##### Annexure – ‘B’

1. **SCOPE:**

This specification covers the design, manufacture, testing and supply of 11KV Composite Polymer Disc Insulators ball and socket type with hardware fittings shall be of the following type:

* 1. **Long rod insulators ball and socket type** for ACSR conductors in **tension application** at dead end/angle/cut point.
  2. The Bidder should be original manufacturer of the composite insulators and shall have all the facilities to manufacturing and in house testing or their product.

##### This will be pre-qualifying requirement as a “Bidder”.

1. **SERVICECONDITIONS**

The composite insulators to be supplied against this specification shall be suitable for satisfactory continuous operation under following tropical conditions.

|  |  |
| --- | --- |
| Maximum ambient temperature (Degree C) | 50 |
| Minimum ambient temperature (Degree C) | 3.5 |
| Relative Humidity (%) | 10 to 100 |
| Maximum Annual Rainfall (mm) | 1450 |
| Maximum Wind pressure (kg/m.sq.) | 150 |
| Maximum wind velocity (km/hour) | 45 |
| Maximum altitude above mean sea level (meter) | 1000 |
| Isoceraunic level (days/year) | 50 |
| Seismic level (Horizontal acceleration) | 0.3 g |
| Moderately hot and humid tropical climate Conductive to rust and fungus growth |  |

##### SYSTEMPARTICULARS

|  |  |  |
| --- | --- | --- |
| 1 | Nominal system voltage | 11 KV (rms) |
| 2 | Highest System voltage | 12 KV (rms) |
| 3 | Visible discharge test voltage | 9 KV (rms) |
| 4 | Frequency | 50 HZ with ± 3 % tolerance |
| 5 | Neutral Earthing | Effectively Grounded |
| 6 | Number of phases | 3 |

1. **STANDARDS:**

Following Indian/International Standards, which shall mean latest revision, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification, shall be referred while accessing conformity of Insulators with these specifications.

|  |  |  |  |
| --- | --- | --- | --- |
| Sr.  No. | Indian Standard | T | International Standard |
| 1 |  | Definition, test methods it nd acceptance  a  criteria for composite Insuelators for a. c. overhead | IEC:61109 |
| 2 | IS: 731 | Porcelain insulators for overhead power lines with a nominal voltage greater than  1000V. | IEC: 60383 |
| 3 | IS:2071 | Methods of High Voltage Testing. | IEC:60060-1 |
| 4 | IS:2486 | Specification for Insulator fittings for  overhead power lines with a nominal voltage greater than 1000V General  Requirements and Tests Dimensional Requirements locking devices. | IEC:60120 IEC:60372 |
| 5 |  | Thermal Mechanical performance test and  mechanical performance test on string Insulators units. | IEC:60575 |
| 6 | IS: 13134 | Guide for the selection of insulators in respect of  polluted condition |  |
| 7 |  | Characteristics of string insulator units of the long rod  type |  |
| 8 |  | Hydrophobicity Classification Guide. | STRI guide 1.92/1 |
| 9 |  | Radio interference characteristics of  overhead power lines and high voltage equipment. | CISPR 18.2  Part 2 |
| 10 | IS:8263 | Methods of RI Test of HV Insulators. | IEC:60437 |
| 11 |  | Standard for Insulators- Composite- Distribution Dead-end Type. | ANSI C 29.13-2000 |
| 12 | IS:4759 | Hot dip zinc coatings on structural steel & other allied products. | ISO:1459 |
| 13 | IS:2629 | Recommended practice for Hot Dip galvanization for iron and steel | ISO:1461(E) |
| 14 | IS:6745 | Determination of weight of zinc coating on zinc coated Iron and steel articles. | ISO:1460 |
| 15 | IS:3203 | Methods of testing of local thickness of electroplated coatings. | ISO:2178 |
| 16 | IS:2633 | Testing of Uniformity of coating of zinc coated articles. |  |
| 17 | - | Standard specification for glass fiber standards. | ASTM D 578-05 |
| 18 | - | Standard specification for compositional analysis by Thermo-gravimetery. | ASTM E 1131-03 |
| 19 | IS:4699 | Specification for refined secondary zinc |  |

