

**VOLUME II**

**NTPC LIMITED**

**3 X 800 MW PATRATU STPS EXPANSION**

**TECHNICAL SPECIFICATION**

**FOR**

***HT XLPE POWER CABLES***

**SPECIFICATION NO: *PE-TS-434-507-E001***

***REVISION: 0***



**BHARAT HEAVY ELECTRICALS LIMITED**

**POWER SECTOR**

**PROJECT ENGINEERING MANAGEMENT**

**NOIDA, UP (INDIA) – 201301**



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR  
HT XLPE POWER CABLES**

SPECIFICATION NO. PE-TS- 434-507-E001

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### COMPLIANCE CERTIFICATE

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

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same
2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

-----  
BIDDER'S STAMP & SIGNATURE



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**SECTION –I**

**SPECIFIC TECHNICAL REQUIREMENTS**



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**1.0 SCOPE OF ENQUIRY**

- 1.1 Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of HT XLPE Power Cables conforming to this specification.
- 1.2 General technical requirements of the HT XLPE Power cables are indicated in Section-II. Project specific technical/ quality requirements / changes are listed in Section-I.
- 1.3 The stipulations of Section-I, followed by those of Data Sheet-A shall prevail in case of any conflict between the stipulations of Section-I, Data Sheet - A & Section-II.
- 1.4 The documents shall be in English Language and MKS system of units.

**2.0 BILL OF QUANTITIES:**

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

**3.0 SPECIFIC TECHNICAL REQUIREMENTS**

| <b>S.No.</b> | <b>Reference Clause No. of Section- II</b> | <b>Specific Requirement/ Change</b>                                                                                                                                                                                                                                                                                                            |
|--------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.           | 3.1                                        | BHEL Standard Quality Plan (PE-QP-999-507-E001) shall be read as "QP. NO. 0000-999-QOE-S-042, REV-00".<br>Additionally, The QP. NO. 0000-999-QOE-S-042 REV-00 shall be read in conjunction with Annexure C (Quality Assurance & Inspection). However, Type testing on cables shall be conducted as per attached BHEL QP along with Annexure-A. |

**4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED**

- 4.1 Following documents/drawings shall be submitted after placement of order for BHEL & customer's approval:-

| <b>SL. No.</b> | <b>DOCUMENT TITLE</b>                                                  | <b>DWG. / DOCUMENT No.</b> | <b>Document Type</b> | <b>First Submission</b>                 | <b>Resubmission</b>       |
|----------------|------------------------------------------------------------------------|----------------------------|----------------------|-----------------------------------------|---------------------------|
| 1              | Technical Data sheet & Cross section drawings for HT XLPE Power Cables | 9585-001-215-PVE-Y-038     | Primary              | Within 2 week of award of contract.     | Within 1 week of comments |
| 2              | Manufacturing Quality Plan for HT XLPE Power Cables                    | 9585-001-215-QVE-Q-020*    | Primary              | Within 2 week of award of contract.     | Within 1 week of comments |
| 3              | Type test reports for HT cables                                        | 9585-001-215-PVE-W-034     | Primary              | Within 1 week from conducting Type Test | Within 1 week of comments |

Note:

1. The above list of drawings and documents is indicative.
2. Document schedule shall be as per NIT.
3. After receiving LOI, the vendor shall submit drawings/documents in requisite number of copies as per NIT.

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

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



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**DATASHEET A**



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|       |                                                                         |                                                                                                                                                                                                                                                                                                                                                  |
|-------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.0   | Type of Cable                                                           | Flame Retardant-Low Smoke (FRLS)                                                                                                                                                                                                                                                                                                                 |
| 2.0   | Standard applicable in general (Latest amendment to be referred if any) | IS:7098 (Part-2), IS:8130, IS:5831, IS:10810, IS:3975, ASTM:2843, ASTM:2863, IEC-754-1, IEC:60332 (Part-1), IEC:60332-3-23, IEEE:60383                                                                                                                                                                                                           |
| 3.0   | Voltage Grade                                                           | 11/11kV(UE) & 3.3/3.3kV(UE)                                                                                                                                                                                                                                                                                                                      |
| 4.0   | Number of cores, cross sectional area of conductors and quantities      | 11 kV – Armoured - 01C X 630 SQ. MM<br>11 kV – Armoured - 03C X 185 SQ. MM<br>11 kV – Unarmoured - 03C X 185 SQ. MM<br>11 kV – Unarmoured - 01C X 240 SQ. MM<br>11 kV – Unarmoured - 01C X 400 SQ. MM<br><br>3.3 kV – Unarmoured - 03C X 150 SQ. MM<br>3.3 kV – Armoured - 01C X 150 SQ. MM<br><br>As per BOQ cum price schedule ( part of NIT ) |
| 5.0   | <b>CONDUCTOR</b>                                                        |                                                                                                                                                                                                                                                                                                                                                  |
| (a)   | Material                                                                | Aluminium                                                                                                                                                                                                                                                                                                                                        |
|       | Grade and Class                                                         | Multi-Stranded, H2, Class 2                                                                                                                                                                                                                                                                                                                      |
| (b)   | Standard Applicable                                                     | IS: 8130                                                                                                                                                                                                                                                                                                                                         |
| (c)   | Shape                                                                   | Compacted Circular                                                                                                                                                                                                                                                                                                                               |
| (d)   | Min. number and diameter of strands                                     | As per Class-2 of IS: 8130                                                                                                                                                                                                                                                                                                                       |
| (e)   | Conductor screen                                                        |                                                                                                                                                                                                                                                                                                                                                  |
| (i)   | Material                                                                | Extruded Cross-linked Semi-conducting compound                                                                                                                                                                                                                                                                                                   |
| (ii)  | Minimum thickness                                                       | 0.3 mm                                                                                                                                                                                                                                                                                                                                           |
| 6.0   | <b>INSULATION</b>                                                       |                                                                                                                                                                                                                                                                                                                                                  |
| (a)   | Material                                                                | Cross-Linked Polyethylene(XLPE)                                                                                                                                                                                                                                                                                                                  |
| (b)   | Standard Applicable                                                     | IS: 7098 (Part-2)                                                                                                                                                                                                                                                                                                                                |
| (c)   | Continuous withstand temperature                                        | 90°C                                                                                                                                                                                                                                                                                                                                             |
| (d)   | Short-circuit withstand temperature                                     | 250°C                                                                                                                                                                                                                                                                                                                                            |
| (e)   | Nominal Thickness of Insulation                                         | As per Table – 4 of IS 7098 Part-2                                                                                                                                                                                                                                                                                                               |
| 7.0   | <b>INSULATION SCREEN</b>                                                | <b>For both SINGLE CORE &amp; MULTI CORE cables</b>                                                                                                                                                                                                                                                                                              |
| (a)   | Non-metallic                                                            |                                                                                                                                                                                                                                                                                                                                                  |
| (i)   | Material                                                                | Extruded Cross-linked Semi-conducting compound                                                                                                                                                                                                                                                                                                   |
| (ii)  | Type of Semiconducting compound                                         | Bonded                                                                                                                                                                                                                                                                                                                                           |
| (iii) | Minimum thickness                                                       | 0.3 mm                                                                                                                                                                                                                                                                                                                                           |
| (b)   | Metallic                                                                | Armour shall constitute metallic part of screening capable of carrying earth fault current of 600A for 2 sec. for single core armoured cable                                                                                                                                                                                                     |
| (i)   | Material                                                                | Copper                                                                                                                                                                                                                                                                                                                                           |
| (ii)  | Type                                                                    | Tape                                                                                                                                                                                                                                                                                                                                             |
| (iii) | Size                                                                    | Nominal thickness 0.1mm with tolerance (±) 10%                                                                                                                                                                                                                                                                                                   |
| (iv)  | Minimum Overlap                                                         | 20%                                                                                                                                                                                                                                                                                                                                              |
| (c)   | Earth fault current withstand capacity                                  | 600A FOR 2 SEC                                                                                                                                                                                                                                                                                                                                   |
| 8.0   | <b>EXTRUSION (Insulation and Screens)</b>                               |                                                                                                                                                                                                                                                                                                                                                  |



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| (a)  | Process                                       | Triple Extrusion<br>(Extruded semi-conducting compound conductor screen and insulation screen shall be applied along with XLPE insulation in a single operation by triple extrusion process).                                                                                                                                                                                                   |
| (b)  | Method of Curing                              | For 11 kV & 3.3 kV - Dry curing/gas curing/steam curing                                                                                                                                                                                                                                                                                                                                         |
| 9.0  | <b>CORE IDENTIFICATION</b>                    | Colour coding as per IS:7098(Part-2)                                                                                                                                                                                                                                                                                                                                                            |
| 10.0 | <b>INNER SHEATH</b>                           | <b>Not applicable for Single Core Cable</b>                                                                                                                                                                                                                                                                                                                                                     |
| (a)  | Material                                      | PVC Type ST-2                                                                                                                                                                                                                                                                                                                                                                                   |
| (b)  | Standard Applicable                           | IS: 7098 (Part-2) & IS: 5831                                                                                                                                                                                                                                                                                                                                                                    |
| (c)  | Colour                                        | Black                                                                                                                                                                                                                                                                                                                                                                                           |
| (d)  | Whether FR-LSH                                | NO                                                                                                                                                                                                                                                                                                                                                                                              |
| (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                                  | [ <input checked="" type="checkbox"/> ] Pressure extruded<br>[ <input checked="" type="checkbox"/> ] Vacuum extruded                                                                                                                                                                                                                                                                            |
| (ii) | Without fillers                               | Pressure extruded                                                                                                                                                                                                                                                                                                                                                                               |
| (i)  | Thickness of inner sheath                     | As per Table-5 of IS: 7098 (Part-2)                                                                                                                                                                                                                                                                                                                                                             |
| 11.0 | <b>ARMOUR</b>                                 | Applicable, as per BOQ cum price schedule ( part of NIT )                                                                                                                                                                                                                                                                                                                                       |
| a)   | Material                                      | Galvanised Steel                                                                                                                                                                                                                                                                                                                                                                                |
| (i)  | Multicore cables                              | Strip Armour (Armour dimensions as per Sl. No.(ii) of table – 6 of IS 7098 Part-II.                                                                                                                                                                                                                                                                                                             |
| (ii) | Single core cables                            | Aluminium Round Wire H4 grade to IS: 8130                                                                                                                                                                                                                                                                                                                                                       |
| b)   | Minimum coverage                              | 90%                                                                                                                                                                                                                                                                                                                                                                                             |
| c)   | Gap between armour wires                      | Shall not exceed one armour wire space (No cross-over/over-riding)                                                                                                                                                                                                                                                                                                                              |
| d)   | Breaking load of joint                        | 95% of normal armour                                                                                                                                                                                                                                                                                                                                                                            |
| e)   | Armour joint surface                          | To be applied with Zinc rich paint                                                                                                                                                                                                                                                                                                                                                              |
| 12.0 | <b>OUTERSHEATH</b>                            |                                                                                                                                                                                                                                                                                                                                                                                                 |
| (a)  | Material                                      | PVC 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-7 of IS: 7098 (Part-2)                                                                                                                                                                                                                                                                                                                                                             |
| (f)  | Marking                                       | (A) Following shall be marked @ 5m (by embossing):<br><br>'FR-LSH', Manufacturer's name and trade mark, Year of manufacture, cable code, Type of cable and Voltage grade, cross section area of conductor and number of cores, Screen fault current 600A for 2 sec, "BHEL-PEM", "NTPC"<br><br>(B) Progressive sequential marking of length of the cable in metres @ 1m (by embossing/ printing) |



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| 13.0 | <b>FR-LSH CHARACTERISTICS</b>        |                                                                                                                                                                                                                                                                                                                                                                                                               |
| (a)  | Oxygen index                         | Min 29 (As per IS 7098-2 /ASTMD 2863)                                                                                                                                                                                                                                                                                                                                                                         |
| (b)  | Temperature index                    | Min. 250°C(As per IS 7098-2 /ASTMD 2863)                                                                                                                                                                                                                                                                                                                                                                      |
| (c)  | Acid gas generation                  | Max. 20% by weight (As per IS 7098-2 /IEC-60754-1)                                                                                                                                                                                                                                                                                                                                                            |
| (d)  | Smoke density rating                 | Max. 60% (As per IS 7098-2 /ASTM D 2843)                                                                                                                                                                                                                                                                                                                                                                      |
| (e)  | <b>Flammability Test</b>             |                                                                                                                                                                                                                                                                                                                                                                                                               |
| (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, CAT-B                                                                                                                                                                                                                                                                                                                                                                         |
| 14.0 | <b>TOLERANCE ON OUTER DIAMETER</b>   | (±)2 mm. over the declared value                                                                                                                                                                                                                                                                                                                                                                              |
| 15.0 | <b>CABLE DRUMS</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                               |
| (a)  | Type of Drum                         | [√] Wooden as per IS 10418<br>[√] Steel as per relevant IS                                                                                                                                                                                                                                                                                                                                                    |
| (b)  | Standard drum length                 | 1000M (±) 5% for Single core cables<br>750M (±) 5% for Multi-core cables                                                                                                                                                                                                                                                                                                                                      |
| (c)  | Painting                             | Entire surface to be painted                                                                                                                                                                                                                                                                                                                                                                                  |
| (d)  | Outermost Layer                      | To be covered with waterproof polyethylene                                                                                                                                                                                                                                                                                                                                                                    |
| (e)  | Others                               | 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. Wood preservative anti-termite treatment shall be applied to the entire drum.                                                                                                                                |
| (f)  | Particular information on Drum       | Each drum shall carry manufacturer's name, owner'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. |

|  |                                                                               |                                      |                  |
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**DATASHEET C**

