

# मध्यम एवं उच्च वोल्टेज केबल तथा सहायक सामग्री के लिए निरीक्षण व परीक्षण योजना

## INSPECTION AND TEST PLAN FOR MEDIUM AND HIGH VOLTAGE CABLES & ACCESSORIES

|          |            |                           |             |            |                              |                           |
|----------|------------|---------------------------|-------------|------------|------------------------------|---------------------------|
| 3        | 30.01.2014 | Revised and Reissued      | MJ          | RS         | SGG                          | SC                        |
| 2        | 15.07.2011 | Revised and Re-issued     | AB          | RJD        | AKC                          | DM                        |
| 1        | 28.09.07   | Revised and Re-issued     | AKG         | PPM        | MVKK                         | VC                        |
| 0        | 30.04.02   | Issued for implementation | RG          | AKC        | AKB                          | GRR                       |
| Rev. No. | Date       | Purpose                   | Prepared by | Checked by | Standards Committee Convenor | Standards Bureau Chairman |
|          |            |                           |             |            | Approved by                  |                           |



## 1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of PVC, XLPE insulated cables and cable jointing/terminating accessories for high and medium voltage systems.

## 2.0 REFERENCE DOCUMENTS:

PO/PR / Standards referred there in /Job specifications / Approved documents.

## 3.0 INSPECTION AND TEST REQUIREMENTS:

| SL NO. | STAGE/ ACTIVITY                                                            | CHARACTERISTICS                                                                                                                                         | QUANTUM OF CHECK                                           | RECORD                                                                | SCOPE OF INSPECTION |          |          |
|--------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------|---------------------|----------|----------|
|        |                                                                            |                                                                                                                                                         |                                                            |                                                                       | SUB SUPPLIER        | SUPPLIER | EIL/TPIA |
| 1.0    | Procedures                                                                 | --                                                                                                                                                      | --                                                         | --                                                                    | --                  | --       | --       |
| 2.0    | Material Inspection                                                        |                                                                                                                                                         |                                                            |                                                                       |                     |          |          |
| 2.1    | Incoming raw material like Copper, Aluminum, PVC, XLPE, Galvanized Armour. | Purity, Dimensions, Physical and Chemical Properties.                                                                                                   | 100%                                                       | Material Test Certificates/ Test Records/Third Party Lab certificates | H                   | H        | R        |
| 3.0    | Inprocess Inspection                                                       |                                                                                                                                                         |                                                            |                                                                       |                     |          |          |
| 3.1    | Inspection during insulation, sheathing                                    | Spark test, thickness of insulation, Conductor Resistance                                                                                               | 100%                                                       | Test Records                                                          | --                  | H        | R        |
| 4.0    | Final Inspection                                                           |                                                                                                                                                         |                                                            |                                                                       |                     |          |          |
| 4.1    | Finished Cable                                                             | Visual, Drum details, Size, Ends Capping, Marking on outer sheath (such as Incremental Length, Voltage grade, manufacturer's name), Colour coding, etc. | 100% for Drum details and Sample drums for balance details | Test Records                                                          | -                   | H        | H/R**    |

