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TECHNICAL SPECIFICATIONS OF

11 kV/33 kV Disc Insulator

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This Tender Specification for procurement of 11kV/33 kV Disc insulators for Overhead Power Lines may be subjected to the modification by the purchaser as per actual field requirement. Supplier to submit the Guaranteed Technical Particulars (GTP) and Drawings, after the award of the contract, for approval of the purchaser.

1. CLIMATIC AND ISOCERAUNIC CONDITIONS (CIC).

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

1.1 Maximum Temperature of Air in sun : 45 ° C

1.2 Maximum Temperature of Air in Shade : 30.6 ° C

1.3 Minimum Temperature of Air in shade : - 20 ° C

1.4 Average daily ambient Air Temperature : 30° C

1.5 Relative humidity : 15% to 90%

1.6 Average rainfall per annum : 800 mm

1.7 Approx. altitude above mean sea level : 1600 Mtrs

1.8 Isoceraunic level (Days/Year) (i.e. Average number of Thunderstorm): 54

1.9 Wind Zone : WZ-3

1.10 Seismic Zone i.e. SZ-5

1.11 Climate: HSZ (Heavy Snow Zone)

1.12 Average Number of Rainy Days Per Year :- 106

2. COMMUNICATION AND TRANSPORT:

The nearest railway station is Jammu on the broad gauge line and is connected to the Divisional Stores by a metal road. The equipment is required to pass en-route through various tunnels on NH-44 (Nandni, Nashri and Jawahar Tunnel). It will be the responsibility of the supplier to ensure timely and proper delivery of the equipment on door delivery basis, at Srinagar, through road transport.The supplier shall also ensure the weights and dimensions of the packages which are suitable to be carried by road transport upto Srinagar.

Technical Specification for Polymer Disc Insulator

Scope : This specification cover the design, manufacturing, testing at manufacturers works, transport to site, insurance, storage of 11 kV & 33 kV Polymer Disc Insulator suitable for use in 11 kV & 33 kV Overhead Lines.

General Requirements :

1 . The Composite insulators will be used on lines on which the conductor will be ACSR of size up to 150 Sq.mm. 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 Phase, 50 Hz effectively earthed 11kV Overhead Lines and 33 kV Impedance Grounded distribution system in a moderately/heavily polluted atmosphere.

3 . Insulators shall be suitable for both Suspension & Strain type of load and shall be of tongue & clevis type.

4 . Insulator shall be suitable for the long Rod Type. The diameter of Composite Insulator shall be as per technical specification.

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 commendation of IEC- 60815/ IS: 13134.

6 . The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows in line with-IEC 61109:

$\pm (0.04d + 1.5)$ mm when $d \leq 300$ mm

$\pm (0.025d+6)$ 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.

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

9. 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.

10 . Inter- changeability: The composite insulator together with the tongue& clevis fittings shall be of standard design suitable for use with the hardware of any other indigenous make confirming to relevant standards referred herewith.

System Parameters :

a) Nominal system voltage : 11 kV & 33 kV.
b) Highest system voltage : 12 kV & 36 kV.
c) Power frequency : 50 Hz.
d) Number of Phases : Three.
e) System earthing : 11 kV solidly earthed, 33 kV Impedance earth.

Standard : The following Indian / International Standards with latest revisions and amendments shall be referred while accessing conformity of insulators with this specification.

Sl. No.	Indian Standard	Title	International Standard
1		Definition, test methods and acceptance criteria for composite insulators for a.c. overhead lines above 1000V	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 insulator units	IEC : 60575
6	IS : 13134	Guide for the selection of insulators in respect of polluted conditions	IEC : 60815
7		Characteristics of string insulator units of the long rod type	IEC : 60433
8		Hydrophobicity classification guide	STRI guide 1.92/1
9		Radio interference characteristics of overhead power lines and high-voltage equipment	CISPR:18-2part
10	IS : 8263	Methods of RI Test of HV Insulators	IEC : 60437
11		Standard for insulators – Composite- Distribution Dead-end type	ANSI C29 13-2000
12	IS : 4759	Hot dip zinc coatings on structural steel & other allied products	ISO : 1459 ISO : 1461
13	IS : 2629	Recommended Practice for Hot, Dip Galvanisation 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 strands	ASTMD 578-05
18		Standard test method for compositional analysis by Thermo-gravimetric	ASTM E 1131-03
19	IS : 4699	Specification for refined secondary zinc	

Technical Requirement :

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.

