HT XLPE CABLE

GeM Tender Enquiry for HT XLPE CABLE for 4X270 MW BHADRADRI TPS -FGD

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Project: - 4X270 MW BHADRADRI TPS -FGD

Package: - HT XLPE CABLE

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ANNEXURE –I

Additional clauses of NIT

1. **Dispatch Markings: -**

Each box shall be marked with Capital Letters in "Red" indicating the PEM supply (Main Supply OR Commissioning spare) for **4X270 MW BHADRADRI TPS -FGD**. Each package delivered under the Contract shall be marked by Supplier and such marking must be distinct and in English Language (all previous irrelevant markings being carefully obliterated). Such marking shall show the description and quantity of contents, the name and address of consignee, the Gross weight and Net weight of the package, the name of the Supplier, PEM P.O. reference number, with a distinctive number of mark sufficient for purposes of identification. Besides above necessary, packing shall bear a special marking `TOP', `BOTTOM', 'DO NOT TURN OVER", "KEEP DRY", "HANDLE WITH CARE", etc.

IMPORTANT

- Two copies of respective standard manufacturer's erection instruction/operation instruction manual shall be kept in each package / container for immediate reference by BHEL site and same shall be reflected in packing slip also
- The Packing list details for the consignment must be put inside the Box/Boxes.

2. **Liquidated Damages: -**

a) **Main Supply:-** Purchaser reserves the right to recover from the Seller/ Contractor, as agreed liquidated damages and not by way of penalty, a sum equivalent to half (½) percent and applicable GST thereon, of the total main supply & commissioning spares contract price excluding GST per week or part thereof, subject to a maximum of ten(10) percent of the total main supply & commissioning Spares contract price excluding GST, if the Seller/ Contractor fails to deliver any part of the ordered goods/stores within the period stipulated in the Order/ Contract.

NOTE:

i. LR/RR date for indigenous supplies (Bill of Lading/AWB for Foreign supplies) shall be treated as the date of dispatch for levying LD. However, if receipted LR date for indigenous supply is beyond 30 days for FTL/ 45 days for PTL from the date of LR (PTL to be clearly mentioned in LR), such excess period shall be considered for LD purpose irrespective of dispatch date. Import General Manifest (IGM)/Bill of entry date (whichever is earlier), for foreign supplies, is beyond 90 days from the date of Bill of Lading/AWB, such excess period shall be considered for LD purpose irrespective of dispatch date.

ii. In case of any amendment/ revision, LD shall be linked to the amended/ revised contract value and delivery date(s).

iii. If Order/ Contract involves two or more Units/ Sets/ Lots/ Stages, then Liquidated Damages shall be levied on order/ contract value excluding GST of the delayed Unit/ Set/ Lot/ Stage, provided delivery stipulated in the Order/ Contract is Unit/ Set/ Lot/Stage wise, however total LD amount shall be limited to 10% of total order/ amended order value excluding GST of delayed Unit/ Set/ Lot/Stage. Any subsequent lot released (not envisaged in original

contract) due to increase in quantity within permissible quantity variation shall be treated as separate lot for the purpose of LD.

iv. The sum specified above is not a penalty but a genuine pre-estimate of the loss/ damage which will be suffered by purchaser on account of delay on the part of the Contractor/Seller and the said amount will be deductible without proof of actual loss or damage caused by such delay.

3. Risk & Cost Purchase

BHEL reserves the right to terminate the contract or withdraw portion of work and get it done through other agency, at the risk and cost of the contractor after due notice of a period of 14 days' by BHEL in any of the following cases:

i) If the Seller/Contractor fails to deliver the goods or materials or any instalment thereof within the period(s) fixed for such delivery or the Seller's poor progress of the supply/ services vis-à-vis delivery/execution timeline as stipulated in the Contract, backlog attributable to seller including unexecuted portion of supply does not appear to be executable within balance available period;

ii) Delivers goods or materials not of the contracted quality and failing to adhere to the contract specifications;

iii) Withdrawal from or repudiation/ abandonment of the supply/ services by Seller before completion as per contract or if the Seller refuses or is unable to supply goods or materials covered by the Order/Contract either in whole or in part or otherwise fails to perform the Order/Contract;

iv) Non-supply by the Seller within scheduled completion/delivery period as per Contract or as extended from time to time, for the reasons attributable to the Seller;

v) Termination of Contract on account of any other reason (s) attributable to Seller.

vi) Assignment, transfer, subletting of Contract without BHEL's written permission resulting in termination of Contract or part thereof by BHEL.

vii) If the Seller be an individual or a sole proprietorship Firm, in the event of the death or insanity of the Seller;

viii) If the Seller/Contractor being an individual or if a firm on a partnership thereof, shall at any time, be adjudged insolvent or shall have a receiving order for administration of his estate made against him or shall take any proceeding for composition under any Insolvency Act for the time being in force or make any assignment of the Order/Contract or enter into any arrangement or composition with his creditors or suspend payment or if the firm dissolved under the Partnership Act;

ix) If the Seller/Contractor being a company is wound up voluntarily or by order of a Court or a Receiver, Liquidator or Manager on behalf of the debenture holders and creditors is appointed or circumstances shall have arisen which entitles the Court of debenture holder and creditors to appoint a receiver, liquidator or manager;

x) Non-compliance to any contractual condition or any other default attributable to Seller.

Such defaulting vendor/Seller shall not be eligible to participate in re-tendering conducted on account of risk purchase made due to fault of such vendor/Seller.

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

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

Risk & Cost Amount= [(A-B) + (A x H/100)]

Where,

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

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

H = Overhead Factor to be taken as 5

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

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

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

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

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

Substitute/ extra items whose rates have already been approved would form part of contract quantities for this purpose.

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

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

NOTE: In case portion of work is being withdrawn at risk & cost of contractor instead of termination of contract, contract

quantities pertaining to portion of work withdrawn shall be considered as 'Balance scope of work' for calculating Risk & Cost amount.

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

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

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

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

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

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

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

v. LD shall be calculated in line with LD clause (clause 16) of the Contract for the delay attributable to contractor taking "X" as Contract Value and "T2" as period of delay attributable to contractor.

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

Without prejudice to the other means of recovery of such dues from the Seller recoveries from the Seller on whom risk & cost has been invoked shall be made from the following:

a) Dues available in the form of Bills payable to seller, SD, BGs against the same contract.

b) Dues payable to seller against other contracts in the same Region/Unit/ Division of BHEL.

c) Dues payable to seller against other contracts in the different Region/Unit/ division of BHEL.

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

4. For recognition of dispatch, vendor to submit following documents to BHEL by e-mail/ fax immediately on dispatch: - GST compliant invoice, LR for Indian Vendors (indicating Invoice No., no. of boxes, PTL (if applicable) etc.) / Bill of Lading or AWB for foreign vendor, Packing List (Must be indicating No. of boxes, Packing size, Gross weight and net weight of each package, Contents of the package with cross reference to BoM item code no. or item serial no. and Quantity of each item separately), Insurance Intimation to underwriter through email/fax, Dispatch Clearance.

B. Following ATC available in GEM shall also be part of NIT: -

i. Bidder's offer is liable to be rejected if they don't upload any of the certificates / documents sought in the Bid document, ATC and Corrigendum if any.

ii. Bidders are advised to check applicable GST on their own before quoting. Buyer will not take any responsibility in this regards. GST reimbursement will be as per actuals or as per applicable rates (whichever is lower), subject to the maximum of quoted GST %.

iii. Data Sheet of the product(s) offered in the bid, are to be uploaded along with the bid documents. Buyers can match and verify the Data Sheet with the product specifications offered. In case of any unexplained mismatch of technical parameters, the bid is liable for rejection.

iv. The bidder is required to upload, along with the bid, all relevant certificates such as BIS license, type test certificate, approval certificates and other certificates as prescribed in the Product Specification given in the bid document.

v. While generating invoice in GeM portal, the seller must upload scanned copy of GST invoice and the screenshot of GST portal confirming payment of GST.

VI. OPTION CLAUSE: The Purchaser reserves the right to increase or decrease the quantity to be ordered up to 25 percent of bid quantity at the time of placement of contract. The purchaser also reserves the right to increase the ordered quantity by up to 25% of the contracted quantity during the currency of the contract at the contracted rates. Bidders are bound to accept the orders accordingly.

VII. Nominated Inspection Agency: On behalf of the Buyer organization, any one of the following Inspection Agency would be conducting inspection of stores before acceptance:
Pre-dispatch Inspection at Seller Premises (applicable only if pre-dispatch inspection clause has been selected in ATC): BHEL TPIA
Post Receipt Inspection at consignee site before acceptance of stores: NA

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Additional Terms and Conditions for subject Tender Enquiry to be complied by Bidders for Consideration in this tender:

A. Bidders to ensure that Third party/Customer issued certificates being submitted as proof of PQR qualification should have verifiable details of document/certificate issuing authority such as name & designation of Issuing Authority and its organization contact number and E-mail Id. In case the same is found not available, BHEL has the right to reject such document from evaluation.

B. "This item /package/system falls under the list of items defined in para 3 of ministry of finance guideline date 20.09.16 (procurement of items related to public safety, health, critical security operations and Equipment's etc.) & hence criteria of prior experience /turnover shall be same for all bidders including start up /MSME".

C. **Guarantee & Warrantee** shall be as per Cl. No. 10 of GTC on GeM for the bid. However, Guarantee & Warrantee time period shall be 18 months from the date of last supply in the contract for Main Supply.

D. Evaluation shall be on the basis of total all inclusive, landed price at consignee destination (Refer cl. No. 6 of GTC on GEM).

E. **Terms of Delivery**: - Terms of delivery shall be F.O.R. dispatch station. All dispatches shall be through Road Carriers on Freight Pre-Paid basis. Road Permit/E-way Bill if required will be arranged by Supplier. However, loading & Transit insurance shall be in the scope of Seller and unloading of items at delivery point shall be in the scope of BHEL. Bidder to quote prices accordingly.

F. Further, w.r.t. Transit Insurance supplier has to inform the details of dispatches (such as Policy No., Consignee Name, Consignment Packing details, Project Name, Purchase Order No., LR No. & date, Invoice No. & date, Dispatch Origin & destination details etc.) to policy underwriter.

G. Bidder has to provide the details as per TECHNICAL PQR (attached with Specifications of product catalogue) in its offer and has to note that bids of only those bidders shall be evaluated who meet the Technical Pre-Qualifying requirements'. The terms of technical PQR shall prevail in conflict (if any).

H. PQR criteria uploaded with Buyer uploaded Bid Specific document shall prevail Value of Experience criteria and Past performance parameter mentioned in GeM bid.

I. **Inspection call to be raised by bidder on BHEL CQIR portal** (details shall be shared at the of execution of order) and Inspection agency shall attend at the inspection within seven (07) days of the date on which the material is notified as being ready. In case of delay in witnessing of inspection beyond stipulated time (i.e. 7 days from the date on which the material is notified as being ready), by BHEL arising due to reasons not attributable to vendor, BHEL will extend the delivery period for such delay in carrying out inspection. If BHEL is not able to witness inspection up to 15 days then in addition to delay beyond stipulated period, extension in delivery time of 07 days for arranging fresh inspection will be given.

When the tests have been satisfactorily completed at Seller/ Contractor's works, the Inspection Agency shall issue an inspection report that effect within seven (07) days after completion of the tests, but if the tests were not witnessed by the Inspection Agency or his representative, the material acceptance report would be issued within seven (07) days after receipt of the test certificates by the Purchaser.

Purchaser will issue MDCC to the Seller/ Contractor within 7 days based on inspection report/ test certificates/Certificate of Conformance as applicable. In case of delay in issuance of MDCC beyond 7 days stipulated time (i.e. from the date of successful inspection report), by BHEL arising due to reasons not attributable to vendor, BHEL will extend the delivery period for such delay in issuing MDCC. If BHEL is not able to issue MDCC up to 15 days then in addition to delay beyond stipulated period, 7 days' additional time shall be given to vendor to facilitate the vendor for arranging logistics arrangements.

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J. All Bidders shall be required to submit applicable Freight % & GST % included in their prices during clarification stage of Tender.

K. Performance Bank Guarantee: shall be as per Cl. No. 7 of GTC of GeM. Performance Security amount shall be @5% of the value of contract value. In case any benefit with respect to BG reduction is applicable at later stage, then similar benefit shall be passed onto the bidders for subject tender as well.

L. **Payment Terms:** For Supply Portion : - As per clause no. 12 (i) of GTC on GeM. Supplier has to provide original+1 copy of Tax invoice, Packing List, LR/RR or AWB, CRAC, Insurance intimation, Guarantee Certificate, E-way bill (as applicable) for payment.

Offline payment mode shall be selected. Payment will be released within 90 days for Non MSME after submission of complete documents (45 days for Micro & Small Enterprises (MSEs), 60 days for Medium Enterprises.

M. **Bid reserved for Make in India products: -** Procurement under this bid is reserved for purchase from Class 1 local suppliers as defined in public procurement (Preference to Make in India), Order 2017 as amended from time to time and its subsequent Orders/Notifications issued by concerned Nodal Ministry for specific Goods/Products. The minimum local content to qualify as a class 1 local supplier is denoted in the bid document as **SIXTY (60)%**. All bidders must upload a certificate from the OEM regarding the percentage of the local content and the details of locations at which the local value addition is made along with their bid, failing which the bid is liable to be rejected.

Regarding verification of local content, the local supplier at the time of tender, bidding or solicitation shall be required to provide certification (as per enclosed annexure-IV) as per para 9 of PP-MII order revision dated 16.09.2020.

N. **This is conditional tender enquiry. Financial bid opening (Part-II) of a bidder shall be subjected to following: -**

(i) Techno-Commercial evaluation/recommendation by BHEL.

(ii) Qualification of Technical PQR

(iii) Offered item should mandatorily conform to PP-MII order provisions.

(iv) Approval of vendor from end Customer **(**TSGENCO**).** shall be taken up by BHEL**-**PEM with customer**.** Bidders who are not approved from TSGENCO **(**end customer**)** should furnish the credentials as per TSGENCO **(**end customer**)** format **– (**Annexure –A**)** along with their bid**.**

O. **Consignee Details** (for PRC - Provisional Receipt Certificate & CRAC - Consignee's Receipt cum Acceptance Certificate, as applicable) shall be as per Project Site official details.

P. The Bidder has to declares that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process. In case, the bidder is found having indulged in above activities, suitable action shall be taken by BHEL as per extant policies/guidelines.

Q. **Bidders to ensure the following: -**

• Ensure compliance to Ministry of Power (MoP) Order No. 11/05/2018Coord. dt. 28/07/2020, if applicable.

• Ensure compliance of Ministry of Finance (MoF) Order (Public Procurement No. 1 & 2) F. No. 6/18/2019/PPD dt. 23/07/2020.

• to submit "Model Certificate for Tenders" as per Annexure-III of Ministry of Finance (MoF) Order (Public Procurement No. 1 & 2) F. No. 6/18/2019/PPD dt. 23/07/2020. Bidder to submit the following undertaking on their letter head duly signed from the highest competent authority at your end (i.e Owner, partner, CMD, Director etc.)

"I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India; I hereby certify that this bidder is not from such a country and is eligible to be considered"

Note: - This bidder is to be replaced with bidders' organizational name.

R. Delivery Period : Delivery Days (365 days from the date of PO) mentioned in GeM bid is to be treated as currency of the contract period. However, vendor to consider Delivery period as given at page no. 13-15 i.e . " Delivery completion for Main supply–shall be 150 days from the PO date. other terms of delivery mentioned at page no. 13-15 of this ATC. Also refer tender documents for delivery schedule.

