

**BHARAT HEAVY ELECTRICALS LTD.
(TRANSMISSION BUSINESS GROUP)
GENERAL TERMS AND CONDITIONS FOR TENDER ENQUIRY**

This Format is to be submitted in original duly signed and stamped 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 will not be accepted.

Sr. No	ENQUIRY NO. 224E227 DATED 07.02.2015 DUE ON 10.03.2015
1.	<p>1. Sealed bids are invited for the items mentioned in the enquiry conforming to specifications. Bids should be typed and free from over writing and erasures, corrections or additions must be clearly written both in words and figures and attested and otherwise offer may be liable for rejection.</p> <p>2. Bidder to ensure that quotation is received / dropped in the tender box on or before 14.00 Hrs. as per Indian standard time (IST) of the due date of opening in Material Management Division, Transmission Business Group, Tower-A, 5th Floor, Advant Navis IT Business Park Plot-7, Sector-142, Expressway Noida, Noida-201305, UP, India</p> <p>3. The tenders will be opened on due date at 14.30 Hrs. as per IST in the presence of participating vendors, who may like to be present. Tenders received late are liable for rejection. Vendors should ensure that an offer is delivered in time.</p> <p>4. Bids are to be submitted in Two parts: Part-I: Qualification Criteria/Technical / Commercial Bid (in two copies) Part-II: Price Bid Part-I Envelopes super scribed with Technical / Commercial Bid to contain information regarding, among others:</p> <ol style="list-style-type: none">1. Specification2. Deviations (if any) in deviation sheet of BHEL's Format.3. All commercial terms, Un-priced copy of Price Bid with units for measurement.4. Delivery terms & period required for supply from order, Filled in activity Schedule format5. Evidence for Qualification criteria. <p>Part-II Envelopes super scribed with Price Bid should contain priced copy of Price Bid. The price should be mentioned both in figures and words. Price bid containing any additional information is liable for rejection. In case of any difference between figures and words, the quoted rate in words will prevail over figure. If there is a calculation mistake in multiplication of unit rate with quantity, then the unit rate quoted will be considered for calculation.</p> <p>Both Part I and Part II bids are to be kept in separate envelopes 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>Note: 1 Representative deputed to witness tender opening must produce an authority letter from the signatory of offer at the time of tender opening.</p> <p>Note: 2 Authorized signatory should authenticate tender documents.</p> <p>Note: 3 The bid of bidder will be accepted subject to vendor approval by Customer. Vendor to submit the credentials with the enquiry along with the offer.</p>

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	<p>5. <u>For any Technical Clarification, please contact:</u> SHRI VIVEK KAPIL, Sr. MANAGER / TBEM BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION BUSINESS GROUP TOWER A, 5TH FLOOR, ADVANT NAVIS IT BUSINESS PARK, PLOT NO-7, SECTOR-142, EXPRESSWAY NOIDA, NOIDA-201305, DISTT- GAUTAM BUDH NAGAR, UP, INDIA Phone : 0120-06748539 / 9818080691 E-mail : vivekk@bhel.in</p> <p><u>For any Commercial Clarification, please contact:</u> SH. S.C. SHIVHARE, Sr. MGR.(TBMM) / SMT. ARCHANA KUMARI, Sr. ENGR. (TBMM) BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION BUSINESS GROUP TOWER A, 5TH FLOOR, ADVANT NAVIS IT BUSINESS PARK, PLOT NO-7, SECTOR-142, EXPRESSWAY NOIDA, NOIDA-201305, DISTT- GAUTAM BUDH NAGAR, UP, INDIA Phone : 0120-6748467 / 0120-6748471 Email: archanak@bhel.in / scshivhare@bhel.in</p> <p>6. Price bid should not contain any information / description / terms & condition other than given in Part-I of the bid except prices, otherwise bid is liable for rejection.</p> <p>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-drawl of quotation by the bidder, at any stage after its opening, may entail blacklisting of vendor.</p> <p>8. Authorized signatory should authenticate tender documents.</p>
2.	<p>PRICES:</p> <p>A. The prices to be quoted are with PVC with following formula.</p> $P_1 = P_0 \times \{0.85 + 0.15 (A_1/A_0)\} - P_0 + (M_1 - M_0)$ <p>Where,</p> <p>P_1 = Price adjustment amount per kilometer of cable (if it works out negative, that would mean the amount to be recovered by the owner from the contractor)</p> <p>P_0 = Ex-works price per kilometer of cable.</p> <p>A = PVC compound: Price of Grade CW-22, as published by IEEMA.</p> <p>M_1-M_0 = Change in metal components of the ex-works price of particular type and size of cable.</p> <p>M = Weight in MT of metal per km of cable X published price index of metal per MT as published by IEEMA.</p> <p>Published price Index for metal:</p> <p>i) For Aluminium: Price of LME Average Settlement Price including Premium for Ingot, as published by IEEMA.</p>

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<p style="text-align: center;">ii) For Copper: Price of copper wire rods, as published by IEEMA.</p> <p>Weight in MT of metal per km of cable and price index of metal per MT: As per IEEMA Circulars.</p> <p>Subscript `0` refers to base indices as on 30 days prior to date of bid opening. The base indices in the formula shall be of first notification of IEEMA of the FEB 2015 month.</p> <p>Subscript `1` refers to indices as applicable on 60 (sixty) days prior to the date of shipment.</p> <p>The date of delivery shall be PO delivery date or date of actual despatch, whichever is earlier.</p> <p>The total adjustment shall be subject to a ceiling of $\pm 20\%$ (plus or minus twenty percent).</p> <p>B. The prices shall be quoted by the vendors considering following</p> <p><u>For Foreign Bidder:</u></p> <p>The break-up of the prices shall be as mentioned in the schedule of price format.</p> <ul style="list-style-type: none"> i. FOB / CIF (Port of loading) including sea worthy packing & forwarding charges. ii. Marine Freight. From load port to discharge port iii. Insurance.do..... iv. Vendor to mention Port of Loading (.....) v. Destination Port (Mumbai) <p>Foreign vendors to quote Freight & Insurance charges from port of loading to port of discharge (Mumbai). However, in case of insurance by foreign vendor, the beneficiary shall be BHEL only.</p> <p><i>Loading shall be done on foreign vendors for Custom Clearance charges as well as Custom Duty at Port and for transportation from Port of Discharge to site including insurance and all other associated Charges, Taxes & duties involved till delivery of goods at site. However, foreign vendor can also quote for inland transport (From Mumbai Port to Site).</i></p> <p>Type Test charges: As per technical specification enclosed with this Enquiry.</p> <p><u>For evaluation purpose:</u></p> <p>Price quoted in any currency will be converted to Indian rupee at the TT Selling Rate of SBI in India on the date of Techno – Commercial Bid opening.</p> <p><u>For Indigenous bidder:</u></p> <p>The prices are to be quoted on FOR (Destination) basis. The break-up of price shall be as under:-</p> <ul style="list-style-type: none"> a) Ex-works Price: Ex- works price including packing & forwarding charges. b) Excise duty: ED as applicable is to be quoted as percentage in both un-price and price bid. c) Sales Tax: 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 	

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	<p>E1/E2 form.</p> <p>d) Entry tax / Octroi Charges: Any Entry tax / Octroi applicable at destination / destination state shall be paid extra on proof of such payment.</p> <p>e) Freight & Insurance: Freight and Transit Insurance for door delivery up to destination/store is to be quoted.</p> <p>f) Type Test charges: As per technical specification enclosed with this Enquiry.</p> <p>Note: The purchase order shall be placed on Ex- Works basis for Indian Vendor.</p> <p>For overseas Vendor, the order is proposed to be placed on CIF basis. However, BHEL reserves the right to convert the order on FOB also. The evaluation of bids shall be done on delivered cost to BHEL, in such case the F & I charges from discharge port to site shall be loaded on CIF value quoted by the overseas vendors.</p> <p>“BHEL reserves the right to go for Reverse Auction (RA) instead of opening the sealed envelope price bid, submitted by the bidder. This will be decided after techno-commercial evaluation. All bidders to give their acceptance for participation in RA. Non-acceptance to participate in RA may result in non-consideration of their bids, in case BHEL decides to go for RA.</p> <p>In case BHEL decides to go for Reverse Auction, only those bidders who have given their acceptance to participate in RA will be allowed to participate in the Reverse Auction. Those bidders who have given their acceptance to participate in Reverse Auction will have to necessarily submit ‘online sealed bid’ in the Reverse Auction. Non-submission of ‘online sealed bid’ by the bidder will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines in vogue.” (Further to above clause, please refer attached Annexure I for Terms & Conditions Of Reverse Auction Page 1 & 2)</p>
3.	<p><u>TERMS OF PAYMENT:- For Overseas Vendors:</u></p> <p><u>FOR SUPPLY PORTION:-</u></p> <p>i) By irrevocable LC (With Usance Period of 60 days, to be counted from the date of presentation of documents in LC opening bank) which will be opened after placement of order and receipt of performance bank guarantee for 10% of order value. All bank charges to supplier’s account.</p> <p>90% against original invoice, original bill of lading, packing list, MICC (dispatch clearance given by BHEL), guarantee certificate, transit insurance certificate, certificate of origin.</p> <p>ii) “10% direct payment within 60 days from the date of confirmation of material receipt by BHEL Site and against submission of invoice to BHEL TBG.”</p> <p>NOTE: In regards LC Payment, please note that all bank charges are in beneficiary account. Period of presentation should be 7-10 working days from the date of shipment / invoice whichever is later. However, documents must reach LC opening bank within 21 days of date of B / L.</p> <p><u>TERMS OF PAYMENT:- For Indian Vendors:</u></p>

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	<p>100 % Payment with Taxes, Duties, Freight & Insurance within 60 days (45 Days for MSE vendor) from the date of receipt of complete invoice with following documents in 3 sets (Original + 2 copies):</p> <ul style="list-style-type: none"> - LR duly endorsed in the name of customer by BHEL site - Receipt of material on the attached format by BHEL site - Excise invoice (If Applicable) - Delivery Challan or Packing list (case wise) - Transit insurance certificate from under writers or Copy of Intimation of Transit Insurance duly endorsed by under writers - MICC - Guarantee Certificate - Copy of Performance Bank Guarantee. <p>[A.] Documents to be furnished by vendor immediately after dispatch:</p> <ul style="list-style-type: none"> - Copy of Invoice - Copy of LR - Copy of Delivery Challan / Packing List - Copy of Insurance Certificate - Copy of Guarantee Certificate <p>[B.] Following Documents to be sent by vendor to TBG, BHEL :</p> <ul style="list-style-type: none"> - LR duly endorsed in the name of customer by BHEL site - Receipt of material on the attached format by BHEL site - Excise invoice (If Applicable) - Delivery Challan / Packing list (case wise) - Transit insurance certificate from under writers or Copy of Intimation of Transit Insurance duly endorsed by under writers - Dispatch Clearance / MICC - Guarantee certificate - All Test & Inspection Reports
4.	<p>INTEREST LIABILITY: In case of any delay in payment due to any reason, BHEL shall not pay any interest on delayed payment.</p>
5.	<p>GUARANTEE : The equipment / material shall be guaranteed for 18 months from the date of delivery or 12 months from the date of commissioning, whichever is earlier. The defective material / component shall be replaced free of cost at site.</p>
6.	<p>PERFORMANCE BANK GUARANTEE: <u>OPTION -A</u></p> <p>For Overseas Vendors: In the event of an order, tenderer shall furnish BG towards Security Cum Performance for 10% of total value of P.O. within two weeks of placement of P.O. valid till 60 days beyond the guarantee period, from any schedule bank subject to acceptance by TBG/BHEL Finance</p> <p>For Indian Vendors: Bidder shall furnish along with first invoice Performance BG / deposit as per following options.</p> <p>BG for 10% of the total Ex-works PO value, initially valid for 18 months + 3 months claim period (i. e. total 21 months) from the date of last delivery</p> <p>In case BG period is expiring before expiry of Guarantee Period, vendor</p>

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	<p>(applicable for both Indian as well overseas vendors) will have to keep the BG extended suitably till the end of Guarantee Period. In case of foreign vendors, BG will be required to be submitted before opening of L/C.</p> <p>All the Bank Guarantee shall be from a scheduled bank in India acceptable to BHEL. The original BG should be sent by issuing bank directly to AGM (Finance), TBG, BHEL, Noida. BANK Guarantee should be valid for lodging claim within two months after expiry of guarantee period.</p> <p><u>OPTION-B(Applicable for Indian as well as Overseas Vendors)</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 Guarantee Period.</p> <p>If no option is specified, by default option – A shall be considered for confirmation</p>
7.	FINAL ENGINEERING DOCUMENTATION: Final documentation as called in the specification is to be submitted within 3 months from the date of despatch of material. In case of default, the Performance BG is liable to be en-cashed.
8.	INSPECTION: BHEL and / or customer / third party may inspect the Equipment / Material before despatch. In the event BHEL / Customer waives off inspection, Test Reports and Results shall be submitted for Approval. Supplier shall obtain Approval on Test Reports and MDCC / MICC (Material Inspection Clearance Certificate) before dispatch of equipment. Stage inspection during manufacturing may also be carried out. Material to be dispatched only after getting Dispatch Clearance from BHEL. Supplier shall send inspection call on prescribed format only, with an advance notice of 15 days. (New Format of Inspection Call attached with this Enquiry).
9.	DESPATCH DOCUMENTS: Following despatch documents are to be immediately sent to purchaser on despatch. - Copy of Invoice - Copy of LR - Copy of Delivery Challan / Packing List - Copy of Insurance Certificate - Copy of Guarantee Certificate For Overseas Vendors: Dispatch documents (Negotiable documents) shall normally comprise Original Invoice, Bill of Lading, Shipping / Packing lists (case wise), Certificate of country of origin, Material Inspection Clearance certificate (MICC), Test Certificates & approval of acceptance & routine test certificates, Insurance certificate and manufacturer's guarantee certificate.
10.	DELIVERY PERIOD: Bidder to specify the delivery period in weeks from the date of PO in the Activity Schedule Format enclosed with enquiry. Time for conduction of type test, if required, is to be separately indicated. Note: LR/BL date or Invoice date whichever is later shall be considered as delivery date.
11.	DELAYED DELIVERY: In case of delay in execution of order beyond the lot wise contractual delivery, an amount of ½ % of total Ex-Works Value per week or part there-of subject to maximum of 10% of total Ex-Works value of P.O. will be levied.
12.	VALIDITY: The offer shall be valid for 120 days from the due date of opening.
13.	ACCEPTANCE / REJECTION OF TENDER: BHEL reserves the right to reject in full or part, any or all tender without assigning any reason thereof. BHEL also reserves right to vary the quantities mentioned in the tender.
14.	EVALUATION: Comparative statement shall be prepared based on overall

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	quantity basis unless otherwise indicated in the enquiry. Evaluation of offers shall be done on the basis of delivered cost to BHEL.
15.	DEVIATION: 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 as mentioned at Sl. No. - 24.
16.	<p><u>ARBITRATION:</u></p> <p>All cases of disputes emanating from and relating to this contract shall be referred to the sole arbitrator appointed by Unit Head / GM, BHEL. The arbitrator may be an employee of BHEL whether serving or retired or any other person nominated by Unit Head/GM BHEL. The arbitration shall be in accordance with 'The Arbitration and Conciliation Act 1996' and the rules there under as amended from time to time. The arbitrator shall give a reasoned award. The decision of the arbitrator shall be final & binding upon both the parties.</p> <p>The venue of arbitration shall be Delhi.</p>
17.	<p><u>LEGAL SETTLEMENT:</u> All disputes shall be subject to jurisdiction of court situated in Delhi/New Delhi only.</p> <p>Notwithstanding contained herein anything in this NIT, the original exclusive jurisdiction shall remain of the court at Delhi / New Delhi.</p>
18.	SUBCONTRACTING: In case further subcontracting of BHEL order or part thereof is envisaged by supplier, the same can be done after written permission is obtained from BHEL. However it shall not absolve the supplier of the responsibility of fulfilling BHEL purchase order requirements.
19.	<p><u>RISK PURCHASE:</u></p> <p>In case the successful bidder fails to supply or fails to comply with the terms & conditions of the purchase order, BHEL reserves the right to source such material/ component / equipment/ system from any other agency at the risk and cost of the successful bidder.</p>
20.	ADJUSTMENT OF RECOVERY: Any amount payable by the supplier under any of the condition of this contract shall be liable to be adjusted against any amount payable to the supplier under any other works/contract awarded to him by any BHEL unit. This is without prejudice to any other action as may be deemed fit by BHEL.
21.	<p><u>FORCE MAJEURE CONDITION:</u></p> <p>Force Majeure will mean: Circumstances beyond the control of contracting parties such as but not limited to act of God, natural catastrophes, fire, war, embargo, industrial dispute, riot, civil commotion, restrictions etc. Vendors willing to plead force majeure shall inform its effect on fulfilment of contract and shall not be held responsible for non performance in such circumstances.</p>
22.	<p><u>DEMURRAGE / WHARFAGE:</u></p> <p>For the reasons of delay in receipt of documents from suppliers or due to the same being found to be incomplete, and/or faulty, the suppliers shall be responsible to reimburse in all demurrages / wharfages, if any, paid by BHEL (for stated reasons).</p>
23.	<p><u>SPECIAL CONDITION:</u></p> <p>Procurement will be from manufacturers only. Manufacturers should submit offers directly. However in case of involvement of any representative the details of the same along with the copy of the agreement should be submitted in the first part of the offer. Principal manufactures must ensure that the nominated representative do not represent any other manufacture for the same item.</p>
24.	<p>LOADING CRITERIA FOR DEVIATIONS TAKEN BY BIDDER ON:</p> <p>24.1 : TERMS OF PAYMENT:</p> <p>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,</p>

