

**2 x 800 MW UPPUR TPS**  
**TAMIL NADU GENERATION & DISTRIBUTION**  
**CORPORATION LIMITED**

**TECHNICAL SPECIFICATION FOR**  
**EPR INSULATED FIRE SURVIVAL CABLES**

**VOLUME-II**

**SPECIFICATION NO: PE-TS-425-507-E006**

**REVISION: 00**



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



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**SECTION – I**

**SPECIFIC TECHNICAL REQUIREMENTS**



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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 Annexure-A [BOQ-Com-Price schedule] of the specification shall not be considered (i.e., technical description & quantities as per specification shall prevail).

-----  
BIDDER'S STAMP & SIGNATURE



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### 1.0 SCOPE OF ENQUIRY

- 1.1 This specification covers the Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of EPR INSULATED FIRE SURVIVAL CABLES.
- 1.2 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation at site conditions.
- 1.3 General technical requirements of the EPR INSULATED FIRE SURVIVAL CABLES are indicated in Section-II. Project specific technical/ quality requirements / changes are listed in Section-I.
- 1.4 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.
- 1.5 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 Annexure for Bill of Quantities (BOQ) enclosed as part of NIT.

### 3.0 TECHNICAL REQUIREMENTS

- 3.1 Specific Technical Requirement:

| <b><u>S.No.</u></b> | <b><u>Reference Clause No. of Section- II</u></b>                                                                                                                                                                                                                                                                                                                                                                 | <b><u>Specific Requirement/ Change</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.                  | 4.1: Cables shall be supplied in non-returnable drums. Material of cable drums shall be as specified in Datasheet-A.                                                                                                                                                                                                                                                                                              | Shall be read as : "Cables shall be supplied in non-returnable drums, <b>of heavy construction</b> . Material of cable drums shall be as specified in Datasheet-A."                                                                                                                                                                                                                                                                                                            |
| 2.                  | 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 finishing or coating to avoid rusting during transit and storage. BIS certification mark shall be stamped on each cable drum. | Shall be read as: " <b>In case of wooden drums, the surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.</b> " |



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**4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED**

4.1 Documents/drawings to be submitted as part of technical offer & after placement of order for BHEL & customer's approval shall be as part of NIT.

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

| Sl. No. | Drawings/Document Description                                     | Drawings / Document Number |
|---------|-------------------------------------------------------------------|----------------------------|
| 1.      | Technical Data Sheet for EPR INSULATED FIRE SURVIVAL CABLES       | PE-V0-425-507-E181         |
| 2.      | Cross-sectional Drawings for EPR INSULATED FIRE SURVIVAL CABLES   | PE-V0-425-507-E183         |
| 3.      | Manufacturing Quality Plan for EPR INSULATED FIRE SURVIVAL CABLES | PE-V0-425-507-E920*        |

Note:

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

4.3 All drawings/ documents indicated above shall be submitted through Document Management System (DMS).



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**DATASHEET A**



# **TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL CABLES**

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|      |                                                                                              |                                                                                                                                        |
|------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| 1.0  | Type of Cable                                                                                | EPR INSULATED FIRE SURVIVAL CABLES                                                                                                     |
| 2.0  | Standard applicable in general(Latest amendment to be referred if any)                       | IS-9968(PART-1), IS-6380, IS -10810,IS 10418, IS-3975, ASTM:2843, ASTM-2863, IEC-60754-1, IEC-60331, IEC-60332, IEEE-60383,SS-424-1475 |
| 3.0  | Voltage Grade                                                                                | 1.1 KV                                                                                                                                 |
| 4.0  | Number of cores, cross sectional area of conductors and quantities                           | As per BOQ-Cum-Price Schedule                                                                                                          |
| 5.0  | <b>CONDUCTOR</b>                                                                             |                                                                                                                                        |
| (a)  | Material                                                                                     | Copper                                                                                                                                 |
|      | Grade and Class (for Power Cables having crosssectional area more than 2.5 sq.mm)            | Stranded, plain, annealed high conductivity, Class 2                                                                                   |
|      | Grade and Class (for Control Cables having crosssectional area upto and including 2.5 sq.mm) | Stranded, plain, annealed high conductivity, Class 2                                                                                   |
| (b)  | Standard Applicable                                                                          | IS - 8130                                                                                                                              |
| (c)  | Shape                                                                                        | Compacted circular / Shaped                                                                                                            |
| (d)  | Min. number and diameter of strands for main and neutral conductor.                          | As per class -2 of IS 8130                                                                                                             |
| (e)  | Fire Barrier tape (separator tape)                                                           | Glass Mica tape in two layers with minimum 50% overlap                                                                                 |
| 6.0  | <b>INSULATION</b>                                                                            |                                                                                                                                        |
| (a)  | Material                                                                                     | Heat resistant Elastomer compound (EPR), type IE2                                                                                      |
| (b)  | Standard Applicable                                                                          | IS : 9968(Part-1),IS -6380                                                                                                             |
| (c)  | Continuous withstand temperature                                                             | 90°C                                                                                                                                   |
| (d)  | Short-circuit withstand temperature                                                          | 250°C                                                                                                                                  |
| (e)  | Method of application                                                                        | By extrusion; sleeve extrusion not permitted.                                                                                          |
| (f)  | Method of curing                                                                             | Dry/Steam/Gas/Sioplas                                                                                                                  |
| (g)  | Nominal Thickness of insulation                                                              | As per IS : 9968(Part-1)                                                                                                               |
| (h)  | Fire proof tape                                                                              | Two Layers of plain Glass Fibre Binder Tape                                                                                            |
| 7.0  | <b>CORE IDENTIFICATION</b>                                                                   | Colour coding as per IS : 9968(Part-1)                                                                                                 |
| 8.0  | <b>INNER SHEATH</b>                                                                          | <b>APPLICABLE FOR BOTH SINGLE &amp; MULTI CORE CABLES</b>                                                                              |
| (a)  | Material                                                                                     | Heat resistant, oil resistant , flame retardant (HOFR) Elastomer compound                                                              |
| (b)  | Grade and type                                                                               | Extruded Type SE-3                                                                                                                     |
| (c)  | Standard Applicable                                                                          | IS : 9968(Part-1), IS : 6380                                                                                                           |
| (d)  | Colour                                                                                       | Black                                                                                                                                  |
| (e)  | Nominal thickness                                                                            | As per IS : 9968(Part-1)                                                                                                               |
| 9.0  | <b>ARMOUR</b>                                                                                |                                                                                                                                        |
| (a)  | Material:                                                                                    |                                                                                                                                        |
| (i)  | Single core cables                                                                           | Galvanised Steel Round Wire                                                                                                            |
|      | Standard Applicable                                                                          | IS-3975                                                                                                                                |
| (ii) | Multi-core cables                                                                            | Galvanised Steel Round Wire                                                                                                            |
|      | Standard Applicable                                                                          | IS-3975                                                                                                                                |
| (b)  | Gap between armour wires                                                                     | Shall not exceed one armour wire space (No cross-over/ over-riding)                                                                    |



