insulators a) Visual inspection - As per IS:731-1971 b) Mechanical routine test - As per IS:731-1971 c) Electrical routine test - As per IS:731-1971			
5.00.00	TESTS DURING MANUFACTURE			
5.01.00	Earthwire a) Chemical analysis of zinc used for galvanising – As per specification enclosed b) Chemical analysis of steel			
5.02.00	Conductor a) Chemical analysis of aluminium used for making strands – As per specification enclosed			
5.03.00	Conductor and Earthwire Accessories a) Chemical analysis of zinc used for galvanising : Samples taken from the zinc ingots shall be chemically analysed as per IS:209-1966 b) Tests on Malleable Castings, Forgings and Fabricated Hardware. The Chemical analysis, mechanical and metallographic tests, inclusion rating and magnetic particle inspection for malleable castings, chemical analysis, hardness test, grain size and magnetic particle inspection for forgings and chemical analysis and mechanical tests for fabricated hardware will be based on heat number and heat treatment batch. The details regarding these tests will be as discussed and mutually agreed to by the Contractor and Owner in the quality assurance programme.			
5.04.00	Hardware Fittings (on all components as applicable) a) Chemical analysis of zinc used for galvanising – As per specification enclosed b) Chemical analysis, hardware tests, grain size, inclusion rating and magnetic particle inspection for forgings/castings c) Chemical analysis and proof load test for fabricated hardware - As per specification enclosed			
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Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
5.05.00	<p>Insulators (on all components as applicable)</p> <p>a) Chemical analysis of zinc used for galvanising - As per specification enclosed</p> <p>b) Chemical analysis, mechanical and metallographic test and magnetic particle inspection for malleable/castings - As per specification enclosed</p> <p>c) Chemical analysis hardness tests and magnetic particle inspection for forgings - As per specification enclosed</p> <p>d) Hydraulic internal pressure tests on shell - As per specification enclosed</p> <p>e) Verification of dimensions – As per IS:731-1971</p>			
6.00.00	<p><b>TESTING EXPENSES</b></p>			
6.01.00	<p>Bidder shall indicate the schedule for all type tests if required to be conducted under this contract as per clause 2.00.00. Bidder shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that the tests can be completed within the time schedule guaranteed by them. The Contractor shall intimate the Owner about carrying out of the type tests alongwith detailed testing program at least 3 weeks in advance (in case of Indian Contractor and at least 6 weeks advance in case of foreign Contractor) of the schedule date of testing during which the Owner will arrange to depute his representative to be present at the time of carrying out the tests.</p>			
6.02.00	<p>The entire cost of testing for acceptance and routine tests and tests during manufacturer specified herein shall be treated as included in the quoted unit price of disc insulators except for the expenses of the Inspector/Owner's representative.</p>			
7.00.00	<p><b>SAMPLE BATCH FOR TYPE TESTING</b></p> <p>The Contractor shall offer at least three times the quantity of material required for conducting all the type tests for sample selection. Before sample selection, the Contractor shall be required to conduct all the acceptance tests successfully in presented of Owner representative.</p>			
8.00.00	<p><b>ADDITIONAL TESTS</b></p>			
8.01.00	<p>Owner reserves the right of having at his own expensed any other tests of reasonable nature carried out at Contractor's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy that the material comply with the specifications.</p>			
8.02.00	<p>Owner also reserves the right to conduct all the tests mentioned in this specification at this own expense on the samples drawn from the site at Contractor's premises or at any other test center. In case of any failure, it shall be binding on the part of Contractor to replace that particular lot completely without any extra cost to the Owner.</p>			
9.00.00	<p><b>TESTS REPORTS</b></p>			
9.01.00	<p>Copies of type test reports shall be furnished in at least six ( 6) copies. One copy will be returned, duly certified by the Owner, only after which the commercial production of the concerned material will start.</p>			
9.02.00	<p>Copies of acceptance test reports shall be furnished in at least six (6) copies. One copy will be returned, duly certified by the Owner, only after which the material will be dispatched.</p>			
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Clause No.	TECHNICAL REQUIREMENTS			
9.03.00	Records of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Owner's representative.			
9.04.00	Test certificates of tests during manufacture as maintained by the Contractor, shall be produced for verification as and when desired by the Owner.			
10.00.00	<b>INSPECTION</b>			
10.01.00	The Owner's representative(s) shall at all times be entitled to have access to works and all places of manufacture, where materials and their components are being manufactured. The representatives shall have full facilities for unrestricted inspection of the Contractor's works, raw materials, manufacture of the material/item for conducting necessary tests as detailed herein.			
10.02.00	The Contractor shall keep the Owner informed in advance of the time of starting and of the progress of manufacture of material / items in their various stages so that arrangement could be made for inspection.			
10.03.00	No material/ item shall be dispatched from its point of manufacturer before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Owner in writing. In the latter case also, the material/items shall be dispatched only after satisfactory testing for all tests specified herein have been completed.			
10.04.00	The acceptance of any quantity of material /item shall in no way relieve the Contractor of his responsibility of meeting all the requirement of the specification, and shall not prevent subsequent rejection if such material / items are later found to be defective.			
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Clause No.	TECHNICAL REQUIREMENTS	
<b>NORMS AND PROCEDURES OF TESTS</b>		<b>ANNEXURE - A</b>
1.00.00	<b>TESTS ON EARTHWIRE</b>	
1.01.00	<b>UTS Test</b>  Circles perpendicular to the axis of the earthwire shall be marked at two places on a sample of earthwire of minimum 5 m length suitably places compressed with dead end clamps at both ends. The load shall be increased at a steady rate upto 50 % of UTS and held for one minute. The circles drawing shall not be distorted due to relative movement of strands. These after the load shall be increased at a steady rate to 100 % of UTS and held for one minute. The earthwire sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and value recorded.	
1.02.00	<b>DC Resistance Test</b>  On an earthwire Sample of minimum 5 m length two contact clamps shall be fixed. The resistance shall be measured by a Kelvin double - bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to 20 ° C. The resistance corrected to 20 ° C shall confirm to the requirement of this specification.	
1.03.00	<b>Visual Check for joints</b>  One drum from each lot shall be rewound in the presence of the inspector. The inspector shall visually check for scratches etc. and see that the earthwire generally conforms to the requirements of this specification.	
1.04.00	<b>Torsion Test</b>  The number of twists which a single steel strand shall withstand during torsion test shall be at least eighteen for a length of 100 time the standard dia of that strand.	
1.05.00	<b>Visual check on Drums</b>  The drums shall be visually checked to ensure that they conform to his specification.	
1.06.00	<b>Dimensional Check</b>  The individual strands shall be dimensionally checked to ensure that they conform to the requirements of this specification.	
1.07.00	<b>Lay length Check</b> The lay length shall be checked to ensure that they conform to the requirements of this specification.	
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Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
1.08.00	<p><b>Galvanising Test</b></p> <p>The test procedure shall be as specified in IS:4826-1968. The material shall conform to the requirements of this specification.</p>			
1.09.00	<p><b>Chemical Analysis of Zinc used for Galvanising</b></p> <p>Samples taken from zinc ingots shall be chemically / spectrographically analysed. The same shall be in conformity to the relevant standards.</p>			
1.10.00	<p><b>Chemical Analysis of Steel</b></p> <p>Sample taken from the steel ingots/coils/strands shall be chemically / spectrographically analysed. The same shall be in conformity to the relevant standards.</p>			
2.00.00	<p><b>TESTS ON CONDUCTOR</b></p>			
2.01.00	<p><b>UTS Test On Stranded Conductor</b></p> <p>Circles perpendicular to the axis of the conductor shall be marked at two places on a sample conductor of minimum 5 m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate upto 50% of rated UTS and held for one minute. The circles drawing shall not be distorted due to the relative movement of strands. Thereafter the load shall be increased at a steady rate to 100% of the rated UTS for one minute. The conductor sample shall not fail during this period the applied load shall then be increased until the failing load is reached and the value recorded.</p>			
2.02.00	<p><b>DC Resistance Test On Stranded Conductor</b></p> <p>On a conductor sample of minimum 5 m length two contact clamps shall be fixed. The resistance shall be measured by a Kevin double bridge by placing the clamps initially zero meter and subsequently one metre apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20 deg.C as per IS:398 (Part-IV)-1979. The resistance corrected at 20 deg. C shall conform to the requirements of this specification.</p>			
2.03.00	<p><b>Chemical Analysis Of Aluminum</b></p> <p>Samples taken from the heat treated batch/coils/strands, shall be chemically/ spectrographically analysed. The same shall be in conformity to the requirements stated in this specification.</p>			
2.04.00	<p><b>Visual And Dimensional Check On Drums</b></p> <p>The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this specification.</p>			
2.05.00	<p><b>Visual Check For Joints, Scratches, etc.</b></p>			
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Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
2.06.00	<p>Conductor drums shall be rewound in the presence of the inspector. The inspector shall visual check for scratches, joints etc. and that the conductor generally conform to the requirements of this specification.</p> <p><b>Dimensional Check On Aluminium Strands</b></p> <p>The individual strands shall be dimensionally checked to ensure that they conform to the requirement of this specification.</p>			
2.07.00	<p><b>Check For Lay-Rations Of Various Layers</b></p> <p>The lay-rations of various layers shall be checked to ensure that they conform to the requirements of this specification.</p>			
2.08.00	<p><b>Elongations Test</b></p> <p>The test procedure shall be as specified in IS-398 (Part-IV)-1979. The material shall conform to the requirements of this specification.</p>			
2.09.00	<p><b>Breaking Load Test On Welded Aluminium Strand</b></p> <p>The aluminium wires shall be welded and shall be subjected to tensile load. The welded point of the wire shall be able to withstand the minimum breaking load of the individual strand guaranteed by the bidder.</p>			
3.00.00	<p><b>CONDUCTOR AND EARTHWIRE ACCESSORIES</b></p>			
3.01.00	<p><b>Mid Span Compression Joint for Conductor and Earthwire</b></p>			
3.01.01	<p><b>Slip Strength Test</b></p> <p>The minimum free length between grips and the tests sample shall be three meters for conductor joint and one meter for earthwire joint. The test shall be carried out as per IS:2121-(Part-II) 1981 clause 6.4 except that the load shall be steadily increased to 95% of minimum ultimate tensile strength of conductor/ earthwire and retained for one minute at this load. There shall be no movement of the conductor/earthwire relative to the fittings during this one minute period and not failure of the fittings.</p>			
3.01.02	<p><b>Hardness Test</b></p> <p>The Brineel hardness at various points on the earthwire compression joint and tension clamp shall be measured.</p>			
3.02.00	<p><b>Flexible Copper Bond</b></p> <p>Slip Strength Test</p>			
<p style="text-align: center;"><b>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</b></p>	<p style="text-align: center;">Bid Doc. No.: CS-0370-572-2</p>	<p style="text-align: center;"><b>TECHNICAL SPECIFICATIONS</b></p>	<p style="text-align: center;"><b>PART-III SECTION-VI</b></p>	<p style="text-align: center;">Page T5-11/21</p>


Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
<p>3.03.00</p> <p>3.03.01</p> <p>a)</p> <p>b)</p> <p>i)</p> <p>ii)</p> <p>iii)</p> <p>c)</p> <p>d)</p> <p>Where <math>F1 = 2 f_i</math> and <math>F2 = 0.5 f_i</math> for vibration damper for conductor / earthwire</p> <p>Where <math>f_i = 2 \times 2 \pi f \sqrt{TM}</math> T = tension of conductor M = mass of conductor</p> <p>e)</p> <p>3.03.02</p>	<p>On applying a load of 3 KN (300kg) between the two ends, stranded flexible copper cable shall not come out damaged. After the test, the lugs shall be cut open to ascertain that the gripping of cable has not been affected.</p> <p>Vibration Damper for Conductor and Earthwire</p> <p>Dynamic Characteristics Tests</p> <p>The damper shall be mounted with its clamp tightened with torque recommended by the manufacturer on shaker table capable of simulating sinusoidal vibrations for frequencies ranging from 5 Hz to 40 Hz conductor and 10 to 60 Hz for earthwire.</p> <p>The damper assembly shall be vibrated vertically with double amplitude of 1 mm at different frequencies to determine the following characteristics with the help of suitable record instruments:</p> <p>Reactance Vs frequency. Phase angle Vs frequency. Power dissipation Vs frequency.</p> <p>The above characteristics shall be determined by averaging the characteristics of the damper by carrying out this test three times on a single damper. This test shall be carried out on atleast five nos, of damper. The mean reactance and phase angle curves shall be drawn with the criteria of best fit method.</p> <p>The reactance Vs frequency curve shall not show steep peaks at resonance frequencies and deep troughs between the resonance frequencies. The resonance frequencies shall be suitably spread within the aeolian vibration frequency band between the lower and upper dangerous frequency limits determined by the vibration analysis of conductor without dampers. The mean damper force response Vs frequency curve shall show a trend compatible with optimum force of the conductor acting on the sinusoidal half wavelength at unit displacement of antinode and it shall lie within the envelope of F1 and F2.</p> <p>F1 and F2 are forces in kg/mm and 'f' is the frequency in hertz. Similarly for mean phase angle Vs frequency curve the phase angles shall lie between 25 deg. and 135 deg. within the frequency range of interest.</p> <p>Vibration Analysis</p> <p>The vibration analysis of the conductor/earthwire shall be done with and without damper installed on the span. The vibration analysis shall be done on a digital computer using energy balance approach, the following parameters shall be taken into account for the propose of analysis:</p>			
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Clause No.	TECHNICAL REQUIREMENTS			
	<p>a) The analysis shall be done for single conductor / earthwire without armour rods as per the parameters given at relevant clauses of this specification. The tension shall be taken as 43 KN and 14 KN for conductor and earthwire respectively for a span ranging from 50 m to 600 m.</p> <p>b) The self damping factor and flexural stiffness (E1) for conductor shall be calculated on the basis of experimental results. The details of experimental analysis with the data should be furnished.</p> <p>c) The power dissipation curve obtained from dynamic characteristic. Test shall be used for analysis with damper.</p> <p>d) Examine the Aeolian vibration level of the conductor with and without vibration damper installed at the recommended location for wind velocity ranging from 0 to 30 Km. Per hour. Predicting amplitude, frequency and vibration energy input.</p> <p>e) From vibrations analysis of conductor / earthwire without damper, antinode vibration amplitude and dynamic strain levels at clamped span extremities as well as antinodes shall be examined and thus lower and upper dangerous frequency limits between the Aeolian vibration level exceeding the specified limits shall be determined.</p> <p>f) From vibrations analysis of conductor / earthwire without damper, antinode vibration amplitude and dynamic strain levels at clamped span extremities as well as antinodes shall be examined and thus lower and upper dangerous frequency limits between the Aeolian vibration level exceeding the specified limits shall be determined.</p> <p>g) The dynamic strain levels at damper attachment points, clamped span extremities and antinodes shall not exceed the specified limits. The damper clamp vibration amplitude shall not be more than that of the specified fatigue limits.</p>			
3.03.03	<p>Clamp Slip and Fatigue Tests</p> <p>a) Test Set Up</p> <p>The clamp slip and fatigue tests shall be conducted on a laboratory set up with a minimum span length of 30 m. The conductor / earthwire shall be tensioned at 43 KN/ 14 KN and shall not be equipped with protective armour rods at any point. Constant tension shall be maintained within the span by means of lever arm arrangement. After the conductor/earthwire has been tensioned, a clamp shall be installed to support the conductor/ earthwire at both ends and thus influence of connecting hardware fittings are eliminated from the free span. The clamps shall not be used for holding the tension on the conductor/ earthwire. There shall be no loose parts, such as suspension clamps, U bolts etc. on the test span supported between clamps mentioned above. The Span shall be equipped with vibrations inducing equipment suitable for producing steady standing vibration. The inducing equipment shall have facilities for stepless speed control as well as stepless amplitude arrangement. Equipment shall be available for measuring the frequency, cumulative number of cycles and the amplitude of vibration at any point along the span.</p>			
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Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
<p>b)</p> <p>c)</p>	<p><b>Clamp Slip Test</b></p> <p>The vibration damper shall be installed on the test span. The damper clamp, after tightening with the manufacturer's specified tightening torque, when subjected to a longitudinal pull of 2.5 KN paralleled to the axis of conductor/ earthwire for a minimum duration of one minute shall not slip i.e. the permanent displacement between conductor/ earthwire and clamp measured after removal of the load shall not exceed 1.0 mm. The load shall be further increased till the clamp starts slipping. The load at which the clamp slips shall not be more than 5 KN.</p> <p><b>Fatigue Test</b></p> <p>The vibration damper shall be installed on the test span with the manufacturer's specified tightening torque. It shall be ensured that the damper shall be kept minimum three loops away from the shaker to eliminate stray signals influencing damper movement. The damper shall then be vibrated at the highest resonant frequency of each damper mass. For dampers involving torsional resonant frequencies tests shall be done at torsional modes also in addition to the highest resonant frequencies at vertical modes. The resonance frequency shall be identified as the frequency at which each damper mass vibrates with the maximum amplitude on itself. The amplitude of the damper clamp be maintained not less than <math>\pm 25 / f</math> mm, where f is the frequency in Hz.</p> <p>The test shall be conducted for minimum ten million cycles at each resonant frequency mentioned above. During the test if resonance shift is observed the test frequency shall be tuned to the new resonant frequency.</p> <p>The clamp slip test as mentioned here in above shall be repeated after fatigue test without retorquing or adjusting the damper clamp and the clamp shall withstand a minimum load equal to 80% of the slip strength for a minimum duration of one minute.</p> <p>After the above tests, the damper shall be removed from conductor/ earthwire and subjected to dynamic characteristics test. There shall not be any major deterioration in the characteristic of the damper. The damper then shall be cut open and inspected. There shall not be any broken, loose, or damaged part. There shall not be significant deterioration or wear of the damper. The conductor/ earthwire under clamp shall be also be free from any damage.</p> <p>For the purpose of acceptance, the following criteria shall be applied:</p> <ol style="list-style-type: none"> <li>i) There shall not be any frequency shift by more than <math>\pm 2</math> Hz for frequencies lower than 15 Hz and <math>\pm 3</math> Hz for frequencies higher than 15 Hz.</li> <li>ii) The percentage variation in reactance curve after fatigue test shall lie within the limit which is to be guaranteed by the manufacturer.</li> <li>iii) The reduction in power dissipation characteristic after the fatigue test shall not be more than the value guaranteed by the manufacturer. However, in no case the minimum power dissipation shall be less than governed by the lower limits of the reactance and phase angle curves as indicated in clause 3 (a) above.</li> <li>iv) The deterioration of characteristics in respect of reactance and power dissipation shall be compared with respect to guaranteed value.</li> </ol>			
<p>NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</p>	<p>Bid Doc. No.: CS-0370-572-2</p>	<p>TECHNICAL SPECIFICATIONS</p>	<p>PART-III SECTION-VI</p>	<p>Page T5-14/21</p>


Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
3.03.04	<p><b>Verification of Resonance Frequencies</b></p> <p>The damper shall be mounted on a shaker table and vibrated at damper clamp amplitude of +/- 0.5 mm to determine the resonance frequencies. The resonance shall be visually identified as the frequency at which damper mass vibrates with maximum amplitude on itself. The resonance frequency thus identified shall be compared with the guaranteed value.</p>			
3.03.05	<p><b>Clamp Bolt Torque Test</b></p> <p>The clamp shall be attached to section of the conductor / earthwire. A torque of 150% of the manufacturers specified torque shall be applied to the bolt. There shall be no failure of component parts.</p>			
3.03.06	<p><b>Strength of the Messenger Cable</b></p> <p>The messenger cable shall be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. The load shall not be less than the value guaranteed by the Bidder.</p>			
3.03.07	<p><b>Mass Pull Off Test</b></p> <p>Each mass shall be pulled off in turn by fixing the mass in one jaw and the clamp in the other of a suitable tensile testing machine. The longitudinal pull shall be applied gradually until the mass begins to pull out off the messenger cable. The pull off loads shall not be less than the value guaranteed by the Bidder (min 500 kg.)</p>			
3.04.00	<p><b>Earthwire Suspension / Tension Clamp</b></p>			
3.04.01	<p><b>Mechanical Strength test</b></p> <p>The suspension assembly / tension assembly (excluding tension clamp) shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. This load shall be held for five minutes and then removed. After removal of the load, the components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to loosen the nuts initially. The components shall not show any visual deformation and it shall be possible to dis-assemble them by hand. Hand tools may be used to loosen the nuts initially. The assembly shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.</p>			
3.04.02	<p><b>Clamp Slip Strength Vs Torque Test for Suspension assembly.</b></p> <p>The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length of the G. S. Earthwire shall be fixed in the clamp. The clamp slip strength at various tightening</p>			
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Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
3.04.03	<p>torque shall be obtained by gradually applying the load at one end of the earthwire. The clamp slip strength Vs torques curve shall be drawn. The clamp slip strength at the recommended tightening torque shall be more than 12 KN but less than 17 KN.</p> <p><b>Slip Strength Test of Tension Clamp</b></p> <p>Tension clamps shall be compressed on a 5 m length of earthwire on both ends. The assembly shall be mounted on a tensile testing machine and anchored in a manner similar to the arrangement to be used in service. A tensile load of 50% of the specified braking load of the earthwire shall be applied and the sample shall be marked in such a way that movement relative to the fitting can easily be detected. Without any subsequent adjustment of the fitting, the load shall be steadily increased to 95% of the specified breaking load and maintained for one minute. There shall be no movement of the earthwire relative to the fitting during this one minute period and no failure of the fitting also.</p>			
3.04.04	<p><b>Resistance Test of Tension Clamp.</b></p> <p>The tension clamp and the jumper shall be compressed on two suitable lengths of earthwire. The electrical resistance shall be measured between points on earthwire near the clamp and near the jumper mouth keeping 25 mm clearance of the fitting and should not exceed 75% of the measured resistance of equivalent length of earthwire. The test shall be conducted with direct current. The current connections shall be at a distance not less than 50 times the diameter of earthwire from the fitting and shall be made so that effective contact is ensured with all those strands of the earthwire which would be taken into account in calculating its equivalent resistance. The test shall be repeated with the polarity reversed and the average of the two results considered assembly the measured value.</p>			
3.04.05	<p><b>Hardness test.</b></p> <p>The Brineel hardness at various points on the steel portion of tension clamp shall be measured.</p>			
3.04.06	<p><b>Magnetic Power Loss Test</b></p> <p>The sample shall be tested in a manner to simulate service conditions. A 50 Hz alternating current over the range of 400 Amps to 900 Amps shall be passed and the Wattmeter readings of the power loss with an without damper or sample for the different values of current shall be tabulated and plotted on a graph. The difference in the power loss with and without damper shall be limited to 1 watt for 600 Amps (rms). The losses shall be determined by averaging the figures obtained from at least four samples of vibration dampers.</p>			
3.04.07	<p><b>Chemical Analysis Test for each components</b></p> <p>Chemical analysis of the material used for the manufacturer of items shall be conducted to check conformity of the same with technical specification and approved drawings.</p>			
3.05.00	<p><b>Spacer for line &amp; Rigid spacer</b></p>			
<p style="text-align: center;">NABINAGAR STPP (3X660MW) 400/132kV SWITCHYARD PACKAGE</p>	<p style="text-align: center;">Bid Doc. No.: CS-0370-572-2</p>	<p style="text-align: center;">TECHNICAL SPECIFICATIONS</p>	<p style="text-align: center;">PART-III SECTION-VI</p>	<p style="text-align: center;">Page T5-16/21</p>