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	<p>loading to be done as follows:</p> <p>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.</p> <p>b) 60 days - No loading</p> <p>24.2 : <u>DELAYED DELIVERY / PENALTY DUE TO DELAYED DELIVERY:</u> Loading for not accepting this clause / accepting only on un delivered portion shall be the maximum amount specified in this clause.</p> <p>24.3 <u>GUARANTEE:</u> 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)</p>
25.	<p>“MSE suppliers can avail the intended benefits only if they submit along with the offer, attested copies of either EM II certificate having deemed validity (five years from the date of issue of acknowledgement in EM II) or valid NSIC certificate or EM II certificate along with attested copy of a CA certificate (Format enclosed at Annexure -1 where deemed validity of EM II certificate of five years has expired) applicable for the relevant financial year (latest audited). Date to be reckoned for determining the deemed validity will be the date of bid opening (Part 1 in case of two part bid). Non submission of such documents will lead to consideration of their bid at par with other bidders. No benefit shall be applicable for this enquiry if any deficiency in the above required documents are not submitted before price bid opening. If the tender is to be submitted through e-procurement portal, then the above required documents are to be uploaded on the portal. Documents should be notarized or attested by a Gazetted officer. “</p>
26.	<p>The manufacturer's must have valid MQP No. Approved from M/s PGCIL. Bidders to furnish Documentary Evidence for Valid PGCIL MQP along with their offers.</p>
27.	<p><u>Consignee Address:</u></p> <p>General Manager / Powergrid / HVDC +/- 800 KV, 6000 MW HVDC Multi Terminal NER / ER Interconnector – I 12.6 KM, Mile Stone on Shamshabad Road, P.O. Shyamo, Agra (UP) Pin : 282003</p>
28.	<p><u>CONVERSION TO SINGLE CURRENCY:</u></p> <p>Prices expressed in currency other than Indian Rupee will be converted to Indian Rupee at the exchange rate (TT selling rate of State Bank of India) on the due date of submission of offer for the purpose of evaluation.</p>
29.	<p><u>Instructions for OEM:</u> Procurement directly from the manufacturers / suppliers shall be preferred. However, if the OEM / Principal insist on engaging the services of an agent, such agent shall not be allowed to represent more than one manufacture / supplier. Moreover, either the agent could bid on behalf of the manufacture / supplier or the manufacture / supplier could bid directly but not both. In case, bids are received from both the manufacture / supplier and the agent, bid received from the agent shall be ignored. Guarantee Certificate should be from OEM only.</p>

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30.	<p><u>INTEGRITY PACT :</u></p> <p>The Integrity Pact shall be issued as part of the bidding documents and shall be returned by the bidder along with the techno-commercial bid, duly signed by the authorized official of the bidder/ vendor/ contractor and authorized official of BHEL will form part of the Purchase order/ contract.</p> <p>Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words entering into this pact would be a preliminary qualification.</p> <p><u>Name of Independent External monitor to be considered (IEM):</u></p> <table border="1" data-bbox="363 527 1354 764"> <tr> <td data-bbox="363 527 906 764">1.1 kV Auxiliary Power & Control Cables</td> <td data-bbox="906 527 1354 764"> Shri D.R.S Chaudhary, IAS (Retd.) Flat No. L-202 & L-203 (1st Floor) Ansal Lake View Enclave Shamla Hills Bhopal- 462 013 Ph: +91 755 -4050495 Email: dilip.chaudhary@icloud.com </td> </tr> </table>	1.1 kV Auxiliary Power & Control Cables	Shri D.R.S Chaudhary, IAS (Retd.) Flat No. L-202 & L-203 (1st Floor) Ansal Lake View Enclave Shamla Hills Bhopal- 462 013 Ph: +91 755 -4050495 Email: dilip.chaudhary@icloud.com
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31.	<p><u>Pre qualifying criteria</u></p> <p>The bidder shall meet the following requirement</p> <ol style="list-style-type: none"> 1. The bidder should have Powergrid approved MQP (Manufacturing Quality Plan). In case the bidders does not have Powergrid approved MQP, the same shall be got approved by the bidder before price bid opening. 2. The manufacturer should have experience of designing, manufacturing, testing and supplying 1.1kV grade Power and control cables for at least 5 years as on date of bid opening. 3. The manufacturer should have designed, manufactured, tested and supplied <ol style="list-style-type: none"> a. Atleast 500km of 1.1kV grade Power and control cables in any one year in last 5 years as on date of bid opening. b. In a single contract at least 50 Kms of 1.1 KV grade PVC insulated control cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 19C x 2.5 Sq.mm or higher size in a single contract as on the date of bid opening. c. In a single contract at least 50 Kms of PVC insulated screened control cables as on the date of bid opening. d. In a single contract atleast 50 Kms of 1.1 KV or higher grade PVC insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 150 Sq. mm or higher size in a single contract as on the date of bid opening. e. In a single contract atleast 25 Kms of 1.1 KV or higher grade XLPE insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 630 Sq. mm or higher size in a single contract as on the date of bid opening. 		

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	<u>The Bidder must ensure that they confirm the Pre qualifying criteria and the necessary documentation in this regard would be provided by Bidder to BHEL along with their offer for ascertaining that they confirm the Pre qualifying criteria. BHEL Reserves the Right to reject any offer from Bidder in case of Non – Compliance to the Pre qualifying criteria or inability of Bidder to produce the necessary documentation for ascertaining that they confirm the Pre qualifying criteria.</u>

Signature of Bidder
Seal

Terms & Conditions of Reverse Auction

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

1. For the proposed reverse auction, technically and commercially acceptable bidders only shall be eligible to participate.
2. Those bidders who have given their acceptance for Reverse Auction (quoted against this tender enquiry) will have to necessarily submit 'online sealed bid' in the Reverse Auction. Non-submission of 'online sealed bid' by the bidder for any of the eligible items for which techno-commercially qualified, will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines in vogue.
3. BHEL will engage the services of a service provider who will provide all necessary training and assistance before commencement of on line bidding on internet.
4. In case of reverse auction, BHEL will inform the bidders the details of Service Provider to enable them to contact & get trained.
5. Business rules like event date, time, bid decrement, extension etc. also will be communicated through service provider for compliance.
6. Bidders have to fax the Compliance form (annexure IV) before start of Reverse auction. Without this, the bidder will not be eligible to participate in the event.
7. In line with the NIT terms, BHEL will provide the calculation sheet (e.g., EXCEL sheet) which will help to arrive at “Total Cost to BHEL” like Packing & forwarding charges, Taxes and Duties, Freight charges, Insurance, Service Tax for Services and loading factors (for non-compliance to BHEL standard Commercial terms & conditions) for each of the bidder to enable them to fill-in the price and keep it ready for keying in during the Auction.
8. Reverse auction will be conducted on scheduled date & time.
9. At the end of Reverse Auction event, the lowest bidder value will be known on auction portal.

10. The lowest bidder has to fax/e-mail the duly signed and filled-in prescribed format for price breakup including that of line items, if required, (Annexure VII) as provided on case-to-case basis to Service provider within two working days of Auction without fail.
11. In case BHEL decides not to go for Reverse Auction procedure for this tender enquiry, the Price bids and price impacts, if any, already submitted and available with BHEL shall be opened as per BHEL's standard practice.
12. Bidders shall be required to read the "Terms and Conditions" section of the auctions site of Service provider, using the Login IDs and passwords given to them by the service provider before reverse auction event. Bidders should acquaint themselves of the 'Business Rules of Reverse Auction', which will be communicated before the Reverse Auction.
13. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action *as per extant BHEL guidelines*, shall be initiated by BHEL and the results of the RA scrapped/ aborted.
14. The Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party.
15. In case BHEL decides to go for reverse auction, the H1 bidder (whose quote is highest in online sealed bid) may not be allowed to participate in further RA process.

UNDERTAKING by Vendors/Contractors for HVDC-NE AGRA project

(± 800kV, 6000MW HVDC Multi Terminal System Package associated with North East/Eastern Region – Northern / Western Region Interconnector – I Project (C-61901R-S056-8))

- a) Bribery and Corruption**-- We represent and warrant that we will not directly or indirectly make any payment, gift or other commitment to BHEL, to government officials or to agents, directors and employees of BHEL, ABB, POWERGRID or any other party associated with this project in a manner contrary to applicable laws and shall comply with all relevant laws, regulations, ordinances and rules regarding bribery and corruption.
- b) Confidentiality**-- We undertake to keep confidential all written and verbal information received from BHEL /POWERGRID in connection with this project. Further, we undertake that the written and verbal information (data, drawings etc) received from BHEL in connection to this project shall not be used for any purpose other than for the purpose of supply or services for this project for which it is intended.

The above undertaking does not however apply to the information which -

- through no fault of receiving Party, is or comes in public domain through publication or otherwise, or
- the receiving Party can establish that the information was in its possession, without any restrictions to its disclosure, at the time of its receipt.
- is subsequently lawfully acquired by the receiving Party independent of this project
- receiving Party is required to disclose to comply with applicable law, rule, regulation or court order or other Compulsory process of a court or other government body.

We understand that in the event of non-compliance of clauses a) and / or b) above, M/s BHEL reserves the right to terminate the Purchase Order / Contract Agreement placed on us for the above package after due notice and forfeit Security Deposit, black list or debar us from any contract with your organization for the period as deemed fit by BHEL and recover the loss, damages, cost of expenses incurred in getting the balance work/balance supplies done through other agencies. We also understand unambiguously that we will require all our sub-vendors and sub-contractors for this project (as applicable) to strictly adhere to these provisions.

Place **(Authorized Signatory of Vendor / Contractor with Seal)**

“In the name and on behalf of the Company’s CEO”

Date

BHEL UN-PRICE BID FORMAT

Enquiry No: 224E227 dated 07.02.2015
 Project: PGCIL NE AGRA HVDC
 Item: 1.1 kV Aux. Power & Control Cable

S.N	PI-ITEM	Unit	Qty	Currency	M Factor for PVC Calculation	Unit Ex-works/ FOB	Total Ex-works/ FOB	Unit marine freight & Insurance	Total Marine Freight & Insurance	Unit Inland F & I Charges	Total Inland F & I Charges	Excise Duty (ED)	Central Sales Tax (CST)	Total Cost to BHEL for indian supplier for each line item	CIF Value + Inland F & I (if opted by foreign bidder)			
Instruction to bidder----->								1. Applicable only for foreign bidder. 2. Quoted prices of marine freight & insurance is inclusive of all taxes & duties		Quoted prices of inland freight & insurance is inclusive of all taxes & duties		Bidder to indicate Percentage and Value of Excise Duty for each item		Bidder to indicate Percentage and Value of Central Sales Tax for each item		Bidder to indicate prices in price bid of BHEL's Format & mention QUOTED / NOT QUOTED OR NOT APPLICABLE of each & every cell		
Applicable formula to bidder----->			(0)			(1)	(2) = (1) X (0)	(3)	(4) = (3) X (0)	(5)	(6) = (5) X (0)	(7) = (...%) X (2)	(8) [Value]	(9) = ((2) + (8)) X ...%	(10) [value]	(11) = [(2)+(6) + (8) + (10)] [EX-WORKS+ INLAND F & I + ED + CST]	[(12)=(2)+ (4) + (6)] FOB+ SEA F & I + INLAND F & I]	
1	1.1kV Aux Power Cables: 2C x 6sqmm PVC / Aluminium	Meter	15500															
2	1.1kV Aux Power Cables: 4C x 6sqmm PVC / Aluminium	Meter	25000															
3	1.1kV Aux Power Cables: 2C x 10sqmm PVC / Aluminium	Meter	17500															
4	1.1kV Aux Power Cables: 2C x 70sqmm PVC / Aluminium	Meter	3500															
5	1.1kV Aux Power Cables: 2C x 95sqmm PVC / Aluminium	Meter	2400															
6	1.1kV Aux Power Cables: 2C x 120sqmm PVC / Aluminium	Meter	1500															
7	1.1kV Aux Power Cables: 4C x 16sqmm PVC / Aluminium	Meter	29500															
8	1.1kV Aux Power Cables: 3.5C x 35sqmm PVC / Aluminium	Meter	29500															
9	1.1kV Aux Power Cables: 3.5C x 70sqmm PVC / Aluminium	Meter	10000															
10	1.1kV Aux Power Cables: 3.5C x 95sqmm PVC / Aluminium	Meter	7900															
11	1.1kV Aux Power Cables: 3.5C x 120sqmm PVC / Aluminium	Meter	3900															
12	1.1kV Aux Power Cables: 3.5C x 150sqmm PVC / Aluminium	Meter	7500															
13	1.1kV Aux Power Cables: 3.5C x 185sqmm PVC / Aluminium	Meter	9100															
14	1.1kV Aux Power Cables: 1C x 150sqmm PVC / Aluminium	Meter	2500															
15	1.1kV Aux Power Cables: 3.5C x 240sqmm XLPE / Aluminium	Meter	3000															
16	1.1kV Aux Power Cables: 3.5C x 400sqmm XLPE / Aluminium	Meter	4500															
17	1.1kV Aux Power Cables: 1C x 630sqmm XLPE / Aluminium	Meter	46000															
18	1.1kV Control Cables: 2C x 2.5sqmm PVC / Copper	Meter	6000															
19	1.1kV Control Cables: 3C x 2.5sqmm PVC / Copper	Meter	56000															
20	1.1kV Control Cables: 5C x 2.5sqmm PVC / Copper	Meter	65500															
21	1.1kV Control Cables: 7C x 2.5sqmm PVC / Copper	Meter	18000															
22	1.1kV Control Cables: 10C x 2.5sqmm PVC / Copper	Meter	0															
23	1.1kV Control Cables: 14C x 2.5sqmm PVC / Copper	Meter	26000															
24	1.1kV Control Cables: 19C x 2.5sqmm PVC / Copper	Meter	12000															
25	1.1kV Control Cables: 4C x 4sqmm PVC / Copper	Meter	500															
A	Total Ex-works / FOB =																	
B	Total Sea freight & Insurance =																	
C	Total Inland freight & insurance charges =																	
D	Total Excise Duty =																	
E	Total central sales taxes =																	
	Total cost to BHEL for Indian supplier in Indian Currency (A + C + D + E)=																	
	CIF Value + Inland F & I (if opted by foreign bidder) (A + B + C) =																	

Note:

1. Each cell to be filled by bidder in the price bid. In case that cell is not applicable as per NIT condition, NA must be mentioned in UN-PRICED BID.
2. In UN-PRICED, Bidder to indicated QUOTED in placed of price. NA in placed of not applicable. For example Marine freight & insurance charges-Not applicable in case of indian supplier.
3. Bidder stickly to quote in BHEL format only. Other format of price bid will be liable for rejection.

**TRANSMISSION BUSSINESS GROUP
MATERIAL MANGEMENT
BHEL, NOIDA**

ACTIVITY SCHEDULE

Please submit this format duly filled in along with offer. Time indicated will be used for calculating contractual delivery period.

ENQUIRY NO. 224E227

Dated: 07.02.2015

PROJECT: PGCIL NE AGRA HVDC

ITEM: 1.1 kV AUXILIARY POWER & CONTROL CABLE

VENDOR :

OFFER REF.

SL. NO.	ACTIVITY	ACTIVITY TIME IN WEEKS	REMARKS IF ANY
1.	Receipt of P.O		
2.	P.O Acceptance	ONE WEEK	Vendor must Submit Po acceptance with in one week
3.	Submission of documents necessary for getting manufacturing clearance like Drawings, data sheet etc.		Documents complete in all respect are to be Submitted. Delay in approval on account of incomplete / inadequate information shall be the responsibility of supplier
4.	Review and Approval of documents and issue of manufacturing clearance	BHEL ACTIVITY	Vendor must ensure to reply all queries expeditiously.
5.	Manufacturing Time		Manufacturing time be indicated considering all constrains & must include time required for internal inspections etc.
6	Raise inspection call	-VE 2 WEEKS TO SL NO 5	Call for inspection must be raised at least two weeks in advance in the prescribed format. Non availability of offered material for inspection to the inspector will be viewed very seriously & may result in financial implications. The date of inspection must be with in the period indicated in 5 above.
7	Inspection	BHEL	
8	Issue of MICC, MDCC & other documents like EDEC , Road permits etc	BHEL	Vendor must indicate requirement well in advance.
9	Dispatch	ONE WEEK	Vendor must ensure to dispatch with in one Week of receiving all documents required

Total time in vendor's scope:

Please mention constraints if any. For multiple lot delivery activity landmark for each lot should be mentioned. Multiple inspection calls for one lot are to be avoided & delay on this account shall be vendor's responsibility. Vendors to quote their Best Delivery Plan.

SIGNATURE AND SEAL

SCHEDULE OF COMMERCIAL DEVIATION

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

SL. NO.	CLAUSE NO. OF GENERAL TERMS & CONDITIONS	STATEMENT OF DEVIATION

Incase, 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 schedule.