S. For registration in BHEL PEM- Online registration portal is operational, Non-registered Vendors who wish to apply for registration in BHEL-PEM can apply through Online Registration Portal available at www.pem.bhel.com - vendor section - Online Supplier Registration. All credentials and/or documents duly signed and stamped related to registration can be uploaded on the website and submit the application for registration. However, registration of suppliers is not mandatory in case of open tender

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

a) They have controlling partner (s) in common; or

b) They receive or have received any direct or indirect subsidy/financial stake from any of them; or

c) They have the same legal representative/agent for purposes of this bid; or

d) They have relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the bid of another Bidder; or

e) Bidder participates in more than one bid in this bidding process. Participation by a bidder in more than one bid will result in the disqualification of all bids in which the parties are involved. However, this does not limit the inclusion of the components/sub-assembly/sub-assemblies from one bidding manufacturer in more than one bid; or

f) In cases of agents quoting in offshore procurements, on behalf of their principal manufacturers, one agent cannot represent two manufacturers or quote on their behalf in a particular tender enquiry. One manufacturer can also authorise only one agent /dealer. There can be only one bid from the following:

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

Or

g) A Bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the contract that is the subject of the Bid; or

h) In case of a holding company having more than one independently manufacturing units, or more than one unit having common business ownership/management, only one unit should quote. Similar restrictions would apply to closely related sister companies. Bidder must proactively declare such sister/common business/management units in same/similar line of business.

U. Instructions to Packing List (annexure –III) and Certification reg. Local content (annexure –IV) to be complied by bidders.

V. Quantity Variation: - Maximum Qty Variation shall be quantity variations as +25%, bidder to quote accordingly. The Purchaser reserves the right to increase or decrease the quantity to be ordered up to 25 percent of bid quantity at the time of placement of contract**.**

W. (a) PVC is applicable for this package.
(b) PVC ceiling limit shall be positive (+ve) 20% and negative (-ve) unlimited
(c) PVC formula shall be attached with tender documents.

X. All the Buyer Added Bid Specific Additional Terms and Conditions shall supersede relevant terms & conditions of GeM GTC and shall prevail in case of conflict with any other terms & conditions of tender (if any).

Y. All other terms & conditions shall be as per selected Additional Terms & Conditions for subject bid from GeM library and GTC version 4.0 (Version 1.10) available on GeM Portal on enquiry floating date shall be applicable.

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An undertaking regarding Model Clauses (To be provided alongwith bid)

Refer,

PROJECT	**:- 4X270 MW BHADRADRI TPS -FGD**
PACKAGE	**:- HT XLPE CABLE**
Primary product category on GeM	:-……
BID No. (Through GeM)	**:- ……., Dtd. ……**

M/s ……..

Reference:

TO WHOM SO IT MAY CONCERN

This is with reference to Ministry of Finance circular dated 23.07.20 reg. restriction under rule 144 (xi) of GFR.

"I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India. I hereby certify that M/s …… .is not from such a country and is eligible to be considered against GeM enquiry no: **…….., Dtd. ……**"

Sign & Signature

Date:

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ANNEXURE -III TO INSTRUCTIONS TO PACKING LIST

For faster verification of bills, successful bidder to submit detailed Bill of Material (BOM) at the time of drawings/ documents submission after placement of PO. Each item of the BOM to be uniquely identified with item code no. or item Sl. No. Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BOM.

Supplier to also give the following undertaking in the BOM:

"The BOM provided herewith completes the scope (in content and intent) of material supply under PO No. ……. Dated …… Any additional material which may become necessary for the intended application of the supplied items/package will be supplied free of cost in most reasonable time.

Packing List must indicate:

a) Packing size
b) Gross weight and net weight of each package
c) Contents of the package with cross reference to BOM item code no. / Sl. No.
d) Quantity of each items separately.

The packing list must cover all the BOM items.

Supplier to give following undertaking in the packing list:

The Packing list provided herewith is as per BOM approved under PO No. -----

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ANNEXURE IV

Letter head of Company

Ref…… Date……

To,
Bharat Heavy Electricals Limited
PEM, PPEI Building, Plot No 25,
Sector 16A, Noida (U.P)201301

Subject: Certification regarding local content

Reference: Tender Enquiry No **……., Dtd. ……..**

Name of Package: **HT XLPE CABLE .**

Dear Sir,

We hereby certify that items offered by us of **HT XLPE CABLE** for **4X270 MW BHADRADRI TPS -FGD**, M/s …….. …….. meets the requirement of minimum local content as a class – I local supplier in line with clause of NIT (GeM NIT) and the Public Procurement (Preference to Make in India), Order 2017 dated 15.06.2017, 28.05.2018 & 29.05.2019, 04.06.20 & 16.09.20

We further confirm that details of location at which the local value addition is made will be our registered works at

……
…(address of the works)

Yours very truly

…… (authorized signatory of company)

…… (firm name)

authorized signatory
of company

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Delivery Term

1. Delivery Schedule

a. **Main Supply including quantity variation:** Delivery completion for Main supply–shall be 150 days from the PO date.

Notes:

a. Supplier to start manufacturing/supply only after getting the applicable engineering Drgs. /docs approved from BHEL/End Customer.

b. Drawings /documents submission/re-submission schedule shall be as indicated in revised Annexure A on next page) shall be used for progress monitoring purpose and required course correction, if any.

c. The delivery date specified is for completion of the deliveries. Deliveries to start progressively so as to meet the completion schedule.

d. The delivery conditions specified are for contractual purposes. However, to meet project requirement, BHEL may ask for early deliveries without any compensation thereof.

2. **Validity of contract (PO rates, terms and conditions):** Vendor has to make supply of goods/services as per the delivery time mentioned above. However, due to unavoidable circumstances if delay happens in providing inputs/ clearances (inputs, Engineering approvals, deputing inspector for inspection, issuance of MDCC and any hold imposed owing to site issues etc.) for which delivery time extension is admissible as per point no.3, in such situation it shall be obligatory at vendor part to execute the contract at PO rates, terms and conditions where inputs/ clearances has been accorded within validity of contract. Validity period for various activities shall be as defined below or as mentioned in the NIT.

2.1. Validity of the contract for main supply including quantity variation.

- Contract shall be valid for 180 days from the PO date. However, delay at vendor's end (if any) shall be added to the validity period and contract validity shall get extended by the delay period at vendor's end.

For example: Original Delivery period for main supply: "150" A (in days)
if Delay at vendor's end: B (in days beyond "A" days)
Contract validity: C (180) + B (in days)

Notes:

a. B is the Vendor delay days beyond original contractual delivery period for main supply /extended delivery period owing to time taken by BHEL at point no. 2 above.

b. Main supply including quantity variation, **O&M Spares (Recommended Spares)** applicable in the contract released/ cleared for manufacturing within contractual validity period, to be supplied by vendor/supplier at PO rates, terms and conditions.

c. Execution of the contract quantities released beyond contract validity period shall be decided on mutual consent basis at PO rates, terms and conditions.

3. Delivery Extension: Extension of contractual delivery time:

Delivery time mentioned in the NIT includes Engineering completion time (time for drawing/document submission/resubmission by the vendor and review/approval of the same by the BHEL/End customer), manufacturing, inspection, Packing and dispatch time. Due diligence is to be observed by the vendor to ensure timely completion of engineering and supply.

During the execution of the contract, time loss occurred owing to the reason attributable to BHEL besides force majeure shall be considered for delivery time extension to the vendor as given below: -

i. Any Delay in providing comments/ approval on Primary drawing/documents beyond the stipulated time as specified in NIT.

ii. Time Loss in approval of the drawing/document as a result of increase in the iteration not attributable to the vendor (i.e. resubmission owing to end customer comments) as certified by BHEL. Time extension equivalent to the resubmission time noted in the tech. spec and consequential increase in the approval time in lieu of increase in iteration shall be applicable. However, for incomplete re- submission time loss shall be in vendor account.

iii. Delay in providing engineering input/material by BHEL.

iv. Delay in deputing inspector for inspection and delay in release of MDCC in line with GCC/ GEM ATC terms.

v. Any hold put by BHEL for whatever reasons during execution of contract (within contract validity period), time extension equivalent to hold period shall be admissible. However, in the event hold period continues for more than 30 days then, an additional fifteen days for the purposes of mobilization and demobilization of resources shall also be admissible.

Note: Extension in delivery period if any with or without imposition of LD shall be considered after detailed delay analysis based on provisions given above. However, no delay analysis will be applicable if supply is completed within delivery schedule as specified in Purchase order.

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Annexure – A

Drawings /documents submission/re-submission schedule

BHEL Drawing No.	*Drawing Title*	*Vendor Sub (Days)**	*Bhel comment (Days)*	*Vendor Sub (Days) #*	*Bhel and Customer comment/approval (Days)*	*Total Engg Time (Days)*
Primary Documents						
PE-V0-440-507-E103	CROSS SECTION DRGS. - HT XLPE CABLES	7	3	2	18	30
PE-V0-440-507-E912	QUALITY PLAN - HT XLPE CABLES	7	3	2	18	30
PE-V0-440-507-E101	TECHNICAL DATA SHEET - HT XLPE CABLES	7	3	2	18	30
Secondary Documents						
PE-V0-440-507-E104	TYPE TEST CERTIFICATES - HT XLPE CABLES	7	3	2	18	30

NOTES:

a) * 1st submission within indicated days from date of purchase order

b) # Submission (within indicated days) after incorporating all BHEL comments

c) Primary documents shall be considered for Delay analysis

CUSTOMER/ BHEL LOGO	VENDOR CREDENTIALS SUMMARY SHEET (TO BE FILLED BY BIDDER AND SUBMITTED WITH BID)

i.	Item/Scope		
ii.	Address of the registered office	Details of Contact Person (Name, Designation, Mobile, Email)	
iii.	Name and Address of the proposed vendor's works where item is being manufactured	Details of Contact Person: (Name, Designation, Mobile, Email)	
iv.	Annual Production Capacity for proposed item		
v.	Annual production for last 3 years for proposed item		
vi.	Details of proposed works		
1.	Year of establishment		
2.	Factory Registration Certificate	Details attached at Annexure – F2.1 (Page No....)	
3.	Overall organization Chart with Manpower Details (Design/Manufacturing/Quality etc.)	Details attached at Annexure – F2.2 (Page No....)	
4.	After sales service set up in India, in case of foreign sub-vendor(Location, Contact Person, Contact details etc.)	Applicable / Not applicable Details attached at Annexure – F2.3 (Page No....)	
5.	Sources of Raw Material/Major Bought Out Item	Details attached at Annexure – F2.4 (Page No....)	
6.	Quality Control exercised during receipt of raw material/BOI, in-process, Final Testing, packing	Details attached at Annexure – F2.5 (Page No....)	
7.	Manufacturing facilities (List of machines, special process facilities, material handling etc.)	Details attached at Annexure – F2.6 (Page No....)	
8.	Testing facilities (List of testing equipment)	Details attached at Annexure – F2.7 (Page No....)	
9.	Supply reference list including recent supplies (Preferably of reputed, well known clients to whom the vendor has supplied the material and are of quantum of item/scope at point (i) above)	Reputed client name (s)..... Details attached at Annexure – F2.8 (as per format given below) (Page No....)	

Project/ package	Customer Name	Supplied Item (Type/Rating/Model /Capacity/Size etc)	PO ref no/date	Supplied Quantity	Date of Supply

CUSTOMER/ BHEL LOGO	VENDOR CREDENTIALS SUMMARY SHEET (TO BE FILLED BY BIDDER AND SUBMITTED WITH BID)

10.	**Product satisfactory performance feedback letter/certificates/End User Feedback**	**Attached at annexure - F2.9 (Page No.…)**
11.	**Average annual turnover for last three years with documentary proof.**	
12.	**Summary of Type Test Report (Type Test Details, Report No, Agency, Date of testing) for the proposed product (similar or higher rating) Note:- Reports need not to be submitted**	**Applicable / Not applicable** **Details attached at Annexure – F2.10 (if applicable) (Page No.…)**
13.	**Copy of ISO 9001 certificate (if available)**	**Attached at Annexure – F2.11 (Page No.…)**
14.	**Product technical catalogues for proposed item (if available)**	**Details attached at Annexure – F2.12 (Page No.…)**

Name		**Desig**		**Sign:**		**Date :**	

Company's Seal/Stamp:-

BHADARDRI TPP

BOQ OF HT XLPE POWER CABLES

6.6/6.6 KV AL. CONDUCTOR/ XLPE INSULATED/ ARMOURED/ UNEARTHED GRADE POWER CABLE.

A)

Sl. No.	Cable Sizes	UOM	Quantity	Drum Length	Unit Price	Total Price
1	6.6 kV , 1C – 500 Sq.mm AL armoured cable	m	6000	a) 600 Meters drum –6 nos. (3600 mtrs.) b) 400 Meters drum - 6 nos. (2400 mtrs.)		

1.Total Quantity indicated above shall be known as Order Quantities. The total quantity variation shall be as per NIT.

2. Lot-I quantity indicated above shall be cleared for manufacturing along with LOI/PO. However, manufacturing of the cables shall be taken up by the successful bidder only after approval of technical and quality documentation.

3. Standard drum length shall be as per BOQ cum price schedule against each size of cable. Tolerance on individual drum length shall be ±5%. For each individual cable size, one short length of not less than 200m may be accepted only in the final drum length to complete the supply. The overall tolerance limits stipulated above shall continue to apply (in case short lengths are accepted).

4. Overall tolerance on total dispatched quantity of each size shall be (-) 2% and (+) 0% except where the total ordered quantity is one single drum length, in which case it shall be -5% to 0%. Cables consumed for testing and inspection shall be to bidder’s account.

5. In case of the quantities cleared by BHEL for manufacturing are manufactured and offered for inspection by successful bidder in more than one batch, BHEL reserves the right to witness type testing on all batches without any price implications.

6. Bidder shall indicate unit price of cables inclusive of type test charges, No separate charges shall be payable for type tests.

ITEMS: HT XLPE POWER CABLE **SCOPE: Supply: YES; Erection & Commissioning: NO;**	
1	Vendor should be a manufacturer of HT Cables
2	Availability of test reports on HT XLPE FRLS Power Cables to establish in-house capability to carry out all routine, type & acceptance tests as per relevant IS/International Standards (except UV Radiation & Hydrolytic Stability Test which can be conducted at Govt. lab/Govt. approved Independent lab).
3	Capacity of manufacturing 5 km of HT XLPE Power Cables per month
4	Manufactured and supplied at least one (1) km of FRLS cables of any voltage level .
5	Manufactured & supplied HT XLPE Power Cable sizes of minimum 500sqmm for single core cable.
6	Manufactured & supplied at least 5km of 11kV/6.6kV/3.3kV XLPE insulated power cables in one single order.
7	Minimum two (2) nos. purchase orders for HT XLPE Power Cables shall be submitted which should not be more than five (5) years old from date of techno-commercial bid opening.

Notes (General points of PQR):

1. Consideration of offer shall be subject to customer's approval of bidder, if applicable.
2. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self-attested English translated document should also be submitted.
3. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities & capacity of the bidder to perform the contract, should the circumstance warrant such assessment in the overall interest of BHEL.
4. After satisfactory fulfilment of all the above criteria/requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.
5. Bidder to submit test reports as per PQR Clause No. 2 to establish vendor has in-house facility to conduct all tests including Impulse withstand test.

