# VOLUME-II

# TECHNICAL SPECIFICATION

# FOR

# LT XLPE POWER CABLE

**SPECIFICATION NO:** ***PE-RC-999-507-E002***

***REVISION:*** **02**


## BHARAT HEAVY ELECTRICALS LIMITED

**POWER SECTOR**
**PROJECT ENGINEERING MANAGEMENT**
**NOIDA, UP (INDIA) – 201301**

## CONTENTS

# SECTION – I

# SPECIFIC TECHNICAL REQUIREMENTS

## 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 is 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).

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BIDDER'S STAMP & SIGNATURE

## 1.0 PURPOSE

This specification is intended for finalization of rate contract between BHEL and Bidder. Standard technical detail as indicated in the specification shall be agreed upon between BHEL and bidder. Project specific technical detail shall be made available to the bidder along with project enquiry.

## 2.0 SCOPE OF ENQUIRY

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

2.2 It is not the intent to specify herein all the details of design & manufacture of material. However, the material shall conform in all respects to high standard of design, engineering & workmanship and shall be capable of performing in continuous commercial operation at site condition.

2.3 Technical requirements of LT XLPE Power Cable are indicated in Data Sheet-A & Section-II.

2.4 The stipulation of Data Sheet-A shall prevail in case of any conflict between the stipulations of Data Sheet-A & Section-II.

## 3.0 BILL OF QUANTITIES

The bidder to quote for items as per price schedule attached with NIT. **The quantity as mentioned in the BOQ is only for evaluation purpose.** However actual ordered quantity may vary from project to project throughout the contract.

## 4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

4.1 After rate contract; against specific project requirement following information shall be furnished by BHEL: -

a) BOQ (Bill of Quantities)

4.2 Following documents shall be submitted for specific project requirement after placement of order for BHEL & customer's approval: -

| Sl. No. | Drawing / Document Description | Drawing / Document no | Document Type | First Submission | Resubmission |
|---|---|---|---|---|---|
| 1 | Technical Data sheet - LT XLPE Power cables | PE-V0-XXX-507-E111 | Primary | Within 2 week of award of contract. | Within 1 week of comments |
| 2 | Cross-sectional Drgs.- LT XLPE Power Cables | PE-V0-XXX-507-E113 | Primary | Within 2 week of award of contract. | Within 1 week of comments |
| 3 | Quality Plan - LT XLPE Power Cables | PE-V0-XXX-507-E913 | Primary | Within 2 week of award of contract. | Within 1 week of comments |

4.3 Drawings/documents shall be submitted through Document Management System (DMS).

## *DATA SHEET-A*

| | | | |
|---|---|---|---|
| 1.0 | Type of Cable | Flame Retardant Low Smoke halogen (FR-LSH) | |
| | | | |
| 2.0 | Standard applicable in general(Latest amendment to be referred if any) | IS:7098 (Part-1), IS:8130, IS:5831, IS:10810, IS:3975, ASTMD:2843, ASTMD:2863, IEC-754-1, IEC:60332 (Part-1), IEC:60332-3-23, IEEE:60383 | |
| | | | |
| 3.0 | Voltage Grade | 1.1kV | |
| | | | |
| 4.0 | Number of cores, cross sectional area of conductors and quantities | As per BOQ-Cum-Price Schedule | |
| | | | |
| 5.0 | **FAULT CHARACTERISTICS** | | |
| | Fault Level | 50kA RMS | |
| | Fault Clearing Time | 1.0 sec – for 630 Sq mm cross section cables<br>0.5 sec – for 400 Sq mm cross section cables<br>0.25 sec – for 300 Sq mm cross section cables<br>0.2 sec – for 240 Sq mm cross section cables<br>0.12 sec – for 185 Sq mm cross section cables | |
| | | | |
| 6.0 | **CONDUCTOR** | | |
| (a) | Material | Aluminium | Copper |
| | Grade and Class | Stranded, Compacted, H2, Class 2 | Stranded, plain annealed high conductivity, Class 2 |
| (b) | Standard Applicable | IS: 8130 | |
| (c) | Shape | Aluminium | Copper |
| | | Circular/ Shaped – as per IS | Circular – for all sizes |
| (d) | Min. number and diameter of strands for main and neutral conductor<br>[Neutral conductor cross section w.r.t main conductor shall be as per Table-2 of IS: 7098 (Part-1)] | As per Table-2 of IS: 8130 | |
| | | | |
| 7.0 | **INSULATION** | | |
| (a) | Material | Cross-Linked Polyethylene(XLPE) | |
| (b) | Standard Applicable | IS: 7098 (Part-1) | |
| (c) | Continuous withstand temperature | 90°C | |
| (d) | Short-circuit withstand temperature | 250°C | |
| (e) | Method of application | By extrusion; sleeve extrusion not permitted. | |
| (f) | Nominal Thickness of insulation | As per IS: 7098 (Part-1) | |
| | | | |
| 8.0 | **CORE IDENTIFICATION** | Colour coding as per IS-7098 (Part-I) | |
| | | | |
| 9.0 | **INNER SHEATH** | | |
| (a) | Material | Extruded HRPVC Type ST-2 | |
| (b) | Standard Applicable | IS: 7098 (Part-1) & IS: 5831 | |
| (c) | Colour | Black | |
| (d) | Whether FR-LSH | No ( Project specific requirement shall be informed later) | |
| (e) | Inner sheath applicable for single core cable | No | |

