

**TELANGANA STATE POWER GENERATION
CORPORATION LIMITED**

1X800MW KOTHAGUDEM, TPS, STAGE-VII, UNIT#12

VOLUME – IIB

**TECHNICAL SPECIFICATION
FOR**

LT FRLSH HRPVC CONTROL CABLES

**SPECIFICATION NO : *PE-TS-410-507-E003*
REVISION : 0**



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



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR
1.1 kV FRLSH HRPVC CONTROL
CABLES**

SPECIFICATION NO. PE-TS-410-507-E003

VOLUME II B

SECTION

REVISION 0

DATE: 15.05.2015

SHEET 1 OF 1

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TOTAL NO. OF SHEETS (including cover sheet) = **32**

**IT IS CONFIRMED THAT OUR TECHNICAL OFFER COMPLIES WITH THE SPECIFICATION
IN TOTO, & THAT THERE ARE NO TECHNICAL DEVIATIONS.**

BIDDER'S STAMP & SIGNATURE
(REFER INSTRUCTION NO. 1 OF 'INSTRUCTIONS TO BIDDERS')

| | | | |
|---|--|--------------------------------------|------------------|
|  | DOCUMENT TITLE | SPECIFICATION NO. PE-TS-410-507-E003 | |
| | TECHNICAL SPECIFICATION FOR 1.1 kV FRLSH HRPVC CONTROL CABLES | VOLUME II B | |
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INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFERS

1. Two signed and stamped copies of the following shall be furnished by all bidders as technical offer :
 - a. Unpriced BOQ-cum-Price Schedule (Annexure-A , writing 'Quoted' against items) with bidder's signature and company stamp.
 - b. A copy of this sheet ("Instructions to Bidders for Preparing Technical Offer"), with bidder's signature and company stamp.
 - c. A copy of previous sheet ("Contents"), with bidder's signature and company stamp.
2. No technical submittal such as copies of type test certificates, data Sheets, write-up, drawing, technical literature, etc. is required during tender stage. Any such submission, even if made, shall not be considered as part of offer.
3. Confirmations/ comments (if any) regarding delivery schedules shall be furnished as part of the commercial offer. Any reference elsewhere/ covering letter of technical offer shall not be considered by BHEL.
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 cable description/ quantities, notes etc. from those given in Annexure-A to Section-C of specification [BOQ-cum-Price Schedule] shall not be considered (i.e., technical description, quantities, notes etc. as per specification shall prevail).
6. Vendor should have manufactured and supplied as on 24.12.2014:
 - a). At least 300 km of PVC insulated, PVC sheathed stranded copper conductor 1.1 kV grade cables in one single contract.
 - b). AT least one (1) km of Flame retardant low smoke cables.

Vendor to provide supportive document in above 6(a) & (b)

BIDDER'S STAMP & SIGNATURE



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PREAMBLE

1 The Tender documents contain three (3) volumes. The bidder shall meet the requirements of all three volumes.

1.1 **VOLUME - I** **CONDITIONS OF CONTRACT**

This consists of four parts as below:

Volume – IA This part contains Instructions to bidders for making bids to BHEL.

Volume – IB This part contains General Commercial Conditions of the Tender & includes provision that vendor shall be responsible for the quality of item supplied by their sub-vendors.

Volume – IC This part contains Special Conditions of Contract.

Volume – ID This part contains Commercial Conditions for Erection & Commissioning site work, as applicable.

1.2 **VOLUME – II** **TECHNICAL SPECIFICATIONS**

Technical requirements are stipulated in Volume – II, which comprises of:-

Volume – IIA General Technical Conditions.

Volume – IIB Technical Specification including Drawings, if any.

1.3 **VOLUME – IIB**

This volume is sub-divided in to following sections:-

Section – A: This section outlines the Intent of Specification.

Section – B: This section provides “Projection Information”.

Section – C: This section indicates Technical Requirements specific to Contract, not covered in Section – D.

Section – D: This section comprises of Technical Specifications of equipment complete with Data Sheets A and C.

Data Sheet-A: Specific data and other requirements pertaining to the equipments.

Data sheet–C: Indicates data / documents to be furnished after the award of Contract as per agreed schedule by the vendor (as applicable)

NOTE: This requirements mentioned in Section – C / Data Sheet – A of Section – D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section – D.



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SECTION – 'A'
SCOPE OF ENQUIRY



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SHEET

SCOPE OF ENQUIRY

- 1.0 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site LT FRLSH HRPVC CONTROL CABLES as mentioned in different sections of this specification for **1 X 800 MW KOTHAGUDEM TPS.**
- 2.0 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation up to bidder's guarantee.
- 3.0 The general terms and conditions, instructions to bidders and other attachment referred to elsewhere are hereby made part of the Technical Specification.
- 4.0 The bidders shall be responsible for and governed by all requirements stipulated hereinafter.
- 5.0 Bidders shall confirm total compliance to the specification without any deviations from the technical/ quality assurance requirements stipulated.
- 6.0 The documents shall be in English language and MKS system of units.



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SECTION – 'B'

PROJECT INFORMATION

SECTION - B

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana. The proposed Power Plant will be installed adjacent to the existing D colony of Kothagudem Thermal Power Station, at Kothagudem.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

Site is located in the existing D Colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road. The Nearest railway station is Bhadrachalam Road (Known as Kothagudem) at a distance of 12 km. Kothagudem- Bhadrachalam National Highway branches off to the power station site near village Paloncha.

3.00.00 LAND

Land is primarily required for the main plant & auxiliaries (BTG) and balance of plant (BOP) like ash handling, coal storage, cooling tower, switchyard etc., which is available within the existing plant boundary.

The existing colony is to be dismantled, and the land of about 137 acres will be used for the main plant building, water facilities, switchyard, coal handling etc. The raw water reservoir will be located adjacent to the existing raw water reservoirs.

230 acres of land required for Ash Dyke will be procured. Land is available for staff colony, which is to be constructed by the EPC contractor.

4.00.00 SOURCE OF COAL

100% Imported and Blended coal (50% imported + 50% indigenous) will be used. Indigenous coal shall be sourced from Suliyari coal mines, Madhya Pradesh.

Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS

5.00.00 **SOURCE OF WATER**

Source of water (total quantity of water is 2192 m³/hr) is Godavari River near Burgampahad & water will be pumped through existing GRP pipe line (of length approx. 26 km).

6.00.00 **ASH DISPOSAL AREA**

Ash shall be dumped in the ash dump area which will be about 9 km from plant. The ash dyke area of 230 acres is adequate for 1x800 MW unit as per MOEF norms.

7.00.00 **SALIENT DESIGN DATA**

7.01.00 Meteorological data of site is given below:-

| | | |
|-----------------------------|-----------|------------------------------------|
| Elevation above MSL | : | 89 m |
| Monthly highest temperature | : | 44.9 °C |
| Monthly lowest temperature. | : | 12.9 °C |
| Rainfall | | |
| | Average.: | 1031 mm |
| | Max. : | 100 mm/ hr |
| Mean Wind speed | : | 5.8 kmph |
| Relative Humidity | | |
| | Max : | 82% |
| | Min : | 35% |
| Seismic Zone | : | Zone-III as per IS- 1893 (Part-IV) |

[Climatological data of Khammam is attached for reference].