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| SL NO. | STAGE/ ACTIVITY                   | CHARACTERISTICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | QUANTUM OF CHECK                                                                                                                                        | RECORD                  | SCOPE OF INSPECTION |          |          |
|--------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------------|----------|----------|
|        |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                         |                         | SUB SUPPLIER        | SUPPLIER | EIL/TPIA |
| 4.2    | Finished Cable(Routine Tests)     | <ul style="list-style-type: none"> <li>Conductor Resistance.</li> <li>High Voltage</li> <li>Partial Discharge (for XLPE only)</li> <li>Check calibration status of all testing equipment.</li> <li>Dimension checks – overall dia, over/under armour, thickness of insulation, sheath, copper screen dimension, etc.</li> <li>Conductor Resistance</li> <li>Insulation resistance /Volume resistivity</li> <li>High Voltage tests</li> <li>Partial Discharge(for XLPE)</li> <li>Hot Set (for XLPE insulation)</li> <li>Tests on Conductor as applicable</li> <li>Tests on PVC/XLPE Insulation &amp; Sheath *</li> <li>Armour Galvanization - dip test</li> <li>Volume resistivity, Insulation resistance</li> <li>Tensile and elongation (without ageing )</li> </ul> | 100%                                                                                                                                                    | Supplier's Test Records | -                   | H        | H/R**    |
| 4.3    | Finished Cable (Acceptance tests) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | As per sampling plan                                                                                                                                    | Inspection Test Records | -                   | H        | H/R**    |
| 4.4    | Finished Cable (Special tests)    | <ul style="list-style-type: none"> <li>Flammability test as per applicable specification.</li> <li>Accelerated water absorption test as per NEMA(Electrical method ) #</li> <li>Test for resistance to Ultra Violet Radiation #</li> <li>Oxygen Index test as per IS /IEC</li> <li>Rodent &amp; Termite repulsion check</li> <li>Drum length /surface finish check by re-winding</li> <li>Test for circuit integrity for fire survival cables as per IEC(If applicable )</li> </ul>                                                                                                                                                                                                                                                                                   | 1 sample/size/ lot<br>1 sample /order<br>1 sample/order<br>1 sample/ order<br>1 sample/size/ lot<br>1 sample/ lot<br>1 or 2 drums/ lot<br>1 sample/ lot | Inspection test records |                     | H        | H/R**    |

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| SL NO. | STAGE/ ACTIVITY                   | CHARACTERISTICS                                                                                                                                                                                                                                                                                                                                         | QUANTUM OF CHECK | RECORD                                      | SCOPE OF INSPECTION |          |          |
|--------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------|---------------------|----------|----------|
|        |                                   |                                                                                                                                                                                                                                                                                                                                                         |                  |                                             | SUB SUPPLIER        | SUPPLIER | EIL/TPIA |
| 4.5    | Finished Cable<br>(Type tests **) | <ul style="list-style-type: none"> <li>Dielectric Retention.</li> <li>Type tests on PVC insulation and Sheath</li> <li>High Voltage test (Water Immersion)</li> <li>Dielectric power factor tests as function of voltage, temperature. (XLPE cables)</li> <li>Heating cycle test (XLPE Cables)</li> <li>Impulse withstand test (XLPE cables)</li> </ul> | Sample           | Test Records                                |                     | H        | R        |
| 4.6    | Cable accessories                 | <ul style="list-style-type: none"> <li>Visual</li> <li>Dimensions</li> <li>Type tests** as per IS/IEC</li> </ul>                                                                                                                                                                                                                                        | Sample           | Test Records                                |                     | H        | R        |
| 5.0    | Painting                          | --                                                                                                                                                                                                                                                                                                                                                      | --               | --                                          | --                  | --       | --       |
| 6.0    | Documentation and IC              |                                                                                                                                                                                                                                                                                                                                                         |                  |                                             |                     |          |          |
| 6.1    | Documentation and IC              | <ul style="list-style-type: none"> <li>Review of Routine, Acceptance, Type test reports.</li> <li>IC issuance</li> </ul>                                                                                                                                                                                                                                | 100%             | Supplier TC & IC                            | -                   | -        | H        |
| 6.2    | Final Document submission         | Compilation of Inspection reports ,drawings, etc as per VDR / PR                                                                                                                                                                                                                                                                                        | 100%             | Final data folder /Completeness certificate | -                   | H        | H        |

# In case TC (not older than one year) from independent test lab is available & type of compound used is same then the same may be accepted.

\* Hot deformation, Heat shock and Shrinkage tests on insulation & sheath (One sample/Lot) shall be witnessed by EIL/TPIA, all other tests as per IS/IEC shall be carried out by supplier and test reports shall be reviewed by EIL/TPIA.