| | | |
|---|---|---|
| (f) | Fillers | Acceptable |
| (g) | Material of fillers (if permitted) | Same as inner sheath (Material of filler to be compatible with that of inner sheath) |
| (h) | Method of application | |
| (1) | Multi-core cables: | |
| (i) | With fillers | Pressure/ Vacuum extruded |
| (ii) | Without fillers | Pressure extruded |
| (2) | Single-core cables: | NOT APPLICABLE |
| | | |
| 10.0 | ARMOUR | |
| (a) | Applicable | Yes/No (As specified in BOQ cum price schedule) |
| (b) | Material: | Wherever armouring is applicable |
| (i) | Single core cables | Non Magnetic Hard drawn Aluminium Round Wire OR Round/Formed Wire H4 grade to IS: 8130 (as specified in BOQ cum price schedule) |
| (ii) | Multi-core cables | Galvanised Steel Round Wire OR Galvanised Steel Formed Wire/Strip, conforming to (i) Type 'a'/ 'b' as per Table-6 of IS 7098 Part-I and (ii) IS 3975 (as specified in BOQ cum price schedule)<br>(Project specific requirement for Type 'a' or 'b' shall be informed later) |
| (iii) | Standard Applicable | Dimension as per IS: 7098 (Part-1) Table-6 and tolerance on dimension as per IS:3975 |
| (c) | Minimum Coverage | 90% |
| (d) | Gap between armour wires | Shall not exceed one armour wire space<br>(No cross-over/ over-riding) |
| (e) | Breaking load of joint | 95 % of normal armour |
| (f) | Paint on joint | Zinc rich paint shall be applied on armour joint surface of G.S. wire / formed wire |
| | | |
| 11.0 | OUTERSHEATH | |
| (a) | Material | HRPVC Type ST2 as per IS: 5831 |
| (b) | Colour | Black |
| (c) | Whether FR-LSH | Yes |
| (d) | Method of application | Extruded |
| (e) | Thickness of outer sheath | As per Table-8 of IS: 7098 (Part-1) |
| (f) | Marking | Cable size (cross section area and no. of cores), voltage grade and Reference IS @ 1m (by embossing)<br>Word "XLPE", "FR-LSH" @ 1m (by embossing)<br>Manufacturer's name and/ or trade name, and year of manufacture @ 1m (by embossing)<br>'BHEL' and 'CUSTOMER' name @1m (by embossing)<br>Progressive sequential marking of length of the cable in metres @ 1m (by embossing/ printing)<br>*Further customer specific marking requirement (if any) shall be informed later.*<br>The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. |
| | | |
| 12.0 | FR-LS CHARACTERISTICS | |
| (a) | Oxygen index | Min 29 (As per IS 7098-I /ASTMD 2863)/ |

| | | |
|---|---|---|
| | | Min 21 (as per NES-715-1)<br>(Project specific requirement shall be informed later) |
| (b) | Temperature index | Min. 250°C(As per IS 7098-I /ASTMD 2863) |
| (c) | Acid gas generation | Max. 20% by weight (As per IS 7098-I /IEC-60754-1) |
| (d) | Smoke density rating | Max. 60% (As per IS 7098-I /ASTM D 2843) |
| (e) | **Flammability Test** | |
| (i) | Flammability test for single cable | YES<br>As per IEC-60332 Part-1 |
| (ii) | Flammability test for bunched cables | YES<br>As per IEC-60332 Part-3-23, CAT-B |
| (iii) | Flammability test as per IEEE: 60383 | YES |
| (iv) | As per Swedish Chimney test SEN-SS-424-1475-F3 | YES |
| (f) | Special Tests | |
| I. | Hydrolytic Stability Test | No/ Refer Cl. 3.4 of Sec-II |
| II. | Ultraviolet Radiation Test | No/ Refer Cl. 3.4 of Sec-II |
| | | |
| 13.0 | **Anti-rodent and Termite repulsion Test** | YES |
| 14.0 | **Anti-Fungal Test** | No |
| | | |
| 15.0 | **TOLERANCE ON OUTER DIAMETER** | ± 2mm |
| | | |
| 16.0 | **MINIMUM BENDING RADIUS** | |
| (a) | Single core cables | 15 x O.D. |
| (b) | Multi core cables | 12 x O.D. |
| | | |
| 17.0 | **SAFE PULLING FORCE** | |
| (a) | Aluminium conductor cable | 30 N/ sq. mm. |
| (b) | Copper conductor cable | 50 N/ sq. mm. |
| | | |
| 18.0 | **CABLE DRUMS** | |
| (a) | Type of Drum | Wooden as per IS 10418 |
| (b) | Standard drum length | 500m (±) 5% / 750m (±) 5% / 1000m (±) 5%. (as specified in BOQ-Cum-Priced Schedule)<br>[Drum length of 750m (±) 5% can be informed later in specific project] |
| (c) | Painting | Entire surface to be painted |
| (d) | Outermost Layer | To be covered with waterproof polyethylene |
| (e) | Construction details | *Clause no 4.2 of Section-II of this technical specification* |
| (f) | Particular details on Drum | Clause no 4.3 of Section-II of this technical specification.<br>Further customer specific marking requirement (if any) shall be informed later. |
| (g) | Cable packing | Please refer Clause no 4.2 of Section-II of this technical specification. 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. (Refer typical drawing of cable drum packing, attached in section -II) |
| 19.0 | Sea Worthy packing | No |