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| (c)   | Minimum Coverage                                            | 90%                                                                                                                                                                                                                                                                                                                                                                                                           |
| (d)   | Breaking load of joint                                      | 95 % of normal armour                                                                                                                                                                                                                                                                                                                                                                                         |
|       |                                                             | Zinc rich paint shall be applied on armour joint surface of GS wire                                                                                                                                                                                                                                                                                                                                           |
| 10.0  | <b>OUTERSHEATH</b>                                          |                                                                                                                                                                                                                                                                                                                                                                                                               |
| (a)   | Material                                                    | Heat resistant, oil resistant , flame retardant (HOFR) Elastomer compound                                                                                                                                                                                                                                                                                                                                     |
| (b)   | Grade and type                                              | Extruded Type SE-3                                                                                                                                                                                                                                                                                                                                                                                            |
| (c)   | Colour                                                      | Black                                                                                                                                                                                                                                                                                                                                                                                                         |
| (d)   | Standard Applicable                                         | IS : 9968(Part-1), IS : 6380                                                                                                                                                                                                                                                                                                                                                                                  |
| (e)   | Nominal thickness                                           | As per IS : 9968(Part-1)                                                                                                                                                                                                                                                                                                                                                                                      |
| (f)   | i) Tensile Strength<br>ii) Percentage elongation at rupture | 8 Newton/Sq. mm min.<br>250% min.                                                                                                                                                                                                                                                                                                                                                                             |
| (g)   | Marking                                                     | Cable size (cross section area and no. of cores) and voltage grade, IS 9968-Part 1 @ 1m (by embossing)<br>Word "EPR-IE2/SE3" "FS" etc, @ 1m (by embossing)<br>ISI mark with C/ML number @ 1m (by embossing)<br>Manufacturer's name and/ or trade name, and year of manufacture @ 1m (by embossing)<br>'BHEL-PEM' and 'TANGEDCO' Name @1m (by embossing)<br>Progressive sequential marking @ 1m (by embossing) |
| 11.0  | <b>HOFR CHARACTERISTICS</b>                                 |                                                                                                                                                                                                                                                                                                                                                                                                               |
| (a)   | Oxygen index                                                | ≥30 (as per ASTM D 2863)                                                                                                                                                                                                                                                                                                                                                                                      |
| (b)   | Temperature Index                                           | ≥350°C (as per ASTM D-2863)                                                                                                                                                                                                                                                                                                                                                                                   |
| (c)   | Acid gas generation                                         | ≤ 2% by weight (as per IEC-60754-1)                                                                                                                                                                                                                                                                                                                                                                           |
| (d)   | Smoke density rating                                        | ≤ 20% (As per ASTM D 2843)                                                                                                                                                                                                                                                                                                                                                                                    |
| (e)   | Water absorption test                                       | IS 10810-28                                                                                                                                                                                                                                                                                                                                                                                                   |
| (e)   | <b>Flammability Test</b>                                    |                                                                                                                                                                                                                                                                                                                                                                                                               |
| (i)   | Flammability test for single cable                          | As per IEC-60332 Part-1                                                                                                                                                                                                                                                                                                                                                                                       |
| (ii)  | Flammability test for bunched cables                        | As per IEC-60332 Part-3 CAT-B                                                                                                                                                                                                                                                                                                                                                                                 |
| (iii) | Flammability test for complete cable                        | As per IEEE-60383                                                                                                                                                                                                                                                                                                                                                                                             |
| (iv)  | Swedish Chimney test                                        | As per SEN-SS-424-1475-F3                                                                                                                                                                                                                                                                                                                                                                                     |
| (f)   | <b>Fire survival test</b>                                   | As per IEC-60331 for min 3 Hrs at 750°C                                                                                                                                                                                                                                                                                                                                                                       |
| 12.0  | <b>Allowable Tolerance on OD</b>                            | ±2 mm (max.)                                                                                                                                                                                                                                                                                                                                                                                                  |
| 13.0  | <b>CABLE DRUMS</b>                                          |                                                                                                                                                                                                                                                                                                                                                                                                               |
| (a)   | Type of Drum                                                | Wooden Drum as per IS 10418                                                                                                                                                                                                                                                                                                                                                                                   |
| (b)   | Standard drum length                                        | 500m (+) 5% (as specified in BOQ-Cum-Price Schedule)                                                                                                                                                                                                                                                                                                                                                          |
| (c)   | Painting                                                    | Entire surface to be painted                                                                                                                                                                                                                                                                                                                                                                                  |
| (d)   | Outermost Layer                                             | To be covered with water-proof polyethylene                                                                                                                                                                                                                                                                                                                                                                   |
| (e)   | Particular information on Drum                              | Both the end of 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 & erection.<br>Wood preservative anti-termite treatment shall be applied to the entire drum.                                                                                                                                   |
| (f)   | Construction Details                                        | As per Section-I of this technical specification.                                                                                                                                                                                                                                                                                                                                                             |

**NOTE:** Suitable fire retardant material fillers shall be used for filling in the interstices. Two layers of plain glass binder tape should be applied over the laid up cores.



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The cable drums should carry the following details in printed form (non returnable):-

- a) TANGEDCO & Manufacturer's name or trade make
- b) Type of cable & voltage grade
- c) Year of manufacture
- d) Type of insulation / sheath e.g. XLPE /PVC FRLS, IE2/SE3 F.S. as applicable.
- e) No. of core and size of cables
- f) Cable code
- g) Length of cable on drum
- h) Direction of rotation, by arrow
- i) Approx. gross mass.
- j) ISI mark
- i) IS/IEC number

**Insulation**

- a) Cores of the cable shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core - Red, Black, Yellow or Blue

2 core - Red & Black

3 core - Red, Yellow & Blue

4 core - Red, Yellow, Blue & Black

|                                                                                   |                                                                                                                 |                                       |                  |
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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        | For general specification of EPR Cables                                     | -       |             |
| 2.2        | For conductor material                                                      | -       |             |
| 2.3        | For material of inner-sheath & outer-sheath                                 | -       |             |
| 2.4        | For method of tests                                                         | -       |             |
| 2.5 F      | or cable drums                                                              | -       |             |
| 2.6        | For oxygen index test                                                       | -       |             |
| 2.7        | For flammability test                                                       | -       |             |
| 2.8        | For acid gas generation test                                                | -       |             |
| 2.9        | For smoke generation test                                                   | -       |             |
| 2.10       | For fire survival test                                                      | -       |             |
| 2.11       | Current rating of cables conforms to                                        | -       |             |
| 2.12       | Short circuit rating conforms to                                            | -       |             |
|            |                                                                             |         |             |
| <b>3.0</b> | <b>INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE</b> |         |             |
| 3.1        | No. of cores x size                                                         | -       |             |
| 3.2        | Voltage grade (Uo/U)                                                        | kV      |             |
| 3.3        | Base current ratings as per standard                                        |         |             |
| a)         | In air                                                                      | Amp     |             |
| b)         | In ground                                                                   | Amp     |             |
| c)         | ducts Am                                                                    | p       |             |
| 3.4        | Short circuit rating                                                        | kA, sec |             |
| 3.5 COND   | UCTOR                                                                       |         |             |
| a)         | Applicable Standard                                                         | -       |             |

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

|                                                                                   |                                                                                                                 |                                       |                  |
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|--------|--------------------------------------------------------|-------------|--|
| b)     | Material type & grade                                  | -           |  |
| c)     | No & dia of wires in each core before stranding        | no x mm     |  |
| d)     | Shape                                                  | -           |  |
| e)     | D.C. resistance of conductor at 20 deg. C              | ohm/km      |  |
| f)     | A.C. resistance of conductor at 85 deg. C              | ohm/km      |  |
| g)     | A.C. resistance of conductor at 90 deg. C              | ohm/km      |  |
| h)     | Reactance of cable at normal frequency                 | ohm/km      |  |
| i)     | Electrostatic capacitance of cable at normal frequency | mF/km       |  |
| j)     | Maximum conductor temperature                          | deg. C      |  |
| k)     | Maximum short circuit temperature                      | deg. C      |  |
| 3.6    | HEAT BARRIER TAPE                                      |             |  |
| a)     | Applicable Standard                                    | -           |  |
| b)     | Material                                               | -           |  |
| c)     | Thickness of tape                                      | mm          |  |
| d)     | No. of layers, overlap                                 | -           |  |
| 3.7 I  | INSULATION                                             |             |  |
| a)     | Applicable Standard                                    | -           |  |
| b)     | Material                                               | -           |  |
| c)     | Method of cross linking                                | -           |  |
| e)     | Method of curing                                       | -           |  |
| f)     | Process of extrusion                                   | -           |  |
| g) Nom | inal thickness                                         | mm          |  |
| h) M   | inimum thickness                                       | mm          |  |
| i)     | Minimum insulation resistance constant at 27 deg. C    | mega ohm/km |  |
| j)     | Minimum volume resistivity at 27 deg. C                | ohm.cm      |  |
| k)     | Minimum volume resistivity at 85/90 deg. C             | ohm.cm      |  |
| l)     | Dielectric strength of insulation                      |             |  |
| m)     | Resistivity of insulation                              |             |  |
| n)     | Acid gas generation of insulation & tape               | %           |  |
| 3.8    | CORE IDENTIFICATION                                    |             |  |
| a)     | Applicable Standard                                    | -           |  |