Clause No.	<b>TECHNICAL REQUIREMENTS</b> 			
3.05.01	<p><b>Clamp slip Test</b></p> <p>The spacer assembly shall be installed on test span of twin ACSR 'MOOSE' conductor bundle string at a tension of 43 kN. In case of spacer for jumper, the clamp of sample shall be tightened with a specified tightening torque. One of the clamp of sample when subjected to a longitudinal pull of 2.5 kN parallel to the axis of conductor for a minimum duration of one minute shall not slip on the conductor i.e. the permanent displacement between the conductor and the clamp of sample measured after removal of the load, shall not exceed 1.0 mm. Similar test shall be performed on the other clamp of the same sample. Such clamp slip tests shall also be conducted after each of the vibration test mentioned in clause 3.03.02 (a). Each clamp shall withstand a minimum longitudinal load of 2 kN for a minimum duration of one minute after the vibration test without any adjustment of sample.</p>			
3.05.02	<p><b>Vibration tests</b></p> <p>The test set up shall be as per Clause 3.03.03 of Annexure – A. The spacer assembly shall be clamped to conductor. During the vibration tests the axis of the clamp of sample be maintained parallel to its initial static position by applying a tension of 43 kN on the ACSR 'MOOSE' conductor. The spacer assembly shall be free to vibrate and shall not be retorqued or adjusted between the tests.</p> <p>All the vibration tests mentioned hereunder shall be conducted on the same sample on same test span. The samples shall withstand the vibration tests without slipping on the conductor, loosening, damage or failure of component parts. After each vibration test, clamp slip test shall be carried out as per the procedure given in clause 3.05.01.</p> <p>i) <b>Longitudinal Vibration Test.</b></p> <p>The stationary conductor and the vibrating conductor/equivalent diameter of aluminum alloy tube shall be restrained by fixed clamps. The displacement of the vibrating conductor shall be 25 mm minimum on either side. The longitudinal movement shall be parallel to the conductor at frequency not less than 2 Hz for minimum one million cycles.</p> <p>ii) <b>Vertical vibration Test</b></p> <p>The spacer/spacer damper shall be installed in middle of the test span and the frequency chosen so as to get an odd number of loops. The shaker shall be positioned at least two loops away from the test specimen to allow free movement of the conductor close to the test specimen. One conductor shall be connected to the shaker and vibrated to an amplitude such that</p> $F^{1.8} Y_{max} > 1000 \text{ mm/sec.}$ <p>Where <math>Y_{max}</math> being the antinode displacement (mm) and <math>f</math> is the test frequency (Hz). The test frequency shall be greater than 24 Hz and the total number of cycles shall be more than 10 millions.</p> <p>iii) <b>Sub-span Oscillation Test</b></p> <p>The test shall be conducted for oscillation in horizontal plane at frequency higher than 3 Hz for minimum one million cycles. The amplitude for oscillation shall be kept equipment to an amplitude of</p>			
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Clause No.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> 			
3.05.03	<p>150 mm for a full sub-span of 80m. Both the conductor shall be vibrated 180 deg. out of phase with the above minimum amplitude.</p>			
3.05.04	<p><b>Ozone Test for Elastomer</b></p> <p>This test shall be performed in accordance with astm d-1171 by ozone chamber exposure method (method b). The test duration shall be 500 hours and the ozone concentration 50 pphm. At the test completion, there shall be no visible crack under a 2x magnification.</p>			
4.00.00	<p><b>Compressive and Tensile Test</b></p> <p>The spacer assembly shall withstand ultimate compressive load of 15 kN and tensile load of 7.5 kN applied between sub conductor bundle and held for one minute without failure. Line distance between clamps shall be recorded during each of the compression and tension test. Measurement shall be recorded at (i) no load (ii) with load (iii) after release of load. The center line distance under load shall be within <math>\pm 100</math> mm of the nominal design spacing. After release of load it shall be possible to retain the clamps at their original position using only slight hand pressure. There shall be no deformation or damage to the spacer assembly which would impair its function of maintaining the nominal spacing.</p>			
4.01.00	<p><b>HARDWARE FITTINGS AND INSULATORS</b></p>			
4.01.00	<p><b>Voltage Distribution Test</b></p> <p>The voltage across each insulator Unit shall be measured by sphere gap method. The result obtained shall be converted into percentage. The Voltage across any disc should not exceed 10 % of the total voltage applied on the string, in case of tension string and 9% in case of suspension string.</p>			
4.02.00	<p><b>Mechanical Strength Test for Complete String</b></p> <p>The complete insulator string alongwith its hardware fittings excluding arcing horn, and suspension assembly /dead end assembly shall be subjected to a load equal to 50% of the specified Minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. This load shall be held for five minutes and then removed. After removal of the load, the string component shall not show any visual deformation and it shall be possible to disassemble term by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS in reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load in reached and the value recorded.</p>			
4.03.00	<p><b>Vibration test</b></p> <p>The suspension string shall be tested in suspension mode and tension string in tension mode and tension string in tension mode itself in a laboratory span of minimum 30 meters. In the case of suspension string a tension more than 600 Kg shall be applied with the help of turn buckle. The insulator string alongwith help of turn buckle. The insulator string alongwith hardware fittings shall be strung at a tension of 86 KN and shall be secured with clamps. Vibration dampers shall not be used. The conductor shall be vibrated at the resonant frequency (f) of the insulator string (more than 10 Hz)</p>			
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	<p>corresponding to two or more loops on the insulator string by the means of vibration inducing equipment. The peak displacement in 'mm' at the antinode point nearest to the string shall be measured and the same shall not be less than 900/ (f** 1.8), mm depending upon 'f' selected. The insulator string shall withstand a minimum of 10 million cycles. After the test is over, the disc insulator shall be examined for looseness of pins and cap or any crack in the cement. The hardware fittings shall be examined for fatigue failure, slip strength and mechanical strength test. The slip strength of suspension assembly shall be carried out without any adjustment/removal. The disc insulators shall be further subjected to the following acceptance tests assembly per relevant standards</p> <p>a) Temperature cycle test followed by mechanical performance test assembly per IEC:575 Clause 4.0 : 60% discs of be tested</p> <p>b) Puncture test : 40% discs of be tested</p> <p>4.04.00 Chemical analysis of zinc used for galvanising</p> <p>Samples taken from the zinc ingot shall be chemically analysed assembly per IS:209-1979. The purity shall not be less than 99.95% and 99.7% for zinc used for galvanising and sleeve respectively.</p> <p>4.05.00 Test for forgings</p> <p>The chemical analysis hardness tests and magnetic particle inspection for forgings, will be conducted as per the internationally recognised procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the contractor and Owner.</p> <p>4.06.00 Tests on castings</p> <p>The chemical analysis, mechanical and metallographic tests and magnetic particle inspection for castings will be as per the internationally recognised procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the contractor and Owner.</p> <p>4.07.00 Hydraulic internal pressure tests on shells</p> <p>The test shall be carried out on 100% shells before assembly. The details regarding test will be as discussed and mutually agreed to by the contractor and Owner.</p> <p>4.08.00 Thermal mechanical performance test</p> <p>The thermal mechanical performance test shall be performed in accordance with IEC-575, clause 3, with the following modifications:</p> <p>The applied mechanical load during this test shall be 70% of the rated electro-mechanical of mechanical value. The acceptance criteria shall be :</p> <p>a) <math>X &gt; R + 3S</math> where X = Mean value of the individual electro-mechanical/</p>			
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<p>4.09.00</p> <p>4.10.00</p> <p>4.11.00</p> <p>4.12.00</p> <p>4.13.00</p>	<p style="text-align: center;">mechanical failing load. R = Rated Electro-mechanical / mechanical failing load. S = Standard deviation.</p> <p>b) The minimum sample size shall be taken as 10. c) The individual electro-mechanical/ mechanical failing load shall be at least equal to the rated value. Also electrical puncture shall not occur before the ultimate fracture.</p> <p><b>Eccentricity Test :</b></p> <p>The insulator shall be vertically on a fixture using dummy pin and socket. A vertical scale with horizontal slider shall be used for the axial run out. The pointer shall be positioned in contact with the bottom of the outermost petticoat of the disc. The disc insulators shall be rotated with reference to the fixture and the slider shall be allowed to move up and down on the scale but always maintaining contact with bottom of the outermost petticoat. After one full rotation of the disc, the maximum and minimum position the slider has reached can be found out. Difference between the above two readings shall satisfy the guaranteed value for axial run out.</p> <p>Similarly using a horizontal scale with a vertical slider the radial run out shall be measured. The slider shall be positioned in the scale so as to establish contact with the circumference of the insulator and disc insulator rotated on its fixture always maintaining contact. After one full rotation the maximum and minimum position the slider has reached on the scale are found out. The difference between the above readings shall satisfy the guaranteed particulars for radial run out.</p> <p><b>Magnetic power Loss Test for Suspension Assembly</b></p> <p>Same as clause 3.04.06 above</p> <p><b>Clamp slip strength Vs Torque Test and clamp slip for AG Suspension Clamp / envelope type suspension clamp.</b></p> <p>The suspension clamp shall be vertically suspended by means of a flexible attachment. A suitable length of ACSR 'MOOSE' conductor shall be fixed in the clamp. The clamp slip strength at various tightening torque shall be obtained by gradually applying the load at one end of the conductor. The clamp slip strength vs torque curve shall be drawn. The above procedure is applicable only for free centre type suspension clamp. For AG suspension clamp only clamp slip strength after assembly shall be found out. The clamp slip strength at the recommended tightening torque shall be more than 11 KN but less than 16 KN.</p> <p><b>Galvanising / Electroplating Test</b></p> <p>The test shall be carried out as per clause no. 5.9 of IS:2496 (Part-I) - 1971 except that both uniformity of zinc coating and standard prece test shall be carried out and the results obtained shall satisfy the requirements of this specification.</p> <p><b>Mechanical Strength Test for welded Joints</b></p>			
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4.14.00	<p>The welded portion of the component shall be subjected to a load of 2000 kgs for one minute. Thereafter, it shall be subjected to dei penetration/Ultrasonic test. There shall not be any crack at the welded portion.</p> <p><b>Mechanical strength test of each component</b></p> <p>Each Component shall be subjected to a its 50 % Minimum UTS load which shall be increased at a steady rate to 67 % of min. UTS. The load shall be held for 5 minute and then removed. The component shall then be again be loaded to 50 % of UTS and then load shall be increased at a steady rate till the specified UTS and held for one minute. No fracture should occur. The load shall then be increased until the failing load is reached and the value recorded.</p>			
4.15.00	<p><b>Test For Forging, Casting and Fabricated Hardware</b></p> <p>The Chemical analysis, hardness test, grain size, inclusion rating and magnetic particle inspection for forging, casting and chemical analysis and proof load test for fabricated hardware shall be as per the internationally recognised procedure for these tests The sampling will be based on heat number and heat treatment batch. The details regarding tests will be as in the quality Assurance programme.</p>			
5.00.00	<p><b>Corona Extinction Voltage Test (Dry)</b></p> <p>The sample when subjected to power frequency voltage shall have a corona extinction voltage of not less than 320 kV rms line to ground under dry condition for 400 kV line. There shall be no evidence of corona on any part of the sample. The atmospheric condition during testing shall be recorded and the test results shall be accordingly corrected with suitable correction factor as stipulated in IS:731.</p>			
6.00.00	<p><b>Radio Interference Voltage Test (Dry)</b></p> <p>Under the conditions as specified under (5.00.00) above, the sample shall have a radio interference voltage level below 1000 micro volts at one MHz when subjected to 50 Hz AC voltage of 305 kV rms line to ground for 400 kV under dry condition. The test procedure shall be in accordance with IS:8263.</p>			
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<b>CHAPTER – T4 : LINE MATERIAL</b>	
1.00.00	<b>GENERAL</b>
1.01.00	All the equipments shall be of the latest design and conform to the best modern practice adopted in the extra high voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 33 KV AC transmission with single conductor and will give continued good performance.
1.02.00	The design, manufacturing process and quality control of all the materials shall be such as to give maximum factor of safety, maximum possible working load, highest mobility, elimination of sharp edges and a good finish.
1.03.00	All ferrous parts shall be hot dip galvanised, after all machining has been completed, nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electrogalvanised. The bolt threads shall be under cut to take care of increase in diameter due to galvanising . Galvanising shall be done in accordance with IS:2629-1972. Fasteners shall withstand four dips while spring washers shall withstand three dips. Other galvanised materials shall be guaranteed to withstand at least six dips each lasting one minute under the standard preece tests for galvanising.
1.04.00	The zine coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continues and free from imperfection such as flux, ash, rust stains, bulky white deposits and blisters. The zine used for galvanising shall be of grade Zn. 99.95 as per IS:209-1966.
2.00.00	<b>EARTHWIRE</b>
2.01.00	The galvanised steel earthwire shall generally conform to the specification of ACSR core wire as mentioned in IS 398 (Part-II)-1976 except where otherwise specified herein
2.02.00	Parameters of the earthwire - Refer Chapter-E12, clause 7.00.00 of Switchyard Technical Specification.
2.03.00	The earth wire shall be pre-formed and post-formed to avoid opening of strands at the time of cutting or joining. The finished material shall have minimum brittleness, as it will be subject to appreciable vibration while in use. It shall withstand 3 and ½ number of one minute dips in the standard preece test.
2.04.00	There shall be no joint of any kind in the finished steel wire strand entering into the manufacture of the earthwire. There shall be no strand joints or strand splicer in any length of the completed stranded earthwire.
3.00.00	<b>CONDUCTOR</b>
3.01.00	The conductor shall be Aluminium Core Steel Reinforced (ACSR) DOG type. The conductor shall confirm to IS: 398 (Part-IV) - 1976 except where otherwise specified in Chapter E12 of Part-II.