## DATASHEET C

### GUARANTEED TECHNICAL PARTICULARS (TO BE SUBMITTED BY SUCCESSFUL BIDDER)

| S.No. | | Unit | Description |
|---|---|---|---|
| **A** | **GENERAL** | - | |
| 1 | Name of manufacturer | - | |
| 2 | Place of Manufacture | - | |
| 3 | Current rating of cables conforms to | - | |
| 4 | Short circuit rating conforms to | - | |
| 5 | Formula for calculating short circuit current for different duration | - | |
| 6 | Permissible conductor temperature | | |
| | (a) Maximum continuous rating | deg. C | |
| | (b) Short circuit rating | deg. C | |
| 7 | (a) Installation Conditions at site | | |
| | i) Ambient air temperature | deg. C | |
| | ii) Ground temperature | deg. C | |
| | iii) Depth of laying of cables buried in ground | cm | |
| 8 | CHARACTERISTICS OF FRLS SHEATH | | |
| | (a) Oxygen index | % | |
| | (b) Temperature index | deg. C | |
| | (c) Acid gas generation | % | |
| | (d) Smoke density rating | % | |
| 9 | CABLE DRUMS | | |
| | (a) Type & construction | - | |
| | (b) Standard drum length | Mtr | |
| | (c) Tolerance on drum length | % | |
| **B** | **INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE** | | |
| 1 | No. of cores x size | No. x sq.mm | |
| 2 | Voltage grade (Uo/U) | kV | |
| 3 | Base current ratings (*) based on Sl. (A) 7.0 | | |
| | (a) In air | Amp | |
| | (b) In ground | Amp | |
| | (c) ducts | Amp | |

| | | | |
|---|---|---|---|
| 4 | Short circuit rating for 1 sec duration | kA | |
| 5 | (a) D.C. resistance of conductor at 20 deg C (main / neutral) | ohm/km | |
| | (b) A.C. resistance of conductor at 90 deg. C (main / neutral) | ohm/km | |
| | (c) Reactance of cable at Normal frequency | ohm/km | |
| | (d) Electrostatic capacitance of cable at normal frequency | µF/km | |
| 6 | CONDUCTOR | | |
| | (a) Material type | - | |
| | (b) Grade | - | |
| | (c) No & dia of wires in each core before stranding | no x mm | |
| | (d) Shape | - | |
| 7 | INSULATION | | |
| | (a) Material | - | |
| | (b) Nominal thickness (main / neutral) | mm | |
| | (c) Minimum thickness (main / neutral) | mm | |
| | (d) Minimum volume resistivity at 27 deg. C | Ohm-cm | |
| | (e) Minimum volume resistivity at 90 deg. C | Ohm-cm | |
| 8 | INNERSHEATH | | |
| | (a) Material | - | |
| | (b) Whether FRLS | - | |
| | (c) Thickness (min.) | mm | |
| | (d) Method of application for multi-core cables | - | |
| | (e) Type and shape of fillers (if used) | - | |
| | (f) Colour | - | |
| 9 | ARMOUR | | |
| | (a) Material | - | |
| | (b) Type of armour | - | |
| | (c) Size/ dimensions (Nominal dia of wire) | mm | |
| | (d) Minimum no. of round / formed wires | No. | |
| | (e) Minimum coverage | % | |
| | (f) Gap between armour wire/strip | - | |
| | (g) Breaking load of joint | - | |
| | (h) Maximum resistivity of GS formed / Round wire | Ohm-cm | |
| | (i) Maximum resistivity of Aluminium round wire | Ohm-cm | |
| 10 | OUTERSHEATH | | |
| | (a) Material | - | |
| | (b) Whether FRLS | - | |
| | (c) Minimum thickness | mm | |

| | | | |
|---|---|---|---|
| | (d) Colour | - | |
| | (e) Method of application | - | |
| 11 | 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 | |
| | (e) Tolerance on overall diameter | (±) mm | |
| 12 | Ovality | mm | |
| 13 | Minimum bending radius | x O.D | |
| 14 | Safe Pulling Force | $N/mm^2$ | |
| 15 | Weight of cable | kg./km | |
| 16 | Dimension of drum | mm | |
| 17 | Shipping weight (approx.) | kg | |
| 18 | Cable marking on outer sheath | - | |
| 19 | Marking on drum | - | |