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SECTION – 'C'

SPECIFIC TECHNICAL REQUIREMENTS



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**TECHNICAL SPECIFICATION FOR
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SECTION - C

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1.0 SCOPE OF ENQUIRY

- 1.1 This enquiry covers the supply of 1.1 KV FRLSH HRPVC Control cables conforming to this specification as detailed below.
- 1.2 General technical requirements of the cables are indicated in Section-D and Data Sheet-A. Project specific technical/ quality requirements/ changes are listed below.
- 1.3 Cables shall conform in all respects to the requirements stipulated in all the above parts of the specification.
- 1.4 The stipulations of Section-C, followed by those of Data Sheet-A shall prevail in case of any conflict between the stipulations of Section-C, Datasheet-A and Section-D.

2.0 BILL OF QUANTITIES:

- 2.1 Quantity requirements shall be as per Annexure-A (Bill of Quantities (BOQ)) enclosed.
- 2.2 Delivery schedule (i.e. contractual calendar dates) for the package shall be given separately to the bidders for compliance. Supplies shall be completed conforming to the lot requirements stipulated in the BOQ within the overall delivery schedule.
- 2.3 The bidder shall indicate the unit price of each type and size of cables listed as per the BOQ in the unit price schedule enclosed with this specification. The unit prices shall apply for adjustment of variation in quantity as stipulated above.

3.0 SPECIFIC TECHNICAL REQUIREMENTS

3.1 Specific technical requirements shall be as listed below :

3.1.1 Technical:

- (i) Control cables shall be 1100 V grade, multi core, minimum 2.5 sq mm cross section, stranded copper conductor having minimum 7 strands, Extruded HRPVC insulated, HRPVC inner sheathed, galvanised steel wire armoured, overall FRLSH HRPVC outer sheathed generally conforming to IS 1554 part-I.
- (ii) The sheath shall be resistant to water, fungus, termite and rodent attacks.
- (iii) The outer sheath of FRLSH HRPVC compound shall meet the following performance requirements :
- (a) The critical oxygen index value shall be minimum 29 when tested at $27\pm 2^{\circ}\text{C}$ as per ASTM- D- 2863-77 and the temperature index shall be minimum 250°C at oxygen index value of 21 when tested as per ASTM-D-2863
- (b) The maximum acid gas generation as determined by titration method shall be less than 20% by weight when tested as per IEC-60754-1 (1994).
- (c) Flammability
- (i) Cables shall pass tests under fire condition as per IS-10810-Part-53.



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- (ii) Cables shall also pass tests as per IS-10810 Part-61 & Part-62. Category group shall be considered as Category 'A'.
- (d) The smoke generation under fire shall have maximum smoke density rating of 60% when tested as per ASTM-D-2843-77 (1977).
- (g) The finished cable shall pass the flammability tests as per IEC-332-1 (1993) and IEEE-383. In addition, it shall also pass flammability tests as per Class F3 of Swedish Standard SS-424-1475 (1977).

Specific requirement/ change :

(iv)

| SL.NO. | Reference Clause No. of Section – D (if any) | Specific requirement/ Change |
|--------|--|--|
| 1. | 2.4.1.b,c,d | May be read as 2.4.1 (b). Additionally 'The type tests are required to be conducted as indicated in Annexure to QAP and the same shall be offered for inspection (conduction of type tests shall be witnessed by BHEL). Bidder to indicate unit price of cables inclusive of type test charges. No separate charges shall be payable for type tests. |
| 2 | 2.4.1 e | Refer SL. NO. 1 above. |

3.1.2 Quality/ Inspection:

| SL. NO. | Reference Clause No. of Section – D (if any) | Specific requirement/ Change |
|---------|--|---|
| 1 | 2.2 | QP (including Annexure to QAP) enclosed with spec. shall be stamped and signed by bidders as token of acceptance. The QP shall be submitted during contract stage for Customer/ BHEL approval without any commercial implication to BHEL. |
| 2 | 2.4.1 (d) | All tests shall be conducted as per contract. Conduction of Testing requirements mentioned in Datasheet-A & Annexure to QAP. |

3.1.3 The successful bidder shall submit the standard list of raw material suppliers/ sub-vendors for approval without any commercial implications. Changes to the same, if proposed by any bidder, shall be to BHEL approval.

3.1.4 Quality Plan applicable for project :

BHEL Standard Quality Plan no. PE-QP-999-507-E003 Rev.00 (Enclosed with specification)

3.1.5 Document distribution schedule for the project shall be as below :



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No. of prints to be submitted by vendor after award of contract shall be as under:

| S. NO. | DESCRIPTION | No. hard /soft copies | No. of CD-ROMs | REMARKS |
|--------|---|---------------------------|----------------|---------|
| 1 | Drawings / docs. for approval (First submission) | PDF File + 2 Hard copies | NIL | |
| 2 | Drawings /docs. for approval (Second & subsequent submission till approval) | PDF File + 2 Hard copies | NIL | |
| 3 | Final approval Drawings / docs. for Distribution after CAT-1. | PDF File + 10 Hard Copies | NIL | |
| 4 | As Built Drawings/ docs. | 6 Hard Copies | 4 CD-ROMS | |
| 5 | Type Test Certificates/ Reports for approval | PDF+ 2 hard Copies | NIL | |
| 6 | Type Test Certificates/ Reports for distribution | 6 hard Copies | 6 CD-ROMS | |

3.1.6 A label shall be securely attached to each end of the reel indicating the Purchaser's order number, length, type voltage grade, conductor size and number of cores of the cable. Also weight of cable drums with and without cables and type of end sealing to be indicated. A tag containing the same information shall be attached to the leading ends of the cable inside. An arrow and necessary instructions shall be marked on the drum indicating the direction in which it should be rolled.