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

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| 3.9 IN    | NERSHEATH                                         |       |  |
| a)        | Material & type                                   | -     |  |
| b)        | Nominal Thickness                                 | mm.   |  |
| c)        | Minimum Thickness                                 | mm.   |  |
| d)        | Process of Extrusion                              | -     |  |
| e)        | Type & Shape of fillers (if used)                 | -     |  |
| f)        | Colour                                            | -     |  |
| 3.10      | ARMOUR                                            |       |  |
| a)        | Applicable Standard                               | -     |  |
| b)        | Material                                          | -     |  |
| c)        | Size/ dimensions                                  | -     |  |
| d)        | Minimum no. of wires/ formed wires                | -     |  |
| e)        | Maximum DC resistance of armour                   | -     |  |
| f)        | Maximum AC resistance of armour                   | -     |  |
| g)        | Minimum coverage                                  | -     |  |
| 3.11 OUTE | RSHEATH                                           |       |  |
| a)        | Material & type                                   | -     |  |
| b)        | Nominal Thickness                                 | mm.   |  |
| c)        | Minimum Thickness                                 | mm.   |  |
| d)        | Process of Extrusion                              | -     |  |
| e)        | Colour                                            | -     |  |
|           |                                                   |       |  |
| 4.0       | PERMISSIBLE VARIATION                             |       |  |
| a)        | Voltage variation                                 | %     |  |
| b)        | Frequency Variation                               | %     |  |
| c)        | Combined voltage & frequency                      | IAbsl |  |
|           |                                                   |       |  |
| 5.0       | CHARACTERISTICS OF HOFR SHEATH (Inner & Outer)    |       |  |
| a)        | Oxygen index at 50 deg. C.                        | -     |  |
| b)        | Temperature index                                 | -     |  |
| c)        | Acid gas generation                               | -     |  |
| d)        | Smoke density rating                              | -     |  |
|           |                                                   |       |  |
| 6.0       | APPLICABLE TESTS UNDER FIRE CONDITIONS FOR SINGLE |       |  |

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

|                                                                                   |                                                                                                                 |                                       |                  |
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|  | <b>TECHNICAL SPECIFICATION FOR<br/>EPR INSULATED FIRE SURVIVAL<br/>CABLES</b><br><br><b>2 X 800MW UPPUR TPS</b> | SPECIFICATION NO. PE-TS- 425-507-E006 |                  |
|                                                                                   |                                                                                                                 | VOLUME II                             |                  |
|                                                                                   |                                                                                                                 | SECTION I                             |                  |
|                                                                                   |                                                                                                                 | REVISION: 00                          | DATE: 21.05.2018 |
|                                                                                   |                                                                                                                 | SHEET 4 OF 5                          |                  |

|             |                                                              |                   |  |
|-------------|--------------------------------------------------------------|-------------------|--|
|             | <b>CABLE &amp; MULTIPLE CABLES</b>                           |                   |  |
| <b>7.0</b>  | <b>High Voltage Test Voltage</b>                             | kV                |  |
| <b>8.0</b>  | <b>Water Absorption Test Voltage</b>                         | kV                |  |
| <b>9.0</b>  | <b>CIRCUIT INTEGRITY TEST</b>                                |                   |  |
| a)          | Applicable Standard                                          | -                 |  |
| b)          | Temperature Deg.                                             | C.                |  |
| c)          | Duration                                                     | hrs               |  |
| <b>10.0</b> | <b>CABLE DRUMS</b>                                           |                   |  |
| a)          | Type & construction                                          | -                 |  |
| b)          | Standard drum length (as per BOQ)                            | -                 |  |
| c)          | Tolerance on drum length                                     | (+/-) 5%          |  |
| <b>11.0</b> | <b>DIAMETERS</b>                                             |                   |  |
| a)          | Overall diameter of conductor                                | mm                |  |
| b)          | Overall diameter over taped conductor                        | mm                |  |
| c)          | Approximate cable diameter of insulated conductor            | mm                |  |
| d)          | Approximate Cable diameter over inner sheath                 |                   |  |
| e)          | Approximate overall diameter of cable                        |                   |  |
| <b>12.0</b> | <b>Tolerance on overall diameter</b>                         | (±) mm            |  |
| <b>13.0</b> | <b>Minimum bending radius</b>                                | x O.D.            |  |
| <b>14.0</b> | <b>Safe pulling force</b>                                    | kg.               |  |
| <b>15.0</b> | <b>Maximum Charging current at nominal voltage (approx.)</b> | amps/km           |  |
| <b>16.0</b> | <b>Minimum Tensile strength</b>                              | N/mm <sup>2</sup> |  |
| <b>17.0</b> | <b>Minimum elongation percentage at rupture</b>              |                   |  |
| <b>18.0</b> | <b>Weight of cable / components</b>                          | kg./m             |  |

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

|                                                                                   |                                                                                                                 |                                       |                  |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------|------------------|
|  | <b>TECHNICAL SPECIFICATION FOR<br/>EPR INSULATED FIRE SURVIVAL<br/>CABLES</b><br><br><b>2 X 800MW UPPUR TPS</b> | SPECIFICATION NO. PE-TS- 425-507-E006 |                  |
|                                                                                   |                                                                                                                 | VOLUME II                             |                  |
|                                                                                   |                                                                                                                 | SECTION I                             |                  |
|                                                                                   |                                                                                                                 | REVISION: 00                          | DATE: 21.05.2018 |
|                                                                                   |                                                                                                                 | SHEET 5 OF 5                          |                  |

|      |                                 |    |  |
|------|---------------------------------|----|--|
| a)   | Weight of conductor             | -  |  |
| b)   | Weight of fire barrier tape     | -  |  |
| c)   | Weight of insulation            | -  |  |
| d)   | Weight of polymeric material    | -  |  |
| e)   | Weight of Armour (GS/Aluminium) | -  |  |
| f)   | Total weight of cable           | -  |  |
|      |                                 |    |  |
| 19.0 | Shipping Weight                 | kg |  |
|      |                                 |    |  |
| 20.0 | Cable marking on outer sheath   | -  |  |

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



**TECHNICAL SPECIFICATION FOR  
EPR INSULATED FIRE SURVIVAL  
CABLES**

**2 X 800MW UPPUR TPS**

SPECIFICATION NO. PE-TS-425-507-E006

VOLUME II

SECTION II

REVISION: 00

DATE: 21.05.2018

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**SECTION-II**

**STANDARD TECHNICAL SPECIFICATION**



## TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL CABLES

2 X 800MW UPPUR TPS

SPECIFICATION NO. PE-TS-425-507-E006

VOLUME II

SECTION II

REVISION: 00

DATE: 21.05.2018

SHEET 1 OF 1

### 1.0 TECHNICAL REQUIREMENTS

- 1.1 Technical requirements for EPR INSULATED FIRE SURVIVAL 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 EPR INSULATED FIRE SURVIVAL 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 BHEL Standard Quality Plan (PE-QP-999-507-E006 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 to QAP. Charges for all these tests for all the equipment & components shall be deemed to be included in the bid price (except UV Radiation test).
- 3.4 The charges of UV Radiation 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.
- 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-I 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 EPR INSULATED FIRE SURVIVAL CABLES.
- 4.4 Each drum shall carry manufacturer's name, purchaser's name, address and contract no., item no. & type, size & length of cable and net gross weight stencilled on both sides of drum. A tag containing same information shall be attached to the leading end of the cable. An arrow & suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.