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

# SECTION-II

# STANDARD TECHNICAL REQUIREMENTS

## 1.0 CODES AND STANDARDS

1.1 The material shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the material is to be installed.

1.2 The design, material, construction, manufacture, inspection and testing of LT XLPE POWER Cable shall conform to the latest revision of relevant standards as per Data Sheet-A.

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

## 2.0 TECHNICAL REQUIREMENTS

2.1 LT XLPE POWER Cable shall be supplied as per technical particulars specified in Data Sheet – A.

## 3.0 QUALITY ASSURANCE, TESTING & INSPECTION

3.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E002, Rev-02) as attached with the specification without any deviations. At contract stage (project specific), 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.

3.2 All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan.

3.3 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).

3.4 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).

3.5 Cost of cables consumed for testing shall be to bidder's account.

## 4.0 PACKING

4.1 Cables shall be supplied in non-returnable drums. Material of cable drums shall be wooden.

4.2 For wooden drums, all wooden parts shall be manufactured from seasoned wood treated with copper napthenates / zinc napthenates (refer IS: 401) and anti-termite. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Dimensions of wooden drums shall be as per IS 10418. All ferrous parts shall be treated with suitable rust protective

finish or coating to avoid rusting during transit and storage. BIS certification mark shall be stamped on each cable drum.

4.3 Each drum shall carry manufacturer's name, purchaser's name, address and contract no., item no. & type, size & length of cable and net gross weight stencilled on both sides of drum. A tag containing same information shall be attached to the leading end of the cable. An arrow & suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | DATE: |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 1 OF 12 |

| Sl. No. | COMPONENTS & OPERATIONS | CHARACTERSTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | | | | | * | ** | | | |
| | | | | | M | C/N | | | | D | M | C | N | |
| 1 | 2 | 3 | 4 | 5 | | | 7 | 8 | 9 | | | | | |
| **1.0** | **RAW MATERIALS** | | | | | | | | | | | | | |
| **1.1** | **Aluminium /Copper Rods** | **GENERAL :** | | | | | | | | | | | | |
| | **(Conductor/ Armour Wire)** | 1. Physical properties | MA | Physical Tests | Sample/ Batch | Sample / Batch | IS:8130 (Al), IS:613 (Cu) | IS:8130 (Al), IS:613 (Cu) | 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 | Verify | 100% | 100% | Manufacturer approved source | Manufacturer approved source | Test Cert. | ✓ | P | V | - | |
| | | b) Grade | MA | -do- | -do- | -do- | IS:8130 (Al), IS:613 (Cu) | IS:8130 (Al), IS:613 (Cu) | -do- | ✓ | P | V | - | |
| | | c) Resistivity | MA | Electrical Tests | Manufacturer std. | Manufacturer std. | IS:613 (Cu), IS:5082 (Al) | IS:613 (Cu), IS:5082 (Al) | -do- | ✓ | P | V | - | |
| | | | | | | | | | | | | | | |
| **1.2** | **XLPE Compound for insulation** | **GENERAL :** | | | | | | | | | | | | |
| | | 1. Physical properties | MA | Physical Tests | Sample/ Batch | Sample / Batch | IS 7098-I | IS 7098-I | Test Cert. | ✓ | P | V | - | |

| BHEL | | | | | | BIDDER/ SUPPLIER | | FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | | Sign & Date | | Doc No: | | | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | | | Sign & Date | Name | Seal |
| Prepared by: | 18.03.2020 | VIKAS KUMAR SINGH | Checked by: | 18/03/20 | KUNAL GANDHI | | | Reviewed by: | | | |
| Reviewed by: | 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/03/2020 | RITESH KUMAR JAISWAL | | | Approved by: | | | |