##### GENERAL REQUIREMENTS

* 1. The Composite insulators will be used on lines on which the conductor will be ACSR of size up to 200 S q . m m and ACSR of any size up to panther (0.2 sq. inch copper equivalent). The insulators should withstand the conductor tension, the reversible wind load as well as the high frequency vibrations due to wind.
  2. Insulator shall be suitable for 3-ph 50 Hz effectively earthed 11KV Overhead distribution system in a moderately/heavily polluted atmosphere. **Long road insulators shall be of ball & socket type as specified.**
  3. Bidder must be an indigenous manufacturer and supplier of composite insulators of rating 11KV or above OR must have developed proven in house technology and manufacturing process for composite insulators of above rating OR possess technical collaboration /association with a manufacturer of composite insulators of rating 11KV or above. The Bidder shall furnish necessary evidence in support of the above along with the bid, which can be in the form of certification from the utilities concerned, or any other documents to the satisfaction of the owner.
  4. Insulator shall be suitable for the strain type of load & shall be of Ball & Socket type for long Rod Type. The diameter of Composite Insulator shall be less than 200mm. The center-to- center distance between Ball &socket shall be max. 300mm for 11KV composite insulator.
  5. Insulators shall have sheds with good self-cleaning properties. Insulator shed profile, spacing, projection etc. and selection in respect of polluted conditions shall be generally in accordance with the recommendation of IEC- 60815/IS: 13134.
  6. The type/size of composite insulator, minimum Creepage distance and mechanical strength along with hardware fittings shall be as follows

|  |  |  |
| --- | --- | --- |
| 1 | Type of Composite insulators | B&S Type long Rod Insulators |
| 2 | Nominal system voltage | 11 KV (rms) |
| 3 | Highest System voltage | 12 KV (rms) |
| 4 | Visible discharge test voltage | 9 KV (rms) |
| 5 | Mechanical characteristic | Min. failing load:45KN |
| 6 | Minimum Creepage distance (mm) | 320mm |
| 7 | Wet power frequency withstand voltage | 45 KV(rms) |
| 8 | Dry lighting Impulse withstand voltage | 1. Positive 75KV 2. Negative: 75KV |
| 9 | Pin Ball shank diameter | 16mm |

* 1. Dimensional Tolerance of Composite Insulators **:**

The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows in line with IEC61109: ± {0.04d+1.5) mm when d<300 mm,

± (0.025d+6J mm when d>300 mm.

Where, d being the dimensions in millimeters for diameter, length or Creepage distance as the case may be. However, no negative tolerance shall be applicable to Creepage distance.

##### Interchangeability:

The composite insulators including the end fitting connection shall be of standard design suitable for use with the hardware fittings of any other indigenous make conforming to relevant IEC/IS standards.

##### Corona and Rl Performance:

All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized

pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not

generate any radio interference beyond specified limit under the operating conditions.

##### TECHNICAL DESCRIPTION OF COMPOSITE INSULATORS

* 1. Composite Insulators shall be designed to meet the light quality, safety and reliability and are capable of withstanding a wide range of environmental conditions.

##### Core- the internal insulating part

* + 1. **Housing – the external insulating part.**
    2. **Metal and fittings – for attaching to hardware to support conductor.**
  1. **CORE**

It shall be a glass-fiber reinforced epoxy resin rod of high strength (FRP rod). Glass fibers and resin shall be optimized in the FRP rod. Glass fibers shall be Boron free electrically corrosion resistant (ECR) glass fiber or Boron free E-Glass and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP shall be manufactured through Pultrusion process. The FRP rod shall be void free.