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4.00.00	<b>CONDUCTOR ACCESSORIES</b>
4.01.00	<b>Mid Span Compressed Joint For Conductor</b> -As per details given in IS:2121 Part-2.
4.02.00	<b>Repair Sleeve</b>  Repair Sleeve of compression type shall be used to repair conductor with not more than one strands broken in the outer layer. The sleeve shall be manufactured from 99.5% pure aluminium and shall have a smooth surface. The repair sleeve shall comprise of two pieces with a provision of seat for sliding of the keeper piece. The edges of the seat as well as the keeper piece shall be of rounded so that the conductor strands are not damaged during installation.  The Contractor shall clearly specify the before and after compression dimensions of the mid span compression joint and repair sleeve for Owners review.
4.03.00	<b>Vibration Damper.</b>
4.03.01	Vibration dampers of 4 R -Stock bridge type with four (4) different resonance spread within the specified aeolian frequency bandwidth shall be used at all suspension and tension points on each span to damp out the Aeolean vibrations of the conductors to the specified level as mentioned hereinafter. Two dampers minimum on each side per conductor shall be used at tension points analysis done damper minimum on each side per conductor at suspension points for ruling design span.
4.03.02	The clamp of the vibration damper shall be made of high strength aluminium alloy of type LM-6 or equivalent..
4.03.03	The messenger cable shall be made of high strength galvanised steel/stainless steel with a minimum strength of 135 kg/mm <sup>2</sup> . It shall be of pre-formed and post-formed quality in order to prevent subsequent droop of weight and to maintain consistent flexural stiffness of the cable in service. The number of strands in messenger cable shall be 19. The messenger cable other than stainless steel shall be hot dip galvanised in accordance with the recommendations of IS:4826-1979 for heavily coated wires.
4.03.04	The manufacturer must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5 KN and 5KN. The clamp when installed on the conductor shall not case excessive stress concentration on the conductor leading to permanent deformation of the conductor strands and premature fatigue failure in operation.
4.03.05	The vibration damper shall not have magnetic power loss more than 0.5 watt at 250 amp at 50 alternating current.
4.03.06	The vibration analysis of the system, with and without damper and dynamic characteristics of the damper shall be submitted to Owner for approval supported by relevant technical documents and sample calculations. The damper placement charts shall include the following: Location of the dampers for various combinations of spans and line tensions clearly indicating the number of dampers to be installed per conductor per span. Placement distances clearly identifying the extremities between which the distances are to be measured. Placement recommendation depending upon type of suspension clamp (viz Free centre

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		<p>type, Armour grip type, etc.) The influence of mid span compression joints, repair sleeves and armour rods (standard and AGS) in the placement of dampers.</p>
5.00.00		<b>EARTHWIRE ACCESSORIES</b>
5.01.00		<b>Mid Span Compression Joint For Earthwire</b>
		It shall be used for joining two lengths of earthwire. The joint shall be made of mild steel. The steel sleeve should not crack or fail during compression in it or service period. The Brinell Hardness of steel should not exceed 200. the steel sleeve shall be hot dip galvanised. The joints shall not permit slipping off, damage or failure of the complete earthwire or any part thereof at a load not less than 95% of the ultimate tensile strength of the earthwire. The joint shall have resistivity less than 75% of resistivity of equivalent length of earthwire. The details of the joint shall be submitted for Owners approval.
5.02.00		<b>Vibration Damper For Earthwire</b>
5.02.01		Refer Clause 4.04.00 detailed above.
5.03.00		<b>Flexible Copper Bond</b> : As detailed in IS:2121 Part3. The flexible copper bond shall be fitted with 2 nos. tinned copper connecting lugs which will be pressed jointed to either ends of the bond. One lug shall be suitable for 12 mm dia bolt and other for 16 mm dia bolt. The complete assembly shall also include one 16 mm dia 40 mm lug HRH MS bolt hot dip galvanised with nut and lock washer.
5.04.00		<b>Suspension Clamp For Earthwire</b> : As detailed in IS:2121 Part3
5.05.00		<b>Tension Clamp For Earthwire</b>
5.05.01		The details shall be as per IS:2121 part-3. Only Compression type tension clamp shall be used to hold 7/3.66 mm galvanised steel earthwire. Anchor shackle shall be supplied which shall be suitable for attaching the tension clamp to strain plates. The strain plates supplied with the towers will have a minimum thickness of 8 mm with a hole of 17.5 mm diameter. Suitable lugs for jumper connection shall also be supplied alongwith necessary bolts and nuts.
6.00.00		<b>HARDWARE FITTINGS</b>
6.01.00		The hardware fittings shall be as per the specification and Indian standards/IEC .
6.02.00		Fasteners
6.02.01		All fasteners shall conform to IS:6639 - 1972. All fasteners shall be hot dip galvanised. All bolts and nuts shall have hexagonal heads, the heads being forged out of solid truly concentric, and square with the shank, which must be perfectly straight.
6.02.02		Fully threaded bolt shall not be used. The length of the bolt shall be such that the threaded portion shall not extend into the place of contact of the component parts.
		All bolts shall be threaded to take the full depth of the nuts and threaded enough to permit the firm gripping of the component parts but not further. It shall be ensured that the threaded portion of the bolt protrudes not less than 5 mm and not more than 10 mm