3.2 LIST OF STANDARD DELIVERABLES FOR LT CONTROL CABLES TO BE SUBMITTED BY SUCCESSFUL BIDDER

| 1.1 KV LT PVC Control Cables | | | |
|------------------------------|--|-------------------------------|--|
| SL. No. | DOCUMENT TITLE | DWG. / DOCUMENT No. | SUBMISSION SCHEDULE |
| 1 | Data Sheet for 1.1KV HRPVC Control Cables | PE-V0-410-507-E206 | Within Two weeks from the date of LOI |
| 2 | Cross-sectional Drawings for 1.1KV HRPVC Control Cables | PE-V0-410-507-E207 | Within Two weeks from the date of LOI |
| 3 | Type Test Procedure for 1.1KV HRPVC Control Cables | PE-V0-410-507-E208 | Within Two weeks from the date of LOI |
| 4 | Quality Plan for HRPVC Control Cables | PE-QP-999-507-E003 Rev.00 (#) | Within Two weeks from the date of LOI |
| 5 | Type Test Reports for Tests conducted under this contract (Ref. Cl. 2.4.1.c & 2.4.1.d of section-D) | PE-V0-410-507-E210 | Within a week from the date of conduction of Type Test |

(#) : Standard Quality Plan for HRPVC Control Cables


1 X 800MW KOTHAGUDEM,TPS,STAGE-VII, UNIT #12
ANNEXURE - A
BOQ-CUM-PRICE SCHEDULE FOR LT HRPVC CONTROL CABLES


1.1 kV control cables with stranded plain annealed copper conductor, HRPVC Type-C insulation, core identification by colour coding and numbering at interval of 100 mm or less (IS : 1554 (Part-I)), distinct extruded inner Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2., GS round wire armour as per IS 3975, and extruded HRPVC Type ST2 outer sheath with FRLSH properties, generally conforming to IS:1554 (Part-1) and BHEL specification.


| 1.1 kV COPPER CONDUCTOR ARMoured CABLES | | | | | | | |
|---|---------------------|-------------------------|-------------------------|----------------------|-----------------------|------------------------|---------|
| SL. NO. | CABLE SIZE (sq. mm) | ORDER QUANTITY (METRES) | LOT-I QUANTITY (METRES) | DRUM LENGTH (METRES) | UNIT PRICE (Ex-Works) | TOTAL PRICE (Ex-Works) | REMARKS |
| 1 | 5C X 2.5 | 56000 | 40000 | 1000 | | | |
| 2 | 7C X 2.5 | 28000 | 20000 | 1000 | | | |
| 3 | 9C X 2.5 | 24000 | 17000 | 1000 | | | |
| 4 | 12C X 2.5 | 14000 | 10000 | 1000 | | | |
| 5.0 | 5C X 4 | 9500 | 7000 | 1000 | | | |


NOTES:


- 1 Quantities indicated above shall be known as order quantities. The variation in quantities shall be limited from -30% to +30% of the total contract value derived on the basis of the Order Quantities.
- 2 The bidder shall indicate the unit price of each type and size of cables listed as per the BOQ-cum-price Schedule enclosed with this specification. The unit prices shall apply for adjustment of variation in quantity as stipulated above.
- 3 Lot-I quantity indicated above shall be cleared for manufacturing along with LOI. However, manufacturing of the cables shall be taken up by the successful bidder only after approval of technical and quality documentation. Subsequent lots if required shall be cleared for manufacturing based on progress of engineering and site requirements.
- 4 Overall tolerance on total dispatched quantity of each size for item shall be (-) 2% and (+) 0%. Cables consumed for testing and inspection shall be to bidder's account.
- 5 The drum length shall be 1000 m (+/- 5%). For each individual cable size, one short lengths 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).
- 6 In case of the quantities cleared by BHEL for manufacturing (in a lot) are manufactured and offered for inspection in more than one batch, BHEL reserves the right to witness type testing on all batches without any price implication.
- 7 Bidder shall indicate unit price of cables inclusive of type test charges. No separate type test charges are to be quoted by bidder.
- 8 Bidder shall quote for all sizes/types of cables as per specification, failing which their offer shall be rejected.
- 9 Delivery schedule of Lot-I and subsequent lots shall be as per NIT

|  | | QUALITY PLAN | | | CUSTOMER : | | PROJECT TITLE | | SPECIFICATION : | | | |
|--|---------------------|---|-------------|----------------------|--------------------|--|--|----------------------|-------------------------------|---|------------|---|
| | | SHEET 1 OF 8 | | | BIDDER/ VENDOR : | | 1X800MW KOTHAGUDAM TPS | | NUMBER : PE-TS-410-507-E003 | | | |
| | | SYSTEM | | | REFERENCE DOCUMENT | | ACCEPTANCE NORM | | SECTION AGENCY | | VOLUME III | |
| SL NO. | COMPONENT/OPERATION | CHARACTERISTICS CHECK | CAT. | TYPE/METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | P | W | V | REMARKS |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 |
| Instructions: 1. 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. 2. 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. | | | | | | | | | | | | |
| 1.0 RAW MATERIAL | | | | | | | | | | | | |
| 1.1 Copper Rods/ Aluminum Rod/ Wires | | | | | | | | | | | | |
| (Al- For Conductor & Armour) (Cu- For Conductor) | | | | | | | | | | | | |
| | | GENERAL : 1. Physical properties | MA | Physical Tests | Sample per Batch | IS 1554 Pt-1/ IS 613/ IS 5082 & Approved datasheet | IS 1554 Pt-1/ IS 613/ IS 5082 & Approved datasheet | Log book/ Test Cert. | 3/2 | - | 1/2 | |
| | | 2. Elec.Properties | MA | Electrical Tests | Sample per Batch | IS 1554 Pt-1/ IS 613/ IS 5082 & Approved datasheet | IS 1554 Pt-1/ IS 613/ IS 5082 & Approved datasheet | Log book/ Test Cert. | 3/2 | - | 1/2 | |
| | | SPECIFIC CHECKS : a) Make | MA | Verify | 100% | Manufacturer approved source | Manufacturer approved source | Log book/ Test Cert. | 3/2 | - | 1 | |
| | | b) Grade | MA | -do- | -do- | IS 613/IS 5082 & Approved datasheet | IS 613/ IS 5082 & Approved datasheet | Log book/ Test Cert. | 3/2 | - | 1 | |
| | | c) Resistivity | MA | Electrical Tests | Manufacturer std. | IS 613/ IS 5082 | IS 613/ IS 5082 | Log book/ Test Cert. | 3/2 | - | 1 | |
| 1.2 PVC Compound (for insulation) | | | | | | | | | | | | |
| | | GENERAL : 1. Physical properties | MA | Physical Tests | Sample per batch | IS 1554 Pt-1/ IS 5831 & Approved datasheet | IS 1554 Pt-1/ IS 5831 & Approved datasheet | Log book/ Test Cert. | 3/2 | - | 1/2 | |
| | | 2. Elec.Properties | MA | Electrical Tests | Sample per batch | IS 1554 Pt-1/ IS 5831 & Approved datasheet | IS 1554 Pt-1/ IS 5831 & Approved datasheet | Log book/ Test Cert. | 3/2 | - | 1/2 | |
| | | SPECIFIC CHECKS : a) Make | MA | Verify | 100% | Manufacturer approved source | Manufacturer approved source | Log book/ Test Cert. | 3/2 | - | 1 | |
| | | b) Type/ Grade | MA | Verify | 100% | Mrs std./ Approved datasheet | Mrs std./ Approved datasheet | Log book/ Test Cert. | 3/2 | - | 1 | |
| | | c) Shelf life/ Storage condition | MA | Verify | 100% | Compound Manufacturer std. | Compound Manufacturer std. | Log book/ Test Cert. | 3/2 | - | 1 | |
| 1.3 Fillers (as applicable) | | | | | | | | | | | | |
| | | 1. Make | MA | Verify | 100% | Manufacturer approved source | Manufacturer approved source | Log book/ Test Cert. | 3/2 | - | 1 | |
| | | 2. Flame retardant & moisture resistant. (as applicable) | CR | Chemical/ Environ. | 100% | Approved datasheet | Approved datasheet | Log book/ Test Cert. | 3/2 | - | 2 | (Fillers material chosen shall be compatible with the temperature rating of the cable and shall have no deleterious effect on any other component of cable) |
| BHEL | | | PARTICULARS | | | BIDDER/VENDOR | | | | | | |
| | | | NAME | | | | | | | | | |
| | | | SIGNATURE | | | | | | | | | |
| | | | DATE | | | | | | BIDDER'S/VENDORS COMPANY SEAL | | | |