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

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

|                |           |      |      |      |  |
|----------------|-----------|------|------|------|--|
| NAME OF VENDOR |           |      | SEAL | REV. |  |
|                |           |      |      |      |  |
| NAME           | SIGNATURE | DATE |      |      |  |

|  |                                                                               |                                      |                  |
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| <b>4.0</b> | <b>INSTALLATION CONDITIONS FOR CURRENT RATING SPECIFIED AT CLAUSE 7.3</b>   |         |  |
| <b>5.0</b> | <b>CHARACTERISTICS OF FR-LSH SHEATH</b>                                     |         |  |
| 5.1        | Oxygen index                                                                | -       |  |
| 5.2        | Temperature index                                                           | -       |  |
| 5.3        | Acid gas generation                                                         | -       |  |
| 5.4        | Smoke density rating                                                        | -       |  |
| <b>6.0</b> | <b>CABLE DRUMS</b>                                                          |         |  |
| 6.1        | Type & construction                                                         | -       |  |
| 6.2        | Standard drum length                                                        | -       |  |
| 6.3        | Tolerance on drum length                                                    | -       |  |
| <b>7.0</b> | <b>INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE</b> |         |  |
| 7.1        | No. of cores x size                                                         | -       |  |
| 7.2        | Voltage grade (Uo/U)                                                        | kV      |  |
| 7.3        | Base current ratings (*) based on Clause No. 3.0                            |         |  |
| a)         | In air                                                                      | Amp     |  |
| b)         | In ground                                                                   | Amp     |  |
| c)         | ducts                                                                       | Amp     |  |
| 7.4        | Short circuit rating                                                        | kA, sec |  |
| 7.5        | Properties                                                                  |         |  |
| a)         | D.C. resistance of conductor at 20 deg. C                                   | ohm/km  |  |
| b)         | A.C. resistance of conductor at 90 deg. C                                   | ohm/km  |  |
| c)         | Reactance of cable at normal frequency                                      | ohm/km  |  |
| d)         | Electrostatic capacitance of cable at normal frequency                      | mF/km   |  |
| 7.6        | CONDUCTOR                                                                   |         |  |
| a)         | Material type & grade                                                       | -       |  |
| b)         | No & dia of wires in each core before stranding                             | no x mm |  |
| c)         | Shape                                                                       | -       |  |

|                |           |      |      |      |  |
|----------------|-----------|------|------|------|--|
| NAME OF VENDOR |           |      | SEAL | REV. |  |
|                |           |      |      |      |  |
| NAME           | SIGNATURE | DATE |      |      |  |

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

|                |           |      |      |      |  |
|----------------|-----------|------|------|------|--|
| NAME OF VENDOR |           |      | SEAL | REV. |  |
|                |           |      |      |      |  |
| NAME           | SIGNATURE | DATE |      |      |  |

|                                                                                   |                                                                                   |                                      |                  |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------|------------------|
|  | DOCUMENT TITLE<br><br><b>TECHNICAL SPECIFICATION FOR HT<br/>XLPE POWER CABLES</b> | SPECIFICATION NO. PE-TS-434-507-E001 |                  |
|                                                                                   |                                                                                   | VOLUME II                            |                  |
|                                                                                   |                                                                                   | SECTION I                            |                  |
|                                                                                   |                                                                                   | REVISION 00                          | DATE: 29.05.2019 |
|                                                                                   |                                                                                   | SHEET 4 OF 4                         |                  |

|      |                                                     |        |  |
|------|-----------------------------------------------------|--------|--|
| 7.13 | DIAMETERS                                           |        |  |
| a)   | Diameter of insulated conductor                     | mm.    |  |
| b)   | Cable diameter under armour                         | mm.    |  |
| c)   | Cable diameter over armour                          | mm.    |  |
| d)   | Overall diameter of cable                           | mm.    |  |
| 7.14 | Tolerance on overall diameter                       | (±) mm |  |
| 7.15 | Minimum bending radius                              | x O.D. |  |
| 7.16 | Safe pulling force                                  | kg.    |  |
| 7.17 | Weight of cable                                     | kg./km |  |
| a)   | Weight of conductor                                 | MT./km |  |
| b)   | Weight of XLPE insulation                           | MT./km |  |
| c)   | Weight of PVC (Inner Sheath & Fillers)              | kg./km |  |
| d)   | Maximum resistivity of GS formed wire               | kg./km |  |
| e)   | Weight of PVC/Polyethylene (Outer Sheath & Fillers) | kg./km |  |
| 7.18 | Dimension of drum                                   | mm.    |  |
| 7.19 | Shipping weight                                     | kg     |  |
| 7.20 | Cable marking on outer sheath                       | -      |  |

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

:

|                |           |      |      |      |  |
|----------------|-----------|------|------|------|--|
| NAME OF VENDOR |           |      | SEAL | REV. |  |
|                |           |      |      |      |  |
| NAME           | SIGNATURE | DATE |      |      |  |



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR  
HT XLPE POWER CABLES**

SPECIFICATION NO. PE-TS-434-507-E001

VOLUME II

SECTION II

REVISION 00

DATE: 29.05.2019

**SECTION – II**

**GENERAL TECHNICAL SPECIFICATION**



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR  
HT XLPE POWER CABLES**

SPECIFICATION NO. PE-TS-434-507-E001

VOLUME II

SECTION II

REVISION 00

DATE: 29.05.2019

SHEET 1 OF 1

**1.0 TECHNICAL REQUIREMENTS**

- 1.1 Technical requirements for HT XLPE POWER CABLES shall be as indicated in this section, in addition to those specified in Section I & Datasheet-A.

**2.0 CODES & STANDARDS**

- 2.1 The design, material, construction, manufacture, inspection, testing and performance of HT XLPE POWER CABLES shall conform to the latest revision of relevant standards and codes of practices mentioned in Data Sheet - A.
- 2.2 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

**3.0 QUALITY ASSURANCE REQUIREMENTS**

- 3.1 Bidder shall confirm compliance with the Standard Quality Plan as attached with the specification without any deviations. At contract stage, the successful bidder shall submit the same QP for BHEL/ ultimate customer's approval. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ultimate customer's approval. There shall be no commercial implication to BHEL on account of minor changes in QP during contract stage.
- 3.2 All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved Quality Plan.
- 3.3 Type testing requirements, routine / acceptance testing and special testing requirements shall be as per Annexure – A to QP. Charges for all these tests for all the equipment & 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 as specified in Datasheet-A.
- 4.2 In case of wooden drums, all wooden parts shall be manufactured from seasoned wood treated with copper naphthenates / zinc naphthenates (refer IS: 401). 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. Over the cables polyethylene sheet shall be wrapped and then sealed properly.
- 4.3 In case of Steel drums, New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. For Typical details of Steel drums, Annexure-B to Section-II, may be referred by the bidder. Bidder may modify, to choose appropriate dimensions of steel drums to suite various sizes/weight/ lengths of HT XLPE POWER CABLES. BIS certification mark shall be stamped on each cable drum.



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR HT  
XLPE POWER CABLES**

SPECIFICATION NO. PE-TS-434-507-E001

VOLUME II

SECTION II

REVISION 00

DATE: 29.05.2019

SHEET -

**QUALITY PLAN**

|                                                                                                                                                             |                        |                                                                                                             |       |               |                  |                                                                                                                           |   |                                                                                          |   |                    |   |               |    |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------|-------|---------------|------------------|---------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------|---|--------------------|---|---------------|----|--|
|  <b>Item:- HT POWER</b><br><b>FRLS CABLE</b><br><b>(3.3 KV TO 33 KV)</b> |                        | <b>STANDARD QUALITY PLAN</b><br>(CONFORMING TO CODE:IS 7098 Part-II<br>AND NTPC TECHNICAL<br>SPECIFICATION) |       |               |                  | QP. NO. 0000-999- QOE- S-<br>042 REV-00<br>DATE : 12-04-12<br>Page 1 of 12<br>VALID UP TO: 11-04-15<br>Reference Document |   | REVIEWED BY<br>INDERJIT SINGH Grewal<br>VIKRAM TALWAR<br>RAJEEV GARG<br>Acceptance Norms |   | Record Format<br>9 |   | REMARKS<br>11 |    |  |
| Sl. No                                                                                                                                                      | Component & Operations | Characteristics                                                                                             | Class | Type of check | Quantum of check |                                                                                                                           |   |                                                                                          |   |                    |   |               |    |  |
| 1                                                                                                                                                           | 2                      | 3                                                                                                           | 4     | 5             | M                | C/N                                                                                                                       | 6 |                                                                                          | 7 |                    | 8 |               | 10 |  |

**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 number.  
 2) Cable manufacturer to maintain all quality control records identified as per all QP stages enumerated below whether it is identified for NTPC verification or witness or not.  
 3) Sources of raw material shall be submitted at the time of submission of endorsement sheet for approval by NTPC.

| Raw material/ Brought out Items |                                            |                                                  |    |        |                           |                           |                               |                               |             |   |    |              |
|---------------------------------|--------------------------------------------|--------------------------------------------------|----|--------|---------------------------|---------------------------|-------------------------------|-------------------------------|-------------|---|----|--------------|
| 1.01                            | Aluminum rod for conductor                 | 1. Make                                          | MA | Verify | 100%                      | --                        | MANUFACTURER APPROVED SOURCES | MANUFACTURER APPROVED SOURCES | QCR         | V | -- | --           |
|                                 |                                            | 2. Grade                                         | MA | --do-- | --do--                    | --                        | NTPC ADS                      | NTPC ADS                      | --do--      | V | -- | --           |
|                                 |                                            | 3. Resistivity                                   | MA | Elect  | As per cable mfr std.     | --                        | IS 5082                       | IS 5082                       | --do--      | P | -- | --           |
| 1.02                            | Aluminum rod for Armouring (as applicable) | 1. Make                                          | MA | Verify | 100%                      | --                        | MANUFACTURER APPROVED SOURCES | MANUFACTURER APPROVED SOURCES | Q.C.R       | V | -- | --           |
|                                 |                                            | 2. Grade                                         | MA | Verify | As per mfr std.           | --                        | NTPC ADS                      | NTPC ADS                      | Manuf. TC   | V | -- | --           |
|                                 |                                            | 3. Resistivity                                   | MA | Verify | --do--                    | --                        | IS 5082                       | IS 5082                       | --do--      | P | -- | --           |
| 1.03                            | Copper rod (if applicable)                 | 1. Make                                          | MA | Verify | 100%                      | --                        | Manufacturer approved vnder   | Manufacturer approved vnder   | QCR         | V | -- | --           |
|                                 |                                            | 2. Resistivity                                   | MA | Verify | As per cable mfr std.     | --                        | IS 613                        | IS 613                        | --do--      | P | -- | --           |
| 1.04                            | XLPE compound for insulation               | 1. Make                                          | MA | Verify | --do--                    | 100%                      | MANUFACTURER APPROVED SOURCES | MANUFACTURER APPROVED SOURCES | --do--      | V | V  | V            |
|                                 |                                            | 2. Type/ Grade                                   | MA | Verify | 100%                      | 100%                      | NTPC ADS                      | NTPC ADS                      | --do--      | V | V  | V            |
|                                 |                                            | 3. Shelf life/ Storage condition                 | MA | Verify | 100%                      | 100%-                     | Compound manuf. Std           | Compound manuf. Std           | QCR         | V | V  | V            |
|                                 |                                            | 4. All acceptance test as per manufacturer norms | MA | Verify | As per manufacturer norms | As per manufacturer norms | NTPC ADS                      | NTPC ADS                      | Supplier TC | V | V  | V            |
|                                 |                                            |                                                  |    |        |                           |                           |                               |                               |             |   |    | Refer note 1 |