PREPARED BY	CHECKED BY	REVIEWED BY	APPROVED BY
23/05/23	23/5/23	23/5/2023	24/5/23
PRIYANKA GUPTA MANAGER	ABHISHEK, SR. MANAGER	PRAVEEN DUTTA, AGM	DEBASISA RATH, AGM (DH)

VOLUME-II

4X270 MW BHADRADRI TPS

TECHNICAL SPECIFICATION

FOR

HT XLPE POWER CABLE

SPECIFICATION NO: ***PE-TS-440-507-E001***

REVISION: **00**

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UP (INDIA) – 201301

CONTENTS

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'.

3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in "BOQ-Cum-Price schedule" of the specification shall not be considered (i.e., technical description & quantities as per specification shall prevail).

BIDDER'S STAMP & SIGNATURE

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

1.0 SCOPE OF ENQUIRY

1.1 Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of HT XLPE Power Cable conforming to this specification.

1.2 Technical requirements of HT XLPE Power Cable are indicated in Data Sheet-A .

1.3 The stipulations of Section-I, followed by those of Data Sheet-A shall prevail in case of any conflict between the stipulations of Section-I, Data Sheet - A .

1.4 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

3.0 BILL OF QUANTITIES

Quantity requirements shall be as per 'BOQ-cum-price schedule' as part of NIT..

4.0 QUALITY REQUIREMENTS

1. All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved Quality Plan.
2. Cost of cables consumed for testing shall be to bidder's account.
3. Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E001, Rev-1) as attached with the specification without any deviations. At contract stage, the successful bidder shall submit the same QP for BHEL/ ultimate customer's approval. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ultimate customer's approval. There shall be no commercial implication to BHEL on account of minor changes in QP during contract stage.
4. The charges of UV Radiation test & Hydrolytic Stability test (if applicable) shall be reimbursed extra at actual against original money receipt of Govt. Lab. (CPRI/ ERDA etc).
5. Type testing, routine / acceptance testing and special testing requirements shall be as per Annexure –A to QAP. Charges for all these tests for all the equipments & components shall be deemed to be included in the bid price (except UV Radiation & Hydraulic Stability test).

4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

Schedule of drawing & documents to be submitted is part of NIT.

Note:

* Standard Quality Plan as enclosed in the technical specification is to be appended with cover sheet bearing document number and description as stated above. The signed and stamped copy of the same shall be submitted to BHEL without making any changes in the contents of the document.

	DOCUMENT TITLE	SPECIFICATION NO. PE-TS- 440-507-E001	
	4X270 MW -BHADRADRI TPS-FGD	VOLUME II	
	TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	SECTION I	
		REVISION 00	DATE: 24.05.2023
	DATA SHEET-A	SHEET OF	

S.No.	Particulars	Unit	Description
1	**Type of Cable**		Flame Retardant-Low Smoke (FR-LSH) HT CABLE
1.1	**Voltage Grade**		*6.6/6.6 kV (unearthed)*
2	**STANDARDS APPLICABLE**		
2.1	Standard applicable in general (Latest amendment to be referred if any)	YES	IS:7098 (Part-2)
2.2	Current rating of cables conforms to	-	As per IS:3961 (P-7)
2.3	Short circuit rating conforms to	-	IEC 60949
3	**INSTALLATION CONDITIONS AT SITE**		
3.1	Ambient air temperature	deg. C	50
3.2	Ground temperature	deg. C	30
3.3	Depth of laying of cables buried in ground	cm	90
3.4	Thermal resistivity of soil	deg. C cm/W	150
5	**CONDUCTOR**		
5.1	Material type & grade	-	H2 Grade Stranded Aluminium Conductor, Class-2 of IS:8130
5.2	Cable Size		As per BOQ-Cum-Price Schedule
5.3	Shape	-	Compacted Circular
6	**CONDUCTOR SCREEN**		
6.1	Material	-	Extruded layer of Semi Conducting Compound
6.2	Minimum thickness	mm	0.3
7	**XLPE INSULATION**		Extruded XLPE compound as per IS:7098 (P-2)
7.1	Nominal thickness of insulation	mm	As per IS:7098 (P-2)
7.2	Extrusion & method of curing	-	Triple Extrusion (Extruded semi-conducting compound conductor screen and insulation screen shall be applied along with XLPE insulation in a single operation by triple extrusion process) by Gas curing / Steam curing/ Dry curing
7.3	Continuous withstand temperature		90°C
7.4	Short-circuit withstand temperature		250°C
8	**INSULATION SCREEN**		
8.1	Type of screen	-	Insulation screen shall consist of two parts: 1. Non-Metallic Part 2. Metallic Part
8.2	Material and thickness (minimum and nominal)	mm	
8.2.1	Metallic	-	Copper Tape ,Nominal thickness 0.1mm or more with tolerance (±) 10% (Suitable to meet 600A for 2 secs for each core)
	Minimum overlapping	-	20%
8.2.2	Non-metallic	-	Extruded Semi Conducting Compound shall be bonded type Thickness of Semi Conducting Compound - 0.3 mm (Min.)
8.3	Earth fault current withstand capacity (calculation to be furnished)	kA, sec.	600A, 2 sec
8.4	Extrusion & method of curing		Same as that, mentioned for Insulation above.

8.5	**CORE IDENTIFICATION**		Colour coding as per IS:7098(Part-2)
9.0	**INNERSHEATH**		NA for single core cable
10	**ARMOUR**		
10.1	Material	-	Non-Magnetic hard drawn H4 grade Aluminium Single Round Wire to IS: 8130 for single core cables.
10.2	Standard Applicable		Dimension as per IS: 7098 (Part-2) Table-6 and tolerance on dimension as per IS:3975
10.3	Tolerance on formed wire dimension	-	±10 %
10.4	Minimum Coverage		90%
10.5	Gap between armour wire		Shall not exceed one armour wire space (No cross over / Over riding)
10.6	Breaking load of Joint		95% of normal armour
10.7	Maximum resistivity of GS Round wire	Ohm-cm	14.5×10^{-6}
10.8	Maximum resistivity of Al round wire	Ohm-mm^2/km	28.264
10.8	Armour joint surface		To be applied with Zinc rich paint
11	**OUTERSHEATH**		
11.1	Material		Extruded *HRPVC*
			Type ST2 as per IS: 5831
11.2	Colour		*Black*
11.3	Whether FR-LSH		YES
11.4	Method of application		Extruded
11.5	Thickness of outer sheath		As per Table-7 of IS: 7098 (Part-2)
11.6	Marking/ Embossing on Outersheath		*(i) Owner's name,* *(ii) Manufacturer's name and trade mark,* *(iii) Year of manufacture,* *(iv) Type of cable and voltage class & Screen fault current 600A for 2 sec* *(v) Nominal cross section area of conductor and no. of cores,* *(vi) 'BHEL-PEM', etc.* *(vii) Progressive Sequential length marking, @ 1M (by embossing/printing) for 6.6 kV cables.* *(viii) Cable shall be marked as having FRLSH outer sheath at every 5 Meters for 6.6 kV cables. (The embossing/printing shall be progressive, automatic, in line and marking shall be legible and indelible)*
12	**FR-LSH CHARACTERISTICS**		
12.1	Oxygen index		Min 29 (As per IS 7098-2 / ASTMD 2863)
12.2	Temperature index		Min. 250°C(As per IS 7098-2 / ASTMD 2863)
12.3	Acid gas generation		Max. 20% by weight (As per IS 7098-2 / IEC-60754-1)
12.4	Smoke density rating		Max. 60% (As per IS 7098-2 / IS 13360 Part 6 Section 9 / ASTM D 2843)

13	**TYPE TEST CONDUCTION REQUIRED**		*YES*
14	**FLAMMABILITY**		
14.1	*Flammability test for single cable*		*YES (As per: IEC-60332 Part-1)*
14.2	*Flammability test for bunched cables*		*YES (As per: IEC-60332 Part-3, CAT-B)*
14.3	*Flammability test as per IEEE: 60383*		*YES*
14.4	*As per Swedish Chimney test SEN-SS-424-1475-F3*		*YES*
15	*Anti-rodent and Termite repulsion Test*		*YES*
16	*Anti-Fungal Test*		*YES (self certification by supplier for Anti-fungal properties)*
17	Special Tests		
17.1	*Hydrolytic Stability as per ASTM D 3137 :81 (Duration:- 14 days)*		*NO (Only type test report to be submitted)*
17.2	*UV Radiation Test as per BS EN ISO 4892-2 (Duration:- 14 days)*		*NO (Only type test report to be submitted)*
17.3	*UV Radiation Test as per ASTM G 154 (Duration:- 14 days)*		*NO (Only type test report to be submitted)*
18	**DIAMETERS**		
18.1	Tolerance on overall diameter	(±) mm	(±)2 mm. over the declared value
19	**Cable Drum Details**		
19.1	*Type of Drum*		Wood (as per IS 10418)
19.2	Painting		Entire surface to be painted. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drums shall be treated with copper nepthenates or zinc nepthenates for preserving the wood. Drum number shall be indicated on each drum.
19.3	Outermost Layer		To be covered with water-proof polyethylene
19.4	Construction Details		All wooden parts from seasoned wood and ferrous parts shall be treated with suitable rust preventive finish or coating. Wooden drum shall be treated by immersing in copper nitrate solution.
19.5	Standard drum length		*600M / 400M (±) 5% (as specified in BOQ-Cum-Priced Schedule).*
19.6	Details of marking on Drum		Each drum shall carry: (i) Manufacturer's name, (ii) Owner's name, (iii) Type of cable & voltage grade, (iv) Year of manufacture, (v) Type of insulation / sheath e.g. XLPE /HRPVC, (vi) FRLS as applicable, (vii) No. of core and size of cables, (viii) Length of cable on drum, Approx. gross mass stencilled on both side of the drum. (ix) A tag containing same information shall be attached to the leading end of the cable. (x) An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.
20	Cable packing		It may be noted that the outer most cable layer shall be covered with water proof cover polythene followed by complete drum covering with wooden plank of suitable thickness across flanges.

DATASHEET C

GUARANTEED TECHNICAL PARTICULARS
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

S.No.	Particulars	Unit	Description
1.0	**GENERAL**		
1.1	Name of Manufacturer	-	
1.2	Place of Manufacture	-	
2.0	**STANDARDS APPLICABLE**		
2.1	IS: 7098 Part-2 For general specification of XLPE Cables	YES	
2.2	IS: 8130 For conductor material	YES	
2.3	IS: 5831 For material of innersheath & outersheath	YES	
2.4	IS: 3975 / IS: 8130 For armour of 3 core/ single core cables	YES	
2.5	IS: 10810 For method of tests	YES	
2.6	ASTMD-2863 For oxygen index test	YES	
2.7	SS:424-14-75 & IEC-60332-3 & IEC-60332-1 & IEEE: 60383 For flammability test	YES	
2.8	IEC-60754-1 For acid gas generation test	YES	
2.9	ASTMD-2843 For smoke generation test	YES	
2.10	Current rating of cables conforms to	-	
2.11	Short circuit rating conforms to	-	
2.12	Formula for calculating short circuit current for different durations	-	
3.0	**INSTALLATION CONDITIONS AT SITE**		
3.1	Ambient air temperature	deg. C	
3.2	Ground temperature	deg. C	
3.3	Depth of laying of cables buried in ground	cm	
3.4	Thermal resistivity of soil	deg. C cm/W	

4.0	**INSTALLATION CONDITIONS FOR CURRENT RATING SPECIFIED AT CLAUSE 7.3**		
5.0	**CHARACTERISTICS OF FR-LSH SHEATH**		
5.1	Oxygen index	-	
5.2	Temperature index	-	
5.3	Acid gas generation	-	
5.4	Smoke density rating	-	
6.0	**CABLE DRUMS**		
6.1	Type & construction	-	
6.2	Standard drum length	-	
6.3	Tolerance on drum length	-	
7.0	**INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE**		
7.1	No. of cores x size	-	
7.2	Voltage grade (Uo/U)	kV	
7.3	Base current ratings (*) based on Clause No. 3.0		
a)	In air	Amp	
b)	In ground	Amp	
c)	ducts	Amp	
7.4	Short circuit rating	kA, sec	
7.5	Properties		
a)	D.C. resistance of conductor at20 deg. C	ohm/km	
b)	A.C. resistance of conductor at90 deg. C	ohm/km	
c)	Reactance of cable at normal frequency	ohm/km	
d)	Electrostatic capacitance of cable at normal frequency	mF/km	
7.6	CONDUCTOR		
a)	Material type & grade	-	
b)	No & dia of wires in each core before stranding	no x mm	
c)	Shape	-	

7.7	CONDUCTOR SCREEN		
a)	Material	-	
b)	Minimum thickness	mm	
7.8	XLPE INSULATION		
a)	Nominal thickness of insulation	mm	
b)	Method of curing	-	
7.9	INSULATION SCREEN		
a)	Type of screen	-	
b)	Material and thickness (minimum and nominal)	mm	
i)	Metallic	-	
	No. of tapes and Minimum overlapping	-	
ii)	Non-metallic	-	
iii)	Earth fault current withstand capacity (calculation to be furnished)	kA, sec.	
7.10	PVC ST2 INNERSHEATH		
a)	Material	-	
b)	Thickness (min.)	mm.	
c)	Method of application	-	
1)	Multi-core cables		
i)	With fillers	-	
ii)	With out fillers	Pressure Extruded	
2)	Single core cables		
d)	Type & Shape of fillers (if used)	-	
e)	Colour	-	
7.11	ARMOUR		
a)	Material	-	
b)	Size/ dimensions	-	
c)	Minimum no. of wires/ formed wires	-	
d)	Tolerance on formed wire dimension	-	
e)	Maximum resistivity of GS formed wire	-	
f)	Maximum resistivity of Al round wire	-	
g)	Earth fault current withstand capacity (calculation to be furnished)	kA, sec.	
7.12	PVC/POLYETHYLENE ST2 FR-LSH OUTERSHEATH		
a)	Nominal thickness of outer sheath	mm.	

7.13	DIAMETERS		
a)	Diameter of insulated conductor	mm.	
b)	Cable diameter under armour	mm.	
c)	Cable diameter over armour	mm.	
d)	Overall diameter of cable	mm.	
7.14	Tolerance on overall diameter	(±) mm	
7.15	Minimum bending radius	x O.D.	
7.16	Safe pulling force	kg.	
7.17	Weight of cable	kg./km	
a)	Weight of conductor	MT./km	
b)	Weight of XLPE insulation	MT./km	
c)	Weight of PVC (Inner Sheath & Fillers)	kg./km	
d)	Maximum resistivity of GS formed wire	kg./km	
e)	Weight of PVC/Polyethylene (Outer Sheath & Fillers)	kg./km	
7.18	Dimension of drum	mm.	
7.19	Shipping weight	kg	
7.20	Cable marking on outer sheath	-	
7.21	End sealing provided	Yes/No	
7.22	Over the cables polyethylene sheet wrapped .	Yes/No	

(*) For single core cables, the continuous current rating shall be furnished separately for armour earthed at one end and at both ends.