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | DATE: |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 2 OF 12 |

| Sl. No. | COMPONENTS & OPERATIONS | CHARACTERSTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | | | | | * | ** | | |
| 1 | 2 | 3 | 4 | 5 | M | C/N | 7 | 8 | 9 | D | M | C | N |
| | | 2. Elec. Properties | MA | Electrical Tests | Sample/ Batch | Sample / Batch | -do- | -do- | -do- | ✓ | P | V | - | |
| | | | | | | | | | | | | | | |
| | | **SPECIFIC CHECKS:** | | | | | | | | | | | | |
| | | a) Make | MA | Verify | 100% | 100% | Manufacturer approved source | Manufacturer approved source | Test Cert. | ✓ | P/ V | V | - | |
| | | b) Type/ Grade | MA | -do- | -do- | -do- | -do- | -do- | -do- | ✓ | P/ V | V | - | |
| | | c) Shelf life/ Storage condition | MA | -do- | -do- | -do- | -do- | -do- | -do- | ✓ | P/ V | V | - | |
| | | | | | | | | | | | | | | |
| 1.3 | **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 | Sample/ Batch | Sample / Batch | -do- | -do- | -do- | ✓ | P/ V | V | - | |
| | | 3. FRLS Properties (as applicable) | CR | Chemical/ Environ. | Sample/ Batch | Sample / Batch | Approved datasheet | Approved datasheet | -do- | ✓ | P/ V | V | - | |
| | | **SPECIFIC CHECKS:** | | | | | | | | | | | | |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
|---|---|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | | Sign & Date | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | |
| Prepared by: | 18.03.2020 | VIKAS KUMAR SINGH | Checked by: | 19/3/20 | KUNAL GANDHI | | |
| Reviewed by: | 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/3/2020 | RITESH KUMAR JAISWAL | | |

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

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | DATE: |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 3 OF 12 |

| 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 | Verify | 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 | - | |
| | | | | | | | | | | | | | | |
| **1.4** | **Fillers (as applicable)** | 1. Make | MA | Verify | 100% | 100% | Manufacturer approved source | Manufacturer approved source | Test Cert. | ✓ | P | V | - | Fillers material chosen shall be compatible with the temperature rating of the cable and shall have no deleterious effect on any other |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
|---|---|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | | Sign & Date | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | |
| Prepared by: | 18.03.2020 | VIKAS KUMAR SINGH | Checked by: | 19/3/20 | KUNAL GANDHI | | |
| Reviewed by: | 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/3/2020 | RITESH KUMAR JAISWAL | | |

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

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | DATE: |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 4 OF 12 |

| Sl. No. | COMPONENTS & OPERATIONS | CHARACTERSTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | | | | | * | ** | | | |
| 1 | 2 | 3 | 4 | 5 | M | C/N | 7 | 8 | 9 | D | M | C | N | |
| | | | | | | | | | | | | | | component of cable) |
| | | 2. Type/ Grade | MA | -do- | -do- | -do- | Appd. Data Sheet | Appd. Data Sheet | -do- | ✓ | P/ V | V | - | |
| | | | | | | | | | | | | | | |
| **1.5** | **Galvanised steel wire/strip for Armour (as applicable)** | **GENERAL:** | | | | | | | | | | | | |
| | | 1. Make | MA | Verify | Manufacturer std. | Manufacturer std. | Manufacturer approved source | Manufacturer approved source | Test Cert. | ✓ | P | V | - | |
| | | 2. Dimension | MA | Measurement | -do- | -do- | Appd. Data Sheet | Appd. Data Sheet | -do- | | P/ V | - | - | |
| | | 3. Phy.and Elec. Properties | MA | Physical & Electrical Tests | Sample* | Sample* | -do- | -do- | -do- | ✓ | P/ V | V | - | |
| | | 4.Galvanization Quality | MA | Galv.Tests | -do- | -do- | IS 3975 | IS 3975 | -do- | | P/ V | - | - | |
| | | | | | | | | | | | | | | |
| **1.6** | **Wooden Drum** | 1. Phy. & Constructional checks | MA | | Mfr's Plant Std. | Mfr's Plant Std. | IS 10418 | IS 10418 | Test Cert. | ✓ | P | V | - | |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
|---|---|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | | Sign & Date | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | |
| Prepared by: | 18.03.2020 | VIKAS KUMAR SINGH | Checked by: | 19/3/20 | KUNAL GANDHI | | |
| Reviewed by: | 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/3/2020 | RITESH KUMAR JAISWAL | | |

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| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | DATE: |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 5 OF 12 |

| Sl. No. | COMPONENTS & OPERATIONS | CHARACTERSTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | | | | 9 | * | ** | | | |
| 1 | 2 | 3 | 4 | 5 | M | C/N | 7 | 8 | | D | M | C | N | |
| | | 2. Anti termite treatment | MA | Chem. | Mfr's Plant Std. | Mfr's Plant Std. | Mfr's Plant Std. | Mfr's Plant Std. | -do- | ✓ | P | V | - | |
| | | | | | | | | | | | | | | |
| **1.7** | **Steel Drum #** | 1. Dimension | MA | Meas. | Mfr's Plant Std. | Mfr's Plant Std. | Approved drg | Approved drg | Test Cert. | ✓ | P | V | - | # If required, as per spec. |
| | | 2. Surface finish | MA | Visual | -do- | -do- | - | Surface shall be smooth | -do- | ✓ | P | V | - | |
| | | | | | | | | | | | | | | |
| **2.0** | **IN PROCESS** | | | | | | | | | | | | | |
| 2.1 | Wire Drawing | 1. Size | MA | Dimensional | Plant Mfg. Std. | Plant Mfg. Std. | Approved datasheet | Approved datasheet | Inspection Report/ Test report | ✓ | P | V | - | |
| | | 2. Surface finish | MA | Visual | -do- | -do- | Surface shall be smooth | Surface shall be smooth | -do- | ✓ | P | V | - | |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
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| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 6 OF 12 |