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|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------|-------|---------------|---------------------------------------------------------------------------------------------------------------------------|-----|--------------------|----------------------------------------------------------------------------------------------------|---------------|-----------------------------------------------|---|---|---------|
| Sl. No                                                                                                                                          | Component & Operations | Characteristics                                                                                                | Class | Type of check | Quantum of check                                                                                                          |     | Reference Document | Acceptance Norms                                                                                   | Record Format | M                                             | C | N | Remarks |
|                                                                                                                                                 |                        |                                                                                                                |       |               | M                                                                                                                         | C/N |                    |                                                                                                    |               |                                               |   |   |         |
| 1                                                                                                                                               | 2                      | 3                                                                                                              | 4     | 5             | 6                                                                                                                         |     | 7                  | 8                                                                                                  | 9             | 10                                            |   |   | 11      |

|      |                                                           |                                   |      |              |                           |      |                                |                                 |             |   |    |    |   |
|------|-----------------------------------------------------------|-----------------------------------|------|--------------|---------------------------|------|--------------------------------|---------------------------------|-------------|---|----|----|---|
| 1.05 | PVC Compound for Inner sheath                             | 1. Make                           | MA   | Verify       | As per manufacturer norms | --   | MANUFACTURER APPROVED SOURCES  | MANUFACTURER APPROVED SOURCES   | Supplier TC | V | V  | -- |   |
|      |                                                           | 2. Type/ Grade                    | MA   | Verify       | --do--                    | --   | NTPC ADS                       | NTPC ADS                        | --do--      | V | V  | -- |   |
| 1.06 | Semi Conducting Compound                                  | 1. Make                           | MA   | Verify       | 100%                      | 100% | NTPC Approved sources          | NTPC Approved sources           | --do--      | P | V  | V  |   |
|      |                                                           | 2. Resistivity                    | MA   | --do--       | 100%                      | 100% | NTPC ADS                       | NTPC ADS                        | --do--      | P | V  | V  |   |
|      |                                                           | 3. Shelf Life / Storage condition | MA   | Verify       | 100%                      | 100% | Compound manuf. recommendation | Compound manuf. recommendations | --do--      | P | V  | V  |   |
| 1.07 | Copper tape (Electrolytic High Conductivity Copper Foils) | 1. Make                           | MA   | Verify       | 100%                      | 100% | NTPC Approved sources          | NTPC Approved sources           | --do--      | ✓ | P  | V  | V |
|      |                                                           | 2. Dimension                      | MA   | Measu        | As per cable mmfr std.    | --   | NTPC ADS                       | NTPC ADS                        | --do--      | P | -- | -- |   |
|      |                                                           | 3. Resistivity                    | MA   | Verify       | 100%                      | ---- | IS 613                         | IS 613                          | Supplier TC | V | V  | V  |   |
|      |                                                           | 4. Chem. & Phy. properties        | MA   | Elec & Mech. | As per cable mmfr std.    | --   | As per cable mmfr std.         | As per cable mmfr std.          | --do--      | V | V  | -  |   |
| 1.08 | Polyester Tape (As applicable)                            | 1. Make                           | MA   | Verify       | 100%                      | 100% | Manufacturer approved vendor   | Manufacturer approved vendor    | --do--      | P | V  | V  |   |
|      |                                                           | 2. Dimension                      | Phy. | Meas         | As per cable mmfr std.    | --   | Manuf. Data sheet              | Manuf. Data sheet               | --do--      | P | -  | -  |   |
|      |                                                           | 3. T.S & Elongation               | Phy. | Phy.         | --do--                    | --   | --do--                         | --do--                          | --do--      | V | -- | -- |   |

|  <b>Item:- HT POWER<br/>FRLS CABLE<br/>(3.3 KV TO 33 KV)</b> |                        | <b>STANDARD QUALITY PLAN<br/>(CONFORMING TO CODE:IS 7098 Part-II<br/>AND NTPC TECHNICAL<br/>SPECIFICATION)</b> |       |               | <b>Q.P. NO. 0000-999- QOE-S-<br/>042 REV-00<br/>DATE : 12-04-12<br/>Page 3 of 12<br/>VALID UP TO: 11-04-15</b> |     | <b>REVIEWED BY</b><br>INDERJIT SINGH<br>VIKRAM TALWAR<br>RAJEEV GARG |                  | <b>APPROVED BY</b><br><br>A.K. Gang<br>Approved |        | <b>3</b> |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------|-------|---------------|----------------------------------------------------------------------------------------------------------------|-----|----------------------------------------------------------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------|--------|----------|--|
| Sl. No                                                                                                                                          | Component & Operations | Characteristics                                                                                                | Class | Type of check | Quantum of check                                                                                               |     | Reference Document                                                   | Acceptance Norms | Record Format                                                                                                                    | Agency | Remarks  |  |
| 1                                                                                                                                               | 2                      | 3                                                                                                              | 4     | 5             | M                                                                                                              | C/N | 7                                                                    | 8                | 9                                                                                                                                | 10     | 11       |  |

|          |                                                   |                                                        |    |        |                                           |                                 |                                           |                                                 |                 |   |    |                            |
|----------|---------------------------------------------------|--------------------------------------------------------|----|--------|-------------------------------------------|---------------------------------|-------------------------------------------|-------------------------------------------------|-----------------|---|----|----------------------------|
| 1.09     | Steel wire /<br>Formed<br>Wire (As<br>applicable) | 1. Make                                                | MA | Verify | As per<br>cable mnfr<br>std.              | 100%                            | MANUFACTURER APPROVED<br>SOURCES          | MANUFACTURER APPROVED<br>SOURCES                | QCR             | V | V  | BIS<br>licensees<br>only   |
|          |                                                   | 2. Dimension                                           | MA | Meas   | 1 sample<br>from each<br>size / lot       | --                              | NTPC APPROVED DATA<br>SHEET & IS 3975     | NTPC<br>APPROVED<br>DATA SHEET &<br>IS 3975     | QCR             | P | -- | --                         |
|          |                                                   | 3. All acceptance<br>tests as per IS 3975              | MA | Verify | As per IS<br>3975                         | --                              | IS 3975                                   | IS 3975                                         | Supplier<br>RTC | V | V  | --                         |
| 1.10     | PVC<br>compound<br>for Sheath                     | 1. Make                                                | MA | Verify | As per<br>manufacturer<br>norms           | 100%                            | MANUFACTURER APPROVED<br>SOURCES          | MANUFACTURER APPROVED<br>SOURCES                | QCR             | V | V  | V                          |
|          |                                                   | 2. Type / Grade                                        | MA | Verify | 100%                                      | 100%                            | NTPC ADS                                  | NTPC ADS                                        | QCR             | V | V  | V                          |
|          |                                                   | 3. All acceptance test<br>as per manufacturer<br>norms | MA | Verify | As per<br>manufacturer<br>norms           | As per<br>manufacturer<br>norms | Compound Mnfr standard                    | IS 5831                                         | QCR             | V | V  | Refer note<br>1            |
|          |                                                   | 4. Thermal Stability                                   | MA | Chem   | One sample /<br>Batch                     | --                              | IS 5831                                   | IS 5831                                         | QCR             | P | -- | --                         |
|          |                                                   | 5. Oxygen Index                                        | MA | Chem   | --do--                                    | --                              | NTPC ADS/ IS 10810 Part 58                | NTPC ADS                                        | --do--          | P | -- | --                         |
| 1.11     | Filler<br>Material (As<br>applicable)             | 1. Type                                                | MA | Verify | As per<br>manuf. Std.                     | ---                             | NTPC ADS                                  | NTPC ADS                                        | QCR             | P | -- | --                         |
| 1.12     | Wooden<br>Drum                                    | 1. Dimension                                           | MI | Meas   | Manuf. Std.                               | --                              | IS 10418                                  | IS10418                                         | --do--          | P | -- | --                         |
|          |                                                   | 2. Anti termite<br>treatment                           | MI | Chem   | Cable manuf.<br>std                       | --                              | CABLE MANUF. STD.                         | CABLE<br>MANUF. STD.                            | COC             | V | V  | COC from<br>drum<br>manuf. |
| 1.13     | Steel Drum                                        | 1. Dimension                                           | MI | Meas   | --do--                                    | --                              | --do--                                    | --do--                                          | QCR             | P | -- | --                         |
|          |                                                   | 2. Surface finish                                      | MI | Meas   | --do--                                    | --                              | --do--                                    | --do--                                          | --do--          | P | -- | --                         |
| <b>B</b> | <b>Process &amp; Stage Inspection</b>             |                                                        |    |        |                                           |                                 |                                           |                                                 |                 |   |    |                            |
| 2.01     | Wire<br>Drawing                                   | 1. Surface finish                                      | MA | Visual | One<br>sample/Settin<br>g of each<br>size | --                              | SHOULD BE SMOOTH & FREE<br>FROM SCRATCHES | SHOULD BE<br>SMOOTH &<br>FREE FROM<br>SCRATCHES | QCR             | P | -- | --                         |
|          |                                                   | 2. Wire Diameter                                       | MA | Meas   | --do--                                    | --                              | NTPC ADS                                  | NTPC ADS                                        | --do--          | P | -- | --                         |

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|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------|-------|---------------|---------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------------------------------------|---------------|--------------------------------------|----|---------|
| Sl. No                                                                                                                                          | Component & Operations | Characteristics                                                                                             | Class | Type of check | Quantum of check                                                                                                          | Reference Document | Acceptance Norms                                              | Record Format | D*                                   | M  | Remarks |
| 1                                                                                                                                               | 2                      | 3                                                                                                           | 4     | 5             | 6                                                                                                                         | 7                  | 8                                                             | 9             |                                      | 10 | 11      |

|      |                                                                               |                                                                    |    |        |                                   |                                   |                                                                                                                                                                                                                                                                                                                     |                                                                        |        |   |    |    |                                                  |
|------|-------------------------------------------------------------------------------|--------------------------------------------------------------------|----|--------|-----------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|--------|---|----|----|--------------------------------------------------|
|      |                                                                               | 3. Tensile test                                                    | CR | Mech   | One sample/Setting of each size   | One sample / Setting of each size | IS 8130                                                                                                                                                                                                                                                                                                             | IS 8130                                                                | QCR    | P | V  | V  | Refer Sl. No.3.03(iii)                           |
|      |                                                                               | 4. Wrapping test                                                   | CR | Mech   | --do--                            | --do--                            | --do--                                                                                                                                                                                                                                                                                                              | --do--                                                                 | --do-- | P | V  | V  | --do--                                           |
|      |                                                                               | 5. Annealing Test                                                  | CR | Mech   | --do--                            | --do--                            | --do--                                                                                                                                                                                                                                                                                                              | --do--                                                                 | --do-- | P | V  | V  | --do--                                           |
| 2.02 | Bunching / stranding                                                          | 1. No. of wires                                                    | MA | Meas   | --do--                            | --do--                            | NTPC ADS                                                                                                                                                                                                                                                                                                            | NTPC ADS                                                               | --do-- | P | -- | -- |                                                  |
|      |                                                                               | 2. Dia of wire                                                     | MA | Meas   | --do--                            | --do--                            | --do--                                                                                                                                                                                                                                                                                                              | --do--                                                                 | --do-- | P | -- | -- |                                                  |
|      |                                                                               | 3. Dimension of Conductor                                          | MA | Meas   | --do--                            | --do--                            | --do--                                                                                                                                                                                                                                                                                                              | --do--                                                                 | --do-- | P | -- | -- |                                                  |
|      |                                                                               | 4. Direction of lay                                                | MA | Visual | --do--                            | --do--                            | --do--                                                                                                                                                                                                                                                                                                              | --do--                                                                 | --do-- | P | -- | -- |                                                  |
|      |                                                                               | 5. Records of strand breakage / welding during conductor stranding | MA | Verify | --do--                            | --do--                            | IS 8130                                                                                                                                                                                                                                                                                                             | IS 8130                                                                | --do-- | P | -- | -- |                                                  |
|      |                                                                               | 6. Surface finish                                                  | MA | Visual | --do--                            | --do--                            | --do--                                                                                                                                                                                                                                                                                                              | --do--                                                                 | --do-- | P | -- | -- |                                                  |
|      |                                                                               | 7. DC Resistance                                                   | CR | Meas   | --do--                            | --do--                            | IS 8130/NTPC ADS                                                                                                                                                                                                                                                                                                    | IS 8130/NTPC ADS                                                       | --do-- | P | -- | -- |                                                  |
| 2.03 | Insulation extrusion (Conductor screen, XLPE Insulation & Insulation screen ) | 1. Surface finish                                                  | MA | Visual | One sample / Setting of each size | One sample / Setting of each size | Extrusion should be by triple extrusion technique<br>Method of curing for cables shall be "dry curing / gas curing/ steam curing" up to 11KV & " dry curing/ gas curing " for 19/33 KV<br>Insulation extrusion area should be preferably clean & dust free.<br>Extrusion Should be smooth. No porosity is permitted | QCR-                                                                   |        | P | -- | -- |                                                  |
|      |                                                                               | 2. Thickness                                                       | CR | Meas   | --do--                            | --do--                            | NTPC ADS                                                                                                                                                                                                                                                                                                            | NTPC ADS                                                               | QCR    | P | -- | -- |                                                  |
|      |                                                                               | 3. Eccentricity & Ovality                                          | CR | Meas   | --do--                            | --do--                            | Eccentricity of core shall not exceed 10% and Ovality not to exceed 2%                                                                                                                                                                                                                                              | Eccentricity of core shall not exceed 10% and Ovality not to exceed 2% | --do-- | P | -- | -- |                                                  |
|      |                                                                               | 3. Hot Set                                                         | CR | Mech   | One sample/Setting of each size   | One sample/Setting of each size   | IS 7098- Part II                                                                                                                                                                                                                                                                                                    | IS 7098- Part II                                                       | --do-- | P | -- | -- | Sample is to be taken from both top & bottom end |