:

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E001, R1.	
		PROJECT:		PO NO.:	
		ITEM: HT XLPE Cables	SYSTEM: CABLE	SECTION: II	SHEET 1 OF 11

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**													
1.1	**Aluminium/copper Rods (Conductor/Armour Wire)**	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	IS 5082 / IS 613	IS 5082/ IS 613	Test Cert.	✓	P/V	V	-	
		2. Elec .Properties	MA	Electrical Tests	Sample/ Batch	Sample/ Batch	-do-	-do-	-do-	✓	P/V	V	-	
		SPECIFIC CHECKS :												
		a) Make	MA	Physical verification	Sample/ Batch	Sample/ Batch	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	-	
		b) Grade	MA	-do-	-do-	-do-	IS 8130	IS 8130	-do-	✓	P	V	-	
		c) Resistivity	MA	Electrical Tests	Manufacturer std.	Manufacturer std.	IS 5082 / IS 613	IS 5082/ IS 613	-do-	✓	P	V	-	
1.2	**XLPE Compound for insulation**	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	IS 7098-II	IS 7098-II	Test Cert.	✓	P	V	-	
		2. Elec. Properties	MA	Electrical Tests	Sample/ Batch	Sample/ Batch	-do-	-do-	-do-	✓	P	V	-	
		SPECIFIC CHECKS :												

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		ABHISHEK	Checked by:		KUNAL GANDHI		
Reviewed by:	MANISH	MANISH SHUKLA	Reviewed by:	RITESH KUMAR JAISWAL	R.K. JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		a) Make	MA	Physical verification	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P/V	V	-	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P/V	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	-do-	-do-	-do-	✓	P/V	V	-	
1.3	**Semi Conducting Compound**	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	IS 7098-II	IS 7098-II	Inspection Report/ Test Cert.	✓	P	V	-	
		SPECIFIC CHECKS :												
		1. Make	MA	Physical verification	100%	100%	Manufacturer approved source	Manufacturer approved source	-do-	✓	P	V	-	
		2. Type/ Grade	MA	-do-	-do-	-do-	IS 7098-II	IS 7098-II	-do-	✓	P	V	-	
		3. Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	✓	P	V	-	
1.4	**Copper Tape**	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	IS 7098-II & Approved datasheet	IS 7098-II & Approved datasheet	Inpection Report/	✓	P	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:		ABHISHEK	Checked by:		KUNAL GANDHI		
Reviewed by:	MANISH	MANISH SHUKLA	Reviewed by:	RITESH KUMAR JAISWAL	R.K. JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
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Reviewed by:			
Approved by:			

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
									Test Cert.					
		2. Elec. Properties	MA	Electrical Tests	Sample/ Batch	Sample/ Batch	-do-	-do-	-do-	✓	P	V	-	
		3. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	-do-	✓	P	V	-	
		3. Continuity	MA	Electrical Tests	-do-	-do-	-do-	-do-	-do-	✓	P	V	-	
		SPECIFIC CHECKS :												
		1. Resistivity	MA	Electrical Tests	Sample/ Batch	Sample/ Batch	IS 613	IS 613	-do-	✓	P	V	-	
1.5	**Fillers (as applicable)**	1. Make	MA	Physical verification	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P/V	V	-	Fillers material chosen shall be compatible with the temperature rating of the cable and shall have no deleterious effect on any other comp. of cable)
		2. Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P/V	V	-	

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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-507-E001, R1.	
		PROJECT:		PO NO.:	
		ITEM: HT XLPE Cables	SYSTEM: CABLE	SECTION: II	SHEET 4 OF 11

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
1.6	PVC Compound (for sheath)	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	IS 5831	IS 5831	Test Cert.	✓	P/V	V	-	
		2. Elec. Properties	MA	Electrical Tests	-do-	-do-	-do-	-do-	-do-	✓	P/V	V	-	
		3. FRLS Properties (as applicable)	CR	Chemical/ Environ.	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P/V	V	-	
		SPECIFIC CHECKS :												
		a) Make	MA	Physical verification	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	-	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	✓	P	V	-	
1.7	Galvanised steel round wire/ formed wire strip/ Aluminium round wire for Armour (as applicable)	**GENERAL :**												
		1. Make	MA	Physical verification	Manufacturer std.	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	-	
		2. Dimension	MA	Measurement	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P/V	V	-	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample *	Sample*	-do-	-do-	-do-	✓	P/V	V	-	*: SAMPLE FROM EACH ARMOUR

BHEL						BIDDER/ SUPPLIER	
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Reviewed by:	MANISH	MANISH SHUKLA	Reviewed by:	RITESH KUMAR JAISWAL			

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	ITEM: HT XLPE Cables	SYSTEM: CABLE	SECTION: II	SHEET 5 OF 11

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
														SIZE/ BATCH /LOT
		4.Galvanization Quality	MA	Galv. Tests	-do-	-do-	IS 3975	IS 3975	-do-	✓	P/V	V	-	
1.8	**Steel Drum (as applicable)**	1. Phy. & Constructional checks	MA	Measurement	Mfr's Plant Std.	Mfr's Plant Std.	Approved drawing of steel drum	Approved drawing of steel drum	Inspection Report	✓	P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	-	Surface shall be smooth	-do-	✓	P	V	-	
1.9	**Wooden Drum (as applicable)**	1. Phy. & Constructional checks	MA	Measurement	Mfr's Std.	Mfr's Std.	IS 10418	IS 10418	Inspection Report	✓	P	V	-	
		2. Anti-termite treatment	MA	Chem.	Mfr's Std.	Mfr's Std.	Mfr's Std.	Mfr's Std.	-do-	✓	P	V	-	
2.0 IN PROCESS														
2.1	**Wire Drawing**	1. Size	MA	Dimensional	Mfr's Std.	Mfr's Std.	Appd. Datasheet	Appd. Datasheet	Inspection Report	✓	P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	-	Surface shall be smooth	-do-	✓	P	V	-	
		3. % of Elongation	MA	Mechanical	-do-	-do-	IS 8130	IS 8130	-do-	✓	P	V	-	
2.2	**Stranding of wires**	1. No. of wires	MA	Counting	Mfr's Std.	Mfr's Std.	Appd. Datasheet	Appd. Datasheet	Inspection Report	✓	P	V	-	

BHEL						BIDDER/ SUPPLIER	
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	PROJECT:		PO NO.:	
	ITEM: HT XLPE Cables	SYSTEM: CABLE	SECTION: II	SHEET 6 OF 11

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		2. Resistance	CR	Electrical	-do-	-do-	-do-	-do-	-do-	✓	P	V	-	
		3. Sequence, lay length & Direction	MA	Visual, Meas.	One Sample of each size/ lot	-	Mfrs Std. / Appd. Datasheet	Mfrs Std. / Appd. Datasheet	-do-		P	-	-	
		4. Surface Finish	MA	Visual	100%	-	-	Surface shall be smooth	-do-		P	-	-	
		5. Dimension	MA	Measurement	One Sample of each size/ lot	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
2.3	**Conductor Screening**	1. Surface Finish	MA	Visual	100%	-	-	Surface shall be smooth	Inpection Report		P	-	-	
		2. Radial Thickness	CR	Mechanical	One Sample of each size/ lot	-	IS 7098-II & Appd. Datasheet	IS 7098-II & Appd. Datasheet	-do-		P	-	-	
2.4	**Core Insulation (XLPE) (No repair permitted)**	1. Surface finish	MA	Visual	100%	100%	-	Free from bulging, burnt particles, lumps, cuts & scratches	Inspection Report/ Test report	✓	P	V	-	
		2. Eccentricity & Ovality #	CR	Measurement	One Sample of each size/ lot	One Sample of each	Mnfr's Std	Mnfr's Std	-do-	✓	P	V	-	# To be checked at starting & finished

BHEL						BIDDER/ SUPPLIER	
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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
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		PROJECT:		PO NO.:	
		ITEM: HT XLPE Cables	SYSTEM: CABLE	SECTION: II	SHEET 7 OF 11

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
						size/ lot								end of extruded length.
		3. Insulation Thickness	CR	Measurement	-do-	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
		4. Dia over insulation	MA	Measurement	-do-	-	-do-	-do-	-do-		P	-	-	
		5. Tensile Strength & % Elongation	MA	Mechanical	100%	-	IS:7098-II	IS:7098-II	-do-		P	-	-	
2.5	Insulation Screening	**NON METTALIC**												
		1. Surface finish	MA	Visual	100%	100%	-	Surface shall be smooth	Inspection Report	✓	P	V	-	
		2. Thickness	CR	Measurement	One Sample of each size/ lot	-do-	Appd. datasheet	Appd. datasheet	-do-	✓	P	V	-	
		METALLIC												
		1. Dimension of tape	CR	Measurement	One Sample of each size/ lot	One Sample of each size/ lot	Appd. datasheet	Appd. datasheet	Inspection Report/ Test report	✓	P	V	-	
		2. Overlap of Tape Band	MA	-do-	-do-	-do-	Mfs Std.	Mfs Std.	-do-	✓	P	V	-	
		3. Tightness of Tape	MA	Visual	-do-	-do-	Mfs Std.	Mfs Std.	-do-	✓	P	V	-	

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		PROJECT:		PO NO.:	
		ITEM: HT XLPE Cables	SYSTEM: CABLE	SECTION: II	SHEET 8 OF 11

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
2.6	Core Laying	1. Dia over laid up core	MA	Measurement	One Sample of each size/ lot	One Sample of each size/ lot	Appd. Datasheet	Appd. Datasheet	Inspection Report	✓	P	V	-	
		2. Sequence of lay & direction	MA	Visual & Meas.	-do-	-do-	IS 7098-II & Mfr. Std.	IS 7098-II & Mfr. Std.	-do-	✓	P	V	-	
		3. Lay Length	MA	Measurement	-do-	-do-	-do-	-do-	-do-	✓	P	V	-	
2.7	InnerSheath Extrusion (as applicable)	1. Surface finish	MA	Visual	100%	-	-	Surface shall be smooth	Inspection Report		P	-	-	
		2. Thickness	CR	Measurement	One Sample of each size/ lot	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
		3. Dia over inner sheath	MA	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
2.8	Armour(as applicable)	1. No.of wires/Strips	MA	Counting	At the start of process	-	Mfr. Std.	Mfr. Std.	Inspection Report		P	-	-	
		2. Lay length & Direction	MA	Visual & Meas.	-do-	-	-do-	-do-	-do-		P	-	-	
		3. Dia over armouring	MA	Measurement	-do-	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
		4. Coverage	MA	Measurement	-do-	-	-do-	-do-	-do-		P	-	-	

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	PROJECT:		PO NO.:	
	ITEM: HT XLPE Cables	SYSTEM: CABLE	SECTION: II	SHEET 9 OF 11

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
2.9	Outer Sheath Extrusion (No repair permitted)	1. Surface finish	MA	Visual	100%	-	-	Surface shall be smooth	Inspection Report/ Test report		P	-	-	
		2. Sheath Thickness	CR	Measurement	One Sample of each size/ lot	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
		3. Dia over outer sheath	MA	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		4. Embossing/ Sequencial Marking	MA	Visual	100%	-	Approved data sheet	Approved data sheet	-do-		P	-	-	
3.0	Finished Cable (INTERNAL)	1. Routine Test (Refer Note-H)	CR	Electrical Tests & Measurement	100%	100%	#	#	-do-	✓	P	V	V	#: Refer Annexure-A to QP
4.0	Final Inspection (EXTERNAL)	1. Finish & Length (cable & drum)	MA	Visual	One drum in each Lot	One drum in each Lot	Appd. Datasheet	Free from Porosity, Bulging, Burnt particles, lumps, cuts & scratches	Inspection Report	✓	P	W	W	
		2. Dimension	MA	-do-	As per IS 7908-II	As per IS 7908-II	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	W	W	

BHEL					
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		PROJECT:		PO NO.:	
		ITEM: HT XLPE Cables	SYSTEM: CABLE	SECTION: II	SHEET 10 OF 11

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		3. Armouring - Coverage No. of Wires/Strips	MA	Visual & Meas.	As per IS 7908-II	As per IS 7908-II	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	W	W	
		4. Marking & Colour Coding	MA	Visual	As per IS 7098-II	As per IS	As per IS 7098-II	Approved Data Sheet	-do-	✓	P	W	W	
		5. Acceptance Tests (Refer Note-H)	CR	Phy, Elect. Tests & FRLS Tests	-do-	-do-	#	-do-	-do-	✓	P	W	W	#: Refer Annexure-A to QP.
		6. Type Tests (Refer Note-H)	CR	Physical & Electrical Tests	#	#	-do-	-do-	-do-	✓	P	W	W	#: Refer Annexure-A to QP.
5.0	**Packing**	**1. Sealing Identification**	MA	Visual	100%	100%	As per IS 7098-II	As per IS 7098-II	-	✓	P	W	-	
		2. Cable drums	MA	Visual	100%	100%	Appd. Datasheet	Appd. Datasheet	-	✓	P	W	-	
NOTES:														

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ENGINEERING			QUALITY			Sign & Date	
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		PROJECT:		PO NO.:	
		ITEM: HT XLPE Cables	SYSTEM: CABLE	SECTION: II	SHEET 11 OF 11

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9	*	**			

A). Joints in conductors & armour shall be as permitted by IS: 8130 & IS: 7098-I respectively.
B). No repair of core insulation permitted.
C). Cable ends shall be sealed.
D). Record of raw material, process & all stages shall be certified by vendors' QC and are liable to audit check by purchaser.
E). Fillers/dummy cores etc. shall be as per BHEL specification.
F). Wherever extent of check for stage is mentioned as 'sample' & not defined in QP, the same shall be as per vendors sampling plan agreed by purchaser.
G). Vendor shall furnish compliance certificate to the inspection agency confirming the packing as per IS/ BHEL specification.
H). For lists of routine tests, acceptance tests & type tests refer annexure to QAP.
I). Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch/ lot no. should be traceable to the final cable drum number or batch no.
J). Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not.
K). BHEL reserves the right to perform repeat test, if required.
L). Photographs of cable to be despatched shall be sent to BHEL Purchase Group for review prior to issue of MDCC.
M). Project specific QP shall be developed based on customer requirement.
N). For export jobs, BHEL Technical Specification for Seaworthy Packing for Export Jobs is to be followed.
O). Packing shall be suitable for storage at site in tropical climate conditions.
P). Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*Records, identified with "Tick"(√) shall be essentially included by supplier in QA documentation.

** **M**: Supplier/ Manufacturer/ Sub-Supplier, **C**: Main Supplier/ BHEL/ Third Party Inspection Agency, **N**: Customer

P: Perform, **W**: Witness, **V:** Verification, as appropriate

MA: Major, **MI**: Minor, **CR:** Critical, **D**: Documentation

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
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Annexure "A" to Quality Plan

TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS

A. Type Test Conduction:

1. Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.

2. Sampling:
   a. Type test to be conducted on 1 drum for every 10 drums or less of each type and size of cable/ lot.
   b. Electrical tests to be conducted on one drum of every size & voltage grade of cables.
   c. FRLS test & Flammability Test to be conducted on every size & voltage grade of cables. Sampling quantity as per appendix –D of IS 7098-2, D2.2.

B. **Acceptance Test Conduction:**

1. Tests for which "A" is indicated in the 'Test Conduction Required As' column below shall be conducted as Acceptance tests.

2. Sampling:
   a. Acceptance tests shall be as per 1 drum for every 10 drums or less of each type and size of cable/ lot.
   b. FRLS test & Flammability Test to be conducted on every size & voltage grade of cables. Sampling quantity as per appendix –D of IS 7098-2, D2.2.

C. Routine Test Conduction:

1. Tests for which "R" is indicated in the 'Test Conduction Required As' column below shall be conducted as Routine tests.