|  | | QUALITY PLAN | | | CUSTOMER : | | PROJECT | | SPECIFICATION : | | | |
|---|--|--|--------------------|---------------------------------|--|--|--|----------------------|-------------------------------|----------------------|-------|---|
| | | | | | BIDDER/ VENDOR | | TITLE | | NUMBER : | | TITLE | |
| SHEET 2 OF 8 | | SYSTEM | | | ITEM :HRPVC/ PVC POWER & CONTROL CABLE | | SECTION | | | VOLUME III | | |
| SL. NO. | COMPONENT/OPERATION | CHARACTERISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY | | | REMARKS |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | P | W | V | 11 |
| 1.4 | Galvanised steel wire/strip for Armour (if applicable) | GENERAL : 1. Make | MA | Verify | Manufacturer std. | Manufacturer approved source | Manufacturer approved source | Log book/ Test Cert. | 3/2 | - | 1 | * Sample from each size/ Batch/ Lot |
| | | 2. Dimension | MA | Measurement | Manufacturer std. | IS 1554 Pt-1/ IS 3975 | IS 1554 Pt-1/ IS 3975 | Log book/ Test Cert. | 3/2 | - | 2 | |
| | | 3. Phy.and Elec. Properties | MA | Physical & Electrical Tests | Sample* | IS 1554 Pt-1/ IS 3975 | IS 1554 Pt-1/ IS 3975 | Log book/ Test Cert. | 3/2 | - | 2 | |
| | | 4.Galvanization Quality | MA | Galv.Tests | Sample* | IS 1554 Pt-1/ IS 3975 | IS 1554 Pt-1/ IS 3975 | Log book/ Test Cert. | 3/2 | - | 2 | |
| 1.5 | PVC compound for Sheath | GENERAL : 1. Physical properties | MA | Physical Tests | Sample per batch | IS 1554 Pt-1/ IS 5831 & Approved datasheet | IS 1554 Pt-1/ IS 5831 & Approved datasheet | Log book/ Test Cert. | 3/2 | - | 1/2 | |
| | | 2. Elec.Properties | MA | Electrical Tests | Sample per batch | IS 1554 Pt-1/ IS 5831 | IS 1554 Pt-1/ IS 5831 | Log book/ Test Cert. | 3/2 | - | 1/2 | |
| | | 3. FRLS Properties (as applicable) | CR | Chemical/ Environ. | Sample per batch | IS 1554 Pt-1/ IS 5831 & Approved datasheet | IS 1554 Pt-1/ IS 5831 & Approved datasheet | Log book/ Test Cert. | 3/2 | - | 1/2 | |
| | | SPECIFIC CHECKS : a) Make | MA | Verify | 100% | Manufacturer approved source | Manufacturer approved source | Log book/ Test Cert. | 3/2 | - | 1 | |
| | | b) Type/ Grade | MA | Verify | 100% | IS 1554 Pt-1/ IS 5831 & Approved datasheet | IS 1554 Pt-1/ IS 5831 & Approved datasheet | Log book/ Test Cert. | 3/2 | - | 1 | |
| | | c) Shelf life/ Storage condition | MA | Verify | 100% | Compound Manufacturer std. | Compound Manufacturer std. | Log book/ Test Cert. | 3/2 | - | 1 | |
| | | 1.6 | Wooden drums | 1. Phy. & Constructional checks | MA | Visual | Mfr's Plant Std. | IS 10418 | IS 10418 | Log book/ Test Cert. | 3/2 | |
| | | 2. Anti termite treatment | MA | Chem. | Mfr's Plant Std. | Mfr's Plant Std. | Mfr's Plant Std. | COC | 3/2 | - | 1 | |
| 1.7 | Steel drums # | 1. Dimension | MA | Meas. | Mfr's Plant Std. | Mfr's Plant Std. | Mfr's Plant Std. | Log book/ Test Cert. | 3/2 | - | 1 | # (if applicable) |
| | | 2. Surface finish | MA | Meas. | Mfr's Plant Std. | Mfr's Plant Std. | Mfr's Plant Std. | Log book/ Test Cert. | 3/2 | - | 1 | |
| 2.0 IN PROCESS | | | | | | | | | | | | |
| 2.1 | Wire Drawing & Annealing. | 1. Size | MA | Dimensional | Plant Mfg. Std. | IS 1554 Pt-1./ IS 8130 & Approved Data Sheet | IS 1554 Pt-1./ IS 8130 & Approved Data Sheet | Log Book | 2 | - | 1 | |
| | | 2. Surface finish | MA | Visual | Plant Mfg. Std. | Surface shall be smooth | Surface shall be smooth | Log Book | 2 | - | 1 | |
| | | 3. % of Elongation | MA | Mechanical | Plant Mfg. Std. | IS 1554 Pt-1./ IS 8130 | IS 1554 Pt-1./ IS 8130 | Log Book | 2 | - | 1 | |
| 2.2 | Tinning (For Conductor) | 1. Size | MA | Dimensional | Plant Mfg. Std. | Approved datasheet | Approved datasheet | Log Book | 2 | - | 1 | (Applicable only for tin-coated copper conductor) |
| | | 2. Chemical test for Tinning (if applicable) | CR | Chemical Test | Sample | IS 1554 Pt-1/ IS:8130 & Mfrs Std | IS 1554 Pt-1/ IS:8130 & Mfrs Std | Log Book | 2 | - | - | |
| BHEL | | | PARTICULARS | | | BIDDER/VENDOR | | | | | | |
| | | | NAME | | | | | | | | | |
| | | | SIGNATURE | | | | | | | | | |
| | | | DATE | | | | | | BIDDER'S/VENDORS COMPANY SEAL | | | |