\*\* EIL witness for HT cables only

Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

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**NOTES :-**

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents



## **GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN**

PAGE 1 OF 2

1. QAP shall be made in landscape mode on A4 size paper as per the format enclosed.  
Font size shall be minimum 10.
2. Each page of QAP shall contain the following information.
  - a) Vendor's name & address.
  - b) Customer: BHEL, Hyderabad.
  - c) Project.
  - d) BHEL Product Standard Number/revision number as referred in P.O.
  - e) BHEL Purchase Order Number & Date.
  - f) Product as per P.O. description.
  - g) QAP Number (unique and shall not repeat)/revision number/date.
  - h) Page number and number of pages
3. QAP shall contain four parts / stages as follows.
  - A) Raw materials and bought out items.
  - B) Inprocess Control / Inspection.
  - C) Final assembly, Inspection & Testing.
  - D) Painting, preservation & packing.
4. Under 'Component', indicate name of the component (say casing, rotor, pressure gauge, etc).
5. Under 'Characteristics', indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc), Hydrostatic test, calibration check etc.)
6. Under 'Class', indicate minor, major or critical depending on the importance of characteristic.
7. Under 'Type of check', indicate appropriately (say chemical, mechanical, UT, DP etc.)
8. Under 'Quantum of check', indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.)
9. Under 'Reference document' and 'Acceptance norms', appropriate National & International standards, BHEL standards, approved drg references etc should be indicated. It is not correct to mention as "Vendor's internal standards or Vendor's standard practise etc". If vendors' internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review & approval by our Engineering dept.
10. Under 'Format of record', indicate appropriately supplier's Test certificate, calibration certificate, lab report, inspection report etc.
11. Please refer 'Agency' in QAP format.  
"Under P: Perform, W: Witness, V: Verify  
Indicate against each characteristic 1: (BHEL CQS/Nominated inspection agency), OR  
2: (Vendor / Sub vendor)  
Note: Performing agency is normally vendor or his sub vendor (Legend 2). Where witness points are indicated in specification, P.O., Drawing etc., for such operations, under Witness (W) column use 1. Under 'Verify' column, use code 1
12. Under 'D' please put (4 Tick) against each characteristic where vendor proposes to submit test certificate/report etc OR as required as per BHEL Spec.
13. Vendor's signature & stamp should be available on each page of QAP.
14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification & Approved Drgs.

## **GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN**

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15. The following operations/characteristics/check points may be included (**AS APPROPRIATE**)

- a) Visual check
- b) Dimensional check
- c) Mechanical and Chemical properties.
- d) Surface preparation before painting (by chemical cleaning, sand blasting, shot blasting etc as the case may be.)
- e) Painting check for shade, Dry Film Thickness (DFT), Adhesion/ peeloff test etc.
- f) Check for correctness for all components mounted as per General arrangement Drg, Bill Of Materials (BOM), etc for range, rating, make, color, size, location as per GA, quantity, label description including tag nos., annunciator facia, loose components, accessories, spares etc.
- g) Verification of test certificate for protection class for the enclosures.
- h) Mechanical functioning of switches.
- i) Continuity of earthing and provision of earth points.
- j) Colour coding of wiring, size, tightness & dressing of wiring.
- k) Review of test certificates of assembled items, raw materials, internal test reports etc.
- l) Witness of functional checks, which may include mechanical run & electrical run, H.V.test, IR measurement, Electrical and Mechanical tests etc.
- m) PQR, WPS, Welder Qualification Record, welding records (fitup, DP) etc.
- n) Material identification ( for punch marks of serial numbers, Heat No, Melt No, Inspector's stamp etc)
- o) Hydraulic Pressure Test, Pneumatic Pressure Test, Liquid Penetration Examination and other Non Destructive Tests.
- p) Tests on Galvanised items (Visual, Hammer Test, Knife Test, Thickness, Preece Test (Copper sulphate test), Hydrogen evaluation test, Stripping test (for Mass of Zinc coating)
- q) All tests as per BHEL Product Standard & approved drawings including Type tests and Routine tests on individual items and on System as a whole.
- r) Packing and Preservation.