2. Sampling: Routine tests shall be conducted on 100% cable drums.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	**Tests for Conductor**				
I.	Annealing test	For copper conductor only	**T, A**	IS 10810 Pt 1	***Internal in process Test Report to be furnished for acceptance test***
II.	Tensile test	For aluminium conductor only *(Not applicable for compacted circular or shaped conductor)*	**T, A**	IS 10810 Pt 2	
III.	Wrapping test	For aluminium conductor only *(Not applicable for compacted circular or shaped conductor)*	**T, A**	IS 10810 Pt 3	
IV.	Resistance test	For Al/Cu	**T, A, R**	IS 10810 Pt 5	
2.0	**Tests for Armour Wires/Strips**				
I.	Measurement of dimensions	Applicable for Aluminium wire & GS wire/Strip	**T,A**	IS 10810 Pt 36	
II.	Tensile test	Applicable for Aluminium wire & GS wire/Strip	**T, A**	IS 10810 Pt 37	
III.	Elongation at break test	Applicable for GS wire/Strip only	**T, A**	IS 10810 Pt 37	
IV.	Torsion test	For GS round wire only	**T, A**	IS 10810 Pt 38	

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Annexure "A" to Quality Plan

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
V.	Winding test	For GS strip only	T, A	IS 10810 Pt 39	
VI.	Resistivity test	Applicable for Aluminium wire & GS wire	*T, A*	IS 10810 Pt 42	
VII.	Uniformity of Zinc coating test	For G. S. wires/Strip only	*T, A*	IS 10810 Pt 40	
VIII.	Mass of Zinc coating test	For G. S. wires/Strip only	*T, A*	IS 10810 Pt 41	
IX.	Wrapping Test	For Aluminium wires only	*T, A*	IS 10810 Pt 3	
3.0	**Physical Tests for XLPE Insulation & PVC sheath**				
I.	Test for thickness & Eccentricity	Applicable for XLPE insulation, HRPVC inner sheath & For HRPVC *inner/outer sheath* only	T, A	IS 10810 Pt 6	
II.	Tensile strength and elongation test at break	Applicable for XLPE insulation & For HRPVC *inner/outer sheath* only			
(a)	Before ageing		T, A	IS 10810 Pt 7	
(b)	After ageing		T, A	IS 10810 Pt 7	
III.	Ageing in air oven	Applicable for XLPE insulation & For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 10	
V.	Hot deformation test	For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 15	
VI.	Heat shock test	For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 14	
VII.	Shrinkage test	For XLPE insulation & For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 12	
VIII.	Thermal stability test	For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 60	
IX.	Hot set test	For XLPE insulation only	T, A	IS 10810 Pt 30	
X.	Water absorption (gravimetric) test	For XLPE insulation only	T	IS 10810 Pt 33	
XI.	Degree of cross-linking	For XLPE insulation only	T	IS 7098-II	
4.0	**Tests On Extruded Semi-conducting Screen**				
I.	Test for Strippability	Applicable for Semi-conducting Strippable screen	T	IS 7098-II	Not applicable since it is bonded type
II.	Volume Resistivity	Applicable for Semi-conducting Strippable screen	T	IS 7098-II	
III.	Test for cross linking		A	IS 7098-II	
5.0	**Improved Fire performance (FR-LSH) Tests**				
I.	Oxygen index test	*For inner/outer sheath only*	T, A	IS 10810 Pt 58 / ASTMD 2863	*Sample shall be as per IS 7098,Part 2*

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Annexure "A" to Quality Plan

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
II.	Smoke density test	*For inner/outer sheath only*	**T, A**	ASTMD 2843	
III.	Acid gas generation test	*For inner/outer sheath only*	**T, A**	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	*For inner/outer sheath only*	**T,A**	IS 10810 Pt 64 / ASTMD 2863	
6.0	**Flammability Tests**				
I.	Flammability test for bunched cables	For complete cable	**T,A**	IEC-60332 (Part-3)	
II.	Flammability test for single cable	For complete cable	**T,A**	IEC:60332 Part-1	
III.	Swedish chimney test	For complete cable	**A**	SEN SS 424 1475 (Class F3)	
IV.	Flammability test	For complete cable	**A**	IEEE: 60383	
7.0	**Electrical Tests**				
I.	High Voltage Test	For complete cable	**T, A, R**	IS 10810 Pt 45	
II.	Insulation Resistance Test (Volume resistivity method)	For complete cable	**T, A**	IS 10810 Pt 43	
III.	Partial discharge test (shall be carried out on full drum length)		**T,A,R**	IS 10810 Pt 46	
IV.	Bending Test followed by Partial Discharge test		**T**	IS 10810 Pt 50	
V.	Dielectric Power Factor Test (i) As a function of voltage (ii) As a function of temperature		**T**	IS 10810 Pt 48	
VI.	Heat Cycle Test		**T**	IS 10810 Pt 49	
VII.	Impulse Withstand Test		**T**	IS 10810 Pt 47	
VIII.	Thermal ageing test	For complete cable	**T**	IS 7098-II	
IX.	*Flammability Test*	*For HRPVC sheathed cable*	*T*	*IS 10810 Pt 53*	
8.0	**Anti-rodent and Termite Repulsion test**	For HRPVC *outer sheath* only	**A**	Refer Note	**Test applicable as indicated in Datasheet-A**
9.0	**Anti-Fungal Test**	For HRPVC outer sheath only	**A**	**Self-certification by vendor for anti-fungal property.**	
10.0	**Special Test**				
I.	Hydrolytic Stability	For Complete Cable	**A (**)**	ASTM D 3137	**Test applicable as indicated in Datasheet-A**
II.	Ultraviolet Test	For Complete Cable	**A (**)**	BS EN ISO 4892-2	

***** These tests shall be conducted on one sample for the entire contract and duration of these tests shall be 14 days.***

Note: A few chipping of the PVC compound is slowly ignited on a porcelain dish or cubicle in a muffle furnace at about 60-degree C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). Place a drop of aqueous sodium sulphide solution on a thick filter paper and allow soaking. Touch the spot with a drop of above extract. A black spot indicates the presence of lead, the anti-termite and rodent compound.

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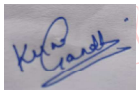

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TYPICAL DRAWING OF CABLE DRUM PACKING

Rev-01

Price Variation Formulae for cables -Annexure-I

1. Prices shall be variable as per price variation formulae given below (basis IEEMA).
The price variation shall be limited to + 20% of total ex-works price actually supplied (cable size wise) and -ve price variation shall be unlimited. Rates for working out price variation shall be as per rates published by IEEMA for the factors given in Annexure-II

2. **Base date for prices:**

Initial Price (As per IEEMA) for-Alo, Cuo, CCo, PVCCo & Feo:
Base Date shall be- 1st working day of the previous month to the date of issue of tender enquiry.

Final Price (as per IEEMA) for- Al, Cu, Cc, PVCC & Fe:
1st working day of month, one month prior to the date on which cable is notified as being ready for inspection i.e TPIA inspection call raise date on web portal.

3. Variation factor value for ALF, CuF, CCFAL, CCFCu, XLFAL, XLFCu, FeF & FeW as applicable shall be as per Technical Specification.

4. PVC shall be payable within contractual delivery period (including any extension thereto).

Vikas
15.01.19

VIKAS KUMAR SINGH
E3 - ELECTRICAL

15/01/19.

Manish Shukla
15/01/19

IEEMA table for Price variation cause for various type of cable

1. Aluminium conductor cable

S.No	Cable Type	AIF (Single core unarmoured & Multi core armoured)	AIF (Single core armoured)	CCFAI	XLFAL (Single core)	XLFAL (Multi core)	FeF	FeW	IEEMA Formula
1.	HT XLPE Power cable	ALP	H1	H2	XL3	XL4	H3	H5	P=Po+AIF(AL-Alo) + XLFAL(CC-CCo) +CCFAI(PVCC-PVCCo) + FeF(Fe-Feo)
2.	LT XLPE Power Cable	ALP	P1	L2	XL1	XL1	P3	P3 (Additional)	P=Po+AIF(AL-Alo) + XLFAL(CC-CCo) +CCFAI(PVCC-PVCCo) + FeF(Fe-Feo)
3.	LT PVC Power Cable	ALP	P1	P2	-	-	P3	P3 (Additional)	P=Po+AIF(AL-Alo) + CCFAI(PVCC-PVCCo) + FeF(Fe-Feo)
4.	LT HRPVC Power Cable	ALP	P1	P2	-	-	P3	P3 (Additional)	P=Po+AIF(AL-Alo) + CCFAI(PVCC-PVCCo) + FeF(Fe-Feo)

2. Copper conductor cable

S no.	Cable type	CuF	AIF (single core armoured)	CCFCu	XLFCU (Single core)	XLFCU (Multi core)	FeF	FeW	IEEMA Formula
I	HT XLPE Power cable	CUP	H4	H2	XL3	XL4	H3	H5	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) +CCFCu(PVCC-PVCCo) + FeF(Fe-Feo) + AIF(AL-Alo)
2	LT XLPE Power Cable	CUP	P4	L2	XL1	XL1	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo) + AIF(AL-Alo)

02

S no.	Cable type	CuF	AlF (single core armoured)	CCFCu	XLFCU (Single core)	XLFCU (Multi core)	FeF	FeW	IEEMA Formula
3	LT PVC Power Cable	CUP	P4	P2	--	--	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo) + AlF(AL-Alo)
4	LT HRPVC Power Cable	CUP	P4	P2	--	--	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo) + AlF(AL-Alo)
5	LT XLPE Control Cable	CUC	--	P5	--	XL2	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
6	LT PVC Control Cable	CUC	--	P5	--	--	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
7	LT HRPVC Control Cable	CUC	--	P5	--	--	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu(PVCC-PVCCo) + FeF(Fe-Feo)
8	LT XLPE Fire Survival Power Cable	CUP	P4	L2	XL1	XL1	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo))+ AlF(AL-Alo)
9	LT XLPE Fire Survival Control	CUC	--	P5	--	XL2	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
10	LT EPR Fire Survival Power Cable	CUP	P4	L2	--	--	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo))+ AlF(AL-Alo)
11	LT EPR Fire Survival Control cable	CUC	--	P5	--	--	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
12	Screened control Cable (Overall screen)	Cu POS	--	--	--	--	Fe POS	Fe POS	P=Po+CuF(Cu-Cuo) + FeF(Fe-Feo)
13	Screened control Cable (Individual	Cu PIS	--	--	--	--	Fe PIS	Fe PIS	P=Po+CuF(Cu-Cuo) + FeF(Fe-Feo)

Annexure-II

IEEMA *Table* for Price Variation Clause for various types of Cables

Notes:-

(i) Cu POS, Cu PIS, Fe POS & Fe PIS tables shall be as per IEEMA circular No. IIEMA (PVC) /Instrumentation Cable/2014 effective from dtd 01.07.2014.

(ii) All other tables shall be as per IEEMA circular No. 35//DIV/CAB/05/ dated 24.04.2018.

Terms used in PVC formulae:

P = Price payable as adjusted in accordance with above appropriate formula (In Rs./Km).
Po= Price quoted/confined (in Rs./km).

1. ALUMINIUM
ALF Variation factor for aluminium.
Al =Price of aluminium.
Alo = Price of aluminium.

2 COPPER
CuF =Variation factor for copper.
Cu = Price of CC copper rods.
Cuo = Price of CC copper rods.

3.PVCc COMPOUND/POLYMER
PVCc = Price of PVC compound.
PVCco= Price of PVC compound.
CCFAL= Variation factor for PVC compound/Polymer for aluminium conductor cable.
CCFCu =Variation factor for PVC compound/Polymer for copper conductor cable.

4. XLPE COMPOUND
Cc = Price of XLPE compound.
Cco= Price of XLPE compound.
XLFAL= Variation factor for XLPE compound for aluminium conductor cable.
XLFCu =Variation factor for XLPE compound for copper conductor cable.

5.STEEL
Fe= Price of steel strips/steel wire.
Feo= Price of steel strips/steel wire.
FeF =Variation factor for steel.
FeW=Variation factor for round wire steel armouring.

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IEEMA (PVC)/Instrumentation Cable/2014 **Effective from: 1st July 2014**

Material Price Variation Clause For Instrumentation Cables

The Price quoted/confirmed is based on the input cost of raw materials/components as on the date of quotation, and the same is deemed to be related to the prices of raw materials as specified in the price variation clause given below. In case of any variation in these prices, the price payable shall be subject to adjustment up or down in accordance with the formulae provided in this document.

Terms used in price variation formulae:

P Price payable as adjusted in accordance with above appropriate formula **(in Rs/Km)**

Po Price quoted/confirmed **(in Rs/Km)**

COPPER

CuF Variation factor for copper

Cu Price of CC copper rods. This price is as applicable on first working day of the month, one month prior to the date of delivery.

Cu_o Price of CC copper rods. This price is as applicable on first working day of the month, one month prior to the date of tendering.

STEEL

FeF Variation factor for steel

Fe Price of Steel Strips/steel wire. This price is as applicable on the first working day of the month, one month prior to the date of delivery.

Fe_o Price of steel strips/steel wire. This price is as applicable on first working day of the month, one month prior to the date of tendering.

The above prices and indices are as published by IEEMA vide Circular reference IEEMA(PVC)/CABLE/--/-- prevailing as on 1st working day of the month i.e. one month prior to the date of tendering.

The date of delivery is the date on which the cable is notified as being ready for inspection/dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

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IEEMA (PVC)/Instrumentation Cable/2014 **Effective from: 1st July 2014**

Notes

(a) All prices of raw materials are exclusive of modvatable excise/CV duty amount and exclusive of any other central, state or local taxes, octroi, etc.

(b) All Prices are as on first working day of the month.

(c) The details of prices are as under:

1. Price of CC copper rods (in Rs/MT) is ex-works price as quoted by the primary producer.

2. Price of galvanized steel strip / steel wire (in Rs/MT) is ex-works price as quoted by the manufacturer for Round steel Wire and Flat steel strip (the relevant price of steel strip or steel wire is to be selected depending upon the type of armouring of the cable).