**TECHNICAL SPECIFICATION FOR  
EPR INSULATED FIRE SURVIVAL  
CABLES**

**2 X 800MW UPPUR TPS**

SPECIFICATION NO. PE-TS- 425-507-E006

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SECTION II

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**ANNEXURE-II**

**QUALITY PLAN**

|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  |                                            |             |                                                           |                   |                                                      |                                                      |                                  |                               |           |     |         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------|-------------|-----------------------------------------------------------|-------------------|------------------------------------------------------|------------------------------------------------------|----------------------------------|-------------------------------|-----------|-----|---------|
|                                                                                                                                                                                                                                                                                                                       |                                                  | STANDARD QUALITY PLAN                      |             | CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD. |                   | PROJECT: 2 X 800MW UPPUR TPS                         |                                                      | SPECIFICATION                    |                               |           |     |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  |                                            |             | BIDDER/ :<br>VENDOR                                       |                   | QUALITY PLAN<br>NUMBER: PE-QP-999-507-E006, R0       |                                                      | NUMBER : PE-TS-425-507-E006, R00 |                               |           |     |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  | SHEET 1 OF 10                              |             | SYSTEM                                                    |                   | ITEM : EPR INSULATED FIRE SURVIVAL CABLES            |                                                      | SECTION                          |                               | VOLUME II |     |         |
| 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      |
| <b>Instructions:</b><br>1. Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch/ lot no. should be traceable to the final cable drum number or batch no.<br>2. Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not. |                                                  |                                            |             |                                                           |                   |                                                      |                                                      |                                  |                               |           |     |         |
| 1.0                                                                                                                                                                                                                                                                                                                                                                                                    | <b>RAW MATERIALS &amp; BOUGHT OUT ITEMS</b>      |                                            |             |                                                           |                   |                                                      |                                                      |                                  |                               |           |     |         |
| 1.1                                                                                                                                                                                                                                                                                                                                                                                                    | Aluminium/copper Rods<br>(Conductor/Armour Wire) | <b>GENERAL :</b><br>1. Physical properties | MA          | Physical Tests                                            | Sample/ Batch     | IS 9968 Pt 1, IS 8130 & Appd Datasheet               | IS 9968 Pt 1, IS 8130 & Appd Datasheet               | Inpection Report/ Test Cert.     | 2/3                           | -         | 1/2 |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  | 2. Elec.Properties                         | MA          | Electrical Tests                                          | Sample/ Batch     | -do-                                                 | -do-                                                 | -do-                             | 2/3                           | -         | 1/2 |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  | <b>SPECIFIC CHECKS :</b><br>a) Make        | MA          | Verify                                                    | 100%              | Manufacturer approved source                         | Manufacturer approved source                         | COC/ Test Cert.                  | 2/3                           | -         | 1   |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  | b) Grade                                   | MA          | -do-                                                      | -do-              | IS 8130/ Approved datasheet                          | IS 8130/ Approved datasheet                          | -do-                             | 2/3                           | -         | 1   |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  | c) Resistivity                             | MA          | Electrical Tests                                          | Manufacturer std. | IS 8130                                              | IS 8130                                              | -do-                             | 2/3                           | -         | 1   |         |
| 1.2                                                                                                                                                                                                                                                                                                                                                                                                    | Insulation (EPR) Copmpound                       | <b>GENERAL :</b><br>1. Physical properties | MA          | Physical Tests                                            | Sample/ Batch     | IS 9968 Pt 1, IS 6380 & Mfs Std./ Approved datasheet | IS 9968 Pt 1, IS 6380 & Mfs Std./ Approved datasheet | Inpection Repor/ Test Cert.      | 2/3                           | -         | 1/2 |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  | 2. Elec.Properties                         | MA          | Electrical Tests                                          | Sample/ Batch     | -do-                                                 | -do-                                                 | -do-                             | 2/3                           | -         | 1/2 |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  | <b>SPECIFIC CHECKS :</b><br>a) Make        | MA          | Verify                                                    | 100%              | Manufacturer approved source                         | Manufacturer approved source                         | COC/ Test Cert.                  | 2/3                           | -         | 1   |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  | b) Type/ Grade                             | MA          | -do-                                                      | -do-              | Approved datasheet                                   | Approved datasheet                                   | -do-                             | 2/3                           | -         | 1   |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  | c) Shelf life/ Storage condition           | MA          | -do-                                                      | -do-              | Compound Manufacturer std.                           | Compound Manufacturer std.                           | -do-                             | 2/3                           | -         | 1   |         |
| BHEL                                                                                                                                                                                                                                                                                                                                                                                                   |                                                  |                                            | PARTICULARS |                                                           |                   | BIDDER/VENDOR                                        |                                                      |                                  |                               |           |     |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  |                                            | NAME        |                                                           |                   |                                                      |                                                      |                                  |                               |           |     |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  |                                            | SIGNATURE   |                                                           |                   |                                                      |                                                      |                                  |                               |           |     |         |
|                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  |                                            | DATE        |                                                           |                   |                                                      |                                                      |                                  | BIDDER'S/VENDORS COMPANY SEAL |           |     |         |

|                                                                                   |                                  |                                                                                                                                                                       |             |                                                           |                 |                                                         |                                                         |                                                                                |                               |           |     |
|-----------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------------------------------------------------|-----------------|---------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------|-----------|-----|
|  |                                  | STANDARD QUALITY PLAN                                                                                                                                                 |             | CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD. |                 | PROJECT: 2 X 800MW UPPUR TPS                            |                                                         | SPECIFICATION NUMBER : PE-TS-425-507-E006, R00                                 |                               |           |     |
|                                                                                   |                                  |                                                                                                                                                                       |             | BIDDER/ :<br>VENDOR                                       |                 | QUALITY PLAN<br>NUMBER: PE-QP-999-507-E006, R0          |                                                         | SPECIFICATION TECHNICAL SPECIFICATION FOR<br>TITLE EPR INSULATED FIRE SURVIVAL |                               |           |     |
|                                                                                   |                                  | SHEET 2 OF 10                                                                                                                                                         |             | SYSTEM                                                    |                 | ITEM : EPR INSULATED FIRE SURVIVAL CABLES               |                                                         | SECTION                                                                        |                               | VOLUME II |     |
| SL. NO.                                                                           | COMPONENT/ OPERATION             | CHARACTERISTIC CHECK                                                                                                                                                  | CAT.        | TYPE/ METHOD OF CHECK                                     | EXTENT OF CHECK | REFERENCE DOCUMENT                                      | ACCEPTANCE NORM                                         | FORMAT OF RECORD                                                               | AGENCY                        | REMARKS   |     |
| 1                                                                                 | 2                                | 3                                                                                                                                                                     | 4           | 5                                                         | 6               | 7                                                       | 8                                                       | 9                                                                              | 10                            | 11        |     |
| 1.3                                                                               | Seathing Compound                | <u>GENERAL :</u><br>1. Physical properties<br><br>2. HOFR properties<br><br><u>SPECIFIC CHECKS :</u><br>1. Make<br>2. Type/ Grade<br>3. Shelf life/ Storage condition | MA          | Physical Tests                                            | Sample/ Batch   | IS 9968 Pt 1 & Mfs Std./ Approved datasheet             | IS 9968 Pt 1 & Mfs Std./ Approved datasheet             | Inpection Report/ Test Cert.                                                   | 2/3                           | -         | 1/2 |
|                                                                                   |                                  |                                                                                                                                                                       | MA          | Envir/Chemical                                            | Sample/ Batch   | ASTMD:2843, ASTMD-2863, IEC-60754-1/ Approved datasheet | ASTMD:2843, ASTMD-2863, IEC-60754-1/ Approved datasheet | Inpection Report/ Test Cert.                                                   | 2/3                           | -         | 1/2 |
|                                                                                   |                                  |                                                                                                                                                                       | MA          | Verify                                                    | 100%            | Manufacturer approved source                            | Manufacturer approved source                            | COC/ Test Cert.                                                                | 2/3                           | -         | 1   |
|                                                                                   |                                  |                                                                                                                                                                       | MA          | -do-                                                      | -do-            | Approved datasheet                                      | Approved datasheet                                      | -do-                                                                           | 2/3                           | -         | 1   |
|                                                                                   |                                  |                                                                                                                                                                       | MA          | -do-                                                      | -do-            | Compound Manufacturer std.                              | Compound Manufacturer std.                              | -do-                                                                           | 2/3                           | -         | 1   |
| 1.4                                                                               | Glass Mica Tape (Separator Tape) | <u>GENERAL :</u><br>1. Physical properties<br><br>2. Elec.Properties                                                                                                  | MA          | Physical Tests                                            | Sample/ Batch   | Mfr. Std./ Approved datasheet                           | Mfr. Std./ Approved datasheet                           | Inpection Report/ Test Cert.                                                   | 2/3                           | -         | 1/2 |
|                                                                                   |                                  |                                                                                                                                                                       | MA          | Electrical Tests                                          | Sample/ Batch   | -do-                                                    | -do-                                                    | -do-                                                                           | 2/3                           | -         | 1/2 |
| BHEL                                                                              |                                  |                                                                                                                                                                       | PARTICULARS |                                                           |                 | BIDDER/VENDOR                                           |                                                         |                                                                                |                               |           |     |
|                                                                                   |                                  |                                                                                                                                                                       | NAME        |                                                           |                 |                                                         |                                                         |                                                                                |                               |           |     |
|                                                                                   |                                  |                                                                                                                                                                       | SIGNATURE   |                                                           |                 |                                                         |                                                         |                                                                                |                               |           |     |
|                                                                                   |                                  |                                                                                                                                                                       | DATE        |                                                           |                 |                                                         |                                                         |                                                                                | BIDDER'S/VENDORS COMPANY SEAL |           |     |