|  | | QUALITY PLAN | | CUSTOMER : | | PROJECT | | SPECIFICATION : | | | | |
|---|--|---|--------------------|-----------------------|------------------------------|--|--|------------------|--------------------|---|---|---|
| | | | | BIDDER/ VENDOR | | TITLE | | NUMBER : | | | | |
| SHEET 3 OF 8 | | | | SYSTEM | | ITEM :HRPVC/ PVC POWER & CONTROL CABLE | | SECTION | | | | |
| SL. NO. | COMPONENT/OPERATION | CHARACTERISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | VOLUME III REMARKS | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| | | | | | | | | | P | W | V | |
| 2.3 | Stranding of wires | 1. No. of wires | MA | Counting | Plant Mfg. Std. | IS 1554 Pt-1./ IS 8130 & Approved Data Sheet | IS 1554 Pt-1./ IS 8130 & Approved Data Sheet | Log Book | 2 | - | - | # To be checked at starting & finish end of Extruded Length |
| | | 2. Resistance | CR | Electrical | Plant Mfg. Std. | IS 1554 Pt-1./ IS 8130 & Approved Data Sheet | IS 1554 Pt-1./ IS 8130 & Approved Data Sheet | Log Book | 2 | - | - | |
| | | 3. Sequence, lay length & Direction | MA | Visual, Measurement | Sample | IS 1554 Pt-1/ Mfrs standard | IS 1554 Pt-1/ Mfrs standard | Log Book | 2 | - | - | |
| | | 4. Surface Finish | MA | Visual | 100% | Surface shall be smooth | Surface shall be smooth | Log Book | 2 | - | - | |
| | | 5.Dimension | MA | Measurement | One Sample of each size/ lot | IS 1554 Pt-1/ IS 8130/Appd. Data Sheet | IS 1554 Pt-1/ IS 8130/Appd. Data Sheet | Log Book | 2 | - | - | |
| 2.4 | Core Insulation (No repair permitted) | 1. Surface finish | MA | Visual | 100% | Free from bulging burnt particles lumps, cuts & Scratches. | Free from bulging burnt particles lumps, cuts & Scratches. | Log Book | 2 | - | 1 | |
| | | 2. Insulation thickness | CR | Measurement | One Sample of each size/ lot | IS 1554 Pt-1 & Appd.data sheet | IS 1554 Pt-1 & Appd.data sheet | Log Book | 2 | - | - | |
| | | 3. Concentricity # | CR | Measurement | One Sample of each size/ lot | Mfrs Std/ IS 1554 Pt-1/ Approved Data Sheet | Mfrs Std/ IS 1554 Pt-1/ Approved Data Sheet | Log Book | 2 | - | 1 | |
| | | 4. Dia over insulation | MA | Measurement | One Sample of each size/ lot | IS 1554 Pt-1 | IS 1554 Pt-1 | Log Book | 2 | - | - | |
| | | 5. Core identification | MA | Visual | 100% | IS 1554 Pt-1 & Appd. Data Sheet | IS 1554 Pt-1 & Appd. Data Sheet | Log Book | 2 | - | - | |
| | | 6. Tensile Strength & % Elongation | MA | Mechanical | 100% | IS 1554 Pt-1/ IS 5831 | IS 1554 Pt-1/ IS 5831 | Log Book | 2 | - | - | |
| | | 7. Spark Test or Water Immersion test | CR | Electrical | 100% | Mfr's Std. | Mfr's Std. | Log Book | 2 | - | 1 | |
| 2.5 | Core Laying | 1. Dia over laidup core | MA | Measurement | One Sample of each size/ lot | IS 1554 Pt-1 | IS 1554 Pt-1 | Log Book | 2 | - | - | |
| | | 2. Sequence of lay, Lay length & direction for laid up core | MA | Visual & Meas. | One Sample of each size/ lot | Mfrs Std | Mfrs Std | Log Book | 2 | - | - | |
| | | 3. Core Identification | MA | Visual | One Sample of each size/ lot | IS 1554 Pt-1 & Appd. Data Sheet | IS 1554 Pt-1 & Appd. Data Sheet | Log Book | 2 | - | - | |
| BHEL | | | PARTICULARS | | BIDDER/VENDOR | | | | | | | |
| | | | NAME | | | | | | | | | |
| | | | SIGNATURE | | | | | | | | | |
| | | | DATE | | | | BIDDER'S/VENDORS COMPANY SEAL | | | | | |

|  | | QUALITY PLAN | | | CUSTOMER : | | PROJECT | | SPECIFICATION : | | | | |
|---|--|--------------------------------|------------------------------|--------------------------------|--|---|---|-------------------------|-------------------------|------------|-------|--|---|
| | | | | | BIDDER/ VENDOR | | TITLE | | NUMBER : | | TITLE | | |
| SHEET 4 OF 8 | | SYSTEM | | | ITEM :HRPVC/ PVC POWER & CONTROL CABLE | | SECTION | | | VOLUME III | | | |
| SL. NO. | COMPONENT/OPERATION | CHARACTERISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY | | | REMARKS | |
| | | | | | | | | | P | W | V | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 | |
| 2.6 | InnerSheath Extrusion (If applicable) | 1. Surface finish | MA | Visual | 100% | Surface shall be Smooth | Surface shall be Smooth | Log Book | 2 | - | - | (Pimple, fish eye, porosity & burnt particles not permitted) | |
| | | 2. Sheath thickness | CR | Measurement | One Sample of each size/ lot | IS 1554 Pt-1 & Approved Data Sheet | IS 1554 Pt-1 & Approved Data Sheet | Log Book | 2 | - | - | | |
| | | 3.Dia over inner sheath | MA | Measurement | One Sample of each size/ lot | IS 1554 Pt-1 & Approved Data Sheet | IS 1554 Pt-1 & Approved Data Sheet | Log Book | 2 | - | - | | |
| | 2.7 | Armouring (If applicable) | 1. No. of wires/Strips | MA | Counting | At the start of the process | IS 1554 Pt-1/ IS 3975 | IS 1554 Pt-1/ IS 3975 | Log Book | 2 | - | | - |
| | | | 2. Lay Direction | MA | Visual | At the start of the process | IS 1554 Pt-1/ IS 3975 | IS 1554 Pt-1/ IS 3975 | Log Book | 2 | - | | - |
| 2.7 | Outer Sheath Extrusion | 3. Lay Length | MA | Visual, Meas. | At the start of the process | IS 1554 Pt-1/ IS 3975 | IS 1554 Pt-1/ IS 3975 | Log Book | 2 | - | - | | |
| | | 4. Coverage | MA | Measurement | At the start of the process | IS 1554 Pt-1/ IS 3975 & approved data sheet | IS 1554 Pt-1/ IS 3975 & approved data sheet | Log Book | 2 | - | - | | |
| | | 5. Dia over armouring | MA | Measurement | At the start of the process | IS 1554 Pt-1 & Appd. Data Sheet | IS 1554 Pt-1 & Appd. Data Sheet | Log Book | 2 | - | - | | |
| | | 2.8 | Finished Cable (INTERNAL) | 1. Surface Finish | MA | Visual | 100% | Surface shall be smooth | Surface shall be smooth | Log Book | 2 | - | - |
| 2.Sheath thickness | CR | | | Measurement | One Sample of each size/ lot | IS 1554 Pt-1 & Appd. Data Sheet | IS 1554 Pt-1 & Appd. Data Sheet | Log Book | 2 | - | - | | |
| 2.8 | Finished Cable (INTERNAL) | 3. Dia over outer sheath | MA | Measurement | One Sample of each size/ lot | IS 1554 Pt-1 & Appd. Data Sheet | IS 1554 Pt-1 & Appd. Data Sheet | Log Book | 2 | - | - | | |
| | | 4. Marking/ Color/ Embossing | MA | Visual | One Sample of each size/ lot | Appd. Data Sheet | Appd. Data Sheet | Log Book | 2 | - | - | Sequential marking shall be done by printing. | |
| | | 1. Routine Test (Refer Note-H) | CR | Electrical Tests & Measurement | 100% | IS 1554-I & Appd. Datasheet | IS 1554-I & Appd. Datasheet | Test Report | 2 | - | 1 | | |
| BHEL | | | PARTICULARS | | BIDDER/VENDOR | | | | | | | | |
| | | | NAME | | | | | | | | | | |
| | | | SIGNATURE | | | | | | | | | | |
| | | | DATE | | | | BIDDER'S/VENDORS COMPANY SEAL | | | | | | |