LEGEND:- \*RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERIFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

FORMAT NO:QS-01-QA1-P-10/F3-R1

|                                                                                                                                                 |                        |                                                                                                                |       |               |                                                                                                                           |                    |                                                               |               |                                      |    |   |   |         |
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|  <b>Item:- HT POWER<br/>FRLS CABLE<br/>(3.3 KV TO 33 KV)</b> |                        | <b>STANDARD QUALITY PLAN<br/>(CONFORMING TO CODE:IS 7098 Part-II<br/>AND NTPC TECHNICAL<br/>SPECIFICATION)</b> |       |               | QP. NO. 0000-999- QOE- S-<br>042 REV-00<br>DATE : 12-04-12<br>Page 5 of 12<br>VALID UP TO: 11-04-15<br>Reference Document |                    | REVIEWED BY<br>INDERJIT SINGH<br>VIKRAM TALWAR<br>RAJEEV GARG |               | APPROVED BY<br>A.K. Garg<br>Approved |    | 5 |   |         |
| Sl. No                                                                                                                                          | Component & Operations | Characteristics                                                                                                | Class | Type of check | Quantum of check                                                                                                          | Reference Document | Acceptance Norms                                              | Record Format | D*                                   | M  | C | N | Remarks |
| 1                                                                                                                                               | 2                      | 3                                                                                                              | 4     | 5             | 6                                                                                                                         | 7                  | 8                                                             | 9             |                                      | 10 |   |   | 11      |

|      |                            |                                   |    |        |                                  |    |                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |        |   |    |    |  |
|------|----------------------------|-----------------------------------|----|--------|----------------------------------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------|---|----|----|--|
| 2.04 | Copper Taping              | 1. Thickness                      | CR | Mech   | One sample/Settin g of each size | -- | NTPC ADS                                                                                                                                                                                                                                                                                                                                                                                                                               | NTPC ADS         | QCR    | P | -- | -- |  |
|      |                            | 2. No. of tape                    | CR | Meas   | --do--                           | -- | --do--                                                                                                                                                                                                                                                                                                                                                                                                                                 | --do--           | --do-- | P | -- | -- |  |
|      |                            | 3. Tape application overlap       | CR | Meas   | --do--                           | -- | --do--                                                                                                                                                                                                                                                                                                                                                                                                                                 | --do--           | --do-- | P | -- | -- |  |
|      |                            | 4. Core identification tape       | CR | Visual | --do--                           | -- | --do--                                                                                                                                                                                                                                                                                                                                                                                                                                 | --do--           | --do-- | P | -- | -- |  |
| 2.05 | Laying up                  | 1. Core sequence                  | MA | Visual | --do--                           | -- | IS 7098- Part II                                                                                                                                                                                                                                                                                                                                                                                                                       | IS 7098- Part II | --do-- | P | -- | -- |  |
|      |                            | 2. Direction of lay               | MA | Visual | --do--                           | -- | --do--                                                                                                                                                                                                                                                                                                                                                                                                                                 | --do--           | --do-- | P | -- | -- |  |
|      |                            | 3. Lay Length                     | MA | Meas   | --do--                           | -- | Manuf. Std                                                                                                                                                                                                                                                                                                                                                                                                                             | Manuf. Std       | --do-- | P | -- | -- |  |
|      |                            | 4. Dia over laid up core          | MA | Meas   | --do--                           | -- | NTPC ADS                                                                                                                                                                                                                                                                                                                                                                                                                               | NTPC ADS         | --do-- | P | -- | -- |  |
| 2.06 | Inner Sheath               | 1 Colour                          | MA | Visual | --do--                           | -- | --do--                                                                                                                                                                                                                                                                                                                                                                                                                                 | --do--           | --do-- | P | -- | -- |  |
|      |                            | 2.Thickness                       | MA | Meas   | One sample/Settin g of each size | -- | NTPC ADS                                                                                                                                                                                                                                                                                                                                                                                                                               | NTPC ADS         | --do-- | P | -- | -- |  |
| 2.07 | Armouring ( As Applicable) | 3 Dia over inner sheath           | MI | Meas   | --do--                           | -- | --do--                                                                                                                                                                                                                                                                                                                                                                                                                                 | --do--           | --do-- | P | -- | -- |  |
|      |                            | 1.Dimension                       | MA | Meas   | --do--                           | -- | --do--                                                                                                                                                                                                                                                                                                                                                                                                                                 | --do--           | --do-- | P | -- | -- |  |
|      |                            | 2.No. of wires / strip            | MA | Meas.  | --do--                           | -- | --do--                                                                                                                                                                                                                                                                                                                                                                                                                                 | --do--           | --do-- | P | -- | -- |  |
|      |                            | 3. Direction of lay               | MA | Visual | --do--                           | -- | IS 7098- Part II                                                                                                                                                                                                                                                                                                                                                                                                                       | IS 7098- Part II | QCR    | P | -- | -- |  |
|      |                            | 4.Coverage & Quality of armouring | MA | Meas.  | 100%                             | -- | Min area of coverage of armouring shall be 90%. The gap between amour wires / formed wires shall not exceed one amour wire/ formed wire space & there shall be no cross over/ over riding of amour wire / formed wire. Zn rich paint shall be applied on amour joint surface of G.S. Wire /formed wire. The breaking load of amour wire joint shall not be less than 95% of that amour wire / formed wire. (As per NTPC specification) | QCR              | QCR    | P | -- | -- |  |
| 2.08 | Outer Sheath               | 5 Dia over armouring              | MA | Meas.  | One sample/Settin g of each size | -- | NTPC ADS                                                                                                                                                                                                                                                                                                                                                                                                                               | NTPC ADS         | --do-- | P | -- | -- |  |
|      |                            | 1. Surface finish                 | MA | Visual | 100%                             | -- | Pimple, Fish Eye, Burnt particles, Blow Hole not permitted. Repairing on outer sheath not permitted. (As per NTPC specification)                                                                                                                                                                                                                                                                                                       | --do--           | --do-- | P | -- | -- |  |

|                                                                                                                                                 |                                                                                                             |                        |                 |       |                                                                                                                             |                  |   |  |                                                               |               |                  |    |                                                 |   |   |         |   |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------------------------|-----------------|-------|-----------------------------------------------------------------------------------------------------------------------------|------------------|---|--|---------------------------------------------------------------|---------------|------------------|----|-------------------------------------------------|---|---|---------|---|
|  <b>Item:- HT POWER<br/>FRLS CABLE<br/>(3.3 KV TO 33 KV)</b> | <b>STANDARD QUALITY PLAN</b><br>(CONFORMING TO CODE:IS 7098 Part-II<br>AND NTPC TECHNICAL<br>SPECIFICATION) |                        |                 |       | <b>QP. NO. 0000-999- QOE-S-042 REV-00</b><br>DATE : 12-04-12<br>Page 6 of 12<br>VALID UP TO: 11-04-15<br>Reference Document |                  |   |  | REVIEWED BY<br>INDERJIT SINGH<br>VIKRAM TALWAR<br>RAJEEV GARG |               |                  |    | APPROVED BY<br>APR 2012<br>APR 2012<br>APR 2012 |   |   |         | 6 |
|                                                                                                                                                 | Sl. No                                                                                                      | Component & Operations | Characteristics | Class | Type of check                                                                                                               | Quantum of check | M |  | C/N                                                           | Record Format | Acceptance Norms | D* | M                                               | C | N | Remarks |   |
| 1                                                                                                                                               | 2                                                                                                           | 3                      | 4               | 5     | 6                                                                                                                           |                  |   |  |                                                               | 7             | 8                | 9  |                                                 |   |   | 11      |   |

| extruder by suction method. |    |        |                                 |    |  |          |                                                                                                                                                                                                                                  |          |          |        |   |    |    |  |  |  |
|-----------------------------|----|--------|---------------------------------|----|--|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|--------|---|----|----|--|--|--|
|                             |    |        |                                 |    |  | NTPC ADS |                                                                                                                                                                                                                                  | NTPC ADS |          | QCR    |   |    |    |  |  |  |
| 2.Colour of sheath          | MA | Visual | One sample/Setting of each size | -- |  |          |                                                                                                                                                                                                                                  |          |          |        | P | -- | -- |  |  |  |
| 3. Dia over outer sheath    | MA | Meas   | --do--                          | -- |  |          | NTPC ADS                                                                                                                                                                                                                         |          | NTPC ADS | --do-- | P | -- | -- |  |  |  |
| 4.Thickness of outer sheath | CR | Meas   | --do--                          | -  |  |          | --do--                                                                                                                                                                                                                           |          | --do--   | --do-- | P | -- | -- |  |  |  |
| 5. Embossing quality        | MA | Visual | 100%                            | -  |  |          | Following shall be embossed or printed on outer sheath at every 5 meter length of cable; (1).Batch number or Drum number (2) IS 7098-II (3) Cable size (4) Voltage grade (5) word "FRLS" (marking shall be legible & indelible). |          |          |        |   |    |    |  |  |  |
| 6. Sequential marking       | MA | Visual | Full length                     | -- |  |          |                                                                                                                                                                                                                                  |          |          | --do-- | P | -- | -- |  |  |  |

| Type Test clearance from NTPC Engineering to be verified at the time of final inspection. |                                |                                         |       |               |                                                                     |        |        |                             |                             |    |   |   |   |                                       |
|-------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------|-------|---------------|---------------------------------------------------------------------|--------|--------|-----------------------------|-----------------------------|----|---|---|---|---------------------------------------|
| Sl. No                                                                                    | Component & Operations         | Characteristics                         | Class | Type of check | Quantum of check                                                    | M      | C/N    | Record Format               | Acceptance Norms            | D* | M | C | N | Remarks                               |
|                                                                                           |                                |                                         |       |               |                                                                     |        |        |                             |                             |    |   |   |   |                                       |
| 3.01                                                                                      | Routine Tests                  | 1.High Voltage test at room temperature | CR    | Elect         | 100%                                                                | 100%   | 100%   | NTPC ADS / IS 7098- Part II | NTPC ADS                    | ✓  | P | W | W | Refer note 2                          |
| 3.02                                                                                      |                                | 2.Conductor Resistance                  | CR    | Elect         | 100%                                                                | 100%   | 100%   | NTPC ADS / IS 7098- Part II | NTPC ADS                    | ✓  | P | W | W | Refer note 2                          |
|                                                                                           |                                | 3. Partial Discharge Test               | CR    | Elect.        | 100%                                                                | 100%   | 100%   | NTPC ADS / IS 7098- Part II | NTPC ADS                    | ✓  | P | W | W | For Screened cable only/ Refer note 2 |
| 3.03                                                                                      | Acceptance Tests               | 1. OD of Cable                          | MA    | Meas.         | Each type & size of cables as per sampling plan of IS 7098- Part II | --do-- | --do-- | NTPC ADS                    | NTPC ADS                    | ✓  | P | W | W |                                       |
| 3.03 (i)                                                                                  | Construction of finished Cable | 2. Laying of core                       | CR    | Visual        | --do--                                                              | --do-- | --do-- | NTPC ADS / IS 7098- Part II | NTPC ADS / IS 7098- Part II | ✓  | P | W | W |                                       |
|                                                                                           |                                | 3. Core Identification                  | CR    | Visual        | --do--                                                              | --do-- | --do-- | --do--                      | --do--                      | ✓  | P | W | W |                                       |