(a) Core : The internal insulating part

(b) Housing : The external insulating part.

(c) Metal and fittings : For attaching to hardware to support conductor.

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 Moulding 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 moulded 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).

WEATHER SHEDS :

The composite polymer Weather sheds made of silicone elastometric compound or silicon alloy shall be firmly bonded to the sheath, vulcanized to the sheath or moulded as part of the sheath and shall be free from imperfections. The Weather sheds should have silicon content of minimum 30% by weight. The strength of the Weather sheds 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 END FITTINGS:

End fittings transmit the mechanical load to the core. They shall be made of Malleable Cast Iron or Spherical Graphite Cast Iron. Hardware of respective specified mechanical load and shall be hot dip galvanized with Zinc coated with minimum 99.95% purity of electrolytic high grade Zinc 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.

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 transitor 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.

Workmanship :

a) All the materials shall be of latest design and conform to the best engineering practices adopted in the high voltage filed.

b) 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.

c) 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.

d) The core shall be sound and free of cracks and voids that may adversely affect the insulators.

e) Weather sheds shall be uniform in quality. They shall be clean, sound and smooth and shall be free from defects and excessive flashing at parting lines.

f) 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 without 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.

g) All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/ sq.m. or 87µm thickness and shall be in accordance with the requirement of IS:4579. 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 (1) minute duration under the standard preece test. The galvanizing shall be carried out only after any machining.

Type Test : The following Type Test shall have to be conducted as per reference IEC mentioned above on insulator unit, components, materials or complete strings :

a) Sudden Load Release Test
b) Thermal Mechanical Pre-stress Test
c) Dry Positive & Negative Lightning Impulse voltage withstand test
d) Dry Positive & Negative Lightning Impulse Flashover voltage test
e) D r y & Wet Power Frequency Voltage withstand test
f) Dry & Wet Power Frequency Voltage Flashover test
g) Mechanical Failing Load test.
h) Radio Interference test
i) Recovery of Hydrophobicity test.
j) Dye Penetration Test.
k) Water Diffusion Test
l) Chemical composition test for Silicon content
m) Brittle facture resistance test.
n) Damage Limit proof & Mechanical Withstand Test.

Routine Test:

a) Identification of marking
b) Visual inspection
c) Mechanical routine test

Acceptance Test: The following test will be carried out at manufacturers works during inspection of the offered insulators before delivery :

a) Visual examination
b) Verification of dimension
c) Galvanizing test
d) Mechanical performance test

Sampling & Rejection during inspection:

The sampling and rejection procedure for Acceptance Test shall be as per IEC 61109.

Test on Insulator units:

1. RIV Test (Dry): The insulator string along with complete hardware fittings shall have a radio interference voltage level below 100 micro volts at one MHz when subjected to 50 Hz voltage of 10 kV & 30 kV for 11 kV & 33 kV class insulators respectively under dry condition. The test procedure shall be in accordance with IS: 8263/IEC: 437/CISPR 18-2.

2. Brittle Fracture Resistance Test: Brittle fracture test shall be carried out on naked rod along with end fittings by applying "1n HNO3 acid" (63 g conc. HNO3 added to 937 g water) to the rod. The rod should be held at 80% of SML for the duration of the test. The rod should not fail within the 96 Hour test duration. Test arrangement should ensure continuous wetting of the rod with Nitric acid.