| Sl. No. | COMPONENTS & OPERATIONS | CHARACTERSTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | | | | | * | ** | | |
| | | | | | M | C/N | | | | D | M | C | N |
| 1 | 2 | 3 | 4 | 5 | | | 7 | 8 | 9 | | | | |
| | | 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 | Plant Mfg. Std. | Plant Mfg. Std. | Appd. Datasheet | Appd. Datasheet | Inspection Report/ Test report | ✓ | P | V | - | |
| | | 2. Resistance | CR | Electrical | -do- | - | -do- | -do- | -do- | -do- | P | - | - | |
| | | 3. Sequence, lay length & Direction | MA | Visual, Meas. | One Sample of each size/ lot | - | Mfrs Std. | Mfrs Std. | -do- | | P | - | - | |
| | | 4. Surface Finish | MA | Visual | 100% | - | Surface shall be smooth | Surface shall be smooth | -do- | | P | - | - | |
| | | 5. Dimension | MA | Measurement | One Sample of each size/ lot | - | Appd. Datasheet | Appd. Datasheet | -do- | | P | - | - | |
| | | | | | | | | | | | | | | |
| **2.3** | **Core Insulation (XLPE)** (No repair permitted) | | | | | | | | | | | | | |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
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| ENGINEERING | | | QUALITY | | | Sign & Date | |
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| Prepared by: | 18.03.2020 | VIKAS KUMAR SINGH | Checked by: | 19/3/20 | KUNAL GANDHI | | |
| Reviewed by: | Manish 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/3/2020 | RITESH KUMAR JAISWAL | | |

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| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | DATE: |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 7 OF 12 |

| Sl. No. | COMPONENTS & OPERATIONS | CHARACTERSTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | | | | | * | ** | | | |
| 1 | 2 | 3 | 4 | 5 | M | C/N | 7 | 8 | 9 | D | M | C | N | |
| | | 1. Surface finish | MA | Visual | 100% | 100% | Free from bulging, burnt particles, lumps, cuts & scratches | 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 size/ lot | Mnfr's Std | Mnfr's Std | -do- | ✓ | P | V | - | |
| | | 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:1554-I, IS:5831 | IS:1554-I, IS:5831 | -do- | | P | - | - | |
| | | 6. Spark Test or Water immersion test | CR | Electrical | 100% | - | Mnfr's Std | Mnfr's Std | -do- | Mnfr's Std | P | - | - | |
| | | | | | | | | | | | | | | |
| **2.4** | **Core Laying** | 1. Dia over laid up core | MA | Measurement | One Sample of each size/ lot | - | Appd. Datasheet | Appd. Datasheet | Inspection Report/ Test report | | P | - | - | |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
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| ENGINEERING | | | QUALITY | | | Sign & Date | |
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| Prepared by: | 18.03.2020 | VIKAS KUMAR SINGH | Checked by: | 19/3/20 | KUNAL GANDHI | | |
| Reviewed by: | 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/3/2020 | RITESH KUMAR JAISWAL | | |

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|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 8 OF 12 |

| Sl. No. | COMPONENTS & OPERATIONS | CHARACTERSTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | * | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | | | | | | ** | | | |
| 1 | 2 | 3 | 4 | 5 | M | C/N | 7 | 8 | 9 | D | M | C | N | |
| | | 2. Sequence of lay & direction | MA | Visual & Meas. | -do- | - | IS 7098-I & Mfr. Std. | IS 7098-I & Mfr. Std. | -do- | | P | - | - | |
| | | | | | | - | | | | | | | | |
| 2.5 | **Inner Sheath Extrusion (as applicable)** | 1. Surface finish | MA | Visual | 100% | - | Surface shall be smooth | Surface shall be smooth | Inspection Report/ Test 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 | - | - | |
| | | | | | | | | | | | | | | |
| 2.6 | **Armour( as applicable)** | 1. No.of wires/Strips | MA | Counting | At the start of the process | - | Mnfr's Std | Mnfr's Std | Inspection Report/ Test report | | P | - | - | |
| | | 2. Lay length / Direction | MA | Visual & Meas. | -do- | - | Mfr. Std. | Mfr. Std. | -do- | | P | - | - | |
| | | 3. Dia over armouring | MA | Measurement | -do- | - | Appd. Datasheet | Appd. Datasheet | -do- | | P | - | - | |

| BHEL | | | | | | BIDDER/ SUPPLIER | | FOR CUSTOMER REVIEW & APPROVAL | | | |
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| ENGINEERING | | | QUALITY | | | Sign & Date | | Doc No: | | | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | | | Sign & Date | Name | Seal |
| Prepared by: | 18.03.2020 | VIKAS KUMAR SINGH | Checked by: | 19/3/20 | KUNAL GANDHI | | | Reviewed by: | | | |
| Reviewed by: | 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/3/2020 | RITESH KUMAR JAISWAL | | | Approved by: | | | |