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| Sl. No                                                                                                                                          | Component & Operations | Characteristics                                                                                                | Class | Type of check                                                                                                                        | Quantity of check |                                                                      | Acceptance Norms | Record Format                                                                                                     | D* | Agency   | Remarks |
| 1                                                                                                                                               | 2                      | 3                                                                                                              | 4     | 5                                                                                                                                    | M                 | C/N                                                                  | 8                | 9                                                                                                                 |    | 10       | 11      |

|               |                                |                                                               |    |        |                                                                     |                           |                            |                  |   |   |   |   |                                                                                                 |
|---------------|--------------------------------|---------------------------------------------------------------|----|--------|---------------------------------------------------------------------|---------------------------|----------------------------|------------------|---|---|---|---|-------------------------------------------------------------------------------------------------|
| 3.03<br>(ii)  | Armour wires/<br>Formed wires. | 4. Colour of outer sheath                                     | MA | Visual | Each type & size of cables as per sampling plan of IS 7098- Part II | NTPC ADS                  | NTPC ADS                   | QCR              | ✓ | P | W | W |                                                                                                 |
|               |                                | 5. Inner sheath thickness                                     | CR | Meas   | - do -                                                              | -do--                     | -do--                      | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 6. Inner sheath colour                                        | MA | Visual | - do -                                                              | - do -                    | - do -                     | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 7. Copper tape / Wire dimension with overlap (As applicable ) | CR | Phy    | --do--                                                              | NTPC ADS/ Min overlap 20% | NTPC ADS/ Min. overlap 20% | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 1. Dimensions                                                 | CR | Meas   | Each type & size of cables as per sampling plan of IS 7098- Part II | NTPC ADS/ IS7098-II       | NTPC ADS                   | Test Certificate | ✓ | P | W | W | Test as applicable for Galvanized wires/ strips / Al wires                                      |
|               |                                | 2. No. of wires/ formed wire                                  | CR | Mech   | -- do --                                                            | --do--                    | --do--                     | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 3. Tensile test                                               | CR | Mech   | --do--                                                              | IS 3975                   | IS 3975                    | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 4. Elongation test                                            | CR | Mech   | --do--                                                              | --do--                    | --do--                     | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 5. Torsion test ( for round wires only)                       | CR | Mech   | --do--                                                              | --do--                    | --do--                     | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 6. Wrapping test                                              | CR | Mech   | --do--                                                              | --do--                    | --do--                     | --do--           | ✓ | P | W | W |                                                                                                 |
| 3.03<br>(iii) | Conductor                      | 7. Resistance test                                            | CR | Mech   | --do--                                                              | --do--                    | --do--                     | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 8. Mass of Zinc coating                                       | CR | Meas   | --do--                                                              | --do--                    | --do--                     | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 9. Uniformity of Zinc Coating                                 | CR | Chem.  | --do--                                                              | --do--                    | --do--                     | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 10. Adhesion test                                             | CR | Mech   | --do--                                                              | --do--                    | --do--                     | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 11. Freedom from defects                                      | CR | Visual | --do--                                                              | --do--                    | --do--                     | --do--           | ✓ | P | W | W |                                                                                                 |
|               |                                | 1. Resistance Test                                            | CR | Elect  | --do--                                                              | --do--                    | --do--                     | --do--           | ✓ | P | W | W | Test report of manufacturer to be reviewed as per SI. No. 2.01 for Tensile test & wrapping test |
|               |                                | 2. Tensile test                                               | CR | Mech   | Each type & size of cables as per sampling plan of IS 7098-Part-II  | IS 8130                   | IS 8130                    | Test Certificate | ✓ | P | W | W |                                                                                                 |
|               |                                |                                                               |    |        |                                                                     |                           |                            |                  |   |   |   |   |                                                                                                 |
|               |                                |                                                               |    |        |                                                                     |                           |                            |                  |   |   |   |   |                                                                                                 |
|               |                                |                                                               |    |        |                                                                     |                           |                            |                  |   |   |   |   |                                                                                                 |

|  |                        | <b>Item:- HT POWER<br/>FRLS CABLE<br/>(3.3 KV TO 33 KV)</b> |       | <b>STANDARD QUALITY PLAN<br/>(CONFORMING TO CODE:IS 7098 Part-II<br/>AND NTPC TECHNICAL<br/>SPECIFICATION)</b> |                  |     | <b>QP. NO. 0000-999- QOE- S-<br/>042 REV-00<br/>DATE : 12-04-12<br/>Page 8 of 12<br/>VALID UP TO: 11-04-15</b><br>Reference Document |                  | <b>REVIEWED BY</b><br>INDERJIT SINGH<br>VIKRAM TALWAR<br>RAJEEV GARG |        | <b>APPROVED BY</b><br>Approved by<br>D.A.K. Garg |   | 8       |    |
|-------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------|------------------|-----|--------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------------------------------------------------------|--------|--------------------------------------------------|---|---------|----|
| Sl. No                                                                              | Component & Operations | Characteristics                                             | Class | Type of check                                                                                                  | Quantum of check |     | Reference Document                                                                                                                   | Acceptance Norms | Record Format                                                        | Agency |                                                  |   | Remarks |    |
| 1                                                                                   | 2                      | 3                                                           | 4     | 5                                                                                                              | M                | C/N | 7                                                                                                                                    | 8                | 9                                                                    | D*     | M                                                | C | N       | 11 |

|           |                              |                                                                                        |    |        |                                                                    |  |                            |                 |                  |   |   |   |   |   |   |                         |
|-----------|------------------------------|----------------------------------------------------------------------------------------|----|--------|--------------------------------------------------------------------|--|----------------------------|-----------------|------------------|---|---|---|---|---|---|-------------------------|
|           |                              | 3. Wrapping test                                                                       | CR | Mech   | --do--                                                             |  | --do--                     | --do--          | --do--           | ✓ | ✓ | P | P | W | W | --do--                  |
| 3.03 (iv) | XLPE Insulation & PVC Sheath | 1. Thickness of insulation & sheath                                                    | CR | Meas.  | --do--                                                             |  | NTPC ADS & IS 7098-Part II | NTPC ADS        | --do--           | ✓ | ✓ | P | P | W | W |                         |
|           |                              | 2. Tensile strength & elongation at break of insulation & outer sheath (before ageing) | CR | Mech   | --do--                                                             |  | IS 7098-Part II            | IS 7098-Part II |                  | ✓ |   | P | W | W | W | Refer Note 3 Also       |
|           |                              | 3. Tensile strength & elongation at break of insulation & outer sheath (after Ageing ) | CR | Mech   | Refer Note 3                                                       |  | IS 7098-Part II            | IS 7098-Part II | Test Certificate | ✓ |   | P | W | W | W | Refer Note 3            |
|           |                              | 4. Insulation resistance (Volume resistivity method)                                   | CR | Elect  | Each type & size of cables as per sampling plan of IS 7098-Part II |  | --do--                     | --do--          | --do--           | ✓ |   | P | W | W | W |                         |
|           |                              | 5. Partial Discharge test                                                              | CR | Elect. | --do--                                                             |  | --do--                     | --do--          | --do--           | ✓ |   | P | W | W | W | For Screened cable only |
|           |                              | 6. High voltage test at room temperature                                               | CR | Elect  | Each type & size of cables as per sampling plan of IS 7098-Part II |  | --do--                     | --do--          | --do--           | ✓ |   | P | W | W | W |                         |
|           |                              | 7. Thermal stability on outer sheath                                                   | CR | Chem   | One sample of each offered lot of all offered sizes                |  | --do--                     | --do--          | --do--           | ✓ |   | P | W | W | W |                         |

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|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------|-------|---------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------|
| Sl. No                                                                                                                                          | Component & Operations | Characteristics                                                                                                | Class | Type of check | Quantum of check                                                                                                                      | Reference Document | Acceptance Norms                                                     | Record Format                                                                                                          | Remarks |
| 1                                                                                                                                               | 2                      | 3                                                                                                              | 4     | 5             | 6                                                                                                                                     | 7                  | 8                                                                    | 9                                                                                                                      | 10      |

|  |  |                                                                                       |    |               |                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |        |   |   |   |                                                                                                           |                          |
|--|--|---------------------------------------------------------------------------------------|----|---------------|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------|---|---|---|-----------------------------------------------------------------------------------------------------------|--------------------------|
|  |  | 8. Hot Set Test for inculation                                                        | CR | Mech          | Each type & size of cables as per sampling plan of IS 7098-Part II | IS 7098-Part II                                                                                                                                                                                                                                                                                                                                                                                                                                     | IS 7098-Part II  | QCR    | ✓ | P | W | W                                                                                                         | For XLPE insulation only |
|  |  | 9 Smoke density test on outer sheath                                                  | CR | Chem          | One sample of each offered lot of all offered sizes                | NTPC ADS & ASTM D2843                                                                                                                                                                                                                                                                                                                                                                                                                               | NTPC ADS         | --do-- | ✓ | P | W | W                                                                                                         |                          |
|  |  | 10. Acid gas generation test on outer sheath                                          | CR | Chem          | --do--                                                             | NTPC ADS & IEC 60754-1                                                                                                                                                                                                                                                                                                                                                                                                                              | NTPC ADS         | --do-- | ✓ | P | W | W                                                                                                         |                          |
|  |  | 11. Oxygen Index                                                                      | CR | Chem          | --do--                                                             | NTPC ADS/ IS 10810 Part 58                                                                                                                                                                                                                                                                                                                                                                                                                          | --do--           | --do-- | ✓ | P | W | W                                                                                                         |                          |
|  |  | 12 Flammability test on completed cable                                               | CR | Chem          | One sample irrespective of size per voltage grade                  | NTPC ADS & IEC 60332 Part-3 (Category-B)                                                                                                                                                                                                                                                                                                                                                                                                            | --do--           | --do-- | ✓ | P | W | W                                                                                                         |                          |
|  |  | 13 Surface finish & length measurement.                                               | CR | Visual & Meas | One length of each size                                            | A) Following shall be embossed or printed on outer sheath at every 5 meter length of cable:<br>(1).Batch number or Drum number (2) IS 7098-II (3) Cable size (4) Voltage grade (5) word "FRLS" (marking shall be legible & indelible).<br>B) Sequential marking of length of cable in meters at every one meter is to be embossed or printed. Embossing or printing shall be progressive, automatic, in line & marking shall be legible & indelible | Test Certificate | ✓      | P | W | W | Pimple, Fish Eye, Burnt particles, Blow Hole etc. not permitted. Repairing on outer sheath not permitted. |                          |
|  |  | 14. Sequence of cores armour coverage, gap between two consecutive armour/formed wire | CR | Visual & Meas | One length of each size                                            | Min. area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire/ formed wire space & there shall be no cross over/ over riding of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire /formed wire                                                                                                                                         | --do--           | --do-- | ✓ | P | W | W                                                                                                         |                          |
|  |  | 15. Measurement of Eccentricity & Ovality                                             | CR | Meas.         | --do--                                                             | Eccentricity of core shall not exceed 10% and Ovality not to exceed 2%                                                                                                                                                                                                                                                                                                                                                                              | --do--           | --do-- | ✓ | P | W | W                                                                                                         |                          |

|                                                                                                                                                 |                        |                                                                                                                |       |                                                                                                                  |                           |                                                                      |                  |                                               |          |         |
|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------------------------------------------------------|------------------|-----------------------------------------------|----------|---------|
|  <b>Item:- HT POWER<br/>FRLS CABLE<br/>(3.3 KV TO 33 KV)</b> |                        | <b>STANDARD QUALITY PLAN<br/>(CONFORMING TO CODE:IS 7098 Part-II<br/>AND NTPC TECHNICAL<br/>SPECIFICATION)</b> |       | <b>Q.P. NO. 0000-999- QOE- S-<br/>042 REV-00<br/>DATE : 12-04-12<br/>Page 10 of 12<br/>VALID UP TO: 11-04-15</b> |                           | <b>REVIEWED BY</b><br>INDERJIT SINGH<br>VIKRAM TALWAR<br>RAJEEV GARG |                  | <b>APPROVED BY</b><br>Dt. ....<br>Approved By |          | 10      |
| Sl. No                                                                                                                                          | Component & Operations | Characteristics                                                                                                | Class | Type of check                                                                                                    | Quantum of check<br>M C/N | Reference Document                                                   | Acceptance Norms | Record Format                                 | D* M C N | Remarks |
| 1                                                                                                                                               | 2                      | 3                                                                                                              | 4     | 5                                                                                                                | 6                         | 7                                                                    | 8                | 9                                             | 10       | 11      |

|      |                |              |    |        |      |      |                                                                                                                                                                                                                                          |     |   |   |    |    |
|------|----------------|--------------|----|--------|------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---|---|----|----|
| 4    | Packing        | 1. Sealing   | MA | Visual | 100% | 100% | (1) IS 7098-Part II (2) The surface of the drum and the outer most cable layer shall be covered with water proof cover; (3) Both the ends of cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by "U" nails. | QCR | ✓ | P | -- | -- |
| 4.01 | Identification | NTPC Sealing | MA | Visual | 100% | 100% | Sealing shall be visible                                                                                                                                                                                                                 | QCR | ✓ | P | V  | V  |

**Notes:**

- 1) If the compound manufacturer is carrying out Ageing test , test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer will carry out ageing test & the test report will be reviewed by NTPC ( quantum of ageing test sample shall be one sample /batch )
- 2) (a) **In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre/ Regional Offices :-** Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection. NTPC will also witness routine tests on cables on 10% sample basis on 1.9 KV/ 3.3 KV and 3.3KV/ 3.3 KV cables , other HT cables will be witnessed on 100% basis.  
 2(b) **In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre/ Regional Offices, :-** Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection. NTPC will also witness routine tests on cables for the first order on 100% basis.
- 3) **Refer table on page 11& 12 of 12 for Sampling & Acceptance criteria.**

LEGEND:- \*RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

-M: MANUFACTURER/SUPPLIER, C: MAIN SUPPLIER, N: NTPC, P: PERFORM W: WITNESS, V: VERIFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"  
 FORMAT NO: QS-01-QAI-P-10/F3-RI

|                                                                                     |                        |                                                     |       |                                                                                                       |                  |                                                                                                                        |   |                                                               |               |                                                                                                                       |         |    |  |
|-------------------------------------------------------------------------------------|------------------------|-----------------------------------------------------|-------|-------------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------|---|---------------------------------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------|---------|----|--|
|  |                        | <b>Item:- HT POWER FRLS CABLE (3.3 KV TO 33 KV)</b> |       | <b>STANDARD QUALITY PLAN</b><br>(CONFORMING TO CODE:IS 7098 Part-II AND NTPC TECHNICAL SPECIFICATION) |                  | QP. NO. 0000-999- QOE- S-042 REV-00<br>DATE : 12-04-12<br>Page 11 of 12<br>VALID UP TO: 11-04-15<br>Reference Document |   | REVIEWED BY<br>INDERJIT SINGH<br>VIKRAM TALWAR<br>RAJEEV GARG |               | APPROVED BY<br><br>Approved<br>Dt... |         | 11 |  |
| Sl. No                                                                              | Component & Operations | Characteristics                                     | Class | Type of check                                                                                         | Quantum of check | Reference Document                                                                                                     |   | Acceptance Norms                                              | Record Format | D*                                                                                                                    | Remarks |    |  |
| 1                                                                                   | 2                      | 3                                                   | 4     | 5                                                                                                     | 6                | 7                                                                                                                      | 8 | 9                                                             | 10            | 11                                                                                                                    |         |    |  |