|                                                                                   |                                                                             |                                                                                                                       |      |                                                           |                   |                                                     |                                                     |                                                                             |     |   |   |                                             |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------|-------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------------------------|-----|---|---|---------------------------------------------|
|  |                                                                             | STANDARD QUALITY PLAN                                                                                                 |      | CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD. |                   | PROJECT: 2 X 800MW UPPUR TPS                        |                                                     | SPECIFICATION NUMBER : PE-TS-425-507-E006, R00                              |     |   |   |                                             |
|                                                                                   |                                                                             |                                                                                                                       |      | BIDDER/ VENDOR :                                          |                   | QUALITY PLAN NUMBER: PE-QP-999-507-E006, R0         |                                                     | SPECIFICATION TECHNICAL SPECIFICATION FOR TITLE EPR INSULATED FIRE SURVIVAL |     |   |   |                                             |
|                                                                                   |                                                                             |                                                                                                                       |      | SYSTEM                                                    |                   | ITEM : EPR INSULATED FIRE SURVIVAL CABLES           |                                                     | SECTION VOLUME II                                                           |     |   |   |                                             |
| SL. NO.                                                                           | COMPONENT/ OPERATION                                                        | CHARACTERISTIC CHECK                                                                                                  | CAT. | TYPE/ METHOD OF CHECK                                     | EXTENT OF CHECK   | REFERENCE DOCUMENT                                  | ACCEPTANCE NORM                                     | FORMAT OF RECORD                                                            | P   | W | V | REMARKS                                     |
| 1                                                                                 | 2                                                                           | 3                                                                                                                     | 4    | 5                                                         | 6                 | 7                                                   | 8                                                   | 9                                                                           | 10  |   |   | 11                                          |
| 1.5                                                                               | Galvanised steel round wire/Aluminium round wire for Armour (as applicable) | <b>GENERAL :</b><br><br>1. Make<br><br>2. Dimension<br><br>3. Phy.and Elec. Properties<br><br>4.Galvanization Quality | MA   | Verify                                                    | Manufacturer std. | Manufacturer approved source                        | Manufacturer approved source                        | Inpection Report/ Test Cert.                                                | 2/3 | - | 1 | * Sample from each armour size/ Batch / Lot |
|                                                                                   |                                                                             |                                                                                                                       | MA   | Measurement                                               | -do-              | IS 3975 & Approved datasheet                        | IS 3975 & Approved datasheet                        | -do-                                                                        | 2/3 | - | 2 |                                             |
|                                                                                   |                                                                             |                                                                                                                       | MA   | Physical & Electrical Tests                               | Sample*           | -do-                                                | -do-                                                | -do-                                                                        | 2/3 | - | 2 |                                             |
|                                                                                   |                                                                             |                                                                                                                       | MA   | Galv.Tests                                                | -do-              | Relevant. IS & Mfr. Std.                            | Relevant. IS & Mfr. Std.                            | -do-                                                                        | 2/3 | - | 2 |                                             |
| 1.6                                                                               | Wooden Drum                                                                 | 1. Phy. And constructional checks                                                                                     | MA   | Meas.                                                     | Mfr's Plant Std.  | IS10418                                             | IS10418                                             | Inpection Report/ Test Cert. COC                                            | 2/3 | - | 1 |                                             |
|                                                                                   |                                                                             | 2. Anti termite treatment                                                                                             | MA   | chemical                                                  | -do-              | Mfr's Plant Std.                                    | Mfr's Plant Std.                                    |                                                                             | 2/3 |   | 1 |                                             |
| 1.7                                                                               | Steel Drum                                                                  | 1. Dimension                                                                                                          | MA   | Meas.                                                     | Mfr's Plant Std.  | Approved drawing of steel drum / BHEL specification | Approved drawing of steel drum / BHEL specification | Inpection Report/ Test Cert.                                                | 2/3 | - | 1 |                                             |
|                                                                                   |                                                                             | 2. Surface finish                                                                                                     | MA   | Meas.                                                     | -do-              | Surface shall be smooth                             | Surface shall be smooth                             | -do-                                                                        | 2/3 | - | 1 |                                             |
| BHEL                                                                              |                                                                             | PARTICULARS                                                                                                           |      | BIDDER/VENDOR                                             |                   |                                                     |                                                     |                                                                             |     |   |   |                                             |
|                                                                                   |                                                                             | NAME                                                                                                                  |      |                                                           |                   |                                                     |                                                     |                                                                             |     |   |   |                                             |
|                                                                                   |                                                                             | SIGNATURE                                                                                                             |      |                                                           |                   |                                                     |                                                     |                                                                             |     |   |   |                                             |
|                                                                                   |                                                                             | DATE                                                                                                                  |      |                                                           |                   | BIDDER'S/VENDORS COMPANY SEAL                       |                                                     |                                                                             |     |   |   |                                             |

|                                                                                   |                                                |                                     |             |                                                           |                              |                                                             |                                                             |                                                                                |                               |           |   |                                                                |
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|  |                                                | STANDARD QUALITY PLAN               |             | CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD. |                              | PROJECT : 2 X 800MW UPPUR TPS                               |                                                             | SPECIFICATION :<br>NUMBER : PE-TS-425-507-E006, R00                            |                               |           |   |                                                                |
|                                                                                   |                                                |                                     |             | BIDDER/ :<br>VENDOR :                                     |                              | QUALITY PLAN<br>NUMBER: PE-QP-999-507-E006, R0              |                                                             | SPECIFICATION TECHNICAL SPECIFICATION FOR<br>TITLE EPR INSULATED FIRE SURVIVAL |                               |           |   |                                                                |
|                                                                                   |                                                | SHEET 4 OF 10                       |             | SYSTEM                                                    |                              | ITEM : EPR INSULATED FIRE SURVIVAL CABLES                   |                                                             | SECTION                                                                        |                               | VOLUME II |   |                                                                |
| SL. NO.                                                                           | COMPONENT/OPERATION                            | CHARACTERISTIC CHECK                | CAT.        | TYPE/METHOD OF CHECK                                      | EXTENT OF CHECK              | REFERENCE DOCUMENT                                          | ACCEPTANCE NORM                                             | FORMAT OF RECORD                                                               | P                             | W         | V | REMARKS                                                        |
| 1                                                                                 | 2                                              | 3                                   | 4           | 5                                                         | 6                            | 7                                                           | 8                                                           | 9                                                                              | 10                            |           |   | 11                                                             |
| 2.0                                                                               | IN PROCESS                                     |                                     |             |                                                           |                              |                                                             |                                                             |                                                                                |                               |           |   |                                                                |
| 2.1                                                                               | Wire Drawing                                   | 1. Size                             | MA          | Dimensional                                               | Plant Mfg. Std.              | IS 8130 & Appd. Datasheet                                   | IS 8130 & Appd. Datasheet                                   | Inpection Report                                                               | 2                             | -         | 1 | * Sample from each armour size/ Batch / Lot                    |
|                                                                                   |                                                | 2. Surface finish                   | MA          | Visual                                                    | -do-                         | Surface shall be smooth                                     | Surface shall be smooth                                     | -do-                                                                           | 2                             | -         | 1 |                                                                |
|                                                                                   |                                                | 3. Phy.and Elec. Properties         | CR          | Physical & Electrical Tests                               | Sample*                      | IS 8130 & Mfr. Std.                                         | IS 8130 & Mfr. Std.                                         | -do-                                                                           | 2/3                           | -         | 2 |                                                                |
| 2.2                                                                               | Stranding of wires                             | 1. No. of wires                     | MA          | Counting                                                  | Plant Mfg. Std.              | IS 8130 & Appd. Datasheet                                   | IS 8130 & Appd. Datasheet                                   | Inpection Report                                                               | 2                             | -         | - |                                                                |
|                                                                                   |                                                | 2. Resistance                       | CR          | Electrical                                                | -do-                         | -do-                                                        | -do-                                                        | -do-                                                                           | 2                             | -         | - |                                                                |
|                                                                                   |                                                | 3. Sequence, lay length & Direction | MA          | Visual, Meas.                                             | One Sample of each size/ lot | Mfrs Std. / Appd. Datasheet                                 | Mfrs Std. / Appd. Datasheet                                 | -do-                                                                           | 2                             | -         | - |                                                                |
|                                                                                   |                                                | 4. Surface Finish                   | MA          | Visual                                                    | 100%                         | Surface shall be smooth                                     | Surface shall be smooth                                     | -do-                                                                           | 2                             | -         | - |                                                                |
|                                                                                   |                                                | 5. Dimension                        | MA          | Measurement                                               | One Sample of each size/ lot | IS 8130 & Appd. Datasheet                                   | IS 8130 & Appd. Datasheet                                   | -do-                                                                           | 2                             | -         | - |                                                                |
| 2.3                                                                               | Glass Mica tape                                | 1. Dimensions                       | MA          | Measurement                                               | 100%                         | Appd. datasheet                                             | Appd. datasheet                                             | Inpection Report                                                               | 2                             | -         | - |                                                                |
|                                                                                   |                                                | 2. Dia over tape                    | MA          | Measurement                                               | Sample                       | Mfrs Std.                                                   | Mfrs Std.                                                   | -do-                                                                           | 2                             | -         | - |                                                                |
|                                                                                   |                                                | 3.Mica tape overlap                 | MA          | Measurement                                               | Sample                       | Appd. datasheet                                             | Appd. datasheet                                             | -do-                                                                           | 2                             | -         | - |                                                                |
| 2.4                                                                               | Core Insulation (EPR)<br>(No repair permitted) | 1. Surface finish                   | MA          | Visual                                                    | 100%                         | Free from bulging, burnt particles, lumps, cuts & scratches | Free from bulging, burnt particles, lumps, cuts & scratches | Inpection Report                                                               | 2                             | -         | 1 | # To be checked at starting & finished end of extruded length. |
|                                                                                   |                                                | 2. Concentricity#                   | CR          | Measurement                                               | One Sample of each size/ lot | IS 9968 Pt 1 & Appd. Datasheet                              | IS 9968 Pt 1 & Appd. Datasheet                              | -do-                                                                           | 2                             | -         | 1 |                                                                |
|                                                                                   |                                                | 3. Insulation Thickness             | CR          | Measurement                                               | -do-                         | -do-                                                        | -do-                                                        | -do-                                                                           | 2                             | -         | - |                                                                |
|                                                                                   |                                                | 4. Dia over insulation              | MA          | Measurement                                               | -do-                         | -do-                                                        | -do-                                                        | -do-                                                                           | 2                             | -         | - |                                                                |
|                                                                                   |                                                | 5. Tensile Strength & % Elongation  | MA          | Mechanical                                                | 100%                         | -do-                                                        | -do-                                                        | -do-                                                                           | 2                             | -         | - |                                                                |
|                                                                                   |                                                | 6. Water absorption test            | CR          | Electrical                                                | 100%                         | IS 6380 ,Mfrs Std.                                          | IS 6380 ,Mfrs Std.                                          | Inpection Report                                                               | 2                             | -         | 1 |                                                                |
| BHEL                                                                              |                                                |                                     | PARTICULARS |                                                           |                              | BIDDER/VENDOR                                               |                                                             |                                                                                |                               |           |   |                                                                |
|                                                                                   |                                                |                                     | NAME        |                                                           |                              |                                                             |                                                             |                                                                                |                               |           |   |                                                                |
|                                                                                   |                                                |                                     | SIGNATURE   |                                                           |                              |                                                             |                                                             |                                                                                |                               |           |   |                                                                |
|                                                                                   |                                                |                                     | DATE        |                                                           |                              |                                                             |                                                             |                                                                                | BIDDER'S/VENDORS COMPANY SEAL |           |   |                                                                |