##### HOUSING (Sheath)

The FRP rod shall be covered by a seamless sheath of a silicone elastometric compound or silicone alloy compound of a thickness of 3 mm minimum. It shall be one-piece housing using injection Molding Principle to cover the core. The elastomer housing shall be designed to provide the necessary creepage distance and protection against environmental influences, external pollution and humidity.

Housing shall conform to the requirement of IEC 61109/92-93 with latest amendments.

It shall be extruded or directly molded on core and shall have chemical bonding with the FRP rod. The strength of the bond shall be greater than the tearing strength of the polymer. Sheath material in the bulk as well as in the sealing/bonding area shall be free from voids. Manufacturer should furnish a description of its quality assurance programme including fabrication; testing and inspection for any material (i.e rubber). Components (i.e rod) or hardware (i.e. end filings). The manufacturer has had fabricated by others should also be included. Manufacturing methods and material composition documentation will be a part of Technical Bid to be submitted along with offer.

##### WEATHERSHEDS

The composite polymer Weathersheds made of silicone elastometric compound or silicon alloy shall be firmly bonded to the sheath, vulcanized to the sheath or molded as part of the sheath and shall be free from imperfections. The weathersheds should have silicon content of minimum 43% by weight. The strength of the weathershed to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath (housing) shall be free from voids.

##### METAL AND FITTINGS:

End fittings transmit the mechanical load to the core. They shall be made of S G Iron or malleable cast iron or forged steel, Metal end fittings shall be suitable for Ball and socket type hardware of respective specified mechanical load and shall be hot dip galvanized in accordance with IS 2629. The material used in fittings shall be corrosion resistant.

Metal end fittings shall be uniform and without sharp edges or corners and shall be free of cracks, flakes, silvers, slag, blow-holes shrinkages defects and localized porosity. They shall be connected to the rod by means of a controlled compression technique. As the main duty of the end fittings is the transfer of mechanical loads to the core the fittings should be property attached to the core by a coaxial or hexagonal compression process and should not damage the individual fibers or crack the core.The gap between fittings and sheath shall be sealed by flexible silicone elastometric compound or silicone alloy compound sealant, system of attached of end fitting to the rod shall provide superior sealing performance between housing, i.e. seamless sheath and metal connection. The sealing must be moisture proof.The dimensions of end fittings of insulators shall be in accordance with the standard dimensions stated in IEC: 60120/IS:2486 – Part- II/1989.

Nominal dimensions of the ball and socket insulator shall be in accordance with the standard shown at Sr. No.4.0. No joints in ball and socket or pin will be allowed. Outer portion of ball or socket should be Zinc Sleeved with minimum 99.95% purity of electrolytic high grade Zinc.

The finished surface shall be smooth and shall have a good performance. The surface shall not crack or get chipped due to ageing effect under normal and abnormal service conditions or while handling during transit or erection.

The design of the fittings and the insulators shall be such that there is no local corona formation or discharges likely to cause the interference to either should or vision transmission.

The insulators shall have “W” type phosphors Bronze or R type Stainless steel security clips for ball

sockets portion of insulators confirming to IS-2486.

* 1. WORKMANSHIP**:**
  2. All the materials shall be of latest design and conform to the best engineering practices adopted in the high voltage field. Bidders shall offer only such Insulators as are guaranteed by them to be satisfactory and suitable for continued good service in power transmission lines.
  3. The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners.
  4. The design of the Insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.
  5. The core shall be sound and free of cracks and voids that may adversely affect the Insulators.
  6. Weather sheds shall be uniform in quality. They shall be clean, sound, smooth and shall be free from defects and excessive flashing at parting lines.
  7. End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively sealed to prevent moisture ingress; effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth with out projecting points or irregularities, which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.
  8. All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/Sq.m, or 87µ m thickness and shall be in accordance with the requirement of IS:4759, The zinc used for galvanizing shall be of purity 99.5% as per IS: 4699. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand at least four successive dips each lasting for one H) minute duration under the standard preece test. The galvanizing shall be carried out only after any machining.