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	<p>when fully tightened.</p> <p>6.02.03 Flat washers and spring washers shall be provided wherever necessary and shall be of positive lock type. Thickness of washers shall conform to IS:2016-1967.</p> <p>6.02.04 To obviate bending stress in bolt, it shall not connect aggregate thickness more than three times its diameter.</p> <p>6.02.05 Bolts may have either rolled or cut threads, Nuts may be threaded after galvanising to ensure clean threads but bolts shall not be threaded or rethreaded after galvanising. Nut threads shall be tapped oversize to closely fit those of the galvanised bolt. With no unnecessary looseness but free enough to permit the nut to be turned freely with fingers over the entire threaded length.</p> <p>6.03.00 <b>Forged Components</b></p> <p>Forged components other than those covered in the clauses mentioned herein above shall be made out class IV steel as per IS:2004 or equivalent. The items shall be normalised to achieve the required tensile properties. The forged components shall not have sharp corners and edges.</p> <p>6.04.00 <b>Markings</b></p> <p>Each component of hardware shall be marked with the trade mark of the manufacturer. Marks shall be forged or stamped with a steel die before galvanising. The marks shall be distinct, durable and conspicuous.</p> <p>6.05.00 <b>INSULATOR</b></p> <p>6.05.01 <b>Polymer Insulators:</b></p> <p>The polymer used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and impervious to moisture.</p> <p>The colour of the polymer insulator shall preferably be brown.</p> <p>When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or when operating at normal rated voltage.</p> <p>The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. The design shall take into account the adequacy in end sealing so as to prevent entry of moisture and subsequent tracking.</p> <p>Contractor shall make available data on all the essential features of design including the method of assembly of FRP and metal parts, polymer housing, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.</p> <p>They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.</p>
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7.00.00	<p>All iron parts shall be hot dip galvanized.</p> <p>The composite insulators shall be meet the requirements of IEC 61109 &amp; IEC 62217. The insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/ sample test in accordance with relevant standards.</p> <p><b>Corona And RI Performance</b></p> <p>All surfaces must be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localised pressure. The metal parts shall not produce any noise generating corona under the operating conditions.</p> <p><b>Hot Line Maintenance</b></p> <p>The insulators offered shall be suitable for employment of hot line maintenance technique so that the usual hot line operations can be carried out with ease, speed and safety.</p> <p>Bidders shall indicate the methods generally used in the routine hot and dead line maintenance of HV lines for which similar insulator have been supplied by them. Bidders shall also indicate the recommended periodicity of such maintenance.</p> <p><b>Routine, Acceptance and Type tests:</b></p> <p>The Contractor shall carry out all the routine and acceptance tests as per relevant standards. All the materials shall confirm to type tests as per relevant standards.</p>
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# SECTION- 3

## PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS

### 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 of tender documents and are 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 prevail.

### 3.1 PROJECT INFORMATION:

	Particular	Details	
a)	Customer	<b>Nabinagar Power Generating Company Ltd. (NPGC)</b> (A joint venture of NTPC Ltd. and Bihar State Electricity Board)	
b)	Project Title	400/132 kV Switchyard including 400 kV & 33 kV Transmission Lines for Nabinagar Super Thermal Power Project (3X660 MW) at Nabinagar Bihar and extension of two line bays at 4X250MW Nabinagar TPP.	
c)	Location	<b>Nabinagar STPP</b> (i.) Place : Nabinagar (ii) District :Aurangabad (iii.) State :Bihar	<b>Nabinagar TPP (BRBCL)</b> (i.) Place : Nabinagar (ii) District :Aurangabad (iii.) State :Bihar
d)	Nearest Road Head	National Highway-2 (Approximately 25 kms from National highway)	
e)	Nearest Rail Head	Dehri-On-Sone (Approximately 30 kms from Railway Station)	

#### SITE CONDITIONS

a)	Max. ambient air temp.	50°C
b)	Min. ambient air temp.	0°C
c)	Max. design ambient temp.	50°C
d)	Design reference RH	100 %
e)	Altitude	<500 MSL
f)	Pollution Severity	High Pollution level (25mm/kV)
g)	Seismic Zone	Zone-III

#### WIND DATA

a)	Basic Wind speed	47m/sec
b)	The risk co-efficient (K1)	1.07
c)	Category of terrain	Category-2

d)	Maximum pressure on members	wind on steel	1500 N/m <sup>2</sup>
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### 3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	400 kV	132 kV	33 kV
1	Highest system voltage	420 kV rms	145 kVrms	36 kVrms
2	Lightning Impulse voltage	±1425kVp	± 650kVp	± 170kVp
3	Switching impulse voltage	±1050kVp	--	--
4	Power frequency withstand for 1 min (rms)	630 kV(rms)	275 kV(rms)	70 kV(rms)
5	Max. fault level (1 sec.)	50 kA	31.5kA	25 kA
6	Minimum creepage distance	10500 mm	3625mm	900 mm

### 3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Voltage	Connection	Variations in Voltage	Frequency	Phase	Neutral
1	415V		±10%	50±5%	3	Solidly Earthed
2	240V		±10%	50±5%	4	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Fault level of 415V system shall not be less than 20kA.

The minimum height of equipment supports shall be 2550mm. The various minimum heights of the switchyard shall be as given below from plinth level :

Voltage	Equipment Level	1 <sup>st</sup> Level	2 <sup>nd</sup> Level	3 <sup>rd</sup> Level
132kV	4600mm		8500mm	12500mm
400kV (1½ breaker)	8000mm		16000mm	--

### 3.2 INSTRUCTION TO BIDDERS:

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification.

It is recognized that the bidders may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and

performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section-Lighting System.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

### **3.3 STANDARDS**

- 3.3.1 The Contractor is required to follow local statutory regulations stipulated in the latest amended Electricity Supply Act 1948 and Indian Electricity Rules 1956, and other local rules and regulations.
- 3.3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments of standards and/or codes specified under respective section heads. The standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other. The Contractor shall also note that list of standards presented in this specified is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC. When the specified requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 3.3.3 Other internationally accepted standards which ensure equivalent or better performance that that specified in the standards referred under section shall also be acceptable.
- 3.3.4 In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in additional information schedule alongwith English language version of standard of relevant extract of the same. The

equipment conforming to standards other than IS/IEC shall be subject to Employer's approval.

3.3.5 The full names of the codes and standards mentioned in abbreviations under various equipment heads are as follows:

BS British Standards

IEC/CISPR International Electro-technical Commission

IS Bureau of Indian Standards

ISO International Organisation for Standards

NEMA National Electric Manufacturers Association

### **3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED**

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions. All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (not applicable for this project) short circuit etc for the equipment.

The equipment shall also comply with the following:

- a) All equipments shall be suitable for hot line washing.
- b). To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
- c) Piping, if any, between equipment control cabinet or operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.
- d) All equipment shall be supplied with necessary interpole cabling, and its cost shall be included in the cost of equipment.

### **3.5 ENGINEERING DATA**

#### **3.5.1 Drawings**

All drawings submitted by the supplier including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

The review of these data by the purchaser will cover only general conformance of the data to the specification and documents, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect substation layout.. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the purchaser shall not be considered by the contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the purchaser in writing.