|  |                       | <b>STANDARD QUALITY PLAN</b><br>SHEET 5 OF 10 |             | CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD. |                              | PROJECT TITLE 2 X 800MW UPPUR TPS              |                                   | SPECIFICATION :<br>NUMBER : PE-TS-425-507-E006, R00                            |        |   |   |                                                                |    |
|-----------------------------------------------------------------------------------|-----------------------|-----------------------------------------------|-------------|-----------------------------------------------------------|------------------------------|------------------------------------------------|-----------------------------------|--------------------------------------------------------------------------------|--------|---|---|----------------------------------------------------------------|----|
|                                                                                   |                       |                                               |             | BIDDER/ VENDOR :                                          |                              | QUALITY PLAN<br>NUMBER: PE-QP-999-507-E006, R0 |                                   | SPECIFICATION TECHNICAL SPECIFICATION FOR<br>TITLE EPR INSULATED FIRE SURVIVAL |        |   |   |                                                                |    |
|                                                                                   |                       |                                               |             | SYSTEM                                                    |                              | ITEM : EPR INSULATED FIRE SURVIVAL CABLES      |                                   | SECTION VOLUME II                                                              |        |   |   |                                                                |    |
| SL. NO.                                                                           | COMPONENT/OPERATION   | CHARACTERISTIC CHECK                          | CAT.        | TYPE/ METHOD OF CHECK                                     | EXTENT OF CHECK              | REFERENCE DOCUMENT                             | ACCEPTANCE NORM                   | FORMAT OF RECORD                                                               | AGENCY |   |   | REMARKS                                                        |    |
| 1                                                                                 | 2                     | 3                                             | 4           | 5                                                         | 6                            | 7                                              | 8                                 | 9                                                                              | 10     | P | W | V                                                              | 11 |
| 2.5                                                                               | Core Laying           | 1. Dia over laid up core                      | MA          | Measurement                                               | One Sample of each size/ lot | IS 9968 Pt 1 & Approved datasheet              | IS 9968 Pt 1 & Approved datasheet | Inpection Report                                                               | 2      | - | - | ( Pimple, fish eye, porosity & burnt particles not permitted.) |    |
|                                                                                   |                       | 2. Sequence of lay & direction                | MA          | Visual & Meas.                                            | -do-                         | IS 9968 Pt 1 & Mfs Std.                        | IS 9968 Pt 1 & Mfs Std.           | -do-                                                                           | 2      | - | - |                                                                |    |
|                                                                                   |                       | 3. Lay Length                                 | MA          | Measurement                                               | -do-                         | -do-                                           | -do-                              | -do-                                                                           | 2      | - | - |                                                                |    |
| 2.6                                                                               | InnerSheath Extrusion | 1. Surface finish                             | MA          | Visual                                                    | 100%                         | Surface shall be smooth                        | Surface shall be smooth           | Inpection Report                                                               | 2      | - | - |                                                                |    |
|                                                                                   |                       | 2. Thickness                                  | CR          | Measurement                                               | One Sample of each size/ lot | Appd. Datasheet                                | Appd. Datasheet                   | -do-                                                                           | 2      | - | - |                                                                |    |
|                                                                                   |                       | 3. Dia over inner sheath                      | MA          | -do-                                                      | -do-                         | -do-                                           | -do-                              | -do-                                                                           | 2      | - | - |                                                                |    |
| 2.7                                                                               | Armour                | 1. No.of wires/Strips                         | MA          | Counting                                                  | At the start of the process  | Mfrs Std. / Appd. Datasheet                    | Mfrs Std. / Appd. Datasheet       | Inpection Report                                                               | 2      | - | - |                                                                |    |
|                                                                                   |                       | 2. Lay length & Direction                     | MA          | Visual & Meas.                                            | -do-                         | -do-                                           | -do-                              | -do-                                                                           | 2      | - | - |                                                                |    |
|                                                                                   |                       | 3. Dia over armouring                         | MA          | Measurement                                               | -do-                         | Appd. Datasheet                                | Appd. Datasheet                   | -do-                                                                           | 2      | - | - |                                                                |    |
|                                                                                   |                       | 4. Coverage                                   | MA          | Measurement                                               | -do-                         | -do-                                           | -do-                              | -do-                                                                           | 2      | - | - |                                                                |    |
| BHEL                                                                              |                       |                                               | PARTICULARS |                                                           | BIDDER/VENDOR                |                                                |                                   |                                                                                |        |   |   |                                                                |    |
|                                                                                   |                       |                                               | NAME        |                                                           |                              |                                                |                                   |                                                                                |        |   |   |                                                                |    |
|                                                                                   |                       |                                               | SIGNATURE   |                                                           |                              |                                                |                                   |                                                                                |        |   |   |                                                                |    |
|                                                                                   |                       |                                               | DATE        |                                                           |                              |                                                | BIDDER'S/VENDORS COMPANY SEAL     |                                                                                |        |   |   |                                                                |    |