Place

Signature of the authorized representative of

Date

Bidder's Name

Designation

Company seal

SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations / variations exception from the Technical Specifications:-

SL. NO.	CLAUSE NO. OF TECHNICAL SPECIFICATIONS	STATEMENT OF DEVIATION

Incase, 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 Technical Specifications.

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

NOTE: Continuation sheets of like size and format may be used as per the Bidder's requirement and shall be annexed to this schedule.

Place

Signature of the authorized representative of

Date

Bidder's Name

Designation

Company seal

CHECKLIST**SCHEDULE OF INFORMATION TO BE FURNISHED WITH THE OFFER**

NOTE: This format is to be submitted in original only, duly filled in. Reproduction of this format on bidder's letter head or on other paper is not acceptable.

Put a tick mark on "YES" if the information is enclosed with the offer or put a tick mark on "NO" if the information is not enclosed or write "NOT APPLICABLE" if the information is not applicable.

1.	Technical offer with detailed schedule of equipment / material and spares enclosed.	YES / NO
2.	Guaranteed Technical Particulars as per Section – 4 enclosed.	YES / NO
3.	Schedule of deviation, if any, clause wise with respect to Technical Specification enclosed.	YES / NO
4.	Standard Manufacturing Quality Plan enclosed.	YES / NO
5.	GA Drawings with dimensions and weights & foundation / fixing details enclosed.	YES / NO
6.	Drawing and Data submission schedule enclosed.	YES / NO
7.	Type Test Reports enclosed.	YES / NO
8.	Bar Chart showing the schedule indicating time required for design, manufacture, test and inspection, transport, erection, site testing and commissioning enclosed.	YES / NO
9.	Makes of all components as per technical Specification enclosed.	YES / NO
10.	Schedule of commercial deviation exception from the General Terms and Conditions	YES / NO

The above checklist is verified for:-

Offer Ref. :
 Equipment :
 Submitted by : M/s
 Project Reference. :

Signed with Seal

Date

INTEGRITY PACT

Between

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

and

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

Preamble

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

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

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

Section 1 – Commitments of the Principal

- 1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-
 - 1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
 - 1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.
 - 1.1.3 The Principal will exclude from the process all known prejudiced persons.
- 1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.

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

- 2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.
 - 2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved

in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he / she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

- 2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.
- 2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant IPC/ PC Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
- 2.1.4 The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.
- 2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

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

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

Section 4 – Compensation for Damages

- 4.1 If the Principal has disqualified the Bidder from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent Earnest Money Deposit/Bid Security.
- 4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/Performance Bank Guarantee, whichever is higher.

Section 5 – Previous Transgression

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

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

- 6.1 The Bidder(s)/ Contractor(s) undertake(s) to obtain from all subcontractors a commitment consistent with this Integrity Pact and report Compliance to the Principal. This commitment shall be taken only from those sub-contractors whose contract value is more than 20 % of Bidder's/ Contractor's contract value with the Principal. The Bidder(s)/ Contractor(s) shall continue to remain responsible for any default by his Sub-contractor(s).
- 6.2 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors.
- 6.3 The Principal will disqualify from the tender process all bidders who do not sign this pact or violate its provisions.

Section 7 – Criminal Charges against violating Bidders/ Contractors /Sub-contractors

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

Section 8 –Independent External Monitor(s)

- 8.1 The Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.

- 8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.
- 8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality.
- 8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.
- 8.5 As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or take corrective action, or heal the situation, or to take other relevant action. The Monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.
- 8.6 The Monitor will submit a written report to the CMD, BHEL within 8 to 10 weeks from the date of reference or intimation to him by the Principal and, should the occasion arise, submit proposals for correcting problematic situations.
- 8.7 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.
- 8.8 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant IPC / PC Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the

Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

8.9 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.

8.10 The word 'Monitor' would include both singular and plural.

Section 9 – Pact Duration

9.1 This Pact begins and shall be binding on and from the submission of bid(s) by bidder(s). It expires for the Contractor 12 months after the last payment under the respective contract and for all other Bidders 6 months after the contract has been awarded.

9.2 If any claim is made / lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified as above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 – Other Provisions

10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.

10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.

10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

10.5 Only those bidders/ contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.

For & On behalf of the Principal

For & On behalf of the Bidder/ Contractor

(Office Seal)

(Office Seal)

Place-----

Date-----

Witness: _____

Witness: _____

(Name & Address) _____

(Name & Address) _____



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP
MATERIAL RECEIPT CERTIFICATE

Date: _____

- a) Site Name :
- b) Site Address:
- c) PO No. with date:
- d) Supplier Name:
- e) Invoice no. with date:
- f) LR No with date:
- g) Transporter Name:
- h) Vehicle No.:
- i) Date of receipt of material at site:
- j) Destination: From _____ To _____
- k) Material details (as mentioned below):

S.No	Item Description	Type of Packages	Unit (MT/KM/NO.)	Qty as per packing list	Qty Received	Qty Accepted	Remarks
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							

Other Remarks:

Signature with date: _____

Name & Designation: _____

(With Seal)

Certificate by Chartered Accountant on letter head

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

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

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

(Strike off whichever is not applicable)

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

Or

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

Date:



(Signature)

Name -

Membership number -

Seal of Chartered Accountant

(ON RS.100/- NON - JUDICIAL STAMP PAPER)

PROFORMA FOR SECURITY-CUM-PERFORMANCE GUARANTEE

1. This deed of Guarantee made this _____ day of _____ 200 ____ by _____ Bank Ltd., _____ in favour of **Bharat Heavy Electricals Limited, Transmission Business Group, Tower-A, 5th Floor, Advant Navis IT Business Park, Plot-7, Sector-142, Expressway Noida, Noida-201305** having their registered office at **BHEL House, Siri Fort, New Delhi - 110 049.**
2. Whereas **M/s** _____ (here in after called the **Contractor / Seller**) have entered into a Contract bearing No. _____ dated _____ (herein after called the **Contract**) for supply / erection of **M/s Bharat Heavy Electricals Limited** (hereinafter called the **Company**).
3. And whereas the said Contract Inter-alia provides that the Contractor / Seller shall pay to the company a sum of Rs. _____ only, towards **Security deposit-Cum-Performance Guarantee** in the for and manner therein specified.
4. And whereas the Seller/Contractor have approached _____ Bank Limited (hereinafter referred to as the **Guarantor**) and at their request and in consideration of the arrangement arrived at between the **Contractor** and the **Guarantor**, the Guarantor has agreed to give the Guarantee as herein after mentioned in favour of the Company.

NOW THIS DEED WITNESSES AS FOLLOWS :

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

(Contd....2.)

6. The company shall have the fullest liberty without effecting in any way the liability of the Guarantor under this Guarantee, from time to time to vary any of the terms and conditions of the contract or extend time by the Seller/Contractor or to postpone for any time and from time to time any of the powers exercisable by its against the Seller/Contractor and either to enforce or forbear from enforcing any of terms and conditions governing the contract or securities available to the Company and the guarantor shall not be released from it's liability under these presents by any exercise by the company of the liberty with reference to the matters aforesaid or by reason of time being given to the seller or any other forbearance, act or omission on the part of the company or any induigence by the company to the Seller/Contractor or of any other matter or thing whatsoever which under the law relating to sureties, would but for this provision have the effect of so releasing the Guarantor/contractor from its liability under this Guarantee.
7. This Guarantee shall remain in full force and effect and the Guarantor shall be liable under the same irrespective of any concession or time being granted by the company to the contractor in or for fulfilling the said contract and this Guarantee shall remain in full force irrespective of any change in terms, conditions, stipulations or any variations in the terms of contract irrespective of whether notice of such change and / or variation is given to the Guarantor or not and the claim to receive such notice of any change and or variation of the terms/or conditions of the contract is hereby specifically waived by the Guarantor.
8. The Guarantor here in contained shall not be determined prejudiced or effected by the liquidation or winding up or insolvency of or change in the constitution of the contractor but shall in all respects and for all purposes be binding and operative until all payments or all moneys due or that may hereafter become payable to the company are paid in respect of any liability or obligation of the contractor under the contract.
9. The Guarantor further agree that the Guarantee herein contained shall remain in full force and effect during the period that would be taken for the commencement of the contract till end of the contract and its claim satisfied or discharged and till the company certified that the terms and conditions of the contract have been fully and properly carried out by the seller and accordingly discharges this Guarantee, subject, however, that the company shall have no claim under this guarantee after _____ months from the date of completion of the guarantee has been served on the guarantor before the expiry of the said period in which case the same shall be enforceable against the Guarantor not with standing the fact that the same is enforced after expiry of said period.

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

(3)

It shall not be necessary for the company to proceed against the seller before proceeding against the Guarantor and the Guarantee herein contained shall be enforceable against them not with standing any security which the company may have obtained or obtained from the seller shall at the time when proceedings are taken against the Guarantor here under be outstanding or unrealised.

The Guarantor hereby declares that it has power to execute this Guarantee and the executant has full powers to do so on its behalf under the power of attorney dated _____granted to him by the proper authorities of the Guarantor.

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

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

**SIGNED FOR AND ON
BEHALF OF THE BANK**

WITNESSESS

Name and Address

Signature

1.

2.



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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DOCUMENT No.	TB-343-510-031	Rev. No.	04		Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	RD	VK	RS		
LT POWER AND CONTROL CABLES		SIGN	-Sd-	-Sd-	-Sd-		
		DATE	17-5-12	17-5-12	17-5-12		
		GROUP	TBEM	W.O. No	80014		
CUSTOMER	POWER GRID CORPORATION OF INDIA LIMITED (POWERGRID)						
PROJECT	±800KV, 6000MW, HVDC MULTI-TERMINAL NER/ER – NR/WR INTERCONNECTOR-I PROJECT						
NOA No.	C-61901R-S056-8/CA-II/3660 dated 22.11.2011 for on-shore Supplies C-61901R-S056-8/CA-IV/3662 dated 22.11.2011 for Services						
STATION	AGRA						

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Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
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SECTION – 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.1 SCOPE

This specification is intended to specify the requirements for design, engineering, manufacture, assembly, stage testing, inspection, testing before supply, packing, loading at works and transport to site of LT Power and Control Cables as mentioned in this section and in various other sections of this specification for **± 800 KV, 6000 MW HVDC Multi-terminal System Package** comprising switchyard at Agra. The scope also includes providing engineering data , O&M Manuals as per specified formats etc for employers review , approval & records .

In case of any conflict among the various sections of this specification, then the order of precedence shall be Section-1, Section-2 & then Section -3.

1.2 PROJECT DETAILS

The equipment is required for the following project

Project title ±800KV, 6000MW, HVDC MULTI-TERMINAL NER/ER – NR/WR
INTERCONNECTOR-I PROJECT

Owner Power Grid Corporation of India Limited (POWERGRID)

Purchaser Bharat Heavy Electricals Limited (BHEL)

Refer Section - 3 for Project Details and General Specifications

1.3 SPECIFIC TECHNICAL REQUIREMENTS

1.3.1 PVC insulated 1.1 kV Aux Power Cables

	Parameters	Aux. Power cables
i.	Voltage grade of cable	1100 Volts.
ii	Material of conductor	Stranded Aluminium, Circular/ Sector shaped and compacted grade H2
iii	Conductor Strands	Minimum no. of strands are 7
iv	Conductor insulation	Extruded PVC, Type A compound
v.	Filler (If required)	Non-hygroscopic, fire retardant.
vi	Inner Sheath	Extruded PVC. Type ST-1 as per IS 5831
vii	Armour **	Aluminium round wire/ strip (Grade H4) for Single core cables and Galvanised Steel round wire/ strip for Multi-core cables as per IS 1554 (Part I)
viii	Overall sheathing	Extruded PVC, Type ST1 as per IS 5831, FRLS , Category C2 as per IS 1554 (Part-I) with Oxygen Index > 29, Temperature Index > 250°C, Acid Gas generation be weight (IEC 754-1) ≤20%, Light Transmission (ASTM-D-2843) ≥40%



1.3.2 PVC insulated 1.1 kV Control Cables

	Parameters	Control cables
i.	Voltage grade of cable	1100 Volts.
ii	Material of conductor	Plain annealed, High conductivity, Stranded Copper Conductor Grade EC
iii	Conductor Strands	Minimum no. of strands are 7
iv	Conductor insulation	Extruded PVC Type A compound
v.	Filler (If required)	Non-hygroscopic, fire retardant.
vi	Overall Screen	Aluminium tape (Which is conducting on both sides) of minimum thickness 0.2mm applied helically and with overlap. Drain wire (7/0.3mm ATC, 0.5sqmm) shall be Tinned and annealed true round copper wire applied longitudinally.
vii	Inner Sheath	Extruded PVC. Type ST-1 as per IS 5831
viii	Overall sheathing	Extruded PVC, Type ST1 as per IS 5831, FRLS , Category C2 as per IS 1554 (Part-I) with Oxygen Index > 29, Temperature Index > 250°C , Acid Gas generation be weight (IEC 754-1) ≤20%, Light Transmission (ASTM-D-2843) ≥40%

1.3.3 XLPE insulated 1.1 kV Aux Power Cables

	Parameters	Aux. Power cables
i.	Voltage grade of cable	1100 Volts.
ii	Material of conductor	Stranded Aluminium, Circular/ Sector shaped and compacted
iii	Conductor Strands	Minimum no. of strands are 7
iv	Conductor insulation	XLPE as per IS 7098 Part-I
v.	Filler (If required)	Non-hygroscopic, fire retardant.
vi	Inner Sheath	Extruded PVC. Type ST-2 as per IS 5831
vii	Armour ^{###}	Aluminium round wire/ strip (Grade H4) for single core cables and galvanized Steel round wire / strip for Multi core cables as per clause 13.2 of IS 7098 (Part I)
viii	Overall sheathing	Extruded PVC, Type ST2 as per IS 5831, FRLS , Category C2 as per IS 7098 (Part-I) with Oxygen Index > 29, Temperature Index > 250°C , Acid Gas generation be weight (IEC754-1)) ≤20%, Light Transmission (ASTM-D-2843) ≥40%

(##) Strip armouring method (a) mentioned in Table 6, Page-6 of IS: 7098 (Part 1) - 1988 shall not be accepted for any of the cables



1.3.4 Instrumentation Cables

	Parameters	Screened Control cables
i.	Voltage grade of cable	225Volts (Peak)
ii	Material of conductor	High conductivity Multi Stranded, Annealed Tin Coated Copper Conductor
iii	Strands	Minimum no. of strands are 7
iv	Conductor insulation	PVC as per VDE
v	Screening	Individual screen with Aluminium Mylar Tape and Annealed Tinned stranded Copper Drain Wire Overall screen with Aluminium tape (Which is conducting on both sides) of minimum thickness 0.2mm and Annealed Tinned stranded Copper Drain Wire
vi	Filler (If required)	Non-hygroscopic, fire retardant.
vii	Inner Sheath	Extruded PVC as per VDE 0207
viii	Overall sheathing	PVC as per VDE 0207, FRLS , Category C2 as per IS 1554 (Part-I) with Oxygen Index > 29, Temperature Index > 250°C

1.4 BILL OF QUANTITY

The different size of cables shall be as per following tables. However, the procurement will be from the list below based on the actual site requirement. **Some of the sizes may not be ordered at all.** The quantities are tentative and subject to change by ±20% of the ordered quantity.

1.4.1 PVC insulated 1.1kV Aux Power Cables

Item No.	Description	Quantity in Meters	Destination (Site)
BOQ shall be as per Purchase Indent.			

1.4.2 XLPE insulated 1.1kV Aux Power Cables

Item No.	Description	Quantity in Meters	Destination (Site)
BOQ shall be as per Purchase Indent.			

1.4.3 PVC insulated 1.1kV Control Cables

Item No.	Description	Quantity in Meters	Destination (Site)
BOQ shall be as per Purchase Indent.			



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1.4.4 PVC insulated Instrumentation Cables

Item No.	Description	Quantity in Meters	Destination (Site)
BOQ shall be as per Purchase Indent.			

1.5 TEST

All cables to be supplied shall be of type tested quality. Cables shall conform to type tests including additional type tests as per technical specification and shall be subject to routine & acceptance tests in accordance with requirements stipulated under respective sections. Any other test as per Manufacturer's Standard Quality Plan (MQP) approved by Powergrid is deemed to be included.

Cables of each type and size shall be subject to all the type tests , routine tests and acceptance tests listed in relevant standards. The bidder will conduct the routine tests on each drum length. The Type , acceptance and routine tests shall be witnessed by purchaser / purchaser's representatives.

The prices for conducting all tests are deemed to be included in respective cable prices.

1.6 DRUM LENGTH :-

- a) Standard lengths of each Size of Power & Control Cable shall be 1000m and for power cables with conductor cross sectional area 300sq.mm and above may be supplied in 500m drums .
- b) Standard drum length for Instrumentation cables shall be 1000m

However drum lengths for following sizes of cable shall be as below-

S.No	Cable Size	Drum Length
1.	2Cx95 sq.mm PVC/Al Aux. Power Cable (S.No. 05 of Purchase Indent)	2 drums of 1200m , Rest of the cable shall be in 1000m drum length
2.	3.5C x 95sqmm PVC / Al Aux Power Cable (S.No. 10 of Purchase Indent)	3 drums of 1300m , Rest of the cable in 1000m drum length
3.	3.5C x 120sqmm PVC / Al Aux Power Cable (S.No. 11 of Purchase Indent)	1300m Drum length
4.	3.5C x 185sqmm PVC / Al Aux Power Cable (S.No. 13 of Purchase Indent)	1300m Drum Length

The cable length per drum shall be subject to a tolerance of plus or minus 5% of the drum length. However the tolerance on overall quantity for each size shall be within plus or minus 2%.