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|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 9 OF 12 |

| 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 | * | ** | | | |
| | | 4. Coverage | MA | Measurement | -do- | - | -do- | -do- | -do- | | P | - | - | |
| | | | | | | | | | | | | | | |
| 2.7 | **Outer Sheath Extrusion (No repair permitted)** | 1. Surface finish | MA | Visual | 100% | - | Surface shall be smooth | 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 | **Final Inspection (INTERNAL)** | **1. Routine Test (Refer Note-H)** | CR | Electrical Tests & Measurement | 100% | 100% | # | # | -do- | ✓ | P | V | V | #: Refer Annexure-A to QP |
| | | | | | | | | | | | | | | |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
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| ENGINEERING | | | QUALITY | | | Sign & Date | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | |
| Prepared by: | 15.03.2020 | VIKAS KUMAR SINGH | Checked by: | 19/3/20 | KUNAL GANDHI | | |
| Reviewed by: | 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/3/2020 | RITESH KUMAR JAISWAL | | |

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| बीएच ई एल BHEL | MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | DATE: |
|---|---|---|---|---|---|
| | | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | | PROJECT: | | PO NO.: | |
| | | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 10 OF 12 |

| 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 | |
| **4.0** | **Final Inspection (EXTERNAL)** | **1. Finish & Length (Cable & 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/ Test report | ✓ | P | W | W | |
| | | **2. Dimension** | MA | -do- | IS 7098-I | IS 7098-I | Appd. Datasheet | Appd. Datasheet | -do- | ✓ | P | W | W | |
| | | **3. Armouring - Coverage & No.of Wires/Strips** | MA | Visual & Meas. | -do- | -do- | -do- | -do- | -do- | ✓ | P | W | W | |
| | | **4. Marking & Colour Coding** | MA | Visual | -do- | -do- | -do- | -do- | -do- | ✓ | P | W | W | |
| | | **5. Acceptance Tests (Refer Note-H)** | CR | Phy, Elect. Tests & FRLS Tests | Sample # | Sample # | # | -do- | -do- | ✓ | P | W | W | |
| | | **6. Type Tests (Refer Note-H)** | CR | Physical & Electrical Tests | Sample # | Sample # | -do- | -do- | -do- | ✓ | P | W | W | |

| BHEL | | | | | | BIDDER/ SUPPLIER | |
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| Prepared by: | 18.03.2020 | VIKAS KUMAR SINGH | Checked by: | 19/3/20 | KUNAL GANDHI | | |
| Reviewed by: | Manish 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/3/2020 | RITESH KUMAR JAISWAL | | |

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|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 11 OF 12 |

| Sl. No. | COMPONENTS & OPERATIONS | CHARACTERSTICS | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 6 | | | | | * | ** | | | |
| 1 | 2 | 3 | 4 | 5 | M | C/N | 7 | 8 | 9 | D | M | C | N | |
| | | | | | | | | | | | | | | |
| **5.0** | **Packing** | **End sealing / Polythene wrapping** | MA | Visual | 100% | 100% | Appd. Datasheet | Appd. Datasheet | -do- | ✓ | P | W | | |
| | | | | | | | | | | | | | | |

**NOTES:**

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 to be prepared in line with this standard QP.
N. In case of export jobs, sea worthy packing as per BHEL technical specification shall be carried out.

**LEGENDS:**

| BHEL | | | | | | BIDDER/ SUPPLIER | | FOR CUSTOMER REVIEW & APPROVAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ENGINEERING | | | QUALITY | | | Sign & Date | | Doc No: | | | |
| | Sign & Date | Name | | Sign & Date | Name | Seal | | | Sign & Date | Name | Seal |
| Prepared by: | 18.03.2020 | VIKAS KUMAR SINGH | Checked by: | 19/3/20 | KUNAL GANDHI | | | Reviewed by: | | | |
| Reviewed by: | 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/3/2020 | RITESH KUMAR JAISWAL | | | Approved by: | | | |

| MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS | STANDARD QUALITY PLAN | | SPEC. NO : | DATE: |
|---|---|---|---|---|
| | CUSTOMER : | | QP NO.: PE-QP-999-507-E002, REV 02. | |
| | PROJECT: | | PO NO.: | |
| | ITEM: LT XLPE POWER CABLE | SYSTEM: CABLE | SECTION: II | SHEET 12 OF 12 |

| 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 | | | | | |

*RECORDS, IDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **B**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: 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 | |
| Prepared by: | 18.03.2020 | VIKAS KUMAR SINGH | Checked by: | 19/3/20 | KUNAL GANDHI | | |
| Reviewed by: | 18/03/20 | MANISH SHUKLA | Reviewed by: | 19/3/2020 | RITESH KUMAR JAISWAL | | |

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| | Sign & Date | Name | Seal |
| Reviewed by: | | | |
| Approved by: | | | |

**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 each type & size of cable on one drum out of every 10 drums for every lot (CU/AL conductor)
   b) Flammability Test to be conducted only on one sample/ lot.