3. Recovery of Hydrophobicity & Corona Test :

i) The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the Hydrophobicity classification in line with STRI guide for Hydrophobicity classification (Extract enclose at Annexure-D) Dry the sample surface.

(ii) The sample shall be subjected to mechanical stress by bending the Sample over a ground electrode. Corona is continuously generated by applying 12 kV to a needle like electrode placed 1 mm above the sample surface. Tentative arrangement shall be as shown in Annexure-E. The test shall be done for 100 hrs.

(iii) Immediately after the corona treatment, spray the surface with Water and record the HC classification. Dry the surface and repeat the corona treatment as at Clause-2 above. Note HC classification. Repeat the cycle for 1000 Hrs. or until an HC of 6 or 7 is obtained. Dry the sample surface.

(iv) Allow the sample to recover and repeat Hydrophobicity Measurement at several time intervals. Silicone rubber should recover to HC 1– HC 2 within 24 to 48 hours, depending on the Material and the intensity of the corona treatment.

4. Chemical composition test for Silicon content :

The content of silicon in the composite polymer shall be evaluated by EDX (Energy Dispersion X-ray) Analysis or Thermo-gravimetric analysis. The test may be carried out at CPRI or any other NABL accredited laboratory.

Challenge Clause:

The purchaser reserves the right to have the material, received after inspection by the authorized inspecting officer, again tested for any parameter(s), from approved/NABL accredited testing house/in house technique of the purchaser. The results if found deviating/unacceptable or in non-compliance with the approved DTP'S, the lot shall be rejected and the bidder shall arrange to replace the rejected lot within thirty(30) days of such detection at his cost including to & fro transportation.

Specific Technical particulars for 11 kV & 33 kV Disc Insulator

S.No	Particulars	11 kV Disc	33 kV Disc
1	Type of insulator	Polymeric composite Disc Insulator	Polymeric composite Disc Insulator
2	Reference Standard	IEC 61109	IEC 61109
3	Material of FRP Rod	Boron free ECR	Boron free ECR
4	Material of sheds	Silicon Rubber	Silicon Rubber
5	Type of metal end fittings	Tongue & Clevis	Tongue & Clevis
6	Material of end fittings	SGCI / MCI	SGCI / MCI
7	Material of sealing compound	RTV Silicon	RTV Silicon
8	Colour of sheds	Grey	Grey
9	Rated voltage	11 kV	33 kV
10	Highest voltage	12 kV	36 kV
11	Dry Power Frequency Withstand voltage	60 kV	95 kV
12	Wet Power Frequency Withstand voltage	35 kV	75 kV
13	Dry Power Frequency Flashover Voltage	75 kV	130 kV
14	Visible Discharge Voltage (PF)	9 kV	27 kV
15	Wet Power Frequency Flashover Voltage	45 kV	90 kV
16	Dry Lightning Impulse withstand voltage	Positive : 75 kV	Positive : 170 kV
		Negative :80 kV	Negative : 180 kV
17	Dry Lightning Impulse Flashover voltage	Positive : 95 kV	Positive : 210 kV
		Negative : 100 kV	Negative : 230 kV
18	RIV at 1 MHz when energized at 10 kV / 30 kV (rms) under dry condition	< 50 microvolt	< 70 microvolt
19	Creepage distance (min)	320 mm	900 mm
20	Min Failing load	45 kN	70 kN
21	Dia of FRP Rod	16 mm	16 mm
22	Length of FRP Rod (min)	200 mm	425 mm
23	Dia of weather sheds	100 mm	110 mm
24	Thickness of housing	3 mm	3 mm
25	Dry arc distance	170 mm	380 mm
26	Method of fixing sheds to housing	Injection moulding	Injection moulding
27	No. of weather sheds (min)	Three	Eight
28	Type of sheds	Aerodynamic	Aerodynamic
29	Type of packing	Wooden/Corrugated box	Wooden/Corrugated box
30	No. of insulator in each pack	Thirty	Twenty