Price variation formula for 'Instrumentaion Cables'

P = Po + CuF (Cu – Cuo) + FeF (Fe – Feo)

1. **For Pair Instrumentation Over all Screen Cables**

Tables References:

Cu POS Copper Factor
Fe POS Steel Factor

2. **For Pair Instrumentation Individual and Over all Screen Cables**

Tables References:

Cu PIS Copper Factor
Fe PIS Steel Factor

3. **For Triad Instrumentation Over all Screen Cables**

Tables References:

Cu TOS Copper Factor
Fe TOS Steel Factor

4. **For Triad Instrumentation Individual & Overall Screen Cables**

Tables References:

Cu TIS Copper Factor
Fe TIS Steel Factor

Deputy Director General

Copper Factors for Instrumentation Cables - CuF

Cu POS

Pair Instrumentation Over all Screen Cables					
No. of Pairs Cable size in sq.mm	0.5 sq.mm	0.75 sq.mm	1.0 sq.mm	1.5 sq.mm	2.5 sq.mm
1	0.0142	0.0185	0.0233	0.0326	0.0500
2	0.0258	0.0345	0.0440	0.0625	0.0978
3	0.0353	0.0484	0.0626	0.0904	0.1433
4	0.0448	0.0623	0.0811	0.1183	0.1888
5	0.0578	0.0800	0.1022	0.1467	0.2356
6	0.0662	0.0926	0.1210	0.1768	0.2829
7	0.0756	0.1067	0.1378	0.2000	0.3245
8	0.0852	0.1204	0.1582	0.2327	0.3741
9	0.0933	0.1334	0.1734	0.2534	0.4134
10	0.1046	0.1485	0.1959	0.2893	0.4665
11	0.1111	0.1600	0.2089	0.3067	0.5023
12	0.1236	0.1764	0.2333	0.3452	0.5580
13	0.1289	0.1867	0.2445	0.3600	0.5912
14	0.1378	0.2000	0.2623	0.3867	0.6356
15	0.1467	0.2134	0.2800	0.4134	0.6801
16	0.1618	0.2322	0.3080	0.4573	0.7409
17	0.1645	0.2400	0.3156	0.4667	0.7690
18	0.1734	0.2534	0.3334	0.4934	0.8134
19	0.1822	0.2667	0.3512	0.5201	0.8579
20	0.1911	0.2800	0.3689	0.5467	0.9023
21	0.2000	0.2934	0.3867	0.5734	0.9468
22	0.2089	0.3067	0.4045	0.6001	0.9912
23	0.2178	0.3200	0.4223	0.6267	1.0357
24	0.2381	0.3437	0.4575	0.6813	1.1068
25	0.2356	0.3467	0.4578	0.6801	1.1246
26	0.2445	0.3600	0.4756	0.7068	1.1690
27	0.2534	0.3734	0.4934	0.7334	1.2135
28	0.2623	0.3867	0.5112	0.7601	1.2579
29	0.2711	0.4001	0.5290	0.7868	1.3024
30	0.2800	0.4134	0.5467	0.8134	1.3468
31	0.2889	0.4267	0.5645	0.8401	1.3913
32	0.2978	0.4401	0.5823	0.8668	1.4357
33	0.3067	0.4534	0.6001	0.8934	1.4802
34	0.3156	0.4667	0.6179	0.9201	1.5246
35	0.3245	0.4801	0.6356	0.9468	1.5691
36	0.3334	0.4934	0.6534	0.9735	1.6135
37	0.3423	0.5067	0.6712	1.0001	1.6580
38	0.3512	0.5201	0.6890	1.0268	1.7024
39	0.3600	0.5334	0.7068	1.0535	1.7469
40	0.3689	0.5467	0.7245	1.0801	1.7913
41	0.3778	0.5601	0.7423	1.1068	1.8358
42	0.3867	0.5734	0.7601	1.1335	1.8802
43	0.3956	0.5867	0.7779	1.1601	1.9247
44	0.4045	0.6001	0.7957	1.1868	1.9691
45	0.4134	0.6134	0.8134	1.2135	2.0136
46	0.4223	0.6267	0.8312	1.2402	2.0580
47	0.4312	0.6401	0.8490	1.2668	2.1025
48	0.4710	0.6759	0.9010	1.3410	2.2009

Copper Factors for Instrumentation Cables - CuF

Cu PIS

Pair Instrumentation Individual and Over all Screen Cables					
No. of Pairs Cable size in sq.mm	0.5 sq.mm	0.75 sq.mm	1.0 sq.mm	1.5 sq.mm	2.5 sq.mm
1	0.0133	0.0178	0.0222	0.0311	0.0489
2	0.0349	0.0437	0.0531	0.0717	0.1069
3	0.0490	0.0621	0.0763	0.1041	0.1570
4	0.0630	0.0806	0.0994	0.1389	0.2071
5	0.0800	0.1022	0.1245	0.1689	0.2578
6	0.0937	0.1200	0.1484	0.2042	0.3103
7	0.1067	0.1378	0.1689	0.2311	0.3556
8	0.1218	0.1569	0.1948	0.2692	0.4107
9	0.1334	0.1734	0.2134	0.2934	0.4534
10	0.1503	0.1943	0.2417	0.3349	0.5122
11	0.1600	0.2089	0.2578	0.3556	0.5512
12	0.1785	0.2313	0.2882	0.4001	0.6128
13	0.1867	0.2445	0.3023	0.4178	0.6490
14	0.2000	0.2623	0.3245	0.4489	0.6979
15	0.2134	0.2800	0.3467	0.4801	0.7468
16	0.2350	0.3053	0.3812	0.5305	0.8141
17	0.2400	0.3156	0.3912	0.5423	0.8446
18	0.2534	0.3334	0.4134	0.5734	0.8934
19	0.2667	0.3512	0.4356	0.6045	0.9423
20	0.2800	0.3689	0.4578	0.6356	0.9912
21	0.2934	0.3867	0.4801	0.6668	1.0401
22	0.3067	0.4045	0.5023	0.6979	1.0890
23	0.3200	0.4223	0.5245	0.7290	1.1379
24	0.3479	0.4535	0.5673	0.7911	1.2165
25	0.3467	0.4578	0.5690	0.7912	1.2357
26	0.3600	0.4756	0.5912	0.8223	1.2846
27	0.3734	0.4934	0.6134	0.8534	1.3335
28	0.3867	0.5112	0.6356	0.8846	1.3824
29	0.4001	0.5290	0.6579	0.9157	1.4313
30	0.4134	0.5467	0.6801	0.9468	1.4802
31	0.4267	0.5645	0.7023	0.9779	1.5291
32	0.4401	0.5823	0.7245	1.0090	1.5780
33	0.4534	0.6001	0.7468	1.0401	1.6269
34	0.4667	0.6179	0.7690	1.0712	1.6758
35	0.4801	0.6356	0.7912	1.1024	1.7247
36	0.4934	0.6534	0.8134	1.1335	1.7736
37	0.5067	0.6712	0.8357	1.1646	1.8225
38	0.5201	0.6890	0.8579	1.1957	1.8713
39	0.5334	0.7068	0.8801	1.2268	1.9202
40	0.5467	0.7245	0.9023	1.2579	1.9691
41	0.5601	0.7423	0.9246	1.2891	2.0180
42	0.5734	0.7601	0.9468	1.3202	2.0669
43	0.5867	0.7779	0.9690	1.3513	2.1158
44	0.6001	0.7957	0.9912	1.3824	2.1647
45	0.6134	0.8134	1.0135	1.4135	2.2136
46	0.6267	0.8312	1.0357	1.4446	2.2625
47	0.6401	0.8490	1.0579	1.4757	2.3114
48	0.6887	0.8936	1.1186	1.5587	2.4186

Steel Factors for Instrumentation Cables - FeF

Fe POS

Pair Instrumentation Over all Screen Cables

No. of Pairs Cable size in sq.mm	0.5 sq.mm	0.75 sq.mm	1.0 sq.mm	1.5 sq.mm	2.5 sq.mm
1	0.1490	0.1565	0.1635	0.1735	0.1930
2	0.2190	0.2335	0.2470	0.2665	0.2595
3	0.2360	0.2545	0.2690	0.2900	0.2680
4	0.2390	0.2580	0.2715	0.2945	0.2830
5	0.2630	0.2820	0.2420	0.2805	0.3155
6	0.2840	0.3160	0.2805	0.2995	0.3430
7	0.2840	0.2595	0.2805	0.2995	0.3430
8	0.3235	0.2930	0.3030	0.3315	0.3780
9	0.2805	0.3180	0.3290	0.3590	0.4205
10	0.2970	0.3215	0.3455	0.3755	0.4385
11	0.3005	0.3255	0.3490	0.3805	0.4435
12	0.3055	0.3440	0.3680	0.3880	0.4520
13	0.3265	0.3530	0.3780	0.4105	0.4785
14	0.3265	0.3530	0.3780	0.4105	0.4785
15	0.3490	0.3765	0.4015	0.4365	0.5195
16	0.3490	0.3765	0.4015	0.4365	0.5195
17	0.3590	0.4005	0.4140	0.4635	0.5470
18	0.3590	0.4005	0.4265	0.4635	0.5470
19	0.3590	0.4005	0.4265	0.4635	0.5470
20	0.3830	0.4240	0.4535	0.4920	0.5760
21	0.3830	0.4240	0.4535	0.4920	0.5760
22	0.4065	0.4520	0.4785	0.5310	0.6190
23	0.4065	0.4520	0.4810	0.5310	0.6190
24	0.4305	0.4770	0.5070	0.5595	0.6475
25	0.4305	0.4770	0.5070	0.5595	0.6475
26	0.4305	0.4770	0.5070	0.5595	0.6475
27	0.4355	0.4820	0.5245	0.5660	0.6700
28	0.4570	0.5045	0.5345	0.5895	0.6950
29	0.4570	0.5045	0.5345	0.5895	0.6950
30	0.4570	0.5045	0.5345	0.5895	0.6950
31	0.4795	0.5285	0.5595	0.6150	0.7225
32	0.4820	0.5285	0.5595	0.6150	0.7225
33	0.4820	0.5285	0.5595	0.6150	0.7225
34	0.4920	0.5520	0.5835	0.6410	0.7500
35	0.4920	0.5520	0.5835	0.6410	0.7500
36	0.4920	0.5520	0.5835	0.6410	0.7500
37	0.4920	0.5520	0.5835	0.6410	0.7500
38	0.5145	0.5760	0.6225	0.6550	0.7805
39	0.5145	0.5760	0.6225	0.6550	0.7805
40	0.5145	0.5760	0.6225	0.6550	0.7805
41	0.5395	0.6025	0.6475	0.6975	0.8230
42	0.5395	0.6025	0.6475	0.6975	0.8230
43	0.5395	0.6025	0.6475	0.6975	0.8230
44	0.5635	0.6265	0.6735	0.7250	0.8540
45	0.5635	0.6265	0.6760	0.7250	0.8540
46	0.5635	0.6265	0.6760	0.7250	0.8540
47	0.5635	0.6265	0.6760	0.7250	0.8540
48	0.5635	0.6265	0.6760	0.7375	0.8665

Steel Factors for Instrumentation Cables - FeF

Fe PIS

Pair Instrumentation Individual and Over all Screen Cables

No. of Pairs Cable size in sq.mm	0.5 sq.mm	0.75 sq.mm	1.0 sq.mm	1.5 sq.mm	2.5 sq.mm
1	0.1880	0.1980	0.2070	0.2220	0.2410
2	0.2315	0.2460	0.2595	0.2815	0.2755
3	0.2505	0.2690	0.2820	0.2495	0.2830
4	0.2645	0.2830	0.2420	0.2805	0.3155
5	0.2895	0.2730	0.2805	0.3005	0.3430
6	0.2755	0.2980	0.3005	0.3280	0.3730
7	0.2755	0.2980	0.3005	0.3280	0.3730
8	0.2980	0.3215	0.3455	0.3740	0.4230
9	0.3230	0.3490	0.3730	0.4040	0.4685
10	0.3405	0.3655	0.3765	0.4215	0.4885
11	0.3430	0.3690	0.3815	0.4265	0.4945
12	0.3490	0.3765	0.4015	0.4470	0.5160
13	0.3715	0.3990	0.4255	0.4720	0.5420
14	0.3715	0.3990	0.4255	0.4720	0.5420
15	0.3955	0.4240	0.4510	0.5020	0.5720
16	0.3955	0.4240	0.4510	0.5020	0.5720
17	0.4190	0.4495	0.4795	0.5295	0.6150
18	0.4190	0.4495	0.4795	0.5295	0.6150
19	0.4190	0.4495	0.4795	0.5295	0.6150
20	0.4445	0.4770	0.5060	0.5570	0.6450
21	0.4445	0.4895	0.5060	0.5695	0.6450
22	0.4695	0.5045	0.5345	0.5870	0.6885
23	0.4695	0.5045	0.5345	0.5870	0.6885
24	0.4970	0.5310	0.5620	0.6285	0.7210
25	0.4970	0.5310	0.5620	0.6285	0.7210
26	0.4970	0.5310	0.5620	0.6285	0.7210
27	0.5035	0.5495	0.5810	0.6360	0.7410
28	0.5135	0.5610	0.6050	0.6610	0.7690
29	0.5135	0.5610	0.6050	0.6610	0.7690
30	0.5260	0.5610	0.6050	0.6610	0.7690
31	0.5495	0.5845	0.6300	0.6885	0.7990
32	0.5495	0.5845	0.6300	0.6885	0.7990
33	0.5495	0.5845	0.6300	0.6885	0.7990
34	0.5735	0.6225	0.6585	0.7285	0.8405
35	0.5735	0.6225	0.6585	0.7285	0.8405
36	0.5735	0.6225	0.6585	0.7285	0.8405
37	0.5735	0.6225	0.6585	0.7285	0.8405
38	0.5990	0.6485	0.6850	0.7575	0.8740
39	0.5990	0.6485	0.6850	0.7575	0.8740
40	0.5990	0.6485	0.6850	0.7575	0.8740
41	0.6250	0.6775	0.7135	0.7880	0.9180
42	0.6250	0.6775	0.7135	0.7880	0.9180
43	0.6250	0.6775	0.7135	0.7880	0.9180
44	0.6485	0.7050	0.7410	0.8165	0.9495
45	0.6485	0.7050	0.7410	0.8165	0.9495
46	0.6485	0.7050	0.7410	0.8165	0.9495
47	0.6485	0.7050	0.7410	0.8165	0.9495
48	0.6485	0.7050	0.7535	0.8290	0.9620

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Cir. No. 35/DIV/ CAB/05/ 24th April 2018

To Members of the Cable Division, Utilities, Railways & Listed purchasing organizations

Sub: Correction in PV formulae of LT XLPE Power Cable and addition of factors for HT XLPE Power Cables

We have recently published revised Price Variation Clause for LT&HT XLPE Power Cables and made it effective from 1st November 2017 vide Cir. No.111/DIV/CAB/05 dated 5th December 2017

While replying to a query of a buyer it is observed that the polymer factor for LT XLPE Power Cables (both aluminium and copper) was incorrectly represented by Table P2.

We have now corrected the anomaly by correcting the PV formulae of LT XLPE Aluminium and Copper Insulated Cables (Sl. No. D & E) by representing Polymer factor by Table L2.

We have also worked out factors for XLPE, Copper and Steel for 3 core HT XLPE Power Cables for 500 and 630 sq.mm.

We now enclose complete PV clause of Cable by including all the PV formulae of different types of power cable (Sl. No. A to I), polymer factor Table L2 and updated XL4, H2 and H5 Table of factors for your perusal & record.

We request to replace PV clause of Cable already circulated vide Cir. 111/DIV/CAB/05 dated 5th December 2017 with the enclosed PV clause in your records for future use.

Senior Director

Encl: as above

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Material Price Variation Clause For PVC And XLPE Insulated Cables

The Price quoted/confirmed is based on the input cost of raw materials/components as on the date of quotation, and the same is deemed to be related to the prices of raw materials as specified in the price variation clause given below. In case of any variation in these prices, the price payable shall be subject to adjustment up or down in accordance with the formulae provided in this document.

Terms used in price variation formulae:

P Price payable as adjusted in accordance with above appropriate formula (in Rs/Km)

Po Price quoted/confirmed (in Rs/Km)

ALUMINIUM

AlF Variation factor for aluminium

Al Price of Aluminiujm. This price is as applicable of first working day of the month, one month prior to the date of delivery.

Alo Price of aluminium. This price is as applicable on first working day of the month, one month prior to the date of tendering.

COPPER

CuF Variation factor for copper

Cu Price of CC copper rods. This price is as applicable on first working day of the month, one month prior to the date of delivery.

Cuo Price of CC copper rods. This price is as applicable on first working day of the month, one month prior to the date of tendering.