SECTION-2

EQUIPMENT SPECIFICATION for 1.1kV Aux Power and Control Cables

2.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of LT power and control cables. In case of any discrepancies between requirements mentioned in this section and those mentioned in Section-3 of this specification, this specification shall prevail and shall be treated as binding requirement.

2.1 APPLICABLE STANDARDS

The auxiliary power and control cables shall conform to following latest Indian and International standards and their amendments.

IS-1255	Code of Practice for Installation and Maintenance of Power Cables, upto and including 33 kV rating
IS-1554	PVC insulated (heavy duty) electric (Part-1) cables for working voltage upto and including 1000V
IS-2982	Copper conductors in insulated cables and cords
IS 4905	Method of Random Sampling
IS-3961	Recommended current ratings for cables
IS-3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables
IS-5831	PVC insulation and sheath of electric cables
IS-7098	Cross-linked polyethylene insulated PVC sheathed (Part 1) cables for working voltage upto and including 1000V
IS-8130	Conductors for Insulated electrical cables and flexible cords
IS 10810	Method of tests for cables.
IS 10418:1982	Specification for Drums for electric cables.
IEC-60189	Low Frequency cables and wires with PVC Insulation and PVC Sheath
IEC-60287	Calculation of the Continuous Current rating of Cables (100% Load Factor)
IEC-60304	Standard Colour for Insulation for Low- Frequency Cables and Wires



IEC-60330	Methods of Test for PVC Insulation and Sheath of Electrical Cables
IEC-60331	Fire-Resisting Characteristics of Electric Cables
IEC-60332	Tests on Electric Cables under Fire conditions
IEC-60502	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto 30 kV
IEC-60540	Tests methods for insulators & sheaths of electric Cables & cords (electrometric & thermoplastic)
IEC-7541	Tests on gases evolved during combustion of electrical cables
IEC 60228	Conductors of Insulated cables
IEC 60754 (Part-1 & 2)	Test on gases evolved during combustion of electric cables - Determination of the amount of halogen acid gas evolved during
IEEE-383	Standard for type test of class IE electric cables, field splices, and connections for nuclear power generating stations.
ASTM-D2863	Standard test method for measuring minimum oxygen concentration to support candle - like combustion of plastics (Temperature and oxygen index).
ASTM-D2843	Standard test method for density of smoke from burning or decomposition of plastics.
SS 4241475	Swedish chimney test

2.2 CABLES

2.2.1 Cable Type

- The Low Voltage power cables shall be 1.1 kV XLPE insulated conforming to IS-7098 (I) or relevant IEC standards and/or PVC insulated conforming to IS-1554 (I) or relevant IEC standard.
- The control cables shall be 1.1 kV PVC insulated conforming to IS-1554 (I) or relevant IEC standard.

2.2.2 Low Voltage (415 V) Power Cables

- The XLPE (90°) insulated cables shall conform to IS-7098 (Part I) or relevant IEC read along with this Specification. These shall be suitable for a steady conductor temperature of 90°C and short circuit withstand temperature of 250°C. The conductor shall be stranded aluminum circular/sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black colored strips or coloring of insulation. A distinct inner sheath shall be provided in all multicore



cables even if they are unarmored. For armored / unarmored cables, the inner /outer sheath shall be extruded PVC to type ST2 of IS-5831. Armoring shall consist of aluminum wires/strip.

b) The PVC (70°C) insulated cables shall conform to IS- 1554 (Part I) read along with all its amendments and this Specification. These shall be suitable for a steady conductor temperature of 70°C and short circuit withstand temperature of 160 °C. The conductor shall be stranded aluminum. The insulation shall be extruded PVC to type A of IS-5831. A distinct inner sheath shall be provided in all multicore cables even if they are not armored. For multicore armored cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to type ST-1 of IS-5831 for all cables.

2.2.3 Control Cables

The control cables shall conform to IS-1554 (Part I) and this Specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS-5831. A distinct inner sheath shall be provided in all cables whether armored or not. The control cables shall be overall screened using Aluminium tape of minimum thickness of 0.2mm and 100% coverage with 20% overlap. The Drain wire of 0.5sqmm (7/0.3) ATC shall run longitudinally along the cable screen. The inner sheath shall be extruded PVC in all armored cables. The outer sheath shall be of extruded PVC to type ST-1 of IS-5831, and shall be preferably gray in color except where specifically advised by the Employer to be black.

While cores shall be generally identified as per IS-1554 (Part I), for the cables with more than five (5) cores, the identification of cores shall additionally be done by printing legible characters on all cores. The characters shall be white, and shall be printed at about 100 mm intervals all along the cable length.

2.3 GENERAL TECHNICAL REQUIREMENTS

a) The cables shall be suitable for laying in racks/trays, ducts, trenches, conduits and underground buried installation with uncontrolled backfill and with chances of flooding by water.

b) They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.

c) The XLPE insulated LV power cables shall suitable for withstanding short circuit currents on the basis of area of cross section of cable as per manufacturer's standard ratings. The area of cross-section of cable shall be decided on the basis of connected load.

d) The armour for XLPE insulated power cables shall be capable of carrying 45kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.

e) Cable construction shall include sufficient electric magnetic shielding and adequate grounding, to



ensure that any interference picked up by the signal pairs is sufficiently attenuated to prevent mal-operation, damage or danger to any equipment and personnel under all operating conditions, including the effects of switching, faults, converter operation and the environment.

f) The Aluminum/copper wires used for manufacturing of the cables shall be true circular in shape before stranding and shall be of uniform good quality, free from defects. All Aluminium used in the cables for conductors shall be of H2 grade. In case of single core cables & XLPE insulated cables, armours shall be of H4 grade Aluminium.

g) The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, softer than insulation & outer sheath and suitable for the operating temperature of the cable.

h) Strip wire armoring following method (a) mentioned in the relevant IS shall not be accepted for any of the cables. For armored control cables only round wire armoring shall be used.

i) Progressive sequential marking of the length in meters at every one meter shall be provided on the outer sheath of all cables.

j) Suitable chemicals shall be added to the outer sheaths of all cables to protect them from rodent and termite attack.

k) The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.

l) The normal current rating of all PVC insulated cables shall be as per IS-3961.

m) During a short circuit as specified in (b) above the PVC insulated cables shall be capable of withstanding a conductor temperature of at least 160°C. However, the XLPE insulated cables shall be capable of withstanding a conductor temperature of at least 250°C.

n) Repaired cables shall not be accepted.

o) Allowable tolerance on the overall diameter of the cables shall be as per the relevant IS/IEC standard.

p) Maximum acid gas generation of weight as per IEC-60754(I) shall not be more than 20% of the outer sheath material. The cables shall meet the requirements of light transmission of 40 % (min) and shall be tested as per ASTM D-2843.

q) All cables shall be armored and of fire retarded low smoke type. However, cables where mechanically protected may be unarmored.

r) Cables shall not be bent below the minimum permissible limit.

The permissible limits are as follows:



Type of cable	Minimum bending radius
Power cable	12 D Control
Cable	10 D

Where D is overall diameter of cable

2.4 CURRENT RATING FOR PVC INSULATED CONTROL and AUX. POWER CABLES

- 2.4.1 Normal current rating shall not be less than that covered by IS 3961.
- 2.4.2 PVC insulated cables shall be suitable for continuous conductor temperature of 70 °C and short circuit withstand temperature of 160 °C. Tables giving de-rating factors for various conditions of cable installation including the following, for all types of cables shall be furnished -
- Variation in ambient air temperature.
 - Variation in ground temperature.
 - Depth of laying
 - Cables laid in the ground
 - Cables laid in trench
 - Cables laid in ducts
 - Soil resistivity
 - Grouping of cables.
- 2.4.3 The value of short circuit withstand current ratings of all cables shall be indicated for a short circuit for 1 second duration and should also specify the maximum temperature during short circuit.
- 2.4.4 The following factors shall also be accounted for, while specifying the maximum short circuit withstand of the cables.
- 2.4.4.1 Deformation of the insulation, due to thermo-mechanical forces produced by the short circuit conditions, can reduce the effective thickness of insulation.
- 2.4.4.2 Conductor and core screens can be adversely affected with loss of screening effect. Likewise the thermal properties of the outer sheath material can be the limitation.
- 2.4.4.3 It is essential that the accessories, which are used in the cable system with mechanical and/or soldered connections, are suitable for the temperature adopted for the cables.
- 2.4.5 Formula for calculating short circuit current for different duration or curve showing short time current v/s time for different sizes of cables shall be furnished by vendor.

2.5 CABLE DRUMS

- 2.5.1 Cables shall be supplied non-returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.



- 2.5.2 Standard lengths for each size of power and control cables shall be 1000 meters, **unless otherwise specified**. For power cable with conductor cross sectional area 300sqmm and above may be supplied in 500m drums. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard drum length. The owner shall have the option of rejecting cable drums with shorter lengths. However, the total quantity of cables after taking into consideration of all cable drums for each size shall be within the tolerance of $\pm 2\%$
- 2.5.3 A layer of waterproof paper shall be applied to the surface of the drums and over the outer most cable layer.
- 2.5.4 A clear space of at least 40 mm shall be left between the cables and the lagging.
- 2.5.5 Each drum shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stenciled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.
- 2.5.6 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

2.6 TESTS

Cables of each type and size shall be subject to all type tests, Routine and Acceptance tests listed in the relevant standards and approved QP of the ultimate customer.

2.6.1 Type test

- a) Annealing test (for Copper conductor), Tensile & Wrapping Tests (for Aluminium for conductor) as per IS 8130.
- b) Conductor resistance test as per IS 8130.
- c) Test for armouring wires/ formed wire (% Elongation, Torsion/ winding, Wt of Zinc coating, Dimension and uniformity of coating) as per IS 1554 (Part-I), IS 7098 (Part-I), IS 3975.
- d) Check for dimensions of insulation, sheath and conductor as per IS 1554 (Part-I), IS 7098 (Part-I).
- e) Physical tests for insulation and sheath as per IS 1554 (Part-I), IS 7098 (Part-I), IS 5831 as applicable.
- f) Insulation resistance test as per IS 1554 (Part-I), IS 7098 (Part-I), IS 5831 as applicable.
- g) Drain wire and Screen dimension test for screened cables.



- h) Drain wire and Screen continuity and resistance test for screened cables.
- i) Screen coverage and overlap test for screened cables.
- j) Mutual capacitance measurement test for screened cables.
- k) Persulphate test on drain wire.
- l) High voltage test at room temperature as per IS 1554 (Part I), IS 7098 (Part-I) as applicable.
- m) High voltage test (water immersion test) as per clause 16.3 of IS 1554 (Part I).
- n) Flammability test as per as per clause 2.5 IEEE-383.
- o) Smoke density rating test as per ASTM-D2843.
- p) Oxygen index and Temperature index test as per ASTM-D2863.
- q) Acid gas generation test as per IEC: 60754
- r) Flammability test as per IS 1554 Part-I/ IS 7098 Part-1.
- s) Swedish chimney test F3 category as per SS 4241475

2.6.2 Routine tests

The following routine tests shall be conducted on full length of the cable.

- a) High voltage test as per clause 16.2 of IS 1554 (Part I).
- b) Conductor resistance test as per clause 6.3 of IS 8130.



EQUIPMENT SPECIFICATION for Instrumentation cable

3.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Screened Instrumentation cables. In case of any discrepancies between requirements mentioned in this section and those mentioned in Section-3 of this specification, this specification shall prevail and shall be treated as binding requirement

- | | | | |
|-----|---|---|---|
| 3.0 | Type of cable | : | FRLS Screened Instrumentation Cables |
| 3.1 | Standards Applicable | : | VDE 0815, VDE 0207, Part-4, Part-5, Part-6, VDE 0816, VDE 0472, SEN 4241475 class F3, IEC 60332, Part-3, Cat-B, IS 10810 (latest editions and it's amendments). |
| 3.2 | Voltage grade | : | 225V (Peak) |
| 3.4 | Number of pairs & cross-sectional area | : | As per BOQ |
| 3.5 | CONDUCTOR | | |
| | a) Material | : | High conductivity multi stranded Copper |
| | b) Grade | : | Electrolytic |
| | b) Standard applicable | : | VDE 0815 |
| | c) Min number of strands and cross sectional area | : | 7, 1.5 sq.mm |
| 3.6 | INSULATION | | |
| | a) Material | : | PVC as per VDE 0207 Part 4, compound Y I3 |
| | b) Application | : | Extruded |
| | c) Insulation thickness:
Min/ Nom/ Max | : | 0.62 / 0.80 / 0.98 (for 1.5 sq mm) |
| | d) Volume resistivity (Min) in ohm-cm | : | 1×10^{14} at 20 deg .C & 1×10^{11} at 70 deg .C |



3.7 LAYING OF CORES

- a) Min. number of twist per Metre for paired cables. : 10 to 12 twists
- b) Maximum lay of individual twisted pair : 80mm to 100mm
- c) Diameter of core : In accordance with clause 3.5 (c)

- 3.8 IDENTIFICATION OF CORES : Conductor/ pair identification: as per VDE-0815
The details of colour coding etc shall be as approved by purchaser during detail engineering stage.

3.9 INDIVIDUALLY SCREENED

- a) Material : Aluminium-Mylar tape
- b) Coverage : 100%
- c) Overlap : Minimum 20%
- d) Min thickness (Micron) : 28

3.10 OVERALL SCREENED

- a) Material : Aluminium
- b) Coverage : 100%
- c) Over lap : Minimum 20%
- d) Min. thickness (Micron) : As per IS/IEC/Applicable Standard

3.11 DRAIN WIRE

To be provided separately for individual pair shield (wherever applicable) and overall shield.

- a) Material : Annealed Tin coated copper conductor as per VDE: 0815
- b) Size (sq.mm.) : Seven (7) strand 20 AWG (0.51 sq. mm.)

3.12 BEDDING

- a) Material : Mylar Tape



3.13 INNER SHEATH

- | | | | |
|----|------------------------|---|--|
| a) | Material | : | Extruded PVC as per VDE standard |
| | Thickness | : | |
| b) | Whether FRLS | : | NO |
| c) | Fillers | : | Acceptable, Flame retardant & Moisture resistant |
| d) | Material of fillers | : | Same as inner sheath |
| e) | Method of application | | |
| | i) With fillers | : | Pressure/ Vacuum extruded |
| | ii) With out fillers | : | Pressure extruded |
| f) | Inner sheath thickness | : | As per IS: 1554 (Part-I) |

3.14 OUTER SHEATH

- | | | | |
|----|-------------|---|--|
| a) | Material | : | PVC (compound YM1) as per VDE 0207 Part-5 with FRLS properties |
| b) | Thickness | : | As per VDE 0816 and shall not be less than 1.8 mm |
| c) | Application | : | Extruded |
| d) | Colour | : | Blue |
| e) | Whether FR | : | YES |
| f) | Other | : | Resistant to water, Termite, rodent Attack |

3.15 CHARACTERISTICS OF FRLS SHEATH & FLAMMABILITY TESTS

- | | | | |
|----|-------------------|---|---|
| a) | Oxygen Index | : | 29% Minimum as per ASTM D 2863 |
| b) | Temperature Index | : | 250 °C Minimum as per ASTM D 2863 |
| c) | Flammability Test | : | As Per IEC 60332-Part-3-CAT-B & SEN-SS-424-1475 |

- | | | | |
|------|-------------------------------|---|--|
| 3.16 | TOLERANCE ON OVERALL DIAMETER | : | ± 2mm max. over the declared value in Technical Data Sheet |
|------|-------------------------------|---|--|



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- 3.17 VARIATION IN DIA : Not more than 1.0 mm throughout the length of cable.
- 3.18 OVALITY AT ANY CROSS-SECTION : Not more than 1.0 mm.
- 3.19 DRUM LENGTH
- a) Standard drum length : 1000 metres: upto and including 12 pairs
500 metres: above 12 pairs
- b) Tolerance on drum length : ±5%
- 3.20 Markings on Outer Sheath
- a) Progressive sequential Length marking to be provided : YES @ 1 m.
- b) Progressive marking to @ 5m : Durable markings shall include manufacturer's name, insulation material, number of pairs
- 3.21 Cable size (cross Section) : Voltage rating, type of cable, year of manufacture to be provided by embossing/ printing.
- 3.22 TEST VOLTAGE
- a) High voltage test : Core – Core Core- shield
2kV RMS for 1 min 0.5kV RMS for 1 min
- b) Resistance to direct current test : 0.22kV DC for 240 hrs/ 10 days



3.23 TECHNICAL PARAMETERS : Refer Table –1 attached

TABLE-1

STANDARD CABLE PARAMETERS FOR INSTRUMENTATION CABLE

Parameter	1.5 mm² (I & OS)
Mutual Capacitance (max.)at 0.8 kHz, nF/Km	120
Conductor Loop Resistance (max.), Ohm/Km	24.6
Insulation Resistance (min), M Ohm/ Km	100
Cross Talk attenuation (min) at 0.8kHz, dB	60
Characteristic impedance(max.) at 1 kHz	230
Attenuation(max.) at 1 kHz db/Km	0.8

Note:

Cable parameters indicated above are at 20 degC (+/- 3 deg C)

3.24 CABLE DRUMS

- 3.24.1 Cables shall be supplied non-returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.
- 3.24.2 Standard lengths for each size of Instrumentation cables shall be 1000 meters, **unless otherwise specified**. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard drum length. The owner shall have the option of rejecting cable drums with shorter lengths. However, the total quantity of cables after taking into consideration of all cable drums for each size shall be within the tolerance of $\pm 2\%$
- 3.24.3 A layer of waterproof paper shall be applied to the surface of the drums and over the outer most cable layer.
- 3.24.4 A clear space of at least 40 mm shall be left between the cables and the lagging.
- 3.24.5 Each drum shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stenciled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.