### **3.5.2 Approval Procedure**

The following procedure for submission and review/approval of the drawings, data, reports, information, etc. shall be followed by Contractor:

- a. All data/information furnished by Vendor in the form of drawings, documents, catalogues or in any other form for NTPC's information/interface and/or review and approval are referred by the general term "drawings".
- b. The 'Master drawings list' shall be submitted for review and approval of Employer before award of contract. The Contractor shall have to prepare and submit any other drawings and reference documents in addition to the drawings contained in the list, if so required during engineering stage as felt necessary by the Employer. Number of copies of the list for the distribution shall be as mutually agreed between Contractor and Employer.
- c. All drawings (including those of subvendors') shall bear at the right hand bottom corner the 'title block' with all relevant information duly filled in. The format of title block shall approved by Engineer within thirty (30) days after the letter of award. The Contractor shall give this format to his subvendor along with his purchase order for subvendor's compliance. The size of title block basic format and its contents shall not be changed. All drawings shall be in English language. All dimensions shall be in metric units.
- d. Contractor shall submit all the drawings in five (5) copies for review of Employer. Employer shall forward their comments within four (4) weeks of receipt of drawings.
- e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

- f. Contractor shall resubmit the drawings approved under Category II and III within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.)
- g. In case Contractor does not agree with any specific comment, he shall furnish the explanation for the same to Employer consideration. In all such cases Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.
- h. It is the responsibility of the Contractor to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.
- i. Contractor shall not make any changes in the portion of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawings identifying the changes (alongwith reasons for changes) for Employer's review and approval.
  - i. Approval of drawings will not in any way relieve the Contractor of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.
  - j. The drawing approval progress report shall be submitted in at least three (3) copies within one (1) week from the last date of the every month.

**3.5.3 Erection Drawings.**

- a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.
- b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

**3.5.4 Instruction Manual**

- a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least thirty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, operation and maintenance procedures, etc. separately for each component/equipment alongwith log record format. These instruction manuals shall be submitted in five (5) copies for approval.
- b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall being corporated and the updated final instruction manuals shall be submitted .
- c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.
- d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets, drawings and list of parts with procedures for ordering spares. Maintenance instructions shall include charts showing lubrication, checking, testing and replacement procedure to be carried out daily, weekly, monthly and at longer intervals to ensure trouble free operation. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or breakdown. A collection of the manufacturer" standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

### **3.5.5 Final Submission of drawings and documents:**

The Contractor shall furnish the following after approval of all drawings /documents and test reports:

- a. List of drawings bearing the Employer's and Contractor's drawing number.
- b. Ten (10) bound sets alongwith 4 CD-ROMs of all drawing.
- c. All documents/designs in five (5) copies as noted above.
- d. Contractor shall also furnish nine (9) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish four (4) sets of film reproducibles or CD-ROMs of all as-built drawings as decided by the Employer.
- e. The Contractor shall also furnish eleven (11) copies of instruction manuals (after approval) for all the equipments.

### **3.5.6 TEST REPORTS**

Five (5) copies of all test reports shall be supplied for approval before shipment of equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval seven bound copies of all type and routine test reports shall be submitted to Employer.

### **3.6 MATERIAL /WORKMANSHIP**

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

### **3.7 LIMIT OF CONTRACT**

All the equipment, materials and services furnished by the manufacturer shall be complete in every respect with all mountings, fitting, fixtures and standard accessories normally provided with such equipment, and needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in technical specification and unless included in the list of exclusions. The manufacturer shall supply at no extra cost to Employer any additional material/service not

covered specifically but which are found to be required for fulfillment of the scope of work under specification.

### **3.8 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE**

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipment located in non-air-conditioned areas shall also be of same type.

#### **SPACE HEATERS**

The heaters shall be suitable for continuous operation at 230 V as supply voltage. On –off switch and fuse shall be provided.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

#### **FUNGI STATIC VARNISH**

Besides the space heaters, special moisture and fungus resistance varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

#### **Ventilation opening**

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

#### **Degree of Protection**

The enclosure of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

- a) Installed out door: IP- 55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area: IP-52
- d) Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41.
- e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS: 13947 (Part –I) / IEC-947 (Part-I) / IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

### **3.9 RATING PLATES, NAME PLATES AND LABELS**

- 3.9.1 The equipment nameplate should preferably be of stainless steel. In case of aluminium, it should be at least 2mm thick.. The inscription on the nameplate shall be engraved and no punching shall be accepted except for equipment serial number and year of manufacture. These nameplates shall be black with white engraved lettering.
- 3.9.2 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.
- 3.9.3 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.
- 3.9.4 Name plates of cubicles and panels may be made of non-rusting metal or 3 ply lamicaid.
- 3.9.5 Each switch shall a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.

### **3.10 GALVANISING :**

- 3.10.1 The galvanised surface shall consist of a continuous film adhering to the steel. The finished surface shall be clean and smooth, and shall be free from defects like dissolved patches, base, spot, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking or peeling off, etc. The presence of any of these defects shall render the material liable to rejection.
- 3.10.2 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, smooth continuous and free from acidspots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at Contractor's cost. The amount of zinc deposit shall be not less than 610 gms. per sq.m. of surface area and in addition, the thickness of zinc at any spot shall not be less than 85 microns. The Employer reserves the right to measure the thickness of zinc deposit by Elkometer or any other instrument acceptable to Employer and reject any component which shows thickness of zinc at any location less than 85 microns. The testing on the galvanised materials shall be carried out as per IS:2633.
- 3.10.3 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area. The threads

having extra deposit of zinc shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have minimum deposits of zinc on them as specified.

### **3.11 PAINTING**

The sheet steel to be painted shall be pretreated in tanks in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "class-C" as specified in IS:6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint on panels shall be applied. Electrostatic painting shall also be acceptable. Finishing paint on outside of the panels shall be as required otherwise by the Employer. The inside of the panels shall be glossy white. Each coat of finishing shall be properly stoved. The paint thickness shall not be less than 50 microns. Finished parts shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

### **3.12 QUALITY ASSURANCE PROGRAMME**

3.12.1 The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his subcontractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS- 14001.

A quality assurance programme of the contractor shall generally cover the following:

- i. His organisation structure for the management and implementation of the proposed quality assurance programme
- ii. Quality System Manual
- iii. Design Control System
- iv. Documentation Data Control System
- v. Qualification data for Bidder's key Personnel.
- vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- vii. System for shop manufacturing and site erection controls including process, fabrication and assembly.
- viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
- ix. Inspection and test procedure both for manufacture and field activities.
- x. Control of calibration and testing of measuring testing equipments.
- xi. System for Quality Audits.
- xii. System for identification and appraisal of inspection status.
- xiii. System for authorising release of manufactured product to the Employer.

- xiv. System for handling storage and delivery.
- xv. System for maintenance of records, and
- xvi. Furnishing quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

### **3.12.2 GENERAL REQUIREMENTS - QUALITY ASSURANCE**

3.12.2.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification.

This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.

3.12.2.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.

3.12.2.3 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control Organisation, during various stages of site activities starting from receipt of materials/equipment at site.

3.12.2.4 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans alongwith Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.

These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer alongwith technical justification for approval and dispositioning.

- 3.12.2.5 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of MDCC.
- 3.12.2.6 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 3.12.2.7 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
- 3.12.2.8 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
- 3.12.2.9 Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.
- 3.12.2.10 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with.
- 3.12.2.11 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 3.12.2.12 No welding shall be carried out on cast iron components for repair.
- 3.12.2.13 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 3.12.2.14 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.
- 3.12.2.15 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's

purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc..

Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders/contracts for such bought out items/components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor.

- 3.12.2.16 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their subvendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 3.12.2.17 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
- 3.12.2.18 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
- 3.12.2.19 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- 3.12.2.20 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
- 3.12.2.21 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment**
- a. All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from Manufacturing works, as per the following cycle.

b. Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

c. Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case the Contractor/ sub-contractor is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Contractor/ sub- contractor alongwith the statistical figures to validate the alternate procedure to be forwarded.