|                                                                                   |                                              |                                                                                                          |                              |                                                           |                                                      |                                                            |                                                                                                |                                                                             |                  |                   |                                                                |
|-----------------------------------------------------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------|------------------------------|-----------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------|-------------------|----------------------------------------------------------------|
|  |                                              | STANDARD QUALITY PLAN                                                                                    |                              | CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD. |                                                      | PROJECT TITLE 2 X 800MW UPPUR TPS                          |                                                                                                | SPECIFICATION : NUMBER : PE-TS-425-507-E006, R00                            |                  |                   |                                                                |
|                                                                                   |                                              |                                                                                                          |                              | BIDDER/ VENDOR :                                          |                                                      | QUALITY PLAN NUMBER: PE-QP-999-507-E006, R0                |                                                                                                | SPECIFICATION TECHNICAL SPECIFICATION FOR TITLE EPR INSULATED FIRE SURVIVAL |                  |                   |                                                                |
|                                                                                   |                                              |                                                                                                          |                              | SHEET 6 OF 10                                             |                                                      | SYSTEM                                                     |                                                                                                | ITEM : EPR INSULATED FIRE SURVIVAL CABLES                                   |                  | SECTION VOLUME II |                                                                |
| SL. NO.                                                                           | COMPONENT/OPERATION                          | CHARACTERISTIC CHECK                                                                                     | CAT.                         | TYPE/ METHOD OF CHECK                                     | EXTENT OF CHECK                                      | REFERENCE DOCUMENT                                         | ACCEPTANCE NORM                                                                                | FORMAT OF RECORD                                                            | AGENCY           | REMARKS           |                                                                |
| 1                                                                                 | 2                                            | 3                                                                                                        | 4                            | 5                                                         | 6                                                    | 7                                                          | 8                                                                                              | 9                                                                           | 10               | 11                |                                                                |
| 2.8                                                                               | Outer Sheath Extrusion (No repair permitted) | 1. Surface finish<br>2. Sheath Thickness<br>3. Dia over outer sheath<br>4. Embossing/ Sequential Marking | MA<br><br>CR<br><br>MA<br>MA | Visual<br>Measurement<br>-do-<br>Visual                   | 100%<br>One Sample of each size/ lot<br>-do-<br>100% | Surface shall be smooth<br>Appd. Datasheet<br>-do-<br>-do- | Surface shall be smooth<br>Appd. Datasheet<br>-do-<br>-do-                                     | Inspection Report<br>-do-<br>-do-<br>-do-                                   | 2<br>2<br>2<br>2 | -<br>-<br>-<br>-  | ( Pimple, fish eye, porosity & burnt particles not permitted.) |
| 3.0                                                                               | Finished Cable (INTERNAL)                    | 1. Routine Test (Refer Note-G)                                                                           | CR                           | Electrical Tests & Measurement                            | 100%                                                 | IS 9968 Pt 1 & Approved datasheet                          | IS 9968 Pt 1 & Approved datasheet                                                              | Test Report                                                                 | 2                | -                 | 1                                                              |
| 4.0                                                                               | Final Inspection (EXTERNAL)                  | 1. Finish<br>2. Dimension<br>3. Armouring - Coverage No.of Wires                                         | MA<br>MA<br>MA               | Visual<br>Measurement<br>Visual & Meas.                   | One drum in each Lot<br>-do-<br>-do-                 | IS 9968 Pt 1 & Approved datasheet<br>-do-<br>-do-          | Free from Porosity, Bulging, Burnt particles,lumps, cuts & Approved Data Sheet<br>-do-<br>-do- | Test Report<br>-do-<br>-do-                                                 | 2<br>2<br>2      | 1<br>1<br>1       | -<br>-<br>-                                                    |
| BHEL                                                                              |                                              |                                                                                                          | PARTICULARS                  |                                                           | BIDDER/ VENDOR                                       |                                                            |                                                                                                |                                                                             |                  |                   |                                                                |
|                                                                                   |                                              |                                                                                                          | NAME                         |                                                           |                                                      |                                                            |                                                                                                |                                                                             |                  |                   |                                                                |
|                                                                                   |                                              |                                                                                                          | SIGNATURE                    |                                                           |                                                      |                                                            |                                                                                                |                                                                             |                  |                   |                                                                |
|                                                                                   |                                              |                                                                                                          | DATE                         |                                                           |                                                      |                                                            | BIDDER'S/VENDORS COMPANY SEAL                                                                  |                                                                             |                  |                   |                                                                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                                                                                                                                                                        |                                  |                                                                                                   |                                                                                  |                                                |                                                                                      |                                                                                |                              |                               |                              |                                  |    |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | STANDARD QUALITY PLAN                                                                                                                                                  |                                  | CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD.                                         |                                                                                  | PROJECT TITLE 2 X 800MW UPPUR TPS              |                                                                                      | SPECIFICATION :<br>NUMBER : PE-TS-425-507-E006, R00                            |                              |                               |                              |                                  |    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                                                                                                                                                                        |                                  | BIDDER/ VENDOR :                                                                                  |                                                                                  | QUALITY PLAN<br>NUMBER: PE-QP-999-507-E006, R0 |                                                                                      | SPECIFICATION TECHNICAL SPECIFICATION FOR<br>TITLE EPR INSULATED FIRE SURVIVAL |                              |                               |                              |                                  |    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                                                                                                                                                                        |                                  | SYSTEM                                                                                            |                                                                                  | ITEM : EPR INSULATED FIRE SURVIVAL CABLES      |                                                                                      | SECTION VOLUME II                                                              |                              |                               |                              |                                  |    |
| SL. NO.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | COMPONENT/OPERATION | CHARACTERISTIC CHECK                                                                                                                                                   | CAT.                             | TYPE/ METHOD OF CHECK                                                                             | EXTENT OF CHECK                                                                  | REFERENCE DOCUMENT                             | ACCEPTANCE NORM                                                                      | FORMAT OF RECORD                                                               | AGENCY                       |                               |                              | REMARKS                          |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2                   | 3                                                                                                                                                                      | 4                                | 5                                                                                                 | 6                                                                                | 7                                              | 8                                                                                    | 9                                                                              | 10                           | P                             | W                            | V                                | 11 |
| 5.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Packing             | <b>4. Marking &amp; Colour coding</b><br><br><b>5. Acceptance Tests (Refer Note-G)</b><br><br><b>6. Type Tests (Refer Note-G)</b><br><br><b>Sealing Identification</b> | MA<br><br>CR<br><br>CR<br><br>MA | Visual<br><br>Phy, Elect. Tests<br>FRLS Tests<br><br>Physical &<br>Electrical Tests<br><br>Visual | IS 9968 Pt 1 &<br>Approved datasheet<br><br>Sample #<br><br>Sample #<br><br>100% | -do-<br><br>-do-<br><br>-do-<br><br>As per IS  | IS 9968 Pt 1 & Approved<br>datasheet<br><br>-do-<br><br>-do-<br><br>As per Mfr. Std. | -do-<br><br>-do-<br><br>-do-<br><br>-do-                                       | 2<br><br>2<br><br>2<br><br>2 | 1<br><br>1<br><br>1<br><br>1  | -<br><br>-<br><br>-<br><br>- | # Refer Annexure to QAP enclosed |    |
| NOTES:-<br>(A) JOINTS IN WIRE SHALL BE AS PERMITTED BY IS / BHEL SPECIFICATION, VENDOR TO CERTIFY THE SAME.<br>(B) NO REPAIR OF CORE INSULATION PERMITTED.<br>(C) CABLE ENDS SHALL BE SEALED AS PER APPROVED DATASHEET.<br>(D) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER.<br>(E) FILLERS/DUMMY CORES ETC. SHALL BE AS PER APPROVED DATA SHEET<br>(F) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER BHEL SPECIFICATION.<br>(G) <b>FOR LIST OF ROUTINE, TYPE &amp; ACCEPTANCE TESTS, REFER ANNEXURE TO QAP ENCLOSED.</b> |                     |                                                                                                                                                                        |                                  |                                                                                                   |                                                                                  |                                                |                                                                                      |                                                                                |                              |                               |                              |                                  |    |
| LEGEND : P : PERFORMER    W: WITNESSER    V: VERIFIER    1- BHEL/ CUSTOMER    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 |                              |                                  |    |

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|----------------------------------------------------------------------------------|-----------------|----------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------|
|  | ANNEXURE TO QAP | CUSTOMER: TAMILNADU GENERATION & DISTRIBUTION CORP. LTD. | PROJECT TITLE: 2 X 800MW UPPUR TPS           | SPECIFICATION NUMBER: PE-TS-425-507-E006, R00                                       |
|                                                                                  |                 | BIDDER/VENDOR:                                           | QUALITY PLAN NUMBER : PE-QP-999-507-E006, R0 | SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL CABLES |
|                                                                                  | SHEET 8 of 10   | SYSTEM                                                   | ITEM: EPR INSULATED FIRE SURVIVAL CABLE      | 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 one size / lot.
  - Fire Survival tests at sl.no. 8 to be conducted on all sizes / lot.

### 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 carried out on 1 drum out of every 10 drums in the lot for each type and size of cable.