|  | | QUALITY PLAN SHEET 5 OF 8 | | | CUSTOMER : | | | PROJECT | | | SPECIFICATION : | | |
|---|---------------------|---|-------------|-------------------------------|--|--------------------------------|---|------------------|--------|---|-----------------|--|--|
| | | | | | BIDDER/ VENDOR | | | TITLE | | | NUMBER : | | |
| SYSTEM | | SYSTEM | | | ITEM :HRPVC/ PVC POWER & CONTROL CABLE | | | SECTION | | | VOLUME III | | |
| SL. NO. | COMPONENT/OPERATION | CHARACTERISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY | | | REMARKS | |
| | | | | | | | | | P | W | V | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 | |
| 3.0 | Final Inspection | 1. Finish | MA | Visual | (See remark) | IS 1554 Pt-1/ Appd. Data Sheet | Free from Porosity, Bulging, Burnt particles, lumps, cuts & scratches | Test Report | 2 | 1 | - | One drum each for Power & Control cables in Lot. | |
| | | 2. Length | MA | Measurement | (See remark) | IS 1554 Pt-1/ Appd. Data Sheet | BHEL Spec./ Data Sheet | Test Report | 2 | 1 | - | Length of each drum shall be as per tolerance given in the data sheet. | |
| | | 3. Dimension | MA | Measurement | As per IS | IS 1554 Pt-1/ Appd. Data Sheet | Approved Data Sheet | Test Report | 2 | 1 | - | | |
| | | 4. Armouring - Coverage No. of Wires/Strips | MA | Visual & Meas. | As per IS | IS 1554 Pt-1/ Appd. Data Sheet | Appd. Data Sheet | Test Report | 2 | 1 | - | | |
| | | 4. Marking/Colour Coding | MA | Visual | As per IS | IS 1554 Pt-1/ Appd. Data Sheet | IS 1554 Pt-1/ Appd. Data Sheet | Test Report | 2 | 1 | - | | |
| | | 5. Acceptance Tests (Refer Note-H) | CR | Phy & Elect. Tests FRLS tests | As per IS | IS 1554 Pt-1/ Appd. Data Sheet | IS 1554 Pt-1/ Appd. Data Sheet | Test Report | 2 | 1 | - | | |
| 4.0 | Packing | 6. Type & FRLS Tests (Refer Note-H) | CR | Phy & Elect. Tests FRLS Tests | Sample# | BHEL Specn. Apprd. Data Sheet | BHEL Specn. Apprd. Data Sheet | Test Report | 2 | 1 | - | Refer Annexure to QAP for Type & Acceptance Tests | |
| | | Sealing Identification | MA | Visual | 100% | As per IS | As per IS | Test Report | 2 | 1 | - | | |
| NOTES:- (A) JOINTS IN WIRE SHALL BE AS PERMITTED BY MFRS STANDARD. VENDOR TO CERTIFY THE SAME. (B) NO REPAIR OF CORE INSULATION PERMITTED (C) CABLE ENDS SHALL BE SEALED AS PER VENDOR'S SPECIFICATION. (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 APPROVED DATA SHEET (F) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS 'SAMPLE' & NOT DEFINED IN QP, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN. (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. LEGEND : P : PERFORMER W : WITNESSER V : VERIFIER 1- BHEL 2- VENDOR 3- SUB VENDOR CHP: CUSTOMER HOLD POINT WHICH WILL BE DECIDED AT CONTRACT STAGE. | | | | | | | | | | | | | |
| BHEL | | | PARTICULARS | | | BIDDER/VENDOR | | | | | | | |
| | | | NAME | | | | | | | | | | |
| | | | SIGNATURE | | | | | | | | | | |
| | | | DATE | | | | | | | | | BIDDER'S/VENDORS COMPANY SEAL | |



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR
1.1 kV FRLSH HRPV CONTROL CABLES**

SPECIFICATION NO. PE-TS-410-507-E003

VOLUME II B

SECTION

REVISION 0

DATE: 15.05.2015

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ANNEXURE TO QAP**II. TYPE/ ACCEPTANCE TEST REQUIREMENTS****A. Type Test Conduction:**

1. Tests for which an asterisk sign (*) is indicated in the 'Conduction Required as Type Test' column shall be conducted on each size of cable to be selected by purchaser at the time of testing as type tests. The same may be witnessed by BHEL/ Owner, for which due notice shall be given by the vendor.

B. Acceptance Test Conduction:

1. Tests for which a hash sign (#) is indicated in the 'Conduction Required as Acceptance Test' column shall be conducted as acceptance tests.
2. Sampling:
Sampling for acceptance tests shall be as per Appendix-A (Clause 15.2.1) of IS: 1554 Part-I.

| S. No. | TEST | APPLICABLE FOR | CONDUCTION REQUIRED AS | |
|-------------------|---|---|-------------------------------|------------------------|
| | | | Type Test | Acceptance Test |
| 1.0 | Tests for Conductor | | | |
| | Annealing test | Copper conductor | * | # |
| | Resistance test | Copper conductor | * | # |
| 2.0 | Tests for Armour Wires | | | |
| | Measurement of dimensions | GS wire | * | # |
| | Tensile test | GS wire | | # |
| | Elongation test | GS wire | * | # |
| | Torsion test | GS round wire | * | # |
| | Resistance test | GS wire | * | # |
| | Zinc coating test | G. S. wires | * | # |
| 3.0 | Physical Tests for PVC Insulation & PVC sheath | | | |
| | Test for thickness | PVC insulation, PVC inner sheath & PVC outer sheath | * | # |
| | Tensile strength and elongation test | PVC insulation & PVC outer sheath | * | |
| | (a) Before ageing | | * | # |
| | (b) Before & after ageing | | * | |
| | Ageing in air oven | PVC insulation & PVC outer sheath | * | |
| | Loss of mass test | PVC insulation & PVC outer sheath | * | |
| | Hot deformation test | PVC insulation & PVC outer sheath | * | |
| | Heat shock test | PVC insulation & PVC outer sheath | * | |