3.24.6 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

3.25 TESTS

Cables of each type and size shall be subject to all Type tests, Routine and Acceptance tests listed in the relevant standards viz. VDE, IS, IEC, ASTM, SS, IEEE etc and approved MQP of Powergrid.

3.25.1 Conductor -

- a) Resistance Test

3.25.2 Insulation –

- a) Loss of Mass,
- b) Ageing in air oven,
- c) Tensile and elongation test before and after ageing,
- d) Heat Shock test,
- e) Hot deformation test,
- f) Shrinkage test as per VDE.
- g) Bleeding and Blooming Test

3.25.3 Sheath-

- a) Loss of Mass,
- b) Ageing in air oven,
- c) Tensile and elongation test before and after ageing,
- d) Heat Shock test,
- e) Hot deformation test,
- f) Shrinkage test.
- g) Bleeding and Blooming Test
- h) Oxygen Index Test as per ASTM D-2863,
- i) Smoke Density test as per ASTM D-2843,
- j) Acid Gas Generation Test as per IEC60754-1



3.25.4 Aluminium Tape and Drain wire

- a) Continuity and resistance Test
- b) Shield Thickness
- c) Overlap and coverage test
- d) Persulphate test on Drain Test

3.25.5 Overall cable

- a) Flammability Test as per IEEE383
- b) Swedish Chimney Test as per SEN4241475
- c) Noise Interference as per IEEE
- d) Dimensional check as per IS10810
- e) Cross Talk test
- f) Mutual capacitance test
- g) Characteristics Impedance at 1.0kHz
- h) Max attenuation test at 1.0kHz
- i) Drain wire continuity
- j) High voltage test (Core to Core and Core to Screen)



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LT POWER AND CONTROL CABLES

Doc. No. : TB-343-510-031 Rev. 04

SECTION-3

GENERAL TECHNICAL REQUIREMENTS

Please refer Document TB-343-316-000 for General Technical Requirements



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

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GENERAL TECHNICAL REQUIREMENTS-SECTION 3

3 General

The Works covered by the Specification shall be designed, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India. The Equipment(s) shall also conform to the general requirements detailed in the following standards, which shall form an integral part of the Specification, in addition to meeting the specific requirements called for elsewhere in the Specification.

The Supplier shall note that the standards mentioned herein are not mutually exclusive or complete in themselves, but are intended to complement each other, with minimum repetition, to define the requirements of the Specification. In the event of a conflict between requirements of any two clauses of the Specification/ documents or requirements of different codes/ standards specified, the more stringent requirement as per the interpretation of the owner shall apply, unless confirmed otherwise by the owner in writing based on a written request from the Supplier.

In case of conflicting requirements between this document (General Technical Requirements - Section 3) and equipment specification (Section 1 & Section 2), equipment specification shall prevail.

When specific requirements stipulated in the Specification exceed or change those required by the applicable standards, the stipulations of the Specification shall take precedence.

Unless specifically agreed to by the Purchaser prior to Award of Contract, the Work shall be in accordance with the standards indicated and the requirements of the Specification. The Supplier shall be held responsible for any deviation.

In case of conflict between the various standards, the decision of owner shall be binding & final.

3.1 Definitions

The following words and expressions shall have the meanings hereby assigned to them throughout this document

"Biswanath Chariali " means Biswanath Chariali Converter Station

"Alipurduar " means Alipurduar Converter Station

"Agra" means Agra Converter Station

"Employer/Owner" means Power Grid Corporation of India Ltd.

"Purchaser" means Bharat Heavy Electricals Limited

"Supplier/Manufacturer" means the person or persons, firm or company assigned to execute the works as defined by the scope of supply, described here.



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"Specification" refers to this document.

3.2 Instructions to Suppliers

The supplier should be approved by Power Grid. If not, it is the responsibility of the vendor to be assessed and approved by Power Grid, before placement of order by BHEL. Any cost involved in vendor assessment/approval must be borne by the vendor himself.

The supplier shall submit the technical requirements, data and information as per the technical data sheets provided in the appropriate clause of bid document.

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 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/substation 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 provided, shall be inter-changeable with one another.

The Supplier shall offer equipment whose similar equipment for similar applications have been in service for at least two years from the date of first stage bid opening (30-06-2009) and should have been type tested as per relevant standards.

The suppliers who have supplied 400 kV equipment rated for 40 kA earlier to POWERGRID, may supply 50 kA rated equipment subject to fulfilling specified requirements:

The supplier shall supply type tested (including special tests as per tech. specification) equipment and materials. The Employer shall accept the equipment type test reports under the following conditions:

(i) Type test in accordance with the relevant specified standards

(ii) Type tests performed within five (5) years from the date of first stage bid opening (30-06-2009)

(iii) The type tested equipment shall be of the same design, insulation class and rating as per the equipment offered under this contract

In the event that equipment furnished includes important modifications of, or significant departure from, the designs of equipment on which type test report has been furnished or if there is evidence that the equipment does not comply with the requirements of the Specifications, the Supplier shall conduct the type test without any cost implication to the Purchaser. In the price bid, the type test charges shall be included and no separate type test charges shall be indicated by the supplier.

Acceptance of the type test reports shall be at the discretion of the Employer. All type tests



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performed after the date of award of the Contract shall be witnessed by the Employer unless authority to proceed with the tests in his absence is received from the Employer in writing.

3.3 Standards

All equipment and materials, unless otherwise specifically required in the Specification, shall conform to latest revisions of the standards listed in the Specification, in force at the time of signing of the contract for this project.

Generally the standards listed in the specification are applicable in accordance with the specific requirements of the technical section covering particular alternating current equipment or materials.

3.4 Site information

Table 3.4 - 1 Table for site information

<i>Particular</i>	<i>Biswanath Chariali</i>	<i>Alipurduar</i>	<i>Agra</i>
a) Employer/Owner	<i>Power Grid Corporation of India Ltd (POWERGRID)</i>		
b) Project Title	<i>±800 kV, 6000 MW HVDC Multi terminal System Package</i>		
c) Location	<i>70 km from Tezpur in Sonitpur district of Assam, Kolkatta port is the nearest port to the site</i>	<i>175 Kms. from Siliguri city in the state of West Bengal. Kolkatta port is the nearest port to the site</i>	<i>12.6 Km Agra-Shamsabad road PO – Shyamo, Agra</i>
d) Nearest Rail Head	<i>Guwahati</i>	<i>Alipurduar junction</i>	<i>Agra</i>
e) Postal Address	<i>To follow</i>	<i>To follow</i>	<i>To follow</i>
f) Design ambient temp.	<i>40°C</i>	<i>40°C</i>	<i>50°C</i>
g) SEISMIC COEFFICIENT	<i>Zone V Importance factor for the stations is 1.5 as per table no. 6 of IS-1893.</i>	<i>Zone IV Importance factor for the stations is 1.5 as per table no. 6 of IS-1893.</i>	<i>Zone III Importance factor for the stations is 1.5 as per table no. 6 of IS-1893.</i>
h) Site Wind Pressure	<i>Zone V with basic wind speed of 50 m/s at 10 m height above mean ground level. The risk level coefficient/factor shall be taken as 1.07.</i>	<i>Zone IV with basic wind speed of 47 m/s at 10 m height above mean ground level. The risk level coefficient/factor shall be taken as 1.07.</i>	<i>Zone III with basic wind speed of 44 m/s at 10 m height above mean ground level. The risk level coefficient/factor shall be taken as 1.07.</i>
i) Isokeraunic Level	<i>150 days per year</i>	<i>150 days per year</i>	<i>50 days per year</i>
j) Relative Humidity	<i>Max. 100%</i>		
k) Rain fall Intensity	<i>In 24 hours: 250mm 80mm/hr (for drainage system Design)</i>	<i>In 24 hours: 250mm 80mm/hr (for drainage system Design)</i>	<i>In 24 hours: 200mm, 30mm/hr (for drainage system Design)</i>



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3.5 Site temperatures for design purposes

The Supplier shall assume the temperatures given below for the design of the works at the converter stations.

Table 3.5 - 2 Table for Site temperatures

<i>Description Site</i>	<i>Temperature in deg C</i>		
	<i>Biswanath Chariali</i>	<i>Alipurduar</i>	<i>Agra</i>
<i>Maximum dry bulb one hour average</i>	40	40	50
<i>Maximum dry bulb 24 hour average</i>	40	40	40
<i>Annual mean dry bulb temperature</i>	30	30	30
<i>Minimum dry bulb one hour average</i>	0	0	0
<i>Maximum wet bulb one hour average</i>	33	33	33
<i>Dry bulb temperature for low ambient condition</i>	33	33	33
<i>Wet bulb temperature for low ambient condition</i>	23	23	23

3.6 Documentation

All technical description, specifications, literature, correspondence, prints, drawings, instruction manuals, test reports(both factory and site), progress photographs, booklets, schedules and all supplementary data or documents furnished in compliance with the requirements of the Contract, shall become the property of the Purchaser/owner and the costs shall be considered as included in the Contract price.

The Supplier shall be responsible for any time delay, misinterpretation, error and conflict during design, manufacturing, testing and erection of the Works resulting from non-compliance with the requirements of this Specification.

The Purchaser/owner shall have the right to make copies of any documents, data, reports, information etc. supplied by the Supplier in connection with the Works. The Purchaser/ owner shall not impart the information of these documents to any other manufacturer or competitor but he shall be free to use these for preparation of technical papers, reports etc.

The Supplier shall submit consolidated list of all symbols used in any drawing, data and information under three separate headings namely Civil, Mechanical & Electrical. If symbols other than IS or IEC are used, the Supplier shall submit consolidated list of these symbols and their significance under a separate section.

The Supplier is not required to supply detailed drawings whose purpose is manufacture only but in case such information is specifically asked for by the Purchaser/owner during evaluation of Bid, finalization of Contract, design review by Purchaser/owner his appointed Consultant or during execution of the Contract, the Supplier shall comply with the same.

All drawings, documents manual etc. as specified in this section shall have to be provided separately for each station.

All documentation shall be in English language.

Requirements for submission of documents, information and data by the supplier



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General

The Supplier shall submit to the Owner/Purchaser all documents in accordance with an approved schedule of submissions and shall submit any further information (in the form of drawings, documents, manuals, literature, reports etc.) when asked by the Owner/Purchaser while commenting/approving any drawings/documents etc. All applicable documents shall be provided for each converter/repeater station separately.

The documents which are subject to the approval of the Owner/Purchaser shall be identified by the Supplier with the stamp "FOR APPROVAL". All other documents shall be submitted to the Owner/Purchaser for information and shall be identified by the Supplier with the stamp "FOR INFORMATION".

The sequence of submission of the documents shall be subject to the approval of the Employer. The sequence of submissions of all documents shall be such that the necessary information is available to enable the Employer to approve or comment the document.

The Supplier shall supply 5 hard copies of all drawings and documents. The final documentation for the project shall be supplied in nine sets of hard copies (three to each site) and nine sets of CDs to the Purchaser.

The entire plant documentation shall include all construction drawings, equipment specifications, design/study reports, O&M documents, factory test reports, etc. All the final/as built drawings shall be submitted in CAD format along with the complete final documentation.

In case a "SUBSEQUENT" revision of any document is made due to any reason whatsoever, a revision of the same, highlighting the changes shall be resubmitted for the Employer's specific approval/information.

Documents for approval

Approved documents shall be considered as the working documents. However the Specification and connected documents shall prevail over these documents in case a decision is required on interpretation.

Documents for information

The Supplier shall not delay the Works pending the receipt by the supplier of the comments on documents submitted to the Owner/Purchaser for information. However, the Owner/Purchaser shall have the right to comment on all the documents submitted by the Supplier, when, in the opinion of the Owner/Purchaser the document does not comply with the Contract or otherwise. The Supplier shall satisfactorily demonstrate that the information contained in the aforesaid document does meet the requirements of the Contract or revise the document in order that the information shall comply with the requirements of the Contract.

Drawings and data

General

The Supplier shall submit to the Owner/Purchaser all assembly and detail drawings of equipment,



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station design, civil work, building, controls, protection, etc., as well as the corresponding computation where necessary in order to establish to the satisfaction of the Owner/Purchaser the Supplier's compliance with the requirements of the Contract.

Drawings, as set forth below shall be submitted to the Owner/Purchaser and shall be complete with all information necessary for complete interpretation of the drawings by the Owner/ Purchaser. All drawings shall show the materials, dimensions, finish, fits, clearances, tolerances, bolting and such other information as is necessary to demonstrate to the Owner/ Purchaser that all items covered by the drawings are in compliance with the requirements of the Contract.

Drawings may consist of several sheets as required in order to provide for the degree of detail required by the Employer, so that he may clearly understand such drawings.

Not later than 90 (ninety) days after completion of successful trial operation of the HVDC station, the Supplier shall supply copies of the last revision of all drawings produced for this project, stamped as "AS BUILT".

The Supplier shall provide separate sets of drawings for each control cubicle. Typical drawings for similar cubicles shall not be accepted. If there are several cubicles per system, then one common bill of material and one system schematic diagram may be provided. Such system schematic diagram shall show the control scheme for the particular system in its entirety and shall be laid out on the minimum number of drawings sheets consistent with clarity and legibility.

The Owner/Purchaser shall not accept typical drawings for control, protection and three-phase schematics, power circuits and single line diagrams. The Supplier shall supply complete set of such drawings for each system, even when drawings are duplicates.

Inspections plans and documentation

The Supplier shall submit in required number copies for the Owner's/Purchaser's approval an inspection plan (quality plan) describing the inspection system indicating the inspections to be carried out and their sequence in the manufacturing stages.

The inspection plan shall be such that it can be related to the manufacturing program. The plan shall also include a description of the inspection methods employed with reference to the Supplier's written inspection procedures.

Separate inspection plans describing the inspection systems for equipment supplied by each sub-Supplier, in the same form as that of the Supplier, shall be submitted for the approval of the Owner/Purchaser.

In addition to the inspection plans referred to above, the Supplier shall submit complete and satisfactory evidence of possessing a working scheme assuring the control of all critical activities pertinent to the assurance of quality, and objective evidence (by means of quality manuals and appropriate forms, etc.) of this capability to employ and maintain quality control to meet the required quality level of the manufacture and construction of the Works.

Supplier's Quality Control Program in the context of this Clause means the implementation of a quality assurance program by means of which full conformance of material and workmanship to best



quality standards can be achieved effectively and economically by the Supplier's control and surveillance of all essential inspection operations, and periodic verification of the results of the manufacture of equipment and the assembly, erection and installation of equipment at the sites.

Required number of copies of all test reports, including those supplied by Sub-Suppliers, and shall be submitted to the Owner/Purchaser for approval. The Supplier shall include in the report all additional data required by the Owner/Purchaser to permit a clear understanding of the reports.

All test reports shall be certified and shall contain the signature of the Inspector as having witnessed the test, unless such witnessing has been specifically waived by the Owner/ Purchaser. A certified test report shall be issued for each test.

Instruction manuals and operating manuals

The Supplier shall provide Instruction & Maintenance Manuals for each part of the Plant and Equipment included in the Works and Operating Manuals for each Station.

The Instruction Manuals and Operating Manuals shall be arranged in an organized library adequately cross referenced to facilitate issuing clauses of the manuals as required by the work i.e. erection instructions shall be required before operating & maintenance instructions.

All Manuals provided by the Supplier shall be fully detailed and specifically prepared for the Works and equipment provided. General manuals not specifically required for the work shall not be acceptable.

The instruction manuals shall at least contain:

- a) A general description of all components
- b) Storage instructions
- c) Erection instructions
- d) Pre-commissioning Instruction :
- e) Material and part list.
- f) Design clearances and settings
- g) Complete sets of drawings as finally issued
- h) Operating Instructions:
- i) Routine and Preventive Maintenance instructions with material requirement for each site
- j) Preventive Maintenance Schedule.
- k) Replacement instruction for all equipment

The operation manuals shall at least contain:

- a) Operator oriented functional descriptions of the equipment.
- b) Operator oriented description of the protection and control systems
- c) Description of the equipment auxiliary systems
- d) Fault finding and diagnostic tools
- e) User software interface tools for modification/augmentation etc.

Notes:

The supplier may please note that all resubmissions must incorporate all comments given in the ear-



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lier submission by the Owner/Purchaser or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Supplier to the Owner/Purchaser.

The Supplier shall furnish to the Owner/Purchaser, catalogues of spare parts also.