##### DESIGN TESTS:

For polymeric insulators it is essential to carry out design test as per clause 4.1 of IEC 61109 / 92- 93 with latest amendments. The design tests are intended to verify the suitability of the design, materials and method of manufacture (technology). When a composite insulator is subjected to the design tests, the result shall be considered valid for the whole class of insulators, which are represented by the one tested and having the following characteristics:

* + - Same materials for the core, and sheds and same manufacturing method.
    - Same material of the fittings, the same design, the same method of attachment.
    - Same or greater layer thickness of the shed material over the core(including a sheath where used).
    - Same or smaller ratio of the highest system voltage to insulation length.
    - Same or smaller ratio of all mechanical loads to the smallest core diameter between fittings.
    - Same or greater diameter of the core.

The tested composite insulators shall be identified by a drawing giving all the dimensions with the manufacturing tolerances.

##### TYPE TESTS:

The type tests are intended to verify the main characteristics of a composite insulator. The type tests shall be applied to composite

insulators, the class of which has passed the design tests. Following type test shall be conducted on a suitable number of individual insulator units, components, materials or complete strings.

|  |  |  |
| --- | --- | --- |
| SN | Description of type test | Ten procedure/standard |
| 1. | Dry lightning impulse withstand voltage test | As per IEC 61109 (clause 6.1) |

|  |  |  |
| --- | --- | --- |
| 2. | Wet power frequency test | As per IEC 61 109 (clause 6,2) |
| 3. | Mechanical failing load test | As per IS:731 (Clause-10.8.2) |
| 4. | Radio interference test | As per IEC 61109 (clause 6.4) |
| 5. | Recovery of Hydrophobicity test | Annexure-B  This test may be repealed every 3 yrs by the manufacturer |
| 6. | Chemical composition test for silicon content | Annexure-B  Or any other test method acceptable to the owner |
| 7. | Brittle fracture resistance test | Annexure - B |

The bidder shall submit type test reports as per IEC 61109 from NABL approved laboratory along with the bid. Additional type tests required if any shall be carried out by the manufacturer, after award of contract for which no additional charges shall be payable. In case, the tests have already been carried out, the manufacturer shall submit reports for the same.

##### ACCEPTANCE(SAMPLE)TESTS:

The test samples after having withstood the routine test shall be subjected to the following acceptance tests:

|  |  |  |
| --- | --- | --- |
| a. | Verification of dimensions | Clause 7.2 IEC: 61109 |
| b. | Verification of the locking system (if applicable) | Clause 7.3 IEC: 61 109 |
| c. | Galvanizing test | IS:2633/IS:6745 |
| d. | Verification of the specified mechanical load | Clause 7.4 IEC: 611 09 /  IS:731 |

##### ROUTINE TESTS:

|  |  |  |
| --- | --- | --- |
| SN | Description | Standard |
| 1. | Identification of marking | As per IEC: 61 109 Clause 8.1 |
| 2. | Visual Inspection | As per IEC 61 109 Clause 8.2 |
| 3. | Mechanical routine test | As per IEC:61109 Clause 8.3 |

Every polymeric insulator shall withstand mechanical routine test at ambient temperature tensile load at RTL corresponding to at least 50% of the SML for at least 10 sec.

##### TESTS DURING MANUFACTURING

Following tests shall also be carried out on all components as applicable:

1. Chemical analysis of zinc used for galvanizing
2. Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.
3. Chemical analysis, hardness tests and magnetic particle inspection for forgings.

##### ADDITIONAL TESTS:

The Purchaser reserves the right of getting done any other test(s) of reasonable nature carried out at Purchaser’s premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material comply with the specifications. In such case all the expenses will be to Suppliers account.

##### TEST CERTIFICATE:

The tenderer shall furnish detailed type test reports of the offered composite Insulators as per clause

8.2 of the Technical Specifications from the NABL laboratory to prove that the composite Insulators offered meet the requirements of the specification.

1. The offered composite Insulators are already fully type tested at approved Laboratory within five years prior to the date of opening of this tender.
2. There is no change in the design of type-tested composite Insulators and those offers against

this tender.