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| <u>S. No.</u> | <u>TEST</u> | <u>APPLICABLE FOR</u> | <u>CONDUCTION REQUIRED AS</u> | |
|---------------|--|-----------------------------------|-------------------------------|------------------------|
| | | | <u>Type Test</u> | <u>Acceptance Test</u> |
| | Shrinkage test | PVC insulation & PVC outer sheath | * | |
| | Thermal stability test | PVC insulation & PVC outer sheath | * | |
| | | | | |
| 4.0 | <u>FRLSH/ Flammability Tests</u> | | | |
| | Oxygen index test | PVC outer sheath only | * | # |
| | Smoke density test | PVC outer sheath only | * | # |
| | Halogen Acid gas generation test | PVC outer sheath only | * | # |
| | Flammability test as per IEC-332-1 (1993) and IEEE-383 | Complete cable | * | |
| | Flammability test as per IS-10810-Part-53, Part-61 & Part-62 | Complete cable | * | # |
| | Swedish chimney test to SEN SS 424 1475 | Complete cable | | # |
| | Temperature index test | PVC outer sheath only | * | # |
| | | | | |
| 5.0 | <u>Electrical Tests</u> | | | |
| | High Voltage Test (Water Immersion test) | On cores | * | |
| | High Voltage Test at room temperature | Complete cable | * | # |
| | Insulation Resistance Test (Volume resistivity method) | Complete cable | * | # |
| | | | | |
| 6.0 | <u>Fungus, Rodent & Termite Test</u> | Complete cable | * | |

NOTE :

Sampling plan for type test shall be as per Quality Plan.



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DATASHEET A



DOCUMENT TITLE

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DATA SHEET-A**I. SPECIFIC TECHNICAL REQUIREMENTS**

| | | |
|-----|-------------------------------------|--|
| 1.0 | Type of cable | LT CONTROL CABLE OF FRLSH TYPE |
| 2.0 | Standard applicable in general | IS:1554 PART (I) |
| 3.0 | Voltage Grade | 1.1 kV |
| 4.0 | Number of cores | As per BOQ (Annexure-A to section-C) |
| | Minimum size | |
| 5.0 | CONDUCTOR | |
| (a) | Material | Copper |
| | Grade and Class | Stranded, high conductivity, Class 2 |
| (b) | Standard applicable | IS : 8130 |
| (c) | Shape | Circular as per IS |
| (d) | Min. number of strands | 7 |
| 6.0 | INSULATION | |
| (a) | Material | EXTRUDED HRPVC, Type C |
| (b) | Standard applicable | IS : 5831 & IS : 1554 (PART I) |
| (c) | Continuous withstand temperature | 70° C |
| (d) | Short circuit withstand temperature | 160° C |
| (e) | Method of Application | By extrusion; sleeve extrusion not permitted |
| 7.0 | CORE IDENTIFICATION | |
| (a) | Control cables | Colour coded and numbering at interval of 100 mm or less (IS : 1554 (Part-I)) |
| 8.0 | INNER SHEATH | |
| (a) | Material | Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2. |
| (b) | Colour | Black |
| (c) | Whether FRLS | yes |
| (d) | Fillers | Acceptable |
| (e) | Material of fillers (if permitted) | Same as innersheath |
| (f) | Method of application | |
| 1 | Multi-core cables : | |
| i) | with fillers | Pressure/Vacuum Extruded |
| ii) | without fillers | Pressure Extruded |
| 9.0 | ARMOUR | |
| (a) | Material | Galvanised Steel round / formed wire |
| (b) | Minimum coverage | 90% |
| (c) | Gap between armour wires | Shall not exceed one armour wire space |



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| | | |
|-------------|--|--|
| | | (No cross-over/ over-riding) |
| (d) | Breaking load of joint | 95% of normal armour |
| 10.0 | OUTER SHEATH | |
| (a) | Material | Extruded FRLS HRPVC Type ST-2 as per IS : 5831 |
| (b) | Colour | Black |
| (c) | Whether FRLS | YES |
| (d) | Other properties | The sheath shall be resistant to water, UV radiation, fungus, termite and rodent attack |
| (e) | Method of application | Extruded |
| (f) | Marking (by embossing) | Cable size (cross section area and no. of cores) and voltage grade @ 1m (by embossing) Type of insulation, Type of inner & outer sheath e.g. "FRLS" etc, @ 1m (by embossing) Manufacturer's name and/ or trade name, and year of manufacture @ 1m (by embossing) 'BHEL-PEM' and TSGENCO' @1m (by embossing) Progressive sequential marking @ 1m (by embossing) |
| 11.0 | FRLSH CHARACTERISTICS | |
| (a) | Oxygen index test | YES ,(Minimum 29 as per ASTM-D-2863-77) |
| (b) | Temperature Index test | YES ,(Minimum 250°C at oxygen index value of 21 when tested as per ASTM-D-2863) |
| (c) | Halogen Acid gas generation test | YES ,(Max. 20% as per IEC-754-1) |
| (d) | Smoke density rating test | YES ,Max. 60% As per ASTM-D-2843. |
| (e) | Flammability Test | As per IEC:60332-III CAT-B, IEC :60332-I, IEEE:383 & 424:1475 (Class-F3),IS :10810 |
| (f) | Flame retardance Test | Flame Retardance test on single cable and on bunched cables (both C1 & C2) After the test, there should be no visible damages on the test specimen within 300mm from its upper end. After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly. |
| (g) | specific optical density of smoke test | The cables shall meet the requirements of IS/IEC. |
| 12.0 | TOLERANCE ON OUTER DIAMETER | Upto 30mm; (+/-) 1.5 mm Above 30mm; (+/-) 5% or (+/-)3 mm whichever is less |
| 13.0 | MINIMUM BENDING RADIUS | 12 x O.D. |
| 14.0 | SAFE PULLING FORCE | 50N/ sq. mm |
| 16.0 | CABLE DRUMS | |
| (a) | Type & construction | As per IS 10418 (wooden) |
| (b) | Standard drum length | 1000m (+/-) 5% |

| | | | |
|---|--|--------------------------------------|------------------|
|  | DOCUMENT TITLE TECHNICAL SPECIFICATION 1.1 kV FRLSH HRPVC CONTROL CABLES | SPECIFICATION NO. PE-TS-410-507-E003 | |
| | | VOLUME II B | |
| | | SECTION | |
| | | REVISION 00 | DATE: 15.05.2015 |
| | | SHEET 1 OF 6 | |

DATASHEET C

GUARANTEED TECHNICAL PARTICULARS (TO BE SUBMITTED BY SUCCESSFUL BIDDER)

1.0 **GENERAL**

1.1 Name of manufacturer :

1.2 Place of manufacture :

2.0 **STANDARDS APPLICABLE**

2.1 **IS-1554 (Part-I)** : YES

For general specification of PVC cables

2.2 **IS:8130** : YES

For conductor material

2.3 **IS-5831** : YES

For material of insulation, innersheath & outersheath.