PVC COMPOUND

PVCc price of PVC compound. This price is as applicable on first working day of the month, one month prior to the date of delivery.

PVCco Price of PVC compound. This price is as applicable on first working day of the month, one month prior to the date of tendering.

CCFAl Variation factor for PVC compound/Polymer for aluminum conductor cable.

CCFCu Variation factor for PVC compound/Polymer for copper conductor cable.

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XLPE COMPOUND

Cc price of XLPE compound. This price is as applicable on first working day of the month, one month prior to the date of delivery.

Cco Price of XLPE compound. This price is as applicable on first working day of the month, one month prior to the date of tendering.

XLFAL Variation factor for XLPE compound for aluminum conductor cable.
XLFCU Variation factor for XLPE compound for Copper conductor cable.

STEEL

FeF Variation factor for steel

FeW Variation factor for round wire steel armouring

Fe Price of Steel Strips/steel wire. This price is as applicable on the first working day of the month, one month prior to the date of delivery.

Feo Price of steel strips/steel wire. This price is as applicable on first working day of the month, one month prior to the date of tendering.

The above prices and indices are as published by IEEMA vide Circular reference IEEMA (PVC)/CABLE R(1)/--/-- prevailing as on 1st working day of the month i.e. one month prior to the date of tendering.

The date of delivery is the date on which the cable is notified as being ready for inspection/dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

Notes

(a) All prices of raw materials are exclusive of GST amount.
(b) All prices excluding Aluminium & Copper are as on first working day of the month.
(c) The details of prices are as under:

1. Price of Aluminium is LME average Cash SELLER Settlement price of Primary Aluminium in US$ per MT as published by London Metal Bulletin (LME) including Premium for Aluminium Ingot in US$ per MT is converted in Indian Rs./MT.
2. Price of PVC Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer.
3. Price of XLPE Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer
4. Price of CC copper rods (in Rs/MT) is ex-works price as quoted by the primary producer.
5. Price of galvanized steel strip / steel wire (in Rs/MT) is ex-works price as quoted by the manufacturer for Round steel Wire and Flat steel strip (the relevant price of steel strip or steel wire is to be selected depending upon the type of armouring of the cable).

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Price variation formulae for 'Power Cables'

A. Aluminum conductor PVC insulated 1.1 kV power cables

P = Po + AlF (AL – Alo) + CCFAl (PVCc – PVCco) + FeF (Fe - Feo)

For unarmourd multicore cables (without steel armour); FeF = 0

Table References:

ALP	Aluminium conductor in single core unarmoured & multicore cables
P1	Aluminium conductor aluminium armour in single core armoured cables
P2	PVC compound
P3	Steel armour

B. Copper conductor PVC insulated 1.1 kV power cables

P = Po + CuF (Cu – Cuo) + CCFCu (PVCc – PVCco) + Fef (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0
For unarmoured cables; FeF, AlF = 0

Tables References:

CUP	Copper conductor
P2	PVC compound
P3	Steel armour
P4	Aluminium armour

C. Copper conductor PVC insulated 1.1 kV control cables

P = Po + CuF (Cu – Cuo) + CCFCu (PVCc-PVCco) + FeF (Fe-Feo)

For unarmoured cables; FeF = 0

Tables References:

CUC	Copper conductor
P5	PVC compound
P6	Steel armour

D. Aluminum conductor XLPE insulated 1.1 kV power cables

P = Po + AlF (AL – Alo) +XLFAL(CC-Cco)+ CCFAl (PVCc – PVCco) + FeF (Fe - Feo)

For unarmourd multicore cables (without steel armour); FeF = 0

Table References:

ALP	Aluminium conductor in single core unarmoured & multicore cables
P1	Aluminium conductor aluminium armour in single core armoured cables
L2	Polymer (CCFAl)
P3	Steel armour
XL1	XLPE Compound (XLFAL)

E. Copper conductor XLPE insulated 1.1 kV power cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc – PVCco) + Fef (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0

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For unarmoured cables; FeF, AlF = 0

Tables References:

CUP	Copper conductor
L2	Polymer (CCFCu)
P3	Steel armour
P4	Aluminium armour
XL1	XLPE Compound (XLFCu)

F. Copper conductor XLPE insulated 1.1 kV control cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc-PVCco) + FeF (Fe-Feo)

For unarmoured cables; FeF = 0

Tables References:

CUC	Copper conductor
P5	PVC compound
P6	Steel armour
XL2	XLPE Compound

G. For Aluminium conductor XLPE insulated 3.3 to 33 kV power cables

P = Po + AlF (Al – Alo) + XLFAL(CC-Cco)+CCFAl (PVCc – PVCco) + FeF (Fe – Feo)

For unarmoured multicore cables (without steel armour); FeF = 0

Table Refernces:

ALP	Aluminium conductor in single core unarmoured & multicore cables
H1	Aluminium conductor + aluminium armour in single core armoured cables
H2	Polymer
H3/H5	Steel armour (Flat/Round)
XL3/XL4	XLPE Compound (Single core /Multicore)

H. Copper conductor XLPE insulated 3.3 to 33 kV power cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc – PVCco) + FeF (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0
For unarmoured cables; FeF, AlF = 0

Table References:

CUP	Copper conductor
H2	Polymer
H3/H5	Steel armour (Flat/Round)
H4	Aluminium armour
XL3/XL4	XLPE Compound (Single core /Multicore)

I. Copper conductor XLPE insulated 1.0 and 1.5 kV Solar PV DC cables

P = Po + CuF (Cu – Cuo)
Table CUsdc Copper Conductor

Authorized Signatory

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TABLE ALP

VARIATION FACTOR FOR ALUMINIUM (AIF)
POWER CABLES WITH ALUMINIUM CONDUCTOR
(EXCLUDING SINGLE CORE ARMOURED CABLES)

Nominal Cross Sectional Area (in Sq. mm.)	1 core	2 core	3 core	3.5 core	4 core
2.5	0.007	0.014	0.021	-	0.028
4	0.011	0.023	0.034	-	0.046
6	0.017	0.034	0.052	-	0.069
10	0.029	0.053	0.087	-	0.116
16	0.046	0.091	0.137	-	0.183
25/16	0.073	0.146	0.219	0.262	0.292
35/16	0.101	0.202	0.302	0.345	0.404
50/25	0.137	0.273	0.410	0.478	0.547
70/35	0.197	0.395	0.593	0.687	0.791
95/50	0.274	0.548	0.821	0.949	1.095
120/70	0.346	0.691	1.035	1.221	1.382
150/70	0.425	0.853	1.279	1.464	1.706
185/95	0.533	1.070	1.605	1.861	2.140
225/120	0.655	1.310	1.965	2.287	2.620
240/120	0.703	1.400	2.099	2.421	2.799
300/150	0.879	1.757	2.635	3.033	3.514
400/185	1.126	2.249	3.374	3.873	4.498
500	1.418	2.838	4.256	-	5.675
630	1.828	3.663	5.494	-	7.326
800	2.340	4.679	7.018	-	9.357
1000	2.951	5.890	8.834	-	11.779

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TABLE CUP

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)
POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	1 core	2 core	3 core	3.5 core	4 core
2.5	0.023	0.046	0.069	-	0.092
4	0.036	0.076	0.112	-	0.151
6	0.056	0.112	0.171	-	0.227
10	0.095	0.174	0.286	-	0.382
16	0.151	0.299	0.451	-	0.602
25/16	0.240	0.480	0.720	0.862	0.960
35/16	0.332	0.664	0.993	1.135	1.329
50/25	0.451	0.898	1.348	1.572	1.799
70/35	0.648	1.299	1.950	2.260	2.602
95/50	0.901	1.802	2.700	3.121	3.601
120/70	1.138	2.273	3.407	4.016	4.545
150/70	1.398	2.806	4.207	4.815	5.611
185/95	1.753	3.519	5.279	6.121	7.038
225/120	2.154	4.309	6.463	7.522	8.617
240/120	2.312	4.605	6.904	7.963	9.206
300/150	2.891	5.779	8.667	9.976	11.558
400/185	3.703	7.397	11.097	12.738	14.794
500	4.664	9.334	13.998	-	18.665
630	6.012	12.048	18.070	-	24.095
800	7.696	15.389	23.082	-	30.775
1000	9.706	19.372	29.055	-	38.741

TABLE CUsdc

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)
1.0 & 1.5KV Solar PV DC Cables with Copper Conductor

Cable Size in sq.mm.	Copper content in MT/km
2.5	0.023
4	0.038
6	0.058
10	0.090

TABLE CUC

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)
CONTROL CABLES WITH COPPER CONDUCTOR

No of Cores	Core size 1.5 sq mm	Core size 2.5 sq mm
2	0.026	0.047
3	0.039	0.070
4	0.052	0.094
5	0.065	0.117
6	0.078	0.141
7	0.091	0.164
8	0.110	0.182
9	0.117	0.205
10	0.130	0.235
12	0.157	0.282
14	0.183	0.329
16	0.209	0.376
18	0.246	0.410
19	0.248	0.446
20	0.260	0.456
24	0.313	0.563
27	0.352	0.634
30	0.391	0.704
37	0.483	0.869
44	0.573	1.033
52	0.678	1.221
61	0.796	1.432

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TABLE P1

VARIATION FACTOR FOR ALUMINIUM (AIF)

ALUMINIUM ARMOURED SINGLE CORE PVC INSULATED 1.1 KV CABLES

Nominal cross sectional area (in Sq.mm)	Aluminium factor for Aluminium armoured cable with aluminium conductor
4	0.0685
6	0.0795
10	0.1017
16	0.1303
25	0.1693
35	0.2090
50	0.2597
70	0.3360
95	0.4567
120	0.5443
150	0.6427
185	0.7743
240	0.9737
300	1.2582
400	1.5502
500	1.8958
630	2.3650
800	2.9306
1000	3.7666

IEEMA (PVC)/CABLE(R-1)/2017 Effective from: 1st November 217

TABLE P2

VARIATION FACTOR FOR PVC COMPOUND (CCFAI/CCFCu)
PVC INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal cross Sectional Area (in Sq. mm)	1 core	2 core		3 core		3.5 core		4 core	
	Unarm	Unarm	arm	Unarm	arm	Unarm	arm	Unarm	arm
2.5	0.079	0.125	0.139	0.141	0.157	-	-	0.161	0.179
4	0.094	0.140	0.156	0.164	0.182	-	-	0.188	0.209
6	0.101	0.154	0.171	0.179	0.199	-	-	0.198	0.220
10	0.114	0.194	0.216	0.214	0.238	-	-	0.249	0.277
16	0.142	0.234	0.246	0.279	0.290	-	-	0.328	0.345
25	0.171	0.288	0.303	0.364	0.383	0.422	0.444	0.443	0.466
35	0.189	0.321	0.338	0.403	0.429	0.489	0.515	0.498	0.524
50	0.211	0.411	0.433	0.508	0.535	0.613	0.645	0.647	0.681
70	0.241	-	-	0.613	0.645	0.707	0.744	-	-
95	0.284	-	-	0.795	0.811	0.908	0.927	-	-
120	0.339	-	-	0.866	0.884	1.024	1.045	-	-
150	0.388	-	-	1.070	1.092	1.289	1.315	-	-
185	0.450	-	-	1.310	1.337	1.499	1.530	-	-
225	0.521	-	-	1.586	1.618	1.840	1.878	-	-
240	0.534	-	-	1.649	1.683	1.990	2.031	-	-
300	0.653	-	-	2.007	2.048	2.361	2.409	-	-
400	0.770	-	-	2.437	2.487	2.616	2.669	-	-
500	0.936	-	-	3.117	3.181	3.687	3.762	-	-
630	1.175	-	-	-	-	-	-	-	-
800	1.433	-	-	-	-	-	-	-	-
1000	1.642	-	-	-	-	-	-	-	-

IEEMA (PVC)/CABLE(R-1)/2017 Effective from: 1st November 217

TABLE P3

VARIATION FACTOR FOR STEEL (FeF)

PVC INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal Cross sectional Area (in Sq. mm)	2 core	Shape	3 core	Shape	3 ½ core	Shape	4 core	Shape
4	0.305	W	0.335	W	-	-	0.363	W
6	0.348	W	0.363	W	-	-	0.407	W
10	0.392	W	0.407	W	-	-	0.293	F
16	0.235	F	0.293	F	-	-	0.323	F
25	0.293	F	0.352	F	0.382	F	0.382	F
35	0.323	F	0.382	F	0.411	F	0.440	F
50	0.382	F	0.440	F	0.469	F	0.499	F
70	0.411	F	0.499	F	-	F	0.587	F
95	0.499	F	0.587	F	0.616	F	0.645	F
120	0.528	F	0.616	F	0.675	F	0.731	F
150	0.587	F	0.675	F	0.731	F	0.790	F
185	0.645	F	0.761	F	0.820	F	0.879	F
240	0.731	F	0.879	F	0.937	F	0.996	F
300	0.820	F	0.966	F	1.055	F	1.113	F
400	0.937	F	1.083	F	1.172	F	1.231	F
500	1.055	F	1.231	F	1.348	F	1.406	F
630	1.172	F	-	-	-	-	-	-

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TABLE P3 (Additional)

VARIATION FACTOR FOR ROUND WIRE 'W' STEEL (FeF)
PVC INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in sq. mm)	2 Core	3 Core	3 .5 Core	4 Core
1.5	0.247	0.259		0.288
2.5	0.273	0.289		0.329
4	0.305	0.335		0.363
6	0.348	0.363		0.407
10	0.392	0.407		0.533
16	0.439	0.523	0.014	0.573
25	0.526	0.625	0.664	0.685
35	0.591	0.685	0.729	0.761
50	0.661	0.790	0.864	1.108
70	0.745	1.122	1.200	1.256
95	1.085	1.286	1.376	1.443
120	1.147	1.386	1.479	1.562
150	1.267	1.526	1.684	2.173
185	1.403	2.090	2.315	2.421
240	1.994	2.397	2.641	2.722
300	2.180	2.642	3.670	3.842
400	2.987	3.728	4.126	4.292
500	3.517	4.226	5.958	6.301
630	4.774	6.013	6.737	7.141

TABLE P4

VARIATION FACTOR FOR ALUMINIUM (AIF)
PVC INSULATED 1.1 KV POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	Aluminium Factor for Aluminium armoured cable with copper conductor
4	0.058
6	0.063
10	0.073
16	0.084
25	0.096
35	0.108
50	0.123
70	0.139
95	0.183
120	0.198
150	0.218
185	0.241
240	0.271
300	0.379
400	0.424
500	0.478
630	0.537
800	0.591
1000	0.816

TABLE P5

VARIATION FACTOR FOR PVC COMPOUND (CCFCu)
PVC INSULAYTED CONTROL CABLES WITH COPPER CONDUCTOR

No of cores	Core size 1.5 sq mm		Core size 2.5 sq mm	
	Unarm	Arm	Unarm	Arm
2	0.118	0.121	0.125	0.139
3	0.121	0.131	0.141	0.157
4	0.137	0.152	0.161	0.179
5	0.157	0.174	0.187	0.206
6	0.179	0.199	0.234	0.260
7	0.179	0.199	0.234	0.260
8	0.193	0.215	0.292	0.325
9	0.216	0.241	0.300	0.335
10	0.236	0.262	0.303	0.337
12	0.249	0.277	0.334	0.371
14	0.311	0.327	0.389	0.409
16	0.344	0.362	0.435	0.458
18	0.352	0.371	0.474	0.500
19	0.375	0.395	0.476	0.501
20	0.391	0.412	0.519	0.546
24	0.457	0.481	0.584	0.615
27	0.491	0.517	0.631	0.664
30	0.529	0.557	0.706	0.743
37	0.615	0.647	0.835	0.879
44	0.739	0.778	1.019	1.026
52	0.845	0.889	1.100	1.158
61	0.952	1.002	1.246	1.312