**LEGEND:** NTPC ADS: NTPC approved data sheet, QCR: quality control records of cable manufacturer, CABLE MANUF STD- cable manufacturer's internal plant standard, MI: minor, MA: major, CR: critical, COC- certificate of conformance

| Sampling & Acceptance Criteria                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                     |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Manufacturer experience prerequisite                                                                                | Condition                                            | Testing procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Remarks                                                                                                                                                  |
| Samples as per relevant IS from every size/ type of cable in the offered lot shall be tested for Tensile Strength & Elongation (before ageing). The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation ( before ageing ) should be within +/- 1.5% tolerance (final values should be more than the minimum values indicated in relevant standard) of the Type Test report | In case of Manufacturers/ Supplier who have supplied cables in the past through Corporate Centre / Regional offices | In case of sizes/ type which meet the criteria       | 1 Sample per size/ type out of sizes which have met the criteria, will be put on accelerated ageing test (refer IRS specification no. IRS: S-63/2007 Rev 3.0). The samples shall be aged in air oven at temperature of 130°C +/- 2°C for 5 hours. 1 Sample of XLPE insulation per type of cables offered which have met the criteria, will be put on ageing test as per IS 7098 –II . After wards the samples shall be tested for Tensile Strength & Elongation. Acceptance norms shall be as per relevant IS. <b>This test shall be witnessed by NTPC.</b> | In case the samples do not meet the requirement in accelerated ageing test <b>then 1 sample of that size/ type will be put on ageing test as per IS.</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                     | In case of size /type which do not meet the criteria | Particular size/ type will be put on ageing test as per IS. <b>This test shall be witnessed by NTPC.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ----                                                                                                                                                     |

|                                                                                     |                        |                                                             |       |                                                                                                                |                       |     |                                                                                                                            |   |                                                               |    |                                                                                                                                           |  |    |
|-------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------|-----------------------|-----|----------------------------------------------------------------------------------------------------------------------------|---|---------------------------------------------------------------|----|-------------------------------------------------------------------------------------------------------------------------------------------|--|----|
|  |                        | <b>Item:- HT POWER<br/>FRLS CABLE<br/>(3.3 KV TO 33 KV)</b> |       | <b>STANDARD QUALITY PLAN<br/>(CONFORMING TO CODE:IS 7098 Part-II<br/>AND NTPC TECHNICAL<br/>SPECIFICATION)</b> |                       |     | QP. NO. 0000-999- QOE- S-<br>042 REV-00<br>DATE : 12-04-12<br>Page 12 of 12<br>VALID UP TO: 11-04-15<br>Reference Document |   | REVIEWED BY<br>Inderjit Singh<br>Vikram Talwar<br>Rajeev Garg |    | APPROVED BY<br><br>A.K. Garg<br>Approved<br>Dt. 12/04/12 |  | 12 |
| Sl. No                                                                              | Component & Operations | Characteristics                                             | Class | Type of check                                                                                                  | Quantum of check<br>M | C/N | 7                                                                                                                          | 8 | 9                                                             | 10 | 11                                                                                                                                        |  |    |
| 1                                                                                   | 2                      | 3                                                           | 4     | 5                                                                                                              | 6                     |     |                                                                                                                            |   |                                                               |    |                                                                                                                                           |  |    |

|  |  |                                                                                                                         |                                                     |                                                                                                                                                  |     |
|--|--|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----|
|  |  | In case of Manufacturers/ Supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre / Regional offices | In case of size /type which meet the criteria       | 1 Sample per sizes/ type out of all sizes which have met the criteria, will be put on aging test and <b>witnessed by NTPC as per relevant IS</b> | --- |
|  |  |                                                                                                                         | In case of size/type which do not meet the criteria | Particular size / type will be put on ageing test as per IS. <b>This test shall be witnessed by NTPC</b>                                         | --- |

|                                                                                                                                                                                                                             |                     |                                 |             |                             |                 |                                 |                               |                       |        |                                    |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------|-------------|-----------------------------|-----------------|---------------------------------|-------------------------------|-----------------------|--------|------------------------------------|--|
| STANDARD QUALITY PLAN                                                                                                                                                                                                       |                     | CUSTOMER                        |             | PROJECT TITLE:              |                 | 3 X 800 MW PATRATU STPS PROJECT |                               | SPECIFICATI ON NUMBER |        | PE-TS-434-507-E001                 |  |
|                                                                                                                                                                                                                             |                     | BIDDER/ VENDOR:                 |             | QUALITY PLAN                |                 | NUMBER: PE-QP-999-507-E001, R0  |                               | SPECIFICATI ON TITLE: |        | POWER CABLES                       |  |
|                                                                                                                                                                                                                             |                     | SYSTEM                          |             | ITEM : HT XLPE Power Cables |                 |                                 |                               | SECTION               |        | VOLUME III                         |  |
| SL NO.                                                                                                                                                                                                                      | COMPONENT/OPERATION | CHARACTERISTIC 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                                 |  |
| 4.0                                                                                                                                                                                                                         | Final Inspection    | 1. Type Tests<br>(Refer Note-A) | CR          | Physical & Electrical Tests | Sample #        | -do-                            | -do-                          | -do-                  | 2 1 -  | # Refer Annexure-A to QAP enclosed |  |
| NOTES:-<br>(A) FOR LIST OF TYPE TESTS, REFER ANNEXURE-A TO QAP ENCLOSED.<br>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 |                       |        |                                    |  |

|                                                                                  |                   |                        |                                              |                                                           |
|----------------------------------------------------------------------------------|-------------------|------------------------|----------------------------------------------|-----------------------------------------------------------|
|  | ANNEXURE-A TO QAP | CUSTOMER: NTPC LIMITED | PROJECT TITLE: 3X800MW PATRATU STPS PROJECT  | SPECIFICATION NUMBER: PE-TS-434-507-E001                  |
|                                                                                  |                   | BIDDER/VENDOR:         | QUALITY PLAN NUMBER : 0000-999-QOE-S-042, R0 | SPECIFICATION TITLE: TECH. SPEC. FOR HT XLPE POWER CABLES |
|                                                                                  |                   | SYSTEM                 | ITEM: HT XLPE POWER CABLES                   | DOC. NO.                                                  |

## TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS

### A. Type Test Conduction:

- Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.
- Sampling:
  - Type test to be conducted on 1 drum for every 10 drums or less of each type and size of cable/ lot.
  - Electrical tests to be conducted on one drum of every size & voltage grade of cables.
  - FRLS test & Flammability Test to be conducted on every size & voltage grade of cables. Sampling quantity as per appendix –D of IS 7098-2, D2.2.

### B. Acceptance Test Conduction:

- Tests for which "A" is indicated in the 'Test Conduction Required As' column below shall be conducted as Acceptance tests.
- Sampling:
  - Acceptance tests shall be as per 1 drum for every 10 drums or less of each type and size of cable/ lot.
  - FRLS test & Flammability Test to be conducted on every size & voltage grade of cables. Sampling quantity as per appendix –D of IS 7098-2, D2.2.

### C. Routine Test Conduction:

- Tests for which "R" is indicated in the 'Test Conduction Required As' column below shall be conducted as Routine tests.
- Sampling: Routine tests shall be conducted on 100% cable drums.

| S. No. | TEST                | APPLICABLE FOR                                                                              | TEST CONDUCTION REQUIRED AS | REFERENCE STANDARD | REMARKS                                                                    |
|--------|---------------------|---------------------------------------------------------------------------------------------|-----------------------------|--------------------|----------------------------------------------------------------------------|
| 1.0    | Tests for Conductor |                                                                                             |                             |                    |                                                                            |
| I.     | Annealing test      | For copper conductor only                                                                   | T, A                        | IS 10810 Pt 1      | <u>Internal in process Test Report to be furnished for acceptance test</u> |
| II.    | Tensile test        | For aluminium conductor only<br>(Not applicable for compacted circular or shaped conductor) | T, A                        | IS 10810 Pt 2      |                                                                            |
| III.   | Wrapping test       | For aluminium conductor only<br>(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      |                                                                            |
|        |                     |                                                                                             |                             |                    |                                                                            |

|      |             |                |                                 |
|------|-------------|----------------|---------------------------------|
| BHEL | PARTICULARS | BIDDER/ VENDOR |                                 |
|      | NAME        |                |                                 |
|      | SIGNATURE   |                |                                 |
|      | DATE        |                | BIDDER'S / VENDORS COMPANY SEAL |

|                                                                                  |                   |                        |                                              |                                                           |
|----------------------------------------------------------------------------------|-------------------|------------------------|----------------------------------------------|-----------------------------------------------------------|
|  | ANNEXURE-A TO QAP | CUSTOMER: NTPC LIMITED | PROJECT TITLE: 3X800MW PATRATU STPS PROJECT  | SPECIFICATION NUMBER: PE-TS-434-507-E001                  |
|                                                                                  |                   | BIDDER/VENDOR:         | QUALITY PLAN NUMBER : 0000-999-QOE-S-042, R0 | SPECIFICATION TITLE: TECH. SPEC. FOR HT XLPE POWER CABLES |
|                                                                                  |                   | SYSTEM                 | ITEM: HT XLPE POWER CABLES                   | DOC. NO.                                                  |

| S. No.     | TEST                                                       | APPLICABLE FOR                                                                                | TEST CONDUCTION REQUIRED AS | REFERENCE STANDARD | REMARKS |
|------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-----------------------------|--------------------|---------|
| <b>2.0</b> | <b>Tests for Armour Wires/Strips</b>                       |                                                                                               |                             |                    |         |
| 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 test                                               | For GS strip only                                                                             | T, A                        | IS 10810 Pt 39     |         |
| VI.        | Resistivity test                                           | Applicable for Aluminium wire & GS wire                                                       | T, A                        | IS 10810 Pt 42     |         |
| VII.       | Uniformity of Zinc coating test                            | For G. S. wires/Strip only                                                                    | T, A                        | IS 10810 Pt 40     |         |
| VIII.      | Mass of Zinc coating test                                  | For G. S. wires/Strip only                                                                    | T, A                        | IS 10810 Pt 41     |         |
| IX.        | Wrapping Test                                              | For Aluminium wires only                                                                      | T, A                        | IS 10810 Pt 3      |         |
| <b>3.0</b> | <b>Physical Tests for XLPE Insulation &amp; PVC sheath</b> |                                                                                               |                             |                    |         |
| I.         | Test for thickness & Eccentricity                          | Applicable for XLPE insulation, HRPVC inner sheath & <i>For HRPVC inner/outer sheath only</i> | T, A                        | IS 10810 Pt 6      |         |
| II.        | Tensile strength and elongation test at break              | Applicable for XLPE insulation & <i>For HRPVC inner/outer sheath only</i>                     |                             |                    |         |
| (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 & <i>For HRPVC inner/outer sheath only</i>                     | T                           | IS 10810 Pt 11     |         |
| IV.        | Loss of mass in air oven test                              | <i>For HRPVC inner/outer sheath only</i>                                                      | T                           | IS 10810 Pt 10     |         |
| V.         | Hot deformation test                                       | <i>For HRPVC inner/outer sheath only</i>                                                      | T                           | IS 10810 Pt 15     |         |
| VI.        | Heat shock test                                            | <i>For HRPVC inner/outer sheath only</i>                                                      | T                           | IS 10810 Pt 14     |         |
| VII.       | Shrinkage test                                             | For XLPE insulation & <i>For HRPVC inner/outer sheath only</i>                                | T                           | IS 10810 Pt 12     |         |
| VIII.      | Thermal stability test                                     | <i>For HRPVC inner/outer sheath only</i>                                                      | T                           | IS 10810 Pt 60     |         |
| IX.        | Hot set test                                               | For XLPE insulation only                                                                      | T, A                        | IS 10810 Pt 30     |         |
| X.         | Water absorption (gravimetric) test                        | For XLPE insulation only                                                                      | T                           | IS 10810 Pt 33     |         |
| XI.        | Degree of cross-linking                                    | For XLPE insulation only                                                                      | T                           | IS 7098-II         |         |

|      |             |                |                                 |
|------|-------------|----------------|---------------------------------|
| BHEL | PARTICULARS | BIDDER/ VENDOR |                                 |
|      | NAME        |                |                                 |
|      | SIGNATURE   |                |                                 |
|      | DATE        |                | BIDDER'S / VENDORS COMPANY SEAL |