### 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% drums.

| S. No.     | TEST                                 | APPLICABLE FOR                                | TEST CONDUCTION REQUIRED AS | REFERENCE STANDARD | REMARKS                                                                    |
|------------|--------------------------------------|-----------------------------------------------|-----------------------------|--------------------|----------------------------------------------------------------------------|
| <b>1.0</b> | <b>Tests for Conductor</b>           |                                               |                             |                    |                                                                            |
| I.         | Persulphate test                     | For copper conductor only                     | T                           | IS 10810 Pt 4      |                                                                            |
| II.        | Annealing test                       | For copper conductor only                     | T, A                        | IS 10810 Pt 1      | <i>Internal in process Test Report to be furnished for acceptance test</i> |
| III.       | Conductor Resistance test            | For Cu                                        | T, A, R                     | IS 10810 Pt 5      |                                                                            |
|            |                                      |                                               |                             |                    |                                                                            |
| <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     |                                                                            |

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

|                                                                                  |                 |                                                          |                                              |                                                                                     |
|----------------------------------------------------------------------------------|-----------------|----------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------|
|  | ANNEXURE TO QAP | CUSTOMER: TAMILNADU GENERATION & DISTRIBUTION CORP. LTD. | PROJECT TITLE: 2 X 800MW UPPUR TPS           | SPECIFICATION NUMBER: PE-TS-425-507-E006, R00                                       |
|                                                                                  |                 | BIDDER/VENDOR:                                           | QUALITY PLAN NUMBER : PE-QP-999-507-E006, R0 | SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL CABLES |
|                                                                                  | SHEET 9 of 10   | SYSTEM                                                   | ITEM: EPR INSULATED FIRE SURVIVAL CABLE      | DOC. NO.                                                                            |

| S. No.     | TEST                                                         | APPLICABLE FOR                                                   | TEST CONDUCTION REQUIRED AS | REFERENCE STANDARD              | REMARKS |
|------------|--------------------------------------------------------------|------------------------------------------------------------------|-----------------------------|---------------------------------|---------|
| 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,R                      | 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><u>Test for Fire Barrier Tape</u></b>                     |                                                                  |                             |                                 |         |
| I.         | Test for minimum thickness                                   | Fire barrier tape                                                | T,A                         | IS 10810 Pt 6                   |         |
|            |                                                              |                                                                  |                             |                                 |         |
| <b>4.0</b> | <b><u>Physical Tests for EPR insulation &amp; sheath</u></b> |                                                                  |                             |                                 |         |
| I.         | Material                                                     | Applicable for insulation, HOFR elastomeric inner & outer sheath | T,A                         | IS 9968 Pt 1                    |         |
| II.        | Test for thickness                                           | Applicable for insulation, HOFR elastomeric inner & outer sheath | T,A                         | IS 10810 Pt 6                   |         |
| III.       | Tensile strength and elongation test at break                | Applicable for insulation, HOFR elastomeric inner & outer sheath | T,A                         | IS 10810 Pt 7                   |         |
| IV.        | Ageing in air oven                                           | Applicable for insulation                                        | T                           | IS 10810 Pt 11                  |         |
| V.         | Ageing in air bomb                                           | Applicable for insulation, HOFR elastomeric inner & outer sheath | T                           | IS 10810 Pt 56                  |         |
| VI.        | Hot set test                                                 | Applicable for insulation, HOFR elastomeric inner & outer sheath | T,A                         | IS 10810 Pt 30                  |         |
| VII.       | Oil resistance                                               | Applicable for HOFR elastomeric inner & outer sheath             | T                           | IS 10810 Pt 31                  |         |
|            |                                                              |                                                                  |                             |                                 |         |
| <b>5.0</b> | <b><u>Electrical Tests</u></b>                               |                                                                  |                             |                                 |         |
| I.         | Insulation resistance                                        | Applicable for EPR insulation                                    | T,A                         | IS 10810 Pt 43                  |         |
| II.        | High voltage (Water immersion) test                          | Applicable for HOFR elastomeric Inner & outer sheath             | T,A,R                       | IS 10810 Pt 45                  |         |
| III.       | Water absorption test                                        | Applicable for EPR insulation                                    | T                           | IS 10810 Pt 28                  |         |
|            |                                                              |                                                                  |                             |                                 |         |
| <b>6.0</b> | <b><u>HOFR Tests (On complete cable)</u></b>                 |                                                                  |                             |                                 |         |
| I.         | Oxygen Index test                                            | Applicable for HOFR elastomeric Inner & outer sheath             | T, A                        | ASTMD-2863                      |         |
| BHEL       |                                                              | PARTICULARS                                                      | BIDDER/ VENDOR              |                                 |         |
|            |                                                              | NAME                                                             |                             |                                 |         |
|            |                                                              | SIGNATURE                                                        |                             |                                 |         |
|            |                                                              | DATE                                                             |                             | BIDDER'S / VENDORS COMPANY SEAL |         |

|                                                                                  |                        |                                                          |                                              |                                                                                     |
|----------------------------------------------------------------------------------|------------------------|----------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------|
|  | <b>ANNEXURE TO QAP</b> | CUSTOMER: TAMILNADU GENERATION & DISTRIBUTION CORP. LTD. | PROJECT TITLE: 2 X 800MW UPPUR TPS           | SPECIFICATION NUMBER: PE-TS-425-507-E006, R00                                       |
|                                                                                  |                        | BIDDER/VENDOR:                                           | QUALITY PLAN NUMBER : PE-QP-999-507-E006, R0 | SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL CABLES |
|                                                                                  | SHEET 10 of 10         | SYSTEM                                                   | ITEM: EPR INSULATED FIRE SURVIVAL CABLE      | DOC. NO.                                                                            |

| <u>S. No.</u> | <u>TEST</u>                                                                                  | <u>APPLICABLE FOR</u>                                | <u>TEST CONDUCTION REQUIRED AS</u> | <u>REFERENCE STANDARD</u>  | <u>REMARKS</u>                                                                                             |
|---------------|----------------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------|----------------------------|------------------------------------------------------------------------------------------------------------|
| II.           | Temperature index test                                                                       | Applicable for HOFR elastomeric Inner & outer sheath | T, A                               | ASTMD-2863                 |                                                                                                            |
| III.          | Smoke density test                                                                           | Applicable for HOFR elastomeric Inner & outer sheath | T, A                               | ASTMD 2843                 |                                                                                                            |
| IV.           | Swedish chimney test                                                                         | For complete cable                                   | T, A                               | SEN SS 424 1475 (Class F3) |                                                                                                            |
| V.            | Acid Gas Generation test                                                                     | Applicable for HOFR elastomeric Inner & outer sheath | T, A                               | IEC 60754-1                |                                                                                                            |
| <b>7.0</b>    | <b><u>Flammability Tests</u></b>                                                             |                                                      |                                    |                            |                                                                                                            |
| I.            | Flammability test for bunched cables                                                         | For complete cable                                   | T                                  | IEC-60332 (Part-3) CAT-B   | Refer Notes 1,2 & 3                                                                                        |
| II.           | Flammability test for single cable                                                           | For complete cable                                   | T                                  | IEC:60332 Part-1           |                                                                                                            |
| III.          | Flammability test                                                                            | For complete cable                                   | T                                  | IEEE: 60383                |                                                                                                            |
| <b>8.0</b>    | <b><u>Fire Survival Test</u></b>                                                             | For complete cable                                   | T                                  | IEC-60331                  |                                                                                                            |
| <b>9.0</b>    | <b><u>Toxicity Index (max 5%)</u></b>                                                        |                                                      | T                                  | NES 713                    | <b><u>Acceptance Criteria: Material Certificate or availability of facility for conduction of test</u></b> |
| <b>10.0</b>   | <b><u>Corrosive Gases Test (pH &gt; 4.3 &amp; conductivity &lt; 100 microSiemens/cm)</u></b> |                                                      | T                                  | IEC 60754-2                |                                                                                                            |
| <b>11.0</b>   | <b><u>Anti-rodent and Termite Repulsion test</u></b>                                         | For outer sheath only                                | A                                  | --                         |                                                                                                            |

Notes:

1. This test shall generally be carried out as per IEEE 383. The cable installation to be tested shall consist of as many cables as are necessary to give at least 10 kg of organic material per metre run.
2. The following cable installation shall be tested: Installation with single / multi core cables in touching formation.
3. Size of cables, number of cables, number of layers and laying arrangements for each installation shall be subject to BHEL / Customer's approval.

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