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:
   Acceptance tests to be conducted on one drum out of every 10 drums/ lot for every size & type.

3. Flammability Test to be conducted only on one sample/ lot (Project specific sampling plan shall be informed later)

**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.

**D. Tests listed in S.No-7.0 & 8.0 shall be conducted only on one sample / lot.**

**Note:** LOT shall be considered as per IS: 7098 Part-I, appendix-B.

| 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 | |
| | | | | | |

| S. No. | TEST | APPLICABLE FOR | TEST CONDUCTION REQUIRED AS | REFERENCE STANDARD | REMARKS |
|---|---|---|---|---|---|
| **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 | |
| V. | Winding / Adhesion 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 | Applicable for Aluminium wire & GS wire | **A** | IS 10810 Pt 3 | |
| **3.0** | **Physical Tests for XLPE Insulation & PVC sheath** | | | | |
| I. | Test for thickness | Applicable for XLPE insulation, PVC inner sheath & PVC outer sheath | **T, A** | IS 10810 Pt 6 | |
| II. | Tensile strength and elongation test at break | Applicable for XLPE insulation & PVC outer sheath | | | |
| (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 & PVC outer sheath | **T** | IS 10810 Pt 11 | |
| IV. | Loss of mass in air oven test | For PVC outer sheath only | **T** | IS 10810 Pt 10 | |
| V. | Hot deformation test | For PVC outer sheath only | **T** | IS 10810 Pt 15 | |
| VI. | Heat shock test | For PVC outer sheath only | **T** | IS 10810 Pt 14 | |
| VII. | Shrinkage test | For XLPE insulation & PVC outer sheath only | **T** | IS 10810 Pt 12 | |
| VIII. | Thermal stability test | For PVC outer sheath only | **T** | IS 10810 Pt 60 | |
| IX. | Cold Impact test | For PVC outer sheath only | **T** | IS 5831/1984 | |
| X. | Bleeding and Blooming test | For PVC outer sheath only | **T** | IS 5831/1984 | |
| XI. | Hot set test | For XLPE insulation only | **T, A** | IS 10810 Pt 30 | |
| XII. | Water absorption (gravimetric) test | For XLPE insulation only | **T** | IS 10810 Pt 33 | |
| | | | | | |
| **4.0** | **Improved Fire performance (FR-LSH) Tests** | | | | |

| S. No. | TEST | APPLICABLE FOR | TEST CONDUCTION REQUIRED AS | REFERENCE STANDARD | REMARKS |
|---|---|---|---|---|---|
| I. | Oxygen index test | For PVC outer sheath only | **T, A** | IS 10810 Pt 58 / ASTMD 2863/ NES 715-I | **Applicable for Inner Sheath also, if the same is indicated in Datasheet-A** |
| II. | Smoke density test | For PVC outer sheath only | **T, A** | IS 10810 Pt 63 / ASTMD 2843 | |
| III. | Acid gas generation test | For PVC outer sheath only | **T, A** | IS 10810 Pt 59 / IEC-754-1 | |
| IV. | Temperature Index Test | For PVC outer sheath only | **T, A** | IS 10810 Pt 64 / ASTMD 2863 | |
| **5.0** | **Flammability Tests** | | | | |
| I. | Flammability test for bunched cables | For complete cable | **T** | IS 10810 Pt 62/ IEC-60332 (Part-3-23-Cat-B | **Test & Category applicable as indicated in Datasheet-A** |
| II. | Flammability test for single cable | For complete cable | **T,A** | IS: 10810 Pt 61 / 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 | |
| | | | | | |
| **6.0** | **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 | |
| | | | | | |
| **7.0** | **Anti-rodent and Termite Repulsion test** | For PVC outer sheath only | **A** | Refer Note | **Test applicable if indicated in Datasheet-A** |
| **8.0** | **Anti-Fungal Test** | For PVC outer sheath only | **A** | -- | |
| | | | | | |
| **9.0** | **Special Tests** | | | | |
| I. | Hydrolytic Stability Test | For complete cable | ** | ASTM D 3137:81 | **Test applicable if indicated in Datasheet-A** |
| II. | Ultraviolet Radiation Test | For complete cable | ** | 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.

# TYPICAL DRAWING OF CABLE DRUM PACKING