|                                                                                  |                   |                        |                                              |                                                           |
|----------------------------------------------------------------------------------|-------------------|------------------------|----------------------------------------------|-----------------------------------------------------------|
|  | ANNEXURE-A TO QAP | CUSTOMER: NTPC LIMITED | PROJECT TITLE: 3X800MW PATRATU STPS PROJECT  | SPECIFICATION NUMBER: PE-TS-434-507-E001                  |
|                                                                                  |                   | BIDDER/VENDOR:         | QUALITY PLAN NUMBER : 0000-999-QOE-S-042, R0 | SPECIFICATION TITLE: TECH. SPEC. FOR HT XLPE POWER CABLES |
|                                                                                  |                   | SYSTEM                 | ITEM: HT XLPE POWER CABLES                   | DOC. NO.                                                  |

| S. No.     | TEST                                                                                        | APPLICABLE FOR                                   | TEST CONDUCTION REQUIRED AS | REFERENCE STANDARD           | REMARKS                                       |
|------------|---------------------------------------------------------------------------------------------|--------------------------------------------------|-----------------------------|------------------------------|-----------------------------------------------|
| <b>4.0</b> | <b><u>Tests On Extruded Semi-conducting Screen</u></b>                                      |                                                  |                             |                              |                                               |
| I.         | Test for Strippability                                                                      | Applicable for Semi-conducting Strippable screen | T                           | IS 7098-II                   | <u>Not applicable since it is bonded type</u> |
| II.        | Volume Resistivity                                                                          | Applicable for Semi-conducting Strippable screen | T                           | IS 7098-II                   |                                               |
| III.       | Test for cross linking                                                                      |                                                  | A                           | IS 7098-II                   |                                               |
|            |                                                                                             |                                                  |                             |                              |                                               |
| <b>5.0</b> | <b><u>Improved Fire performance (FR-LSH) Tests</u></b>                                      |                                                  |                             |                              |                                               |
| I.         | Oxygen index test                                                                           | <i>For inner/outer sheath only</i>               | T, A                        | IS 10810 Pt 58 / ASTM D 2863 | <i>Sample shall be as per IS 7098, Part 2</i> |
| II.        | Smoke density test                                                                          | <i>For inner/outer sheath only</i>               | T, A                        | ASTM D 2843                  |                                               |
| III.       | Acid gas generation test                                                                    | <i>For inner/outer sheath only</i>               | T, A                        | IS 10810 Pt 59 / IEC-754-1   |                                               |
| IV.        | Temperature Index Test                                                                      | <i>For inner/outer sheath only</i>               | T, A                        | IS 10810 Pt 64 / ASTM D 2863 |                                               |
| <b>6.0</b> | <b><u>Flammability Tests</u></b>                                                            |                                                  |                             |                              |                                               |
| I.         | Flammability test for bunched cables                                                        | For complete cable                               | T, A                        | IEC-60332 (Part-3)           |                                               |
| II.        | Flammability test for single cable                                                          | For complete cable                               | T, A                        | IEC:60332 Part-1             |                                               |
| III.       | Swedish chimney test                                                                        | For complete cable                               | A                           | SEN SS 424 1475 (Class F3)   |                                               |
| IV.        | Flammability test                                                                           | For complete cable                               | A                           | IEEE: 60383                  |                                               |
|            |                                                                                             |                                                  |                             |                              |                                               |
| <b>7.0</b> | <b><u>Electrical Tests</u></b>                                                              |                                                  |                             |                              |                                               |
| I.         | High Voltage Test                                                                           | For complete cable                               | T, A, R                     | IS 10810 Pt 45               |                                               |
| II.        | Insulation Resistance Test (Volume resistivity method)                                      | For complete cable                               | T, A                        | IS 10810 Pt 43               |                                               |
| III.       | Partial discharge test (shall be carried out on full drum length)                           |                                                  | T, A, R                     | IS 10810 Pt 46               |                                               |
| IV.        | Bending Test followed by Partial Discharge test                                             |                                                  | T                           | IS 10810 Pt 50               |                                               |
| V.         | Dielectric Power Factor Test (i) As a function of voltage (ii) As a function of temperature |                                                  | T                           | IS 10810 Pt 48               |                                               |
| VI.        | Heat Cycle Test                                                                             |                                                  | T                           | IS 10810 Pt 49               |                                               |
| VII.       | Impulse Withstand Test                                                                      |                                                  | T                           | IS 10810 Pt 47               |                                               |
| VIII.      | Thermal ageing test                                                                         | For complete cable                               | T                           | IS 7098-II                   |                                               |
| IX.        | <i>Flammability Test</i>                                                                    | <i>For HRPVC sheathed cable</i>                  | T                           | <i>IS 10810 Pt 53</i>        |                                               |

|      |             |                |                                 |
|------|-------------|----------------|---------------------------------|
| BHEL | PARTICULARS | BIDDER/ VENDOR |                                 |
|      | NAME        |                |                                 |
|      | SIGNATURE   |                |                                 |
|      | DATE        |                | BIDDER'S / VENDORS COMPANY SEAL |

| CLAUSE NO. | <div data-bbox="634 128 1024 159">TECHNICAL REQUIREMENTS</div> <div data-bbox="1284 113 1425 184">एनटीपीसी<br/>NTPC</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------|------------------------|---------|----|----------------------------------------------------|--|----|---------------------------|--|----|--------------|--|----|-----------------|--|----|--------------|----------------------|----|---------------|--|----|-----------------|--|------|-----------------------------------------|---------------------------------|------|---------------------------------------------------|--------------------------------|----|--------------------|--|-----|---------------------------------------------------------------------|--|-----|--------------------|--|-----|-------------------|----------------------------|
|            | <table> <tr> <th data-bbox="397 825 462 852">S. No</th><th data-bbox="521 825 651 884">Type Test<br/>Conductor</th><th data-bbox="976 825 1084 852">Remarks</th></tr> <tr> <td data-bbox="397 898 418 926">1.</td><td data-bbox="521 898 898 989">Resistance test<br/>For Armour Wires / Formed Wires</td><td></td></tr> <tr> <td data-bbox="397 1014 418 1041">2.</td><td data-bbox="521 1014 841 1041">Measurement of Dimensions</td><td></td></tr> <tr> <td data-bbox="397 1073 418 1100">3.</td><td data-bbox="521 1073 662 1100">Tensile Test</td><td></td></tr> <tr> <td data-bbox="397 1131 418 1159">4.</td><td data-bbox="521 1131 699 1159">Elongation test</td><td></td></tr> <tr> <td data-bbox="397 1190 418 1218">5.</td><td data-bbox="521 1190 656 1218">Torsion test</td><td data-bbox="976 1190 1203 1218">For round wires only</td></tr> <tr> <td data-bbox="397 1249 418 1276">6.</td><td data-bbox="521 1249 686 1276">Wrapping test</td><td></td></tr> <tr> <td data-bbox="397 1308 418 1335">7.</td><td data-bbox="521 1308 703 1335">Resistance test</td><td></td></tr> <tr> <td data-bbox="397 1367 446 1394">8(a)</td><td data-bbox="521 1367 951 1425">Mass &amp; uniformity of Zinc Coating tests</td><td data-bbox="976 1367 1333 1394">For GS wires/formed wires only.</td></tr> <tr> <td data-bbox="397 1457 446 1484">8(b)</td><td data-bbox="521 1457 911 1547">Adhesion test<br/>For XLPE insulation &amp; PVC Sheath</td><td data-bbox="976 1457 1333 1484">For GS wires/formed wires only</td></tr> <tr> <td data-bbox="397 1579 418 1606">9.</td><td data-bbox="521 1579 719 1606">Test for thickness</td><td></td></tr> <tr> <td data-bbox="397 1638 435 1665">10.</td><td data-bbox="521 1638 951 1696">Tensile strength and elongation test before ageing and after ageing</td><td></td></tr> <tr> <td data-bbox="397 1728 435 1755">11.</td><td data-bbox="521 1728 724 1755">Ageing in air oven</td><td></td></tr> <tr> <td data-bbox="397 1787 435 1814">12.</td><td data-bbox="521 1787 719 1814">Loss of mass test</td><td data-bbox="976 1787 1279 1814">For PVC outer sheath only.</td></tr> </table> |                                 | S. No | Type Test<br>Conductor | Remarks | 1. | Resistance test<br>For Armour Wires / Formed Wires |  | 2. | Measurement of Dimensions |  | 3. | Tensile Test |  | 4. | Elongation test |  | 5. | Torsion test | For round wires only | 6. | Wrapping test |  | 7. | Resistance test |  | 8(a) | Mass & uniformity of Zinc Coating tests | For GS wires/formed wires only. | 8(b) | Adhesion test<br>For XLPE insulation & PVC Sheath | For GS wires/formed wires only | 9. | Test for thickness |  | 10. | Tensile strength and elongation test before ageing and after ageing |  | 11. | Ageing in air oven |  | 12. | Loss of mass test | For PVC outer sheath only. |
| S. No      | Type Test<br>Conductor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Remarks                         |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 1.         | Resistance test<br>For Armour Wires / Formed Wires                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 2.         | Measurement of Dimensions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 3.         | Tensile Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 4.         | Elongation test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 5.         | Torsion test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | For round wires only            |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 6.         | Wrapping test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 7.         | Resistance test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 8(a)       | Mass & uniformity of Zinc Coating tests                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | For GS wires/formed wires only. |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 8(b)       | Adhesion test<br>For XLPE insulation & PVC Sheath                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | For GS wires/formed wires only  |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 9.         | Test for thickness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 10.        | Tensile strength and elongation test before ageing and after ageing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 11.        | Ageing in air oven                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
| 12.        | Loss of mass test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | For PVC outer sheath only.      |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |
|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                 |       |                        |         |    |                                                    |  |    |                           |  |    |              |  |    |                 |  |    |              |                      |    |               |  |    |                 |  |      |                                         |                                 |      |                                                   |                                |    |                    |  |     |                                                                     |  |     |                    |  |     |                   |                            |

| CLAUSE NO.                                                                                                                                   | TECHNICAL REQUIREMENTS                                                                          |                                                        |                            |  |
|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------|
| 5.02.00                                                                                                                                      | S. No                                                                                           | Type Test                                              | Remarks                    |                                                                                     |
|                                                                                                                                              | 13.                                                                                             | Hot deformation test                                   | For PVC outer sheath only. |                                                                                     |
|                                                                                                                                              | 14.                                                                                             | Heat shock test                                        | For PVC outer sheath only  |                                                                                     |
|                                                                                                                                              | 15.                                                                                             | Shrinkage test                                         |                            |                                                                                     |
|                                                                                                                                              | 16.                                                                                             | Thermal stability test                                 | For PVC outer sheath only  |                                                                                     |
|                                                                                                                                              | 17.                                                                                             | Hot set test                                           | For XLPE insulation only   |                                                                                     |
|                                                                                                                                              | 18.                                                                                             | Water absorption test                                  | For XLPE insulation only   |                                                                                     |
|                                                                                                                                              | 19.                                                                                             | Oxygen index test                                      | For PVC outer sheath only  |                                                                                     |
|                                                                                                                                              | 20.                                                                                             | Smoke density test                                     | For PVC outer sheath only  |                                                                                     |
|                                                                                                                                              | 21.                                                                                             | Acid gas generation test                               | For PVC outer sheath only  |                                                                                     |
|                                                                                                                                              | 22                                                                                              | Flammability test as per IEC-332                       | For completed cable only   |                                                                                     |
|                                                                                                                                              | Part-3 (Category -B)                                                                            |                                                        |                            |                                                                                     |
|                                                                                                                                              | The following type tests shall be carried out on each type (voltage grade) & size of the cable: |                                                        |                            |                                                                                     |
|                                                                                                                                              | S. No.                                                                                          | Type Test For all cables                               |                            |                                                                                     |
|                                                                                                                                              | 1.                                                                                              | Insulation resistance test (Volume Resistivity method) |                            |                                                                                     |
|                                                                                                                                              | 2.                                                                                              | High voltage test                                      |                            |                                                                                     |
|                                                                                                                                              | For cables of 19/33kV, 11/11KV & 6.6/6.6KV Grade only.                                          |                                                        |                            |                                                                                     |
|                                                                                                                                              | 3.                                                                                              | Partial discharge test                                 |                            |                                                                                     |
|                                                                                                                                              | 4.                                                                                              | Bending test                                           |                            |                                                                                     |
|                                                                                                                                              | 5.                                                                                              | Dielectric power factor test                           |                            |                                                                                     |
|                                                                                                                                              |                                                                                                 | a) As a function of voltage                            |                            |                                                                                     |
|                                                                                                                                              |                                                                                                 | b) As a function of temperature                        |                            |                                                                                     |
| 6.                                                                                                                                           | Heating cycle test                                                                              |                                                        |                            |                                                                                     |
| 7.                                                                                                                                           | Impulse withstand test                                                                          |                                                        |                            |                                                                                     |
| Indicative list of tests/ checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of H.T. Cables enclosed. |                                                                                                 |                                                        |                            |                                                                                     |



## QUALITY ASSURANCE

CLAUSE NO.