##### TESTING FACILITIES :

The following additional facilities shall be available at Supplier’s works:

* 1. The tenderer must clearly indicate what testing facilities are available in the works of the manufacturer and whether facilities are adequate to carryout all Routine & acceptance Tests. These facilities should be available to JBVNL’s Engineers if deputed or carry out or witness the tests in the manufacturer works. If any test cannot be carried out at the manufacturer’s work, the reasons should be clearly stated in the tender.
  2. The insulators shall be tested in accordance with the procedure detailed in IEC 61109/92-93 with latest amendments.
  3. Calibration Reports from Government approved testing laboratory of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burelle, thermometer, barometer etc.
  4. Finished insulator shall be checked for dimension verification and surface finish separately. Manufacturers of foreign origin shall, in addition to the above, also have arrangements in India, either at works of their authorized representative/ licenses or in the NABL laboratory for conducting sampling test in accordance with IEC 81109/92-93 with latest amendments.

##### DRAWINGS:

The schematic drawing of the composite long rod (B&S) insulator is attached herewith for reference, the bidder has to submit their own drawing as under:

* 1. The Bidder shall furnish full description and illustration of the material offered.
  2. The Bidder shall furnish along with the bid the outline drawing (3 copies) of each insulator unit including a cross sectional view of the long rod insulator unit. The drawing shall include but not be limited to the following information.
     1. Long rod diameter with manufacturing tolerances.
     2. Minimum Creepage distance with positive tolerance.
     3. Protected creepage distance.
     4. Eccentricity of the long rod
        1. Axial run out. (ii)

Radial run out

* + 1. Unit mechanical and electrical characteristics.
    2. Size and weight of ball and socket. (g) Weight of composite long rod units. (h)

Materials

1. Identification mark.
2. Manufacturer’s catalogue number

##### 12.0 GALVANIZINGTEST:

This test shall be performed according to IS: 2633/IS: 6745 on galvanized parts.

##### PACKING:

1. **All insulators shall be packed in strong wooden crates**. The gross weight of the crates along with the material shall not normally exceed 100 Kg. to avoid handling problem. The crates shall be suitable for outdoor storage under wet climate during rainy season.
2. The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
3. Suitable cushioning, protective padding of dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.
4. All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing

C:\Uasnerds\jfsaeub\lDtyesoktroipl\lTeEgNibDlEeRm4IaTrEkMinSg\ste.nEdaerc7h2.dwoco1o9den case/crate shall have all the markings stenciled on it in

indelible ink.

1. The bidder shall provide instructions regarding handling and storage precautions to be taken at site.

##### INSPECTION:

Party has to offer the materials for inspection duly packed in crates as mentioned in GTP. The inspection approval is valid for a period of 15 days from the date of inspection to enable the firm to dispatch the materials by arranging transportation at destination allotted thereof within the said period. After this period of 15 days, the validity of the inspection will lapse. Thereafter, the inspection approval will be revalidated by competent authority on furnishing written application explaining there in the valid reasons for delay in affecting dispatches.

The firms shall not dispatch the offered lot unless the same is inspected by the inspector of JBVNL and accepted by him after passing in all acceptance tests, and/or receipt of arrival of inspection in writing from competent authority of JBVNL.

**SPECIFICATION FOR HARDWARE FITTINGS SUITABLE FOR TENSION STRING**

**TO BE USED FOR 11KV (3 bolt type)**

All the hardware fittings shall be confirm IS 2486(Part II) -1989 and shall be ball and socket type