3.7 Quality assurance requirements

Quality assurance programme

To ensure that the equipment and services under the scope of Contract, whether manufactured or performed at the Supplier's Works or at his Sub-supplier's premises or at the Purchaser's site or at any other place of Work, are in accordance with the specifications, the Supplier shall adopt a suitable quality assurance programme to control such activities at all points, as necessary. Such programme shall be outlined by the Supplier and shall be submitted by the supplier after the award of contract and finally accepted by the owner after discussions prior to commencement of manufacturing.

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

- (a) Supplier's organisation structure for the management and implementation of the proposed quality assurance programme;
- (b) Design and Documentation control system;
- (c) Qualification data of Supplier's key personnel;
- (d) The procedure for purchases of materials, parts components and selection of sub-Supplier's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchased etc.
- (e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
- (f) Control of non-conforming items and system for corrective actions;
- (g) Inspection and test procedure both for manufacture and field activities;
- (h) Control of calibration and testing of measuring and testing equipment.
- (i) System for quality audits;
- (j) System for indication and appraisal of inspection status
- (k) System for authorising release of manufactured product to the Purchaser
- (l) System for maintenance of records;
- (m) Furnishing of quality plans (QP)/inspection and test plan (ITP) 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.

General requirements - Quality assurance

1. All services, materials, components and equipment covered under this specification shall be engineered, designed, procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. It is the Supplier's responsibility to draw up and implement agreed programme for system as a whole as well as for individual equipment.



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The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Supplier and shall be submitted to the Employer for approval.

The Supplier shall furnish with his bid a list of approved suppliers for the information of the Employer.

2. Engineering and design quality Plan shall detail out the studies, overall detail design documentation and communicating, defining interfaces and controlling changes. To achieve quality, reliability and schedule objectives that project shall be designed so that it meets performance requirements. Manufacturing Quality Plan shall 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 Supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents etc., during all stages of materials procurement, manufacture, assembly, and final testing/performance testing.
3. Field Quality Plan shall detail out for all the equipment, the quality practices and procedures etc. to be followed by the Supplier's site Quality Control Organisation, during various stages of site activities from receipt of materials/equipment at site onwards.
4. The Supplier shall also furnish copies of the reference documents/plant standards/ acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with respective Quality Plan. These Quality Plans and reference documents/standards etc. shall be subject to Employer's approval without which manufacture shall not proceed. In these approved QPs, the Employer shall identify customer inspection points (CIP), test/checks which shall be carried out in presence of the Employer's Engineer or his authorised representative and beyond which the work shall not proceed without consent of Employer or his authorised representative in writing. All deviations to specification, approved quality plans and applicable standards must be documented and referred to the Employer for approval and disposition.
5. No material shall be dispatched from the manufacturer's works before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Employer's Engineer and / or his authorised representative, and duly authorised for dispatch issuance of Material Inspection Clearance Certificate (MICC). Before making request for issuance of MICC, the Supplier shall ensure that approval of type tests, data sheets, drawing etc. had already been obtained from Employer. All materials used or supplied shall be accompanied by valid materials certificates and tests and inspection reports. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.
6. 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.
7. All the (sub)-Vendors proposed by the Supplier for procurement of bought out item list of which shall be drawn up by the Supplier and finalised with the Employer shall be subject to the Employer's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Employer and shall form part of the purchase order between the Supplier and the Vendor.



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8. The Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Supplier's of their sub-Supplier's (sub-vendor's) quality management and control activities. The Supplier shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
9. As a part of quality assurance of engineering and design, the technical review meetings (TRMs) shall be conducted between the Employer and/or his consultants/representative and the Supplier and/or his subSupplier(s). The duration and cycle of such TRMs shall be as frequent and regular as required to meet the time schedules. The meetings shall be held at either at the Employer's office and/or at the office/manufacturing place of the Supplier/sub-Supplier or at any other place as agreed mutually.
10. The Supplier shall agree upon a schedule of submissions of documents concerning the Quality Assurance Program within two months of the effective date of the Contract. This schedule shall indicate the list of mutually agreed items/equipment for which quality Plans shall be submitted by the Supplier and the last dates for the submissions. It shall be ensured by the Supplier that the submissions are so programmed that all relevant approvals are obtained from the Employer for these documents in a timely manner before the material induction and commencement of the manufacture for any equipment.
11. The documents that shall be submitted by the Supplier to the Employer for review and approval as per the agreed schedule include:
 - a) QA Manuals
 - b) Quality Plans (Inspection & Test Plans) for all equipment/materials manufactured in the Supplier's works and/or in the sub-Supplier's works
 - c) Purchase Specifications for equipment procured from sub- Suppliers.
 - d) Supplier's assessment reports of his sub-Suppliers
 - e) Field Quality Plans for all activities at site
 - f) Reference documents referred to in Quality Plan.
 - g) Erection, commissioning, operation and maintenance manuals

12. QA Document Package

The Supplier shall submit the following Quality Assurance Documents to the Employer. These documents shall be as per the approved Quality Plans for the concerned equipment. The documents shall include, but not limited to, the following:

- a) Routine test reports & Acceptance test reports
- b) Type test reports
- c) Quality records etc. corresponding to items identified Quality Plan
- d) Inspection reports for Customer inspection points
- e) Reports on repair/modification carried out to make the item/equipment acceptable.
- f) Non-destructive examination result reports including radiography interpretation reports, wherever applicable.

The above documents are required to be submitted in required number of copies within three weeks after dispatch of equipment.



Inspection and testing

1. In order to verify that all the manufacturing of equipment by the Supplier as well as materials & equipment being procured and provided by the Supplier are in complete conformance with the requirement of the Contract, the Employer and/or his duly authorized representative shall have access to the Supplier's premises or works at all reasonable times to inspect and examine the material, equipment and workmanship during its manufacture or installation. In addition to carrying out inspection the Employer and/or his authorized representative/Consultant all carry out quality audit on the Supplier's Quality Assurance System and conduct quality surveillance to check conformance to quality procedure/practice in general. The Supplier shall provide necessary facilities to carry out all the above activities at their works and the works of the sub-Suppliers.
2. The Supplier shall provide a detailed inspection schedule for those inspection stages identified as CIP and shall furnish updated schedules once every two months.
3. The Supplier shall give the Employer/Inspector six(6) weeks written notice, by telex or by letter, of the tentative date any material/equipment shall be ready for witness points, corresponding to Customer inspection points (CIP), when the Employer/Inspector is based in India. Final confirmation shall be given at least 15 days in advance. The Employer/Inspector, unless witnessing of the tests is waived, shall attend such tests, failing which the Supplier may proceed with the test which shall be deemed to have been made in the Inspector's presence. The Supplier shall forthwith forward to the Employer copies of duly certified test reports. Test reports of all tests corresponding to CIP performed in the supply shall be reviewed and approved, subject to satisfactory conduction and successful passing of the test, by the Employer or his authorized representative (even if the witnessing of the test was waived).
4. The Employer or his authorized representative shall, within fifteen (15) days from receipt of such reports, give notice in writing to the Supplier of any objection to any aspect of the test reports or any or all equipment and workmanship which in his opinion is not in conformance with the Contract. The Employer or his authorized representative shall advise his reasons for objections on completion and review of the activity. The Supplier shall give due consideration to such objection(s) and shall either make the modifications that may be necessary to overcome the said objection(s) or shall confirm in writing giving reasons therein that no modifications are necessary to comply with the Contract. However, the Supplier may proceed with the works/dispatch even before the receipt of written objection(s), if any, at his own cost & risk.
5. Whenever the Employer's inspection engineer undertakes the inspection, at a particular stage identified as Customer inspection point (CIP) in the Quality Plan, the acceptance of test reports/test results and the MICC where applicable shall be given immediately after the test if the results, including those for previous points identified as per clause 9.6 are found to be in conformity with the Contract. In case of any deviations, the Employer/Inspector at his discretion may refer the matter to the Employer's main office, together with the manufacturer's comments, who in turn shall communicate his final decision regarding the acceptance or otherwise to the Supplier within fifteen (15) days of the receipt of such test reports/results. In case the presence of the Employer/Inspector is waived, the acceptance of test results and issuance by the Employer of Material Inspection Clearance certificate wherever applicable, shall be given within fifteen (15) days after receipt of test reports/results for the CIP as well as for previous CIP's identified in the approved Quality Plan, provided such test reports/test results are found to be in order. The Em-



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ployer/Inspector shall at his discretion and based on the outcome of any inspection and the requirements of the contract, have the right to 'accept', 'accept as noted' or 'reject' any equipment/material. The reasons/comments in case of each ruling shall be communicated to the Supplier in writing.

6. In all cases where the contract provides for tests, whether at the premises of works of the Supplier or of any sub-Supplier, the Supplier, except where otherwise specified, shall provide free of charge such items as labour, materials, electricity, fuel, water, apparatus and instruments as required to fulfil the requirements of the approved Quality Plan.
7. The inspection by Employer/Inspector or waiver of the presence of the Employer/Inspector, issue of CIP clearance certificate and issue of Material Inspection clearance certificate (MICC) thereon shall in no way limit the liabilities and responsibilities of the Supplier in respect of the agreed quality plans forming part of the contract. The Employer shall not be found to accept the material/equipment if on further testing it is found to be not in compliance with the requirements of the contract. The Supplier shall include in all orders to his sub-Suppliers, the requirements for any equipment, being supplied by the sub-Supplier for incorporation in his equipment to be subjected to inspection and testing by the Employer or is authorised representative. Copies of such orders or purchase specifications, blanked for prices, shall be forwarded to the Employer.
8. The costs of all tests specified in the Contract together with the same for all tests facilities, test samples and such like shall be to the Supplier's account.
9. The Employer/Inspector shall have complete authority to reject, on behalf of the Employer, any material, equipment or parts thereof considered unsatisfactory and not in accordance with the Contract. Accept, accept as noted or reject materials, equipment or any components thereof shall not relieve the Supplier of any of his obligations under the Supplier, nor impose any liability whatsoever on the Employer.
10. The Employer shall have the right to have Inspectors on the Sites, on a regular basis or from time to time as required at his sole discretion to monitor the quality and the progress of the work. Generally the site inspection shall be as per the approved Field Quality Plans (FQPs) and the Installation & Operation Manual(s). All quality related documents and test results shall be a part of plant documentation.

3.8 Materials and workmanship

Where the specification does not contain references to workmanship, it is understood that the equipment shall be new, of the best quality and in accordance with the purpose for which they are intended.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the owner shall decide upon the question of similarity. When required by the specification or when required by the Purchaser & owner the Supplier 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 Supplier.



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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 shall be used throughout the design.

All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned to fulfil 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 owner.

Whenever possible, all similar parts of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be made interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. All the equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Supplier shall apply oil and grease of the proper specification as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary in readiness for applying the lubricant required for operation. The Supplier shall apply all operational lubricants to the equipment installed by him. All insulating oil, lubricating material, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Supplier has any special requirement for the specific application for a type of oil or grease not available in India. If such is the case he shall declare in the proposal where such oil or grease or other consumables is available. In any case he shall identify equivalent Indian makes and inform the Purchaser & owner of the name of at least two Indian suppliers before handing over of the Works to the Purchaser. All consumables required upto operational acceptance shall be the part of supply scope of the Supplier.

The supplier shall perform all tests and inspection necessary to ensure that the material and workmanship conform to the approved design drawings and that such tests are adequate to demonstrate that the equipment shall comply with the requirements of the Specification & relevant standards. The supplier shall test the component parts at his plant or his Sub-supplier's plant, prior to packaging and shipping, to determine that the performance requirements have been met. All testing shall be in accordance with the Standards related to the piece of work.

3.9 Colour schemes

The Supplier shall propose a colour scheme for the equipment for the approval of the Employer. The decision of the Employer shall be final. However, the finishing colour shall be RAL 7035 for indoor panels and RAL 7032 for outdoor panels. The scheme shall include:

- Finishing colour of Indoor equipment
- Finishing colour of Outdoor equipment
- Finishing colour of various auxiliary system equipment including piping
- Finishing colour of various building items.



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- Finishing colour of all cubicles.

All steel structures, plates etc shall be painted with non-corrosive paint on a suitable primer. The galvanised structures in the switchyard shall not be painted. However galvanised structures in other areas may require painting for aesthetic reasons.

3.10 Clamps & connectors

- i) All power clamps and connectors shall conform to IS: 5561, and/or IEC standard and shall be made of materials listed below:

a)	For connecting ACSR conductors	Aluminium alloy casting, conforming to designation A6 of IS: 617 and shall be tested for all tests as per IS:617
b)	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminium alloy casting, conforming to designation A6 of IS 617 with 2 mm thick Bimetallic liner and shall be tested as per IS: 617.
c)	For connecting G.I. Shield wire	Galvanised mild steel
d).1	Bolts, nuts & Plain washers.	Electro galvanised for sizes below M12, for others hot dip galvanised
d).2	Spring washers for items 'a' to 'c'	Electro-galvanised mild steel suitable for at least service condition-3 as per IS: 1573

- ii) Equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor terminations of equipment shall be either expansion, sliding or rigid type. The requirements regarding external corona and RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position. In case the connector is not available then equivalent connector may be used. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of Work.
- iii) Where copper to aluminium connections are required, bi-metallic clamps shall be used, which have been properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current t shall be furnished to the Employer.
- iv) Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified are also included in the scope of Work.
- v) No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2mm thickness shall be cast integral with aluminium body for Bi-metallic clamps. When copper alloy is not cast integral with aluminium body, a bimetallic washer or strip shall be used to meet the functional requirement.
- vi) All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.



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- vii) Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of IPS Aluminium tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- viii) Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.
- ix) All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- x) TESTS

The following is the list of type tests.

- a) Temperature rise test (maximum temperature rise allowed is 35deg C over 50 deg C ambient)
- b) Short time current test
- c) Dry corona and RIV test as per annexure-A
- d) Resistance test and tensile test

3.11 Name Plates and Markings

All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual nameplates with equipment designation engraved. Also on the top of each panel on front as well as rear side, large and bold nameplates shall be provided for circuit/feeder designation.

All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.

All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

Name Plates shall be made of non-rusting metal or 3-ply lamicaid. Name plates shall be black with white engraving lettering.

All the panels shall be provided with nameplate mounted inside the panel. Stainless steel nameplates shall be installed on all apparatus and on all major equipment components. For indoor cubicles, nameplates made of aluminium shall also be acceptable. Name plates shall be white with black engraved lettering and shall carry all the applicable information specified in the applicable items of the Standards, together with any other relevant information which may be required. For groups of smaller items for which this is not possible e.g. switch bays etc. a common nameplate with the title and special instructions on it shall be provided. No scratching, corrections or changes shall be allowed on nameplates. Main equipments like converter transformer, CBs, Reac-



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tor, Filter gates etc shall have nameplates in Hindi also.

All equipment mounted on front and rear sides as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. Also on the top of each panel on front as well as rear sides large name plates with bold size lettering shall be provided for circuit / feeder / cubicle / box designation.

All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate tracing of the wiring. The nameplates shall be mounted directly by the side of the respective equipment and shall not be hidden by the equipment wiring.

The nameplate inscription and size of nameplates and letters shall be submitted to the Employer for approval.

The nameplates of the apparatus shall include, at least, the information listed below, together with any other relevant information specified in the applicable standards:

- a) A concise descriptive title of the equipment
- b) Rating and circuit diagram reference numbers
- c) Manufacturer's name, trade-mark, model type, serial number
- d) Instruction book number
- e) Year of manufacture
- f) Total weight (for capacitor racks indicate weight, for capacitors indicate quantity of liquid)
- g) Special instructions, if any, about storage, transportation, handling etc.

Each measuring instrument and meter shall be prominently marked with the quantity measured e.g. kV, A, MW etc. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

Danger plates and plates for phase colours shall be provided as per requirement. The Supplier shall devise a system to designate equipment and sub-systems. The nameplates/ labels displaying these designations shall be installed at appropriate locations. Wherever motion/ flow of fluids are involved, plates/ marks showing direction of motion/ flow shall also be provided.

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.



3.12 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 favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

3.12.1 Space Heaters

The heaters shall be suitable for continuous operation at 240 V ac supply voltage & shall be connected to the supply through a fuse.

One or more heaters shall be provided, with thermostats or hygrostat, to prevent condensation in any compartment. The heaters shall be suitable to maintain the compartment temperature at approximately 10 deg. C, above the outside air temperature to prevent condensation.

Control cubicles installed in air-conditioned area need not be provided with space heaters. These cubicles shall, however, have space heaters in case of storage of cubicles for long duration.

3.12.2 Fungi Static Varnish

Besides the space heaters, special moisture and fungus resistant 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.

3.12.3 Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass or galvanized steel 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.

3.12.4 Tropicalisation

The service building and bay kiosk shall be air-conditioned whereas the valve halls and indoor DC yard at Agra shall have ventilation system with positive pressure. All equipments shall, however, be suitable for installation in a tropical monsoon area having hot, humid climate and dry & dusty seasons with ambient conditions as specified. All control wiring, equipment and accessories shall be protected against fungus growth, condensation, vermin and other harmful effects due to a tropical environment.

3.13 Painting and finishing of metal surfaces

All sheet steel work shall be phosphated in accordance with the IS:6005 "Code of practice for phos-



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phating iron and steel".

Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.

Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with a slightly alkaline hot water and drying.

After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.

The phosphate coating shall be sealed with application of two coats of ready mixed, stoved type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall be of a slightly different shade to enable inspection of the painting.