## MV (3.3 kV / 6.6. kV / 11 kV / 33 kV) Cables

| Attributes /<br>Characteristics<br><br>Item / Components /<br>Sub System Assembly  |                                              |                          |                       |                      |                           |                       |                                                       |                                                            |                                                                       |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
|------------------------------------------------------------------------------------|----------------------------------------------|--------------------------|-----------------------|----------------------|---------------------------|-----------------------|-------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------|-----------------------------------------------|-----------------------------------------|----------------------------------------------------|-----------------------------------------------------------------|-----------|
|                                                                                    | Make, Type & T.C as<br>per relevant standard | Dimension/surface finish | Mechanical properties | Chemical Composition | Spark Test(as applicable) | Electrical properties | Hot Set Test/ Eccentricity &<br>Lay length & Sequence | Armour coverage, cross over,<br>looseness, gap between two | Sequential marking/ Batch<br>marking/ surface finish/ cable<br>length | T.S & elongation before & after<br>ageing on outer sheath &<br>insulation | Thermal stability on outer | Metallic ( Cu ) Screening<br>( If applicable) | Anti termite coating on wooden<br>drums | Constructional requirements<br>feature as per NTPC | Routine & Acceptance Test as<br>per<br>relevant standard & NTPC | FRLS Test |
| Aluminum (IS-8130)                                                                 | Y                                            | Y                        | Y                     | Y                    | Y                         | Y                     |                                                       |                                                            |                                                                       |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
| Semiconducting Compound                                                            | Y                                            |                          | Y                     |                      | Y                         |                       |                                                       |                                                            |                                                                       |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
| XLPE Compound<br>(IS-7098 Part-II)                                                 | Y                                            |                          | Y                     |                      | Y                         |                       |                                                       |                                                            |                                                                       | Y                                                                         | Y                          |                                               |                                         |                                                    |                                                                 |           |
| FRLS PVC Compound<br>(IS-5831, ASTM-D2843, IS10810( Part 58)<br>,IEC-60754 Part-1) | Y                                            |                          | Y                     |                      |                           |                       |                                                       |                                                            |                                                                       | Y                                                                         |                            |                                               |                                         |                                                    |                                                                 | Y         |
| Triple Extrusion & curing /Manufacturing of<br>Core                                |                                              | Y                        | Y                     |                      | Y                         | Y                     | Y                                                     |                                                            |                                                                       |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
| Copper Tape                                                                        | Y                                            | Y                        | Y                     |                      | Y                         |                       |                                                       |                                                            |                                                                       |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
| Polyster tape                                                                      | Y                                            | Y                        |                       |                      |                           |                       |                                                       |                                                            |                                                                       |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
| Core Laying                                                                        |                                              | Y                        |                       |                      |                           |                       | Y                                                     |                                                            |                                                                       |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
| Armour wire/strip                                                                  | Y                                            | Y                        | Y                     |                      |                           |                       |                                                       |                                                            |                                                                       |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
| Copper tapping                                                                     | Y                                            | Y                        |                       |                      |                           |                       |                                                       |                                                            |                                                                       |                                                                           |                            | Y                                             |                                         |                                                    |                                                                 |           |
| Inner sheath                                                                       | Y                                            | Y                        |                       |                      |                           |                       |                                                       |                                                            |                                                                       |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
| Armouring                                                                          |                                              | Y                        |                       |                      |                           |                       |                                                       | Y                                                          |                                                                       |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
| Outer Sheathing                                                                    |                                              | Y                        |                       |                      |                           |                       |                                                       |                                                            | Y                                                                     |                                                                           |                            |                                               |                                         |                                                    |                                                                 |           |
| <b>Power Cable (Finished)</b>                                                      |                                              |                          |                       |                      |                           |                       |                                                       | Y                                                          | Y                                                                     |                                                                           | Y                          |                                               |                                         | Y                                                  | Y                                                               | Y         |
| Wooden drum(IS-10418) /Steel Drum                                                  |                                              | Y                        |                       |                      |                           |                       |                                                       |                                                            |                                                                       |                                                                           |                            |                                               | Y                                       | Y                                                  |                                                                 |           |

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought out items will be subject to NTPC approval.

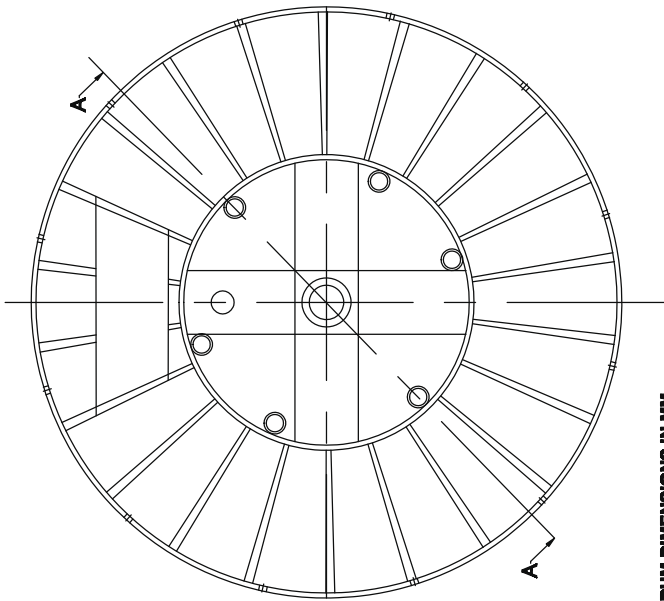
| Clause No.                                                                                                       | <div> <div>QUALITY ASSURANCE</div> <div>  </div> </div> |
|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ROUTINE TESTS</b>                                                                                             | Following routine tests shall be carried out on each drum of finished cables for all types & sizes.                                      |
| 1)                                                                                                               | Conductor Resistance test                                                                                                                |
| 2)                                                                                                               | High voltage test                                                                                                                        |
| 3)                                                                                                               | Partial discharge test (for Screened cables only)                                                                                        |
| <b>ACCEPTANCE TESTS</b>                                                                                          | Following Acceptance tests shall be carried out on each size of each type (voltage rating) of cables, in the offered lot.                |
| <b>A) For Conductor (as per sampling plan mentioned in IS: 7098 Part II)</b>                                     |                                                                                                                                          |
|                                                                                                                  | 1) Annealing test (Copper)                                                                                                               |
|                                                                                                                  | 2) Tensile Test ( Aluminum)                                                                                                              |
|                                                                                                                  | 3) Wrapping Test ( Aluminum)                                                                                                             |
|                                                                                                                  | 4) Resistance test                                                                                                                       |
| <b>B) For copper tape / Wires (as per sampling plan mentioned in IS: 7098 Part II)</b>                           |                                                                                                                                          |
|                                                                                                                  | 1) Measurement of Dimensions                                                                                                             |
|                                                                                                                  | 2) Conductivity check                                                                                                                    |
| <b>B) For Armour Wires / Formed Wires ( If applicable ) (as per sampling plan mentioned in IS: 7098 Part II)</b> |                                                                                                                                          |
|                                                                                                                  | 1. Measurement of Dimensions                                                                                                             |
|                                                                                                                  | 2. Tensile Tests                                                                                                                         |
|                                                                                                                  | 3. Elongation Test                                                                                                                       |
|                                                                                                                  | 4. Torsion Test For Round wires only                                                                                                     |
|                                                                                                                  | 5. Wrapping Test                                                                                                                         |
|                                                                                                                  | 6. Resistance Test                                                                                                                       |
|                                                                                                                  | 7. Mass of Zinc coating test For G S wires / Formed wires only                                                                           |
|                                                                                                                  | 8. Uniformity of Zinc coating For G S wires / Formed wires only                                                                          |
|                                                                                                                  | 9. Adhesion test For G S wires / Formed wires only                                                                                       |
|                                                                                                                  | 10. Freedom from surface defects                                                                                                         |
| <b>c) For XLPE insulation &amp; PVC Sheath (as per sampling plan mentioned in IS: 7098 Part II)</b>              |                                                                                                                                          |
|                                                                                                                  | 1) Test for thickness                                                                                                                    |
|                                                                                                                  | 2) Tensile strength & Elongation before ageing (for tests after ageing see "D")                                                          |
|                                                                                                                  | 3) Hot set test (For XLPE insulation)                                                                                                    |

| QUALITY ASSURANCE                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| CLAUSE NO.                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                   |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
| D) Ageing test:                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                   |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|                                                                                                           | Criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Condition                                                                         | Test Requirements                                                                                                                                                                                                                                                                 | Remarks                                                                                                                                                            |  |
| PVC outer sheath :                                                                                        | Samples as per relevant IS, from each size of each type (voltage rating) of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). <b>Tensile &amp; elongation testing shall preferably be done with a computerized machine.</b><br>The values will be compared with corresponding values mentioned in the Type Test report accepted by NTPC. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard). | All sizes which meet the criteria                                                 | For PVC: The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°C+/- 2°C for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS. | In case the size does not meet the requirement in accelerated ageing test <b>then all sizes (which had met the criteria) will be put on ageing test as per IS.</b> |  |
| XLPE Insulation                                                                                           | Samples as per relevant IS, from each size of each type (voltage rating) of cables in the offered lot, will be put on ageing test as per IS.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Sizes which do not meet the criteria                                              | Every size will be put on ageing test as per IS.                                                                                                                                                                                                                                  | ----                                                                                                                                                               |  |
| E) Following tests will be carried out on completed cables as per IS on each size of each type            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                   |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|                                                                                                           | 1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Insulation resistance test ( Volume resistivity method )                          |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|                                                                                                           | 2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | High voltage test                                                                 |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|                                                                                                           | 3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Partial discharge test ( for Screened cables only )                               |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
| F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                   |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|                                                                                                           | 1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Thermal stability test on outer sheath                                            |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|                                                                                                           | 2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Oxygen index test on outer sheath                                                 |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|                                                                                                           | 3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Smoke density rating test on outer sheath                                         |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|                                                                                                           | 4)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Acid gas generation test on outer sheath                                          |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|                                                                                                           | 5)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable     |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |
|                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                   |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                    |  |

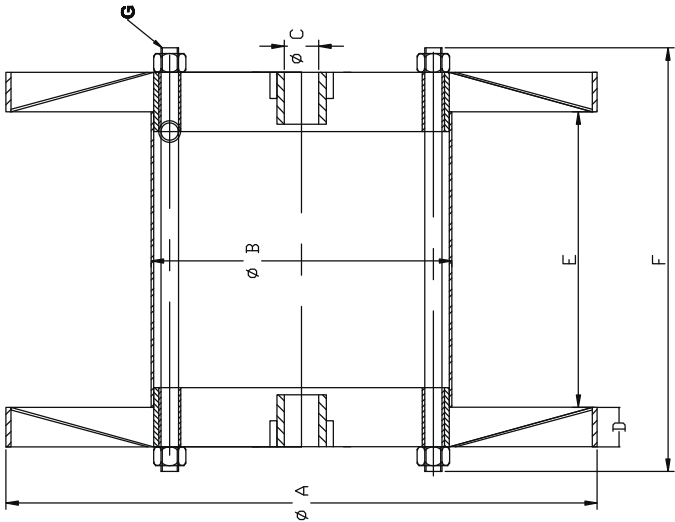
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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---------------------------------------|--|
| <div> <div>CLAUSE NO.</div> <div>QUALITY ASSURANCE</div> <div>  </div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                       |    |                                       |  |
| <div> <div>G) Following tests shall be carried on one length of each size of each type of offered lot:</div> <table> <tr> <td data-bbox="272 1312 354 1417">1)</td><td data-bbox="272 210 354 1312">Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, marking of drum no. / Batch number of outer sheath extrusion</td></tr> <tr> <td data-bbox="354 1312 393 1417">2)</td><td data-bbox="354 210 393 1312">Measurement of Eccentricity &amp; Ovality</td></tr> </table> </div> | 1)                                                                                                                                                                                                                                                    | Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, marking of drum no. / Batch number of outer sheath extrusion | 2) | Measurement of Eccentricity & Ovality |  |
| 1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, marking of drum no. / Batch number of outer sheath extrusion |                                                                                                                                                                                                                                                       |    |                                       |  |
| 2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Measurement of Eccentricity & Ovality                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                       |    |                                       |  |

STEEL DRUM DRAWING (TYPICAL)

ANNEXURE-C TO SECTION-II



APPROXIMATE DRUM DIMENSIONS IN MM  
ALL DIMENSIONS AND VALUES ARE  
TYPICAL AND ARE DEPENDENT ON  
CABLE WEIGHT.



|   |              |        |
|---|--------------|--------|
| A | FLANGE       | 2200   |
| B | BARREL       | 1200   |
| C | CENTRAL HOLE | 100    |
| D | FLANGE       | 50     |
| E | TRAVERSE     | 1400   |
| F | GROSS WIDTH  | 1600   |
| G | STUD SIZE    | 16 MM. |

- Dwg. not to scale.
- ALL DIMENSIONS ARE IN MM.