The Contractor/Sub-contractor shall carry out routine test on 100% item at contractor/sub-contractor's works. The quantum of check/test for routine & acceptance test by employer shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

### **3.12.3 QUALITY ASSURANCE DOCUMENTS**

3.12.3.1 The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (  ) mark within three weeks after despatch of the equipment. Typical contents of Quality Assurance Document is as below:-

- i) Quality Plan,
- ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) Factory test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- iv) Type test report(whenever applicable).
- v) Non-destructive examination results /reports including radiography interpretation reports.  
Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- vi) Heat Treatment Certificate/Record (Time- temperature Chart)
- vii) All the accepted Non-conformance Reports (Major/Minor) / deviation,

including complete technical details / repair procedure) Verification sketches, if used and methods used to verify that the inspection and testing points in the Quality Plan were performed satisfactorily

- viii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
- ix) Certificate of Conformance (COC) wherever applicable.
- x) MDCC

3.12.3.2 Similarly, the contractor shall be required to submit two hard copies and two sets on CD ROM of Quality Assurance Documents ( in line with above) pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

3.12.3.3 Due to the large variety of equipment items, it is always possible to adapt the content of the quality document to better match the particularities of any equipment. This shall be done in agreement with the Supplier and the Inspector. The Quality Document file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. Each quality document shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

3.12.3.4 Before shipping any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

- i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory. The Inspector shall stamp, the quality document ( or applicable section) for release.
- ii) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document ( or applicable section) is stamped by the Inspector.
- iii) If a decision is made to ship equipment, whereas all outstanding actions cannot be readily cleared for the release of the quality document by the time as per contract documents ( or finalization of the applicable section of the quality document within one month as per corresponding shipment date). The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status ( signed by the Supplier Representative) to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The final quality document will be compiled and issued at the final assembly place of equipment before shipment.

#### **3.12.4 TRANSMISSION OF QUALITY DOCUMENTS**

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer not later than 1 month after the delivery date for the corresponding equipment . One set of quality document shall be forwarded to

Corporate Quality Assurance Department and other set to respective Site .

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 1 month after the date of the last delivery similarly as stated above

### **3.13 TYPE TESTING , INSPECTION, TESTING & INSPECTION CERTIFICATE**

- 3.13.1 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.
- 3.13.2 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
- 3.13.3 The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
- 3.13.4 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 3.13.5 When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 3.13.6 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

- 3.13.7 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
- 3.13.8 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 3.03.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- 3.13.9 All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipments in the presence of Project Manager / Inspector.

### **3.14 PACKAGING & PROTECTION**

#### **3.14.1 Packing, Marking and shipping**

The packing and shipping shall be carried out in accordance with the standard practice of Contractor and with the following additional requirements:

- a. The equipment shall be prepared in such a manner as to protect the equipment from damage or deterioration during shipping or storage. The shipments can be exposed to heavy rains, hot sun, high humidity and sudden extreme changes of temperature. The equipment shall be packed and shipped so as to protect it from all such conditions and any other abnormal conditions, generally expected during shipping & storage.
- b. The metallic containers, if any, shall be considered as the property of the Contractor and he will be allowed to remove them from site once the contents are unpacked, inspected, documented and placed in temporary storage or in final position.
- c. The equipment shall be shipped in such a manner as to facilitate unloading, handling and storage enroute and at the site. The Contractor shall provide lifting lugs and special lifting devices for proper handling and erection.
- d. The Contractor shall be liable for any damage or loss resulting due to careless, improper, poor or insufficient packing and handling.
- e. Spare parts and spare equipment shall be packed separately in containers adequate for long term storage, plainly marked "Spare Parts Only". They shall be crated individually or in kits to be used in one single renewal or overhaul operation. Other spare part kits shall not be disturbed when using one set or kit.
- f. The Contractor shall at all times protect and preserve from damage, loss, corrosion and all other forms of damage, all parts of the works.

#### **3.14.2 Transportation**

- a. The Contractor shall make a careful examination of access rail/roadways to the site in order to confirm the practical maximum transport weight and dimensions as well as a careful examination of the ports of disembarkation particularly with respect to the capacity of the cranes installed and access roads.
- b. All instruments and computer/microprocessor based equipment imported into India from overseas for the purpose of this contract shall be air freighted

to the nearest possible point and further by rail/road taking due precautions as per manufacturer's recommendations. Employer shall have the right to decide the items that should be air freighted and Employer's decision shall be binding on Contractor

### **3.14.3 Insurance**

- a. The Contractor shall insure all shipments and works at his own expense for not less than the full replacement cost plus any additional cost for accelerated manufacturing of the replacement parts.
- b. Loss or the damage to equipment during shipping or transportation to the site(s) or otherwise shall not constitute grounds for claims for extension in time or for extra payment.

### **3.14.4 Storage of Equipment**

- a. The Contractor shall provide and construct adequate storage sheds for proper storage of equipment. Sensitive equipments shall be stored indoors. All equipment during storage shall be protected against damage due to act of nature or accidents. The storage instructions of the equipment manufacturers shall be strictly adhered to.
- b. The necessary transport packing shall be removed as soon as possible after receipt of equipment at the work site(s).

## **3.15 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS**

- 3.15.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC:137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5284. The support insulators shall be manufactured and tested as per IS:2544 / IEC 168/IEC 273. The insulators shall also conform to IEC 815 as applicable.  
Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- 3.15.2 Porcelain used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Hollow porcelain should be in one integral piece in green & fired stage.
- 3.15.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burns and other similar defects.
- 3.15.4 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or when operating at normal rated voltage.
- 3.15.5 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.


- 3.15.6 Contractor shall make available data on all the essential features of design including the method of assembly of shells and metal parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.
- 3.15.7 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.
- 3.15.8 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.
- 3.15.9 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued; porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.
- 3.15.10 Bushings, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/ sample test in accordance with relevant standards.
- 3.15.11 Insulator shall also meet requirement of IEC - 815 as applicable, having alternate long & short sheds.

**3.16 CORONA AND RIV TESTS AND SEISMIC WITHSTAND TEST:**


The corona (for 400kV only) and RIV tests shall confirm to the requirements as per **Annexure A** to this chapter. The seismic withstand test for 400kV shall conform to requirements as per **Annexure B** to this chapter.

**3.17 Enclosures:**

1. Annexure- A - CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST
2. Annexure- B - SEISMIC WITHSTAND TEST
3. Appendix -Q3 - Manufacturing Quality Plan
4. Appendix -Q4 - Endorsement sheet for QP
5. Appendix -Q5 - Field Quality plan
6. Annexure-J- Quality Assurance & Inspection (switchyard) -Module No. SQE 19

Clause No.	TECHNICAL REQUIREMENTS				
<b>ANNEXURE – A</b>					
<b>CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST</b>					
1.0	<b>General</b> Unless otherwise stipulated, all equipment together with its associated connectors where applicable shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and measurement of radio interference voltage ( RIV).				
2.0	<b>Test Levels</b> The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.				
3.0	<b>Test Methods for RIV:</b>				
3.1	RIV tests shall be made according to measuring circuit as per International Special – committee on Radio Interference ( CISPR) Publication 16 -1 ( 1993) Part – I. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The result shall be in microvolts.				
3.2	Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107 – 1964 except otherwise noted herein.				
3.3	In measurement of RIV temporary additional external corona shielding may be provided. In measurement of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.				
3.4	Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85% , 100%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 420 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.				
3.5	The metering instruments shall be as per CISPR recommendations or equivalent device so long as it has been used by other testing authorities.				
RIHAND STPP-III SWITCHYARD EXTN. PKG.	BID DOC. NO: CS-1240-572D-2	TECHNICAL SPECIFICATIONS	PART-II SECTION-VI	Page E0- 6 of 8	



<b>Clause No.</b>	<b>TECHNICAL REQUIREMENTS</b> 			
	<p style="text-align: right;"><b>ANNEXURE – B</b></p> <p><b>SEISMIC WITHSTAND TEST</b></p> <p>The seismic withstand test on the complete equipment (except BPI) shall be carried out along with supporting structure.</p> <p>The bidder shall arrange to transport the structure from his contractor's premises / owner's sites for purpose of seismic withstand test only.</p> <p>The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pad of the equipment and at any other point as agreed by the owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the purchaser.</p>			
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<b>PROJECT: 400/132kV Switchyard at Nabinagar STPP</b> <b>CUSTOMER: Nabinagar Power Generating Company Ltd.</b>	
<b>Technical Specification of Transmission Line Accessories</b> <b>Section-4: GTP</b>	<b>TB-350-316-028</b> <b>REV.00</b>

**SECTION 4**

**GUARANTEED TECHNICAL PARTICULARS**

**(To be submitted by the supplier at the contract execution stage)**

<b>PROJECT: 400/132kV Switchyard at Nabinagar STPP</b>	
<b>CUSTOMER: Nabinagar Power Generating Company Ltd.</b>	
<b>Technical Specification of Transmission Line Accessories</b>	<b>TB-350-316-028</b>
<b>Section-5: Quality Plan</b>	<b>REV.00</b>

**SECTION - 5**

**QUALITY PLAN**

Supplier shall follow valid approved Quality Plan of NTPC.