A small quantity of finished paint shall be supplied for minor touching up required at site after installation of the panels.

In case the Supplier proposes to follow his own standard surface finish and protection procedures any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted along with the Bids for Purchaser's review & approval. The Supplier shall use procedures for painting approved by the Employer during detailed Engineering.

3.14 Hot Dip Galvanising

The minimum weight of the zinc coating shall be 615 gm/ sq.m and minimum thickness of coating shall be 85 microns for all items thicker than 6 mm. For items less than 6 mm, requirements of coating thickness shall be as per relevant ASTM. For surfaces, which shall be embedded in concrete, the zinc coating shall be 900-gm/sq.m .

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

After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment except the nuts may be rethreaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

The galvanized steel shall be subjected to six one-minute dips in copper sulphate solution as per IS-2633.

Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions.



The following galvanizing tests should be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

3.15 Control cabinets, junction boxes, terminal boxes & marshalling boxes for equipment

All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439, as applicable, and the clauses given below:

1. Enclosure for control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of stainless steel or aluminium and shall be dust, water and vermin proof. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation.
2. The enclosures of the control cabinets, junction boxes, terminal boxes & marshalling boxes located outdoor shall provide a degree of protection of not less than IP 55 as per IS-13947:Part I One control cabinet, junction box, terminal box & marshalling box of each type shall be tested for the same.
3. Cabinets/boxes shall be freestanding floor-mounting type, wall mounting type, or pedestal mounting type as required. Equipments such as telephone exchange, Public address systems etc shall be kept inside cubicles.
4. Cabinets/ boxes shall be provided with double-hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
5. All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM gaskets. The gasket shall be tested in accordance with approved Quality Plan. Ventilating louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.
6. All boxes/cabinets shall be designed for the entry of cables from the bottom by means of weatherproof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. A suitable horizontal cable gland plate positioned at least 150 mm above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required. The glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS: 6121 and shall be nickel-plated.



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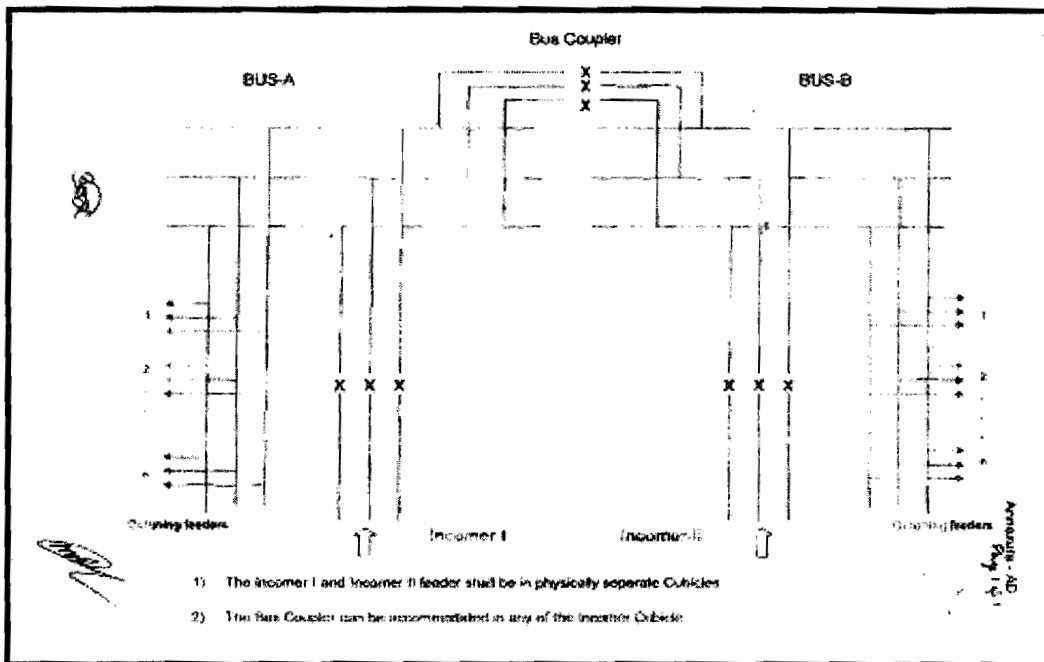
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Boxes / cabinets to be located inside a building in a non air- conditioned area may be designed for the entry of cables from the bottom or from the top.

The (415 V) secondary distribution system shall be made up of 415 V power centres serving the different classes of loads either directly or thorough motor control centres. Two separate 415 V power centres, one for each pole shall be provided. The two sections of power control centres (PCC) feeding the duplicated loads, like pumps, fans, heat exchangers, etc. as well as the duplicated supply circuits shall be physically independent, permanently energized and fed by different sections of the 415 V power centres. A tie circuit breaker, shall be provided between the two sections of above PCC feeding the duplicated loads, in order that when one section of PCC is out for maintenance or fault, the other section can supply all the loads.

The motor control centres (MCC) shall be provided in accordance with the relevant Standards. The MCC shall be located near the supplied loads. The incomers of the MCC shall be individually interlocked to prevent paralleling of two different power centre buses. The 240 V loads shall be supplied by 240 V panels located in the MCC or outside the MCC where it is required.

415 V MCCs for valve cooling, pump house, valve hall ventilation system, air-conditioning system etc. shall be arranged as per figure given below:



25% spare feeders, but not less than one of each type and rating shall be provided on 415V switchgears, power centres and motor, control centres as well as on all dc distribution boards

The AC & DC Distribution Boards shall have a fixed type, floor-mounted, free-standing, metal enclosed, with compartmentalised construction. They shall have separate Busbar chamber and cable alleys. All equipment for each feeder (i.e. main switch, HRC fuses, neutral link and cable terminals) shall be housed in a fully enclosed compartment with a separate hinged door,



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such that fuse replacement, cable termination/replacement etc. are possible with complete safety, even if the Busbar and adjacent feeders are live. The connections from Busbar to the main switch shall be fully insulated/shrouded, and securely bolted. The partition between the feeder compartment and cable alley shall be non-metallic and shall be of such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination. Cable alley shall have no exposed live parts, and shall have no communication with Busbar chamber. The main switch shall be operated from outside, and shall be interlocked with the compartment door such that the latter can be opened only when the switch is OFF. However, it shall be possible to defeat this interlock and open and close the door with the switch ON. Busbar chamber shall be completely enclosed with metallic partitions. Bolted covers shall be provided for access to horizontal and vertical Busbar and all joints, for repair and maintenance, which shall be feasible without disturbing the feeder compartment. Cable alley door shall preferably be hinged. The main switch shall have the facility of being pad-locked in both ON and OFF positions. The switch handle shall clearly indicate the position of main switch. The Supplier shall furnish suitable plugs to cover the cable openings in the partition between feeder compartment and cable alley, for at least 50% of the total number of feeders. The distribution boards shall have a degree of protection of at least IP52 as per IS-13947:Part I.

All 415V switchgear (circuit breaker boards) shall be of single front type, with fully draw out circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between SERVICE, TEST and ISOLATED positions and for withdrawal from the Switchboard. Testing of the breaker shall be possible in the TEST position. Unless kept in OFF position it shall not be possible to withdraw the modules from service position or rack them into service position.

All outgoing feeders in distribution boards shall be through MCBs/MCCBs.

Circuit breakers shall be three pole air break horizontal draw out type and shall have inherent fault making and breaking capacities as specified. The circuit breakers which meet specified parameter only after provision of releases or any other devices shall not be acceptable.

All circuit breakers shall be provided at least with 4 NO and 4 NC potentially free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be provided in both 'SERVICE' & 'TEST' position of the breaker.

Control cabinets, junction boxes, Marshalling boxes and terminal boxes shall be made of sheet steel or aluminium enclosure. Sheet steel used shall be at least 2.0-mm thick cold rolled or 2.5 mm hot rolled. In case of aluminium enclosed box the thickness of aluminium shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

7. Earthing

The provision for earthing shall be generally as per requirements given in Clause 3.16.2

8. Tests

- a) The Marshalling Kiosks shall be subject to routine tests as per IS: 5039



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b) The following routine tests shall also be conducted:

- i) Check for wiring
- ii) Visual and dimension check

Marshalling kiosk shall be provided with danger plate and a diagram showing the numbering/ connection/ ferruling by pasting the same on the inside of the door.

Marshalling kiosk shall also be provided with incoming MCB and one 15 Amp interlocked switched socket in addition to the MCB required.

3.16 Indoor control cubicles

The control panel, cubicles and desks shall be in accordance with the relevant IEC standards and shall be installed in air-conditioned space. Indoor electronic cubicles shall not generally require fans for cooling in order to operate successfully and correctly at the maximum ambient temperature. However, if it is absolutely necessary to install fans etc. in cubicles for cooling then these shall be driven by the same dc supply as used for control, and necessary redundancy, failure alarm etc. shall be incorporated. Louvers in the doors and side panels shall be permitted, if required.

The control and relay panels shall be suitable for numerical relays of modular type mounted in standard 19 inch racks located on the vertical front panel with rear doors for access or located on the front doors for front access type panels. Panels Cubicles shall be completely metal enclosed and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP 32 in accordance with IS-13947:Part I for cubicles located in air-conditioned areas. IP 31 may also be acceptable for these areas if the layout is arranged such that there is no possibility at all of any liquid entering the area. However, for ventilation reasons the cubicles may be provided with a ventilation hood at the top with a protection class of IP21.

Panels shall be free standing, floor mounting type and shall comprise structural frames enclosed completely with specially selected smooth finished, cold rolled sheet steel of thickness not less than 2.5 mm for weight bearing members of the cubicles such as base frame, front sheet and door frames, and 1.5 mm for sides, door top and bottom portions. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transportation and installation. The cubicles shall be provided with lifting lugs.

All doors, removable covers and plates shall be gasketed all around with neoprene gaskets. Ventilation louvers, if provided, shall have screens and filters. The screens shall be made of either brass or GI wire mesh with a graduation of 1 mm or less.

Design, material selection and workmanship shall be such as to result in a neat appearance, inside and outside with no welds rivets or bolt heads apparent from outside, with all exterior surfaces true and smooth. All cubicles located in any room shall be matched in appearance.

The Supplier along with anchor bolts and necessary hardware for mounting the cubicles shall furnish metal sills in the form of metal channels properly drilled. Panels shall have an additional rolled channel plinth at the bottom with a smooth bearing surface. The panels shall be fixed on channels with intervening layers of anti-vibration strips made of shock absorbing material, which shall be



supplied by the Supplier.

Supplier's standard practice for control panels shall be acceptable to the Employer/Purchaser subject to approval during detailed engineering and meeting all functional requirements of the specification.

3.16.1 Mounting

All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush. No equipment shall be mounted on the doors.

Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.

The Supplier shall carry out cut out, mounting and wiring of the free issue items supplied by others, which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.

The centre lines of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The centre lines of relays, meters and recorders shall be not less than 450mm from the bottom of the panel

The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Like wise the top lines of all meters, relays and recorders etc. shall be matched.

No equipment shall be mounted on the doors.

At existing station, panels shall be matched with other panels in the control room in respect of dimensions, colour, appearance and arrangement of equipment (centre lines of switches, push buttons and other equipment) on the front of the panel.

3.16.2 Earthing

- 1) All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq. mm perforated copper with threaded holes at a gap of 50mm with a provision of bolts and nuts for connection with cable armours and mounted equipment etc for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of Supplier. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.
- 2) Provision shall be made on each bus bar of the end panels for connecting Substation earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope



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of supply of Supplier.

- 3) All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 sq. mm. The colour code of earthing wires shall be green.
- 4) Looping of earth connections, which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. Earthing may be done in such a manner that no circulating current shall flow in the panel.
- 5) VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.
- 6) An electrostatic discharge point shall be provided in each panel connected to earth bus via 1 Mega Ohm resistor.

3.16.3 Instruments, meters and recorders

Only digital displays and systems shall be provided. The requirements in this section are applicable to auxiliary systems only. All instruments, meters and recorders shall be enclosed in dust proof, moisture resistant, black finished cases and shall be suitable for tropical use. They shall be calibrated to read directly the primary quantities. They shall be accurately adjusted and calibrated at the factory and shall have means of calibration, checking and adjustment at site.

3.16.4 Miscellaneous

- 1) The Supplier shall submit all type and routine test certificates to the Employer & Purchaser for approval before dispatching the equipment. Control and relay panels shall also be subjected to the following tests:
 - i) Mechanical operation test
 - ii) Verification of degree of protection as per IS-13947:Part I
 - iii) High voltage test
 - iv) Electrical control, Interlock and sequential operation test
 - v) Verification of wiring as per approved schematic.
- 2) Plug Point: 240V, Single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15 Amps pin round standard Indian plug, shall be provided in the interior of each cubicle with ON-OFF switch.
- 3) Interior Lighting: Each panel shall be provided with a CFL lighting fixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch. Adequate lighting shall also be provided for the corridor in Duplex panels.
- 4) MCB's: Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB).



- 5) Space Heater: Panels wherever required shall be provided with a space heater rated for 240V single phase, 50 Hz Ac supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with thermostat and switch fuse /MCB unit.

3.16.5 Terminal blocks and wiring

All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be 650 V grade and have 10 Amps. Continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.

Disconnecting type terminal blocks for current transformer and voltage transformer secondary leads shall be provided. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

Spare terminals for Employer's use for upgrading to 6000 MW shall be provided wherever required. In addition, at least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

The terminal blocks shall be suitable for connecting the conductors of external cable on each side.

Terminal blocks shall be of (at least) 650V grade and have 10 amps continuous rating. These shall be moulded, complete with insulated barriers, stud type terminals, complete with washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud terminals with locking type. The terminal blocks shall be of reputed make subject to Employer's acceptance.

Terminal block design shall include a white fibre marking strip with clear plastic, /clip-on terminal covers. Markings on the terminal strips shall correspond to wire numbers on the wiring diagrams.

Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short-circuiting and earthing facilities.

The conducting part in contact with the cable shall preferably be tinned or silver-plated however; nickel-plated copper shall also be acceptable. Insulating barriers shall be provided between the terminal blocks.

Manufacturer's standard practice for internal wiring of cubicles shall be acceptable to the Employer. However all external cabling requirements shall be strictly as per TS.

The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.



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3.17 Degree of protection

The enclosures of the control cabinets, Junction boxes and Marshalling boxes, panels etc. to be installed as detailed here under:

The minimum requirements for panels are as follows:

Installed out door: IP- 55

Installed indoors in air-conditioned area: IP-32

Installed in covered area: IP-52

Installed indoors in non air-conditioned area where possibility of entry of water is limited: IP-41.

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

3.18 Welding and welders' qualifications

All welding shall be in accordance with the corresponding standards of the American Welding Society or the American Society of Mechanical Engineers. Welding shall comply with powergrid approved quality plan.

Other standards to determine the quality of welding processes and qualifications of welders may be considered, provided that sufficient information is first submitted for the approval of the Employer.

Prior to the start of fabrication, the Supplier shall submit to the Employer for approval, a description of each of the welding procedures which he proposes to adopt, together with certified copies of reports of the results from tests made in accordance with these procedures.

The Supplier shall be responsible for the quality of the work performed by his welding organization. All welding operators shall be assigned to the work, including for repair of castings, shall pass the required tests for qualification of welding procedures. The Employer reserves the right to witness the qualification tests for welding procedures and operators and the mechanical tests of the samples. If the Inspector so requires, the Supplier shall furnish to the Inspector certified copies of reports of the mechanical test results of the samples.

The Supplier shall bear all his own expenses in connection with the qualification tests. If the work of any operator at any time appears questionable, such operator shall be required to pass appropriate re-qualification tests as specified by the Inspector and at the expense of the Supplier.

Strict measures for quality control shall be exercised throughout the Equipment/Works. The Engineer may call for an adequate NDT test of the work of any operator, who, in his opinion, is not maintaining the required standard of workmanship. Should this NDT test prove defective, all work done by that operator, since his last test shall be tested at the Supplier's expense. If three or more of these tests prove defective, the operator shall be removed from the project.

A procedure for the repair of defects shall be submitted to the Employer for his approval prior to any



repairs being made.

3.19 Motors

All motors shall conform to IEC-60034-5 / IS Standard and with principal dimensions in accordance with IEC 60072-1 (1991), IEC 60072-2 (1990) and IEC 60072-3 (1994).

Motors rated 0.5 kW and above, and reversing motors, shall be rated 415 V, three phase, grounded neutral;

Motors rated below 0.5 kW shall be rated 240 V one phase;

All motors shall be designed to operate at full load dynamic conditions with a voltage range of variation of +10%, -20% and a frequency range variation of +5%,-10%. Motors shall also be designed to operate at 125% of the rated speed without mechanical damage, and to start with 80% of their rated voltage;

All motors shall be designed and rated for continuous operation at maximum ambient temperature of 50°C. The class of insulation shall be at least one class higher than used for defining the temperature rise of the motor;

Vertical motors rated 60 kW and above shall be provided with oil-lubricated self-cooled pivoted shoe-type thrust bearing. Vertical motors below 60 kW shall be provided with re-greasable anti-friction ball or roller bearings;

All anti-friction bearings shall be guaranteed to operate successfully for a minimum of 131,000 hours;

All bearings shall be quiet operating and statically and dynamically balanced;

All belts to be used shall be "V" type and designed for the maximum power to be transmitted and for the maximum speed. The selection of the "V" belt drive for any application shall also be based on the nature of the load and the type of the driving unit. Belts installed outdoors shall be suitably protected.