1. one pair of mild steel cross arm straps confirming to IS 2486(Part II) -1989 and REC specification No.3/1971(Rev-1993).
2. One hexagonal headed bolt with length 145 mm & 16 mm dia, with 1 No. nut, one No. flat washer of 16mm dia. and 3 mm thickness and 1 No. Split pin of 4 mm dia. conforming to IS 1363(Part-1)1992.
3. One No. forged steel ball eye 16mm suitable for attaching the socket end of the strain insulator to the cross arm strap. Forgings shall be made of steel as per IS 2004-1991. The ball eye shall also be conforming to REC specification No.3/1971(Rev.1993) with this. One no. MS Pin (rivet) of 55mm length 16mm dia along with one no. Spring washer of 3 mm thickness and 1 no. Split pin of 4 mm dia. is to be supplied.
4. One No. aluminium alloy socket made out of permanent mould cast, high strength aluminium alloy for attaching to the strain insulator on one end and for accommodating the helically formed dead-end fittings at the other end in its smooth internal contour. The socket shall be attached to the strain insulator with the help of ‘w’ clip as per IS 2486 (Part II) 1989.
5. 1 No. U bolt with dimension 62mmx12mm with 2 Nos. 12 mm nuts, 2 Nos. flat washer of 2 mm thickness and, 2 Nos. spring washers of 2.5mm thickness and one No. keeper piece of aluminium alloy suitable to U bolt
6. The minimum breaking strength of alloy socket shall be 4500 KG.

VI I Strain clamp shall confirm IS 2486(Part II) -1989 **3 Bolt aluminium alloy** “**type A**” and as per Drawing given.

### Ball & Socket type Hardware fittings (Conversional) for B & S type Strain Insulators

The hardware fittings (Ball and Socket type) shall be suitable for fixing on 100 mm x 50 mm channel cross arms and for accommodation of 55 mm² / 100 mm² Conductor. The set shall complete with following components.

* 1. Cross-arms straps with Bolts & Nuts, Brass split and Spring Washer.
  2. Two numbers forged cotter pins, Brass split pins, Plain washer.
  3. One number Ball Eye of malleable cast iron
  4. One number of socket eye complete with security clips made of Phosphor bronze made cut of aluminium alloys-A/6.
  5. Strain clamps shall be suitable for above ACSR / AAAC. The ultimate strength of

clamp should not be less than 4500Kg and Slipping strength shall not be less than 90% of these figures.

* 1. All ferrous parts shall be hot dip galvanised as per ISS-2633/1986. However spring washer shall be electro-galvanised.

1. ROUTINE TEST

The following routine tests shall be carried out on each insulator fitting by the manufacturer.

* 1. Visual examination.
  2. Mechanical routine test.

The supplier shall maintain the record of such tests carried out on each fitting and shall submit the records to Inspector, whenever required by him.

D ACCEPTANCE TESTS

Following tests will be carried out on the offered lot by the supplier in the presence of Inspector of JBVNL. All tests will be carried out at the works of the suppliers at the cost of supplier. In case testing facilities are not available then it shall be at the discretion of JBVNL to agree to the request for testing at other place, however for this, a prior permission has to be obtained for the same. & then the tests shall be carried out at any Govt. approved laboratory in presence of inspector.

1. Verification of dimensions within the limit of specified tolerance as per relevant
2. Mechanical failing load test as per IS 2486 Part I or latest version thereof.
3. Mechanical slip strength on clamp as per IS 2486-1993 Part I or latest version thereof.
4. Galvanising test as per IS 2633/1986 or latest version thereof.

Sample criteria shall be in accordance with IS 2486 Part I or latest revision thereof. Samples for inspection shall be randomly selected from the offered lot & the same shall be inspected & tested in presence of JBVNL Inspector. However if any sample fails, then further action shall be taken as per Section B-1 of Annexure-B of IS 2486 Part I 1993.

E. PACKING

The hardware fittings shall be packed in double gunny bags in 25 sets. Gunny bags should withstand the weight of the hardware fittings and should not become loose or torn out during transportation. Further on each gunny bag, supplier shall make arrangement for providing suitable seal wire to enable the JBVNL Inspector to fix identification seal for the inspected lot. Unless the materials are inspected and accepted by the Inspector and/ or waival of the testing or delivery instructions are received in writing material, shall not be dispatched by the supplier.