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TABLE P6

VARIATION FACTOR FOR STEEL (FeF)
PVC INSULATED CONTROL CABLES WITH COPPER CONDUCTOR

No of cores	Core size 1.5 sq mm	Shape of armour	Core size 2.5 sq mm	Shape of armour
2	0.243	W	0.277	W
3	0.257	W	0.289	W
4	0.277	W	0.314	W
5	0.303	W	0.342	W
6	0.329	W	0.379	W
7	0.329	W	0.379	W
8	0.341	W	0.456	W
9	0.383	W	0.275	F
10	0.408	W	0.325	F
12	0.289	F	0.342	F
14	0.306	F	0.360	F
16	0.317	F	0.372	F
18	0.332	F	0.350	F
19	0.343	F	0.397	F
20	0.368	F	0.400	F
24	0.398	F	0.475	F
27	0.414	F	0.478	F
30	0.425	F	0.503	F
37	0.461	F	0.548	F
44	0.507	F	0.601	F
52	0.556	F	0.641	F
61	0.585	F	0.685	F

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TABLE P6 (Additional)

VARIATION FACTOR FOR ROUND WIRE 'W' STEEL (FeF)
PVC INSULATED CONTROL CABLES WITH COPPER CONDUCTOR

No. of Cores	Core size 1.5 sq mm	Core size 2.5 sq mm
2	0.243	0.273
3	0.257	0.289
4	0.277	0.314
5	0.303	0.342
6	0.329	0.379
7	0.329	0.379
8	0.341	0.456
9	0.383	0.508
10	0.408	0.535
12	0.510	0.572
14	0.546	0.625
16	0.581	0.660
19	0.608	0.696
24	0.714	0.819
25	0.679	0.798
27	0.732	0.837
28	0.696	0.815
30	0.758	0.881
33	0.747	0.883
37	0.820	1.217
44	0.926	1.355
48	1.122	1.308
50	1.122	1.308
52	1.149	1.361
56	1.202	1.388
61	1.299	1.520

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TABLE L2

VARIATION FACTOR FOR POLYMER (CCFAI / CCFCu)
XLPE INSULATED 1.1 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (In Sq. mm)	1 core	2 core		3 core		3.5 core		4 core	
	Unarm	Unarm	Arm	Unarm	Arm	Unarm	Arm	Unarm	Arm
2.5	0.055	0.163	0.175	0.166	0.177	-	-	0.177	0.188
4	0.075	0.201	0.204	0.205	0.213	-	-	0.218	0.213
6	0.085	0.213	0.234	0.205	0.230	-	-	0.242	0.232
10	0.082	0.252	0.280	0.217	0.251	-	-	0.285	0.298
16	0.089	0.278	0.341	0.289	0.246	-	-	0.300	0.279
25	0.101	0.307	0.278	0.276	0.247	0.295	0.264	0.331	0.290
35	0.109	0.330	0.319	0.305	0.270	0.328	0.292	0.368	0.319
50	0.124	0.482	0.685	0.348	0.311	0.372	0.335	0.422	0.394
70	0.146	0.354	0.335	0.469	0.397	0.489	0.420	0.528	0.464
95	0.163	0.436	0.389	0.504	0.441	0.544	0.471	0.591	0.523
120	0.176	0.475	0.421	0.556	0.498	0.599	0.538	0.722	0.656
150	0.217	0.510	0.490	0.690	0.611	0.717	0.633	0.840	0.762
185	0.236	0.631	0.608	0.836	0.738	0.854	0.756	1.007	0.899
240	0.273	0.750	0.726	1.002	0.842	1.079	0.952	1.238	1.119
300	0.303	0.919	0.887	1.161	1.012	1.170	1.031	1.457	1.414
400	0.372	1.093	1.040	1.376	1.283	1.545	1.379	1.778	1.626
500	0.413	1.342	-	1.568	1.400	1.806	1.456	-	-
630	0.469	1.546	-	-	-	-	-	-	-
800	0.569	-	-	-	-	-	-	-	-
1000	0.667	-	-	-	-	-	-	-	-

225 removed

L2 LC R2

TABLE XL1
VARIATION FACTOR FOR XLPE COMPOUND (XLFAL/XLFCU)
XLPE INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal cross Sectional Area (in Sq. mm)	1 core		2 core		3 core		3.5 core		4 core	
	Unarm	Arm	Unarm	Arm	Unarm	arm	Unarm	Arm	Unarm	arm
2.5	0.007	0.010	0.014	0.014	0.021	0.021			0.028	0.028
4	0.009	0.012	0.018	0.018	0.027	0.027			0.036	0.036
6	0.010	0.015	0.022	0.022	0.033	0.033			0.043	0.043
10	0.013	0.018	0.025	0.025	0.039	0.039			0.053	0.053
16	0.016	0.023	0.034	0.034	0.049	0.049			0.065	0.065
25	0.021	0.030	0.048	0.048	0.070	0.070	0.084	0.084	0.093	0.093
35	0.025	0.035	0.059	0.059	0.084	0.084	0.099	0.099	0.112	0.112
50	0.033	0.044	0.075	0.075	0.108	0.108	0.130	0.130	0.144	0.144
70	0.042	0.054	0.095	0.095	0.137	0.137	0.160	0.160	0.179	0.179
95	0.048	0.062	0.110	0.110	0.160	0.160	0.190	0.190	0.211	0.211
120	0.060	0.076	0.138	0.138	0.200	0.200	0.239	0.239	0.266	0.266
150	0.078	0.095	0.180	0.180	0.259	0.259	0.296	0.296	0.344	0.344
185	0.097	0.116	0.224	0.224	0.324	0.324	0.369	0.369	0.430	0.430
240	0.116	0.137	0.266	0.266	0.388	0.388	0.446	0.446	0.518	0.518
300	0.138	0.164	0.325	0.325	0.467	0.467	0.540	0.540	0.620	0.620
400	0.175	0.214	0.357	0.357	0.536	0.536	0.619	0.619	0.714	0.714
500	0.217	0.260	0.440	0.440	0.660	0.660	0.769	0.769	0.880	0.880
630	0.265	0.318	0.542	0.542	0.814	0.814	0.941	0.941	1.085	1.085
800	0.323	0.389								
1000	0.375	0.444								

TABLE XL2
VARIATION FACTOR FOR XLPE COMPOUND (XLFCU)
XLPE INSULAYTED CONTROL CABLES WITH COPPER CONDUCTOR

No of cores	Core size 1.5 sq mm		Core size 2.5 sq mm	
	Unarm	Arm	Unarm	Arm
2	0.010	0.010	0.012	0.012
3	0.016	0.016	0.018	0.018
4	0.021	0.021	0.025	0.025
5	0.026	0.026	0.031	0.031
6	0.031	0.031	0.037	0.037
7	0.036	0.036	0.043	0.043
8	0.036	0.036	0.043	0.043
9	0.042	0.042	0.049	0.049
10	0.052	0.052	0.061	0.061
12	0.062	0.062	0.074	0.074
14	0.073	0.073	0.086	0.086
16	0.083	0.083	0.098	0.098
18	0.094	0.094	0.110	0.110
19	0.099	0.099	0.116	0.116
20	0.104	0.104	0.123	0.123
24	0.125	0.125	0.147	0.147
27	0.140	0.140	0.165	0.165
30	0.156	0.156	0.184	0.184
37	0.192	0.192	0.227	0.227
44	0.229	0.229	0.270	0.270
52	0.270	0.270	0.319	0.319
61	0.317	0.317	0.374	0.374

TABLE XL3

VARIATION FACTOR FOR XLPE(XLFAL/XLFCU)

SINGLE CORE ARMOURED /UNARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH CU / AL CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	XLPE Factor for Armoured/ Unarmoured Cable with AL /CU Conductor					
	3.3 KV	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	0.110	0.131	0.170	0.279		
35	0.122	0.137	0.175	0.284	0.317	0.522
50	0.135	0.151	0.191	0.307	0.341	0.563
70	0.155	0.172	0.215	0.342	0.379	0.615
95	0.174	0.193	0.241	0.377	0.417	0.670
120	0.192	0.212	0.262	0.407	0.449	0.713
150	0.209	0.229	0.283	0.437	0.481	0.757
185	0.228	0.250	0.308	0.471	0.518	0.809
240	0.255	0.279	0.343	0.519	0.569	0.883
300	0.280	0.322	0.372	0.560	0.613	0.943
400	0.326	0.392	0.420	0.625	0.683	1.041
500	0.388	0.461	0.469	0.694	0.757	1.142
630	0.467	0.520	0.529	0.777	0.845	1.265
800	0.567	0.593	0.602	0.874	0.949	1.407
1000	0.656	0.665	0.660	0.955	1.036	1.525

Note : XLPE factors include Semicons for Conductor & Insulation screen

TABLE – XL4

VARIATION FACTOR FOR XLPE (CCF1Al / CCF1Cu)

3 CORE XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	3.3 KV ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM
25	0.315	0.394	0.511	0.838		
35	0.339	0.427	0.545	0.880	0.982	1.638
50	0.378	0.474	0.600	0.957	1.065	1.751
70	0.435	0.541	0.679	1.067	1.183	1.916
95	0.489	0.604	0.755	1.171	1.295	2.071
120	0.537	0.661	0.822	1.265	1.396	2.210
150	0.585	0.719	0.890	1.359	1.497	2.350
185	0.642	0.784	0.968	1.468	1.614	2.513
240	0.717	0.873	1.074	1.615	1.773	2.732
300	0.781	1.006	1.167	1.744	1.928	2.919
400 ✓	0.886 ✓	1.227 ✓	1.314 ✓	1.948 ✓	2.130 ✓	3.229 ✓
500	0.956	1.421	1.446	2.148	2.381	3.538
630	1.129	1.582	1.609	2.382	2.630	3.940

Added 11

Note : XLPE factors include Semicons for Conductor & Insulation screen

TABLE H1
VARIATION FACTOR FOR ALUMINIUM (AIF)
ALUMINIUM ARMOURED SINGLE CORE XLPE INSULATED 3.3 TO 33 KV CABLES

Nominal Cross Sectional Area (in Sq. mm.)	Aluminium Factor for Aluminium Armoured Cable with Aluminium Conductor					
	3.3 KV	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
35	0.251	0.284	0.301	0.344	0.358	0.473
50	0.312	0.336	0.352	0.397	0.408	0.672
70	0.385	0.409	0.423	0.469	0.501	0.723
95	0.476	0.500	0.518	0.637	0.656	0.856
120	0.561	0.586	0.601	0.726	0.744	0.949
150	0.653	0.678	0.696	0.823	0.842	1.050
185	0.773	0.797	0.893	0.949	0.965	1.183
240	0.997	1.063	1.083	1.139	1.154	1.387
300	1.209	1.271	1.283	1.333	1.307	1.753
400	1.438	1.556	1.565	1.620	1.636	2.046
500	1.873	1.901	1.910	2.110	2.128	2.484
630	2.337	2.361	2.369	2.580	2.595	2.978
800	3.007	3.071	3.080	3.145	3.163	3.588
1000	3.737	3.741	3.749	3.804	3.822	4.565

TABLE H2
VARIATION FACTOR FOR POLYMER (CCFAI / CCFCu)
3 CORE XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	3.3 KV ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM
35	0.374	0.990	1.142	1.604	1.782	-
50	0.445	1.119	1.260	1.834	2.046	2.864
70	0.547	1.290	1.396	2.011	2.284	3.219
95	0.594	1.440	1.647	2.269	2.428	3.367
120	0.732	1.692	1.877	2.498	2.715	3.646
150	0.812	1.906	2.061	2.767	2.931	3.927
185	0.960	2.086	2.406	3.028	3.180	4.166
240	1.130	2.484	2.744	3.398	3.580	4.589
300	1.219	2.912	3.161	3.840	4.016	5.029
400	1.313	3.530	3.664	4.353	4.666	5.736
500	1.652	3.925	3.971	4.621	4.878	5.913
630	1.949	4.487	4.982	5.225	5.477	6.696

Added → Added →

Fillers added in PVC consumption

TABLE H3
VARIATION FACTOR FOR STEEL (FeF)
XLPE INSULATED 3.3 TO 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area Sq. mm.	3.3 KV	6.6 KV (E)	11 KV (E) / 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	0.551	0.604	0.656	0.814		
35	0.645	0.645	0.731	0.879	0.937	-
50	0.675	0.703	0.761	0.937	0.966	1.181
70	0.761	0.761	0.849	0.996	1.055	1.289
95	0.820	0.849	0.907	1.083	1.113	1.348
120	0.879	0.907	0.966	1.142	1.172	1.406
150	0.966	0.966	1.055	1.201	1.259	1.494
185	1.025	1.055	1.113	1.259	1.318	1.553
240	1.142	1.142	1.231	1.377	1.406	1.641
300	1.231	1.259	1.318	1.465	1.524	1.758
400	1.348	1.406	1.435	1.582	1.641	1.876

TABLE H4
VARIATION FACTOR FOR ALUMINIUM (AlF)
XLPE INSULATED SINGLE CORE 3.3 TO 33 KV POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	Aluminium Factor for Aluminium Armoured Cable with Copper Conductor					
	3.3 KV	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
35	0.153	0.187	0.204	0.247	0.258	0.372
50	0.179	0.203	0.220	0.262	0.275	0.425
70	0.196	0.219	0.233	0.278	0.311	0.444
95	0.213	0.237	0.254	0.373	0.392	0.470
120	0.228	0.253	0.268	0.393	0.410	0.488
150	0.243	0.269	0.287	0.414	0.432	0.504
185	0.261	0.285	0.381	0.437	0.455	0.526
240	0.324	0.389	0.410	0.465	0.480	0.556
300	0.365	0.428	0.440	0.490	0.510	0.737
400	0.432	0.471	0.480	0.536	0.552	0.783
500	0.489	0.517	0.526	0.726	0.744	0.844
630	0.544	0.568	0.572	0.787	0.801	0.902
800	0.706	0.787	0.797	0.862	0.880	0.982
1000	0.824	0.865	0.867	0.923	0.940	1.324

TABLE - H5
VARIATION FACTOR FOR STEEL (FeW)
XLPE INSULATED 3.3KV TO 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area in Sq. mm	3.3/3.3 KV	3.3/6.6 KV	11 KV (E) / 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	1.258	1.457	1.612	2.509	1.503	--
35	1.361	1.569	1.853	2.644	2.797	2.517
50	1.682	1.687	2.321	2.800	2.921	4.569
70	2.033	1.979	2.503	3.219	3.347	4.809
95	2.202	2.507	2.718	4.019	4.200	5.437
120	2.371	2.675	2.882	4.241	4.416	6.713
150	2.870	2.847	3.265	4.447	4.621	6.976
185	3.121	3.309	4.148	4.726	5.289	7.356
240	3.758	4.227	4.442	5.442	6.651	7.718
300	4.099	5.024	5.182	6.894	7.084	8.187
400	5.750	6.572	6.658	7.433	7.657	8.760
500	6.716	6.777	6.861	7.588	7.797	8.830
630	7.492	7.465	7.477	8.209	8.386	9.413

Added
Added