3.20 Conduits, pipes and accessories

The Supplier shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes etc. including all necessary sundry materials, such as tees, elbows, check-nuts, bushings, reducers, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes etc. The size of the conduit/pipe shall be selected to limit the fill to a maximum of 40%. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed in an approved manner to prevent damage to threaded portions and entrance of moisture and foreign materials.

PVC conduits shall be of high impact, heavy gauge (at least class 2) conduit conforming to BS-4607.

The outer surface of the steel conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel



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pipes shall be hot-dip galvanized. All rigid conduits/pipes shall be of a reputed make.

The hume pipes and accessories shall be of reinforced concrete conforming to class NP2 of IS-458. All tests on hume pipes shall be conducted as per IS-458.

Flexible conduits shall be of heat-resistant lead coated steel, water-leak, fire and rust proof.

3.21 Packaging & protection

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Purchaser, the Supplier shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Purchaser to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Supplier shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, warping and other such charges claimed by the transporters, railways etc. shall be to the account of the Supplier. Purchaser takes no responsibility of the availability of the wagons.

All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

3.22 Auxiliary supply

The sub-station auxiliary supply is normally met through a system having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform to the parameters as indicated in the following :

Table 24 - 3 Table for Auxiliary Supply

<i>Normal Voltage</i>	<i>Variation in Voltage</i>	<i>Frequency in Hz</i>	<i>Phases</i>	<i>Neutral Connection</i>
415V	± 10%	50 ± 5%	3 or 4 Wire	Solidly Earthed
240 V	± 10%	50 ± 5%	2 Wire	Solidly Earthed
220V	190 - 242	DC	-	Isolated 2 wire system DC unearthed system
48 V	41 - 52.8	DC	-	Isolated 2 wire system positive pole directly earthed

Combined variation of voltage and frequency shall be limited to ± 10%.

3.23 Lamps and sockets

Lamps



All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters. Degree of protection for outdoor switch sockets shall be IP55.

Hand Lamp

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

Switches and Fuses

Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses. All fuses shall be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

3.24 Availability spares

The Supplier shall supply the spare parts required to meet the specified guaranteed availability, and shall include such spare parts in the scope of supply. The detailed lists of spare parts to meet the guaranteed reliability & availability requirements shall be part of the contract documents. However if it is found during detailed engineering and/or Reliability & Availability prediction calculation that additional spares are required to meet target values, the same shall be made available by the Supplier without any additional cost to the Employer.

3.25 Commissioning spares

The Supplier shall supply additional spares which he expects to consume during installation, testing and commissioning of the systems. The quantity of these spares shall be decided based on his previous experience, such that site work shall not be hampered due to non-availability of these spares.

3.26 Tools & tackles

The Supplier shall also supply at each site one set of all special tools & tackles, testing equipment, handling equipment, etc. which are required by the Employer's maintenance staff to maintain the stations successfully.

3.27 Seismic force consideration



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All structures shall be designed for seismic forces in accordance with IS-1893.

The seismic design of electrical equipment shall be performed using estimated actual earth/ ground motion, defined by a response spectrum, rather than the equivalent loads specified in typical Building Codes.

For brittle materials like glass, porcelain and glass fibre reinforced plastic the maximum calculated load should not exceed 2/3 of the guaranteed minimum rupture (breaking) strength (safety factor 1.5) as defined by the manufacturer/supplier of the material used. The minimum rupture value is defined as $(X - 2 \cdot \sigma)$, where X is the mean value and 'sigma' is the standard deviation. For load combinations in porcelain insulators and similar the following expressions shall be fulfilled:

$$\{F_t / (F_t)_b\} + \{M_b / (M_b)_b\} < 2/3 \text{ and} \\ \{F_c / (F_c)_b\} + \{M_b / (M_b)_b\} < 2/3$$

Where:

F_t, F_c, M_b : calculated maximum tensile force; compressive force and bending respectively

(F)_t, (F)_c, (M)_b : corresponding guaranteed strength values

(For normal operating loads, a higher safety factor more than 1.5 shall be used, normally 2.0-2.5 depending on type of load as per recommendations of manufacturer).

Factor regarding importance of structures (I), as defined in IS-1893, shall not be taken less than 1.5.

3.28 Safety requirements

The requirements regarding provision of additional staircases and approachability as defined in the Fire Protection Manual, issued by the Regional Committees of the Tariff Advisory Committee shall be completely fulfilled. All other safety requirements shall be met as per the factories Act, TAC etc.



ANNEXURE-A
Corona and Radio Interference Voltage (RIV) Test

1. General

Unless otherwise stipulated, all equipment (except Auto Transformer & Shunt Reactor) 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 by measurement of radio interference voltage (RIV). The test procedure shall be reviewed for different equipment during submission of MQP/ITP.

2. Test Levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3. Test Methods for RIV:

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 -1. 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 results 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 measurements 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% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 400 kV, 220 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 recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise level meter.

4. Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130% of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130 %, test



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shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, 115% and 130%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

- 4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
- 4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
- 4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.
- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

SECTION-5
GUARANTEED TECHNICAL PARTICULARS

SL.NO	PARTICULARS
1.0	GENERAL :
i)	Name and address of the Manufacturer :
ii)	Location of factory
2.0	Cable Type :
i)	Type and size of cable
ii)	Standard applicable
iii)	Voltage rating
iv)	Permissible variation in voltage, frequency and combined voltage and frequency
v)	Suitable for earthed/unearthed system
3.0	Conductor and its Hardness :
i)	Material copper/aluminium (indicating grade)
ii)	Nominal cross sectional area
iii)	Form of conductor circular/shaped
iv)	Minimum No. of strands
v)	Nominal dia. of each strand
vi)	Whether strands are tinned or not
vii)	Temperature co-efficient of resistance at 20 °C per °C
4.0	Insulation :
i)	Material (mention type)
ii)	Minimum average thickness
iii)	Tolerance on the smallest of the measured values of thickness of insulation
iv)	Dia. of core over insulation
v)	a) Min. volume resistivity at 27 Deg C b) Min. volume resistivity at 70 Deg C

SECTION-5
GUARANTEED TECHNICAL PARTICULARS

- vi) Colour scheme of identification of cores
 - vii) Average dielectric strength
 - viii) Suitability with regard to moisture, ozone, acid, oil and alkaline surroundings
- 5.0 Inner Sheath:**
- i) Material (mention type)
 - ii) Whether extruded
 - iii) Minimum thickness of inner sheath
 - iv) Calculated diameter over stranded cores of the cables
 - v) Calculated diameter over inner sheath
 - vi) Whether the inner sheath and the filling material are suitable for the operating temperature of the cable
- 6.0 Armour**
- i) Material
 - ii) Type
 - iii) Nominal Diameter of wire
 - iv) Short Circuit Carrying capacity of Armour
(For 1 sec)
- 7.0 Outer Sheath / Overall Covering :**
- i) Material (mention type, if any)
 - ii) Whether extruded
 - iii) Minimum average thickness (mm)
 - iv) Tolerance on the smallest of the measured values of thickness of outer sheath
 - v) Calculated dia under sheath (mm)
 - vi) Whether anti-termite treatment has been given in the outer sheath
 - vii) Outer sheath tested for FRLS properties

SECTION-5
GUARANTEED TECHNICAL PARTICULARS

- 8.0 Electrical Properties :**
- I) Maximum DC conductor resistance at 20 °C
 - II) Maximum permissible conductor temperature :
 - a) Under continuous full load
 - b) Under transient conditions
 - III) Loss tangent at normal frequency
 - IV) Reactance at 50 c/s per Km at 50 ° C
 - v) Capacitance at 50 c/s per Km.
 - vi) Current rating (A)
 - a) In air (continuous)
 - b) Reference ambient temperature for the above
 - c) Short circuit current rating for 1 sec. Duration (kA)
 - vii) Derating factor for an ambient temperature of 50°C
- 9.0 Mechanical Data :**
- i) Overall dia of the cable (mm)
 - ii) Tolerance in overall diameter (mm)
 - iii) Weight of cable per km.
 - iv) Total volume of non-metallic material cm³/m
 - v) Total weight of non-metallic material in kg/m
 - vi) Drum length
 - vii) Tolerance on drum length
 - viii) Total weight of the drum
 - ix) Dimensions of the drum
 - x) Recommended minimum installation radius
 - xi) Maximum safe pulling force



DATASHEET FOR INSTRUMENTATION CABLE

1.	Manufacturer's Name
2.	Type of cable
3.	Reference design standards
4.	Voltage Grade
5.	Conductor size
6.	Conductor
	a) Reference Standard
	b) Material
	c) Grade
	d) No. of strands / Diameter of strands (mm)
7.	Insulation
	a) Reference standard
	b) Material
	c) Thickness (mm) Min/Nom./Max
	d) Minimum volume resistivity (in ohm cm) (i) at 27 deg C (ii) at 85 deg C
8.	Pair & Twisting
	a) Whether pairs are twisted
	b) Max. lay of twist (mm)

	c)	Pair / Unit identification
	d)	Unit Formation of four pairs with numbered polyester binder tape for cables more than 4P is provided.
9.	Shield	
	a)	Material
	b)	Min. Thickness over individual pair (in mm)
	c)	Min. Thickness of overall shield (in mm)
	d)	Overlapping
10.	Drain wire	
	a)	Reference standard
	b)	Material
	c)	Size (sq mm) / No. of stands / Diameter of strands (mm)
	d)	Separate drain wires for individual as well as over all shield provided.
11.	Fillers (if applicable) are non hygroscopic & flame retardant	
12.	Outer sheath	
	a)	Reference standard
	b)	Material
	c)	Min thickness of outer sheath.(in mm)
	d)	Min. Oxygen index (as per ASTM D 2863) in %
	e)	Min. Temp Index (in deg C as per ASTM-2863) at O ₂ index 21%
	f)	Max. Acid gas generation (as per IEC-60754-1) in % (by weight)
	g)	Max. Smoke density rating (as per ASTM-2843) in %

	h)	Color of outer sheath
13.	Complete cable	
	a)	Overall diameter of cable (mm)
	b)	Allowed Tolerance on overall diameter(mm)
	c)	Ovality at any cross-section not more than 1 mm
	d)	Variation in diameter not more than 1 mm
14.	Cable parameters at 20 deg C (+/- 3 deg. C)	
	a)	Max. Conductor loop resistance (in ohm/km)
	b)	Min. Insulation resistance (in Mohm x km)
	c)	Max. Mutual capacitance at 0.8 KHz (in nF/km)
	d)	Min. Cross talk for near end at 0.8 KHz (In dB)
	e)	Max. Attenuation at 1 KHz (dB/km.)
	f)	Max. Characteristic impedance at 1 KHz (in ohm)
	g)	Min Noise Interference (in dB) as per IEEE Transactions 1967
15.	Continuous maximum operating temp (deg. C)	
16.	Whether complete cable assembly flame retardant as per Specification	
17.	Whether complete cable assembly passes Swedish chimney test as per SEN 4241475 (Class F3)	
18.	Identification	
	a)	Progressive automatic on-line sequential marking of length in meters at every one meter on outer sheath
	b)	FRLS marked at every 5 meter

	c)	Durable marking at intervals not exceeding 625 mm including- Manufacturer's name, Conductor's size, Insulation Material, Number of pairs, Type Of Cable, Voltage Grade, Year of manufacturer.
19.	Test voltage	
	a)	High voltage test (Dielectric strength)
	i)	Voltage (kV)
	ii)	Duration (in min)
	b)	Resistance to direct current test
	i)	Voltage (in Volts +/- 10%)
	ii)	Duration
20.	Cable Drums	
	a)	Length of single coil in a drum -
	b)	Tolerance on individual drum length w.r.t (a) above and tolerance on overall quantity
	c)	Wooden drum provided.
	d)	Identification marks provided on drum Manufacturer's name, Country of Manufacturing, Consignee Address, LOA No, Drum No, Length of cable, Nett & Gross Wt, Year of manufacture, Type /Size of cable, Voltage Grade

SECTION 5
CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN
THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

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

BHEL ENQUIRY. NO:

BIDDER: OFFER REFERENCE:

A) TECHNICAL PARAMETERS-

S. No.	Parameters	Data	Confirma tion	Remarks
1.	Applicable Standards	Latest IS -1554, 5831, 8130, 3975, 613, ASTM-D2843, ASTM-D2863, IEC60754, IEC60332, IS3961, IS 10418, SS4241475, NEMA WC-70, IEEE-383	Yes	
2.	Rated Voltage	1100V Grade	Yes	
3.	Construction feature for PVC Control and Aux Power cable			
3.1	Material of Conductor for Control cables	Plain annealed, High conductivity, Stranded Copper Conductor Grade EC (with Min. 7 strands)	Yes	
3.2	Material of Conductor for Power cables	Stranded Aluminium, Circular/ Sector shaped and compacted (with Min. 7 strands)	Yes	
3.3	Conductor Insulation	Extruded PVC, Type-A	Yes	
3.4	Overall Screening for Control Cable	Aluminium tape (Which is conducting on both sides) of minimum thickness 0.2mm applied helically and with overlap. Drain wire (7/0.3mm ATC, 0.5sqmm) shall be Tinned and annealed true round copper wire applied longitudinally.	Yes	
3.5	Inner sheath	Extruded PVC, Type ST-1 as per IS 5831	Yes	
3.6	Armouring for Aux Power Cables	Aluminium round wire (H4 grade) for Single core And Galvanised Steel round wire/strip for Multi-core cables	Yes	
3.7	Outer sheath	PVC extruded, FRLS, Type ST-1 , (as per IS:5831) , Category C2 as per IS 1554 (Part-I) with Oxygen Index > 29, Temperature Index > 250°C , Acid Gas generation be weight (IEC 754-1) ≤20%, Light Transmission (ASTM-D-2843) ≥40%	Yes	

S. No	Parameters	Data	Confirmation	Remarks
4.	Construction feature for XLPE Aux Power cable			
4.1	Material of Conductor for Power cables	Stranded Aluminium grade H2(electrolytic Grade) with min 7 strands; Circular/ Sector shaped and compacted	Yes	
4.2	Conductor Insulation	XLPE	Yes	
4.3	Inner sheath	Extruded PVC. Type ST-2 as per IS 5831	Yes	
4.4	Armouring for XLPE Aux Power Cables	Aluminium round wire (H4 grade) for Single core And Galvanised Steel round wire/Strip for Multi-core cables	Yes	
4.5	Outer sheath	Extruded PVC, Type ST2 as per IS 5831, FRLS , Category C2 as per IS 7098 (Part-I) with Oxygen Index > 29, Temperature Index > 250°C , Acid Gas generation be weight (IEC754-1)) ≤20%, Light Transmission (ASTM-D-2843) ≥40%	Yes	
5.	Construction feature for Instrumentation cable			
5.1	Material of Conductor	High conductivity Multi Stranded, Annealed Tin Coated Copper Conductor	Yes	
5.2	Conductor Insulation	PVC as per VDE	Yes	
5.3	Individual Screen	Individual screen with Aluminium Mylar Tape and Annealed Tinned stranded Copper Drain Wire	Yes	
	Overall Screen	Overall screen with Aluminium tape (Which is conducting on both sides) of minimum thickness 0.2mm and Annealed Tinned stranded Copper Drain Wire	Yes	
5.4	Inner Sheath	Extruded PVC as per VDE 0207	Yes	
5.5	Outer sheath	PVC as per VDE 0207, FRLS , Category C2 as per IS 1554	Yes	
6.	FRLS properties of Outer sheath			
6.1	Minimum Oxygen index	29 as per IS 10810 part-58	Yes	
6.2	Minimum Temperature index	250°C	Yes	
6.3	Acid gas emission	Max 20% as per IEC-754-I	Yes	
6.4	Smoke density rating	Max 60% as per ASTM-D-2843	Yes	
7.	Allowable Tolerance on overall diameter	± 2mm	Yes	

8.	Chemicals added to outer sheath to protect from rodent, vermin and termite attack	Yes	Yes	
8.	Drum lengths of each Power ,Control Cable & Instrumentation Cable	As per Clause 1.6 of Section I of TS	Yes	
9.	Tolerance on Cable Length per Drum.	+/-5% of the standard drum length.	Yes	
	Tolerance on total quantity of each size	+/-2%	Yes	
11	Minimum bending radius for multicore cables	12 x D	Yes	
12	Core Identification / markings		Yes	
12.a	For control cables & Power Cables	By colour coding as per IS 1554 Part-I /IS 7098 Part-I for cables upto 5 (Five) cores and for cables wit more than 5 cores , by printing legible Hindu Arabic numerals on all cores as per Clause 10.3 of IS 1554 (Part-I)	Yes	
12.b	For Instrumentation Cables`	Conductor /Pair Identification as per VDE 0815	Yes	

B) TYPE TESTS

i)Type , Acceptance and routine tests shall be performed on each type and size of the offered cable as per approved MQP

(YES)

C)

S.No.	Description	Confirmation of Supplier
1.	Bidder to confirm that all drawings /data sheet /QP/test reports / all relevant information shall be submitted to BHEL for organizing approval of ultimate customer	

Date:

**Signature of the authorized representative of Bidder
Company Seal**