2.4 **IS:3975/ IS:8130** : YES/NO/NA

For armour multi core/ single core cables)

2.5 **IS:10810** : YES

For method of tests

2.6 **IS:10418** : YES


For cable drums

2.7 **ASTMD-2863** : YES


For oxygen index test

2.8 **SS:424-14-75,
IEC-332-Part-III and Part-I (Category-A),
IEEE 383/74** : YES

For flammability test

| | | | |
|---|--|--------------------------------------|------------------|
|  | DOCUMENT TITLE TECHNICAL SPECIFICATION 1.1 kV FRLSH HRPVC CONTROL CABLES | SPECIFICATION NO. PE-TS-410-507-E003 | |
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| | | SHEET 1 OF 6 | |

| | | | |
|------|--|---|-------------------|
| 2.9 | IEC-754-1 | : | YES |
| | For acid gas generation test | | |
| 2.10 | ASTMD-2843 | : | YES |
| | For smoke generation test | | |
| 2.11 | IS:5831 | : | YES |
| | For heat shock test, loss of mass test and thermal heat stability test | | |
| 2.12 | Current rating of cables conforms to | : | |
| 2.13 | Short circuit rating conforms to | : | |
| 3.0 | CABLE CONSTRUCTION | | |
| 3.1 | Conductor : | | |
| | Conductor material to IS:8130 (Class/Grade) | | |
| | a) Control cables | : | |
| 3.2 | Insulation | | |
| | a) Material | : | |
| | b) Dielectric constant at normal frequency | : | KV/mm |
| | c) Insulation resistance constant (min.) | | |
| | i) at 27 deg. C | : | Mega-ohm km |
| | ii) at 70/85 deg.C | : | Mega-ohm km |
| | d) Minimum volume resistivity | | |
| | i) at 27 deg. C | : | Mega-ohm km |
| | ii) at 70/ 85 deg.C | : | Mega-ohm km |
| | e) Minimum tensile strength | : | N/mm ² |
| | f) Minimum % Elongation at rupture | : | |
| | g) Tolerance on thickness | : | |

| | | | |
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3.3 Inner Sheath


- | | | | |
|----|-----------------------------------|---|-------------------|
| a) | PVC Type ST1 to IS: 5831 | : | YES |
| b) | Whether FRLS | : | YES/NO |
| c) | Method of application | | |
| | i) with fillers | | |
| | ii) without fillers | : | Pressure extruded |
| d) | Type & shape of fillers (if used) | : | |
| e) | Colour | | |

3.4 Armour

- | | | | |
|----|---|---|--------|
| a) | Galvanised steel wire/ formed wire conforming to IS:3975 for multi-core cables. | : | YES |
| b) | Hard drawn aluminium wire H4 grade conforming to IS:8130 | : | YES/NA |
| c) | Method of joining | : | |
| d) | Breaking load of joint | : | |

3.5 Outer Sheath

- | | | | |
|----|---|---|-------------------|
| a) | PVC Type ST1 to IS: 5831 | : | YES |
| b) | Whether FRLS | : | YES |
| c) | Method of application | : | |
| d) | Minimum Tensile strength | : | N/mm ² |
| e) | Minimum % elongation at rupture | : | |
| f) | Colour | | |
| g) | Tolerance on thickness | : | |
| h) | Whether progressive sequential length marking provided. | : | |

| | | | |
|---|--|--------------------------------------|------------------|
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4.0 PERMISSIBLE VOLTAGE AND FREQUENCY VARIATION

- a) Voltage : (±) %
- b) Frequency : (±) %
- c) Voltage-frequency combined : |ABS| %
combined

5.0 Permissible Conductor Temp. for

- a) Maximum Continuous Rating : °C
- b) Short Circuit : °C

6.0 Installation Conditions for specified current rating

- a) ambient air temperature in deg. C : °C
- b) ground temperature : °C
- c) depth of laying of cables buried in ground : cm
- d) thermal resistivity of soil : °C cm/W
- e) thermal resistivity of insulation : °C cm/w


7.0 Formula for calculating short circuit current for different durations

8.0 CHARACTERISTICS OF FRLS SHEATH

- a) Oxygen index :
- b) Temperature index :
- c) Acid gas generation :
- d) Smoke density rating :

9.0 CABLE DRUMS

- a) Type & construction :
- b) Standard drum length :
- c) Tolerance on drum length :

| | | | |
|---|--|--------------------------------------|------------------|
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10.0 DOCUMENTATION

Whether following enclosed

- | | | |
|--|---|--------|
| a) X-sectional drawing with construction details | : | YES |
| b) BHEL's Quality Plan with seal of acceptance | : | YES |
| c) Derating factors as stipulated in Section-D | : | YES |
| d) Packing drawing | : | YES/NO |

(TO BE FILLED IN FOR EACH SIZE OF CABLE IN THE FORM OF TABLE)

- | | | | |
|------|--|---|----------|
| 11.0 | No. of cores x size | : | |
| 12.0 | Voltage grade | : | kV |
| 13.0 | Base current ratings (*) based on cl.5.0, cl.6.0 | | |
| | a) In air | : | Amp |
| | b) In ground | : | Amp |
| | c) In ducts | : | Amp |
| 14.0 | Short circuit rating | : | kA, sec. |
| 15.0 | a) D.C. resistance of conductor at 20 °C | : | ohm/km |
| | b) A.C. resistance of conductor at 70 °C/ 85 °C | : | ohm/km |
| | c) Reactance of cable at normal frequency | : | ohm/km |
| 16.0 | CONDUCTOR | | |
| | a) Material, type & grade | : | |
| | b) No & dia of wires in each core before stranding | : | no x mm |

| | | | |
|---|--|--------------------------------------|------------------|
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| | | | |
|------|---|---|---------|
| | c) Shape | : | |
| 17.0 | Nominal thickness of insulation | : | mm |
| 18.0 | Inner sheath thickness (min.) | : | mm |
| 19.0 | Sizes of armour | : | no x mm |
| 20.0 | Nominal thickness of outersheath | : | mm |
| 21.0 | DIAMETERS | | |
| | a) i) Fictitious diameter of insulated conductor | : | mm |
| | ii) Approximate cable diameter of insulated conductor | : | mm |
| | b) i) Fictitious cable diameter of under armour/ over innersheath | : | mm |
| | ii) Approximate cable diameter under armour/ over innersheath | : | mm |
| | c) i) Fictitious cable diameter of under armour/ over innersheath | : | mm |
| | ii) Approximate cable diameter over armour | : | mm |
| | d) i) Fictitious overall diameter of cable | : | mm |
| | ii) Approximate overall diameter of cable | : | mm |
| 22.0 | Tolerance on overall diameter | : | (±) mm. |
| 23.0 | Minimum bending radius | : | x O.D. |
| 24.0 | Safe pulling force | : | kg. |
| 25.0 | Weight of cable | : | kg./km |
| 26.0 | Dimension of drum | : | mm |
| 27.0 | Shipping weight | : | kg. |
| 28.0 | Identification mark on outersheath | : | |
| 29.0 | Identification marks on drum | : | |