PSGSG149	SPECIFICATIONS FOR **Gas-to-Cable termination**	Drg.No.	
		Date	**16.09.10**
		Product	**GSM-145**

1.0 APPLICATION:

Gas-to-cable termination is a part of high voltage gas insulated indoor switchgear equipment. The component is intended for a high voltage system of 132 kV (AC), 50 Hz. The supply shall include; Termination kit, Insulator, Cable termination and its installation at site by trained and certified staff.

2.0 SPECIFICATION:

The terminations for gas insulated switchgear will be installed with an epoxy resin insulator including an integrated insulating clearance for potential isolation between the switchgear housing and the cable screen / sheath. Gas-to-cable termination shall be designed with following features:

1. Dry type termination suitable for SF6 gas insulated switchgear equipment.
2. Metal-clad plug-in cable termination.
3. Adopt pre-moulded stress cone and epoxy bushing.
4. Pre-mould stress cone shall be of feasible rubber material.
5. The cable clamp shall be short circuit proof and shall provide soft support for cable.
6. Maintenance free.
7. Termination insulation level, current capacity, operating temperature shall match to cable specifications of IEC 60840 / 60859 and revisions there of.
8. The design of termination shall be such that no mechanical forces are transferred to GIS by cable.

2.1 **Epoxy Insulator / Bushing:** High grade non-tracking epoxy insulators shall provide excellent mechanical and electrical characteristics. The insulators to be compatible with SF6 gas by-products ensuring long life of the termination. The insulator shall be capable of operating at a normal pressure difference of 4.5 bar (g). The insulator shall withstand for more than two times normal pressure (2P+1) under transient/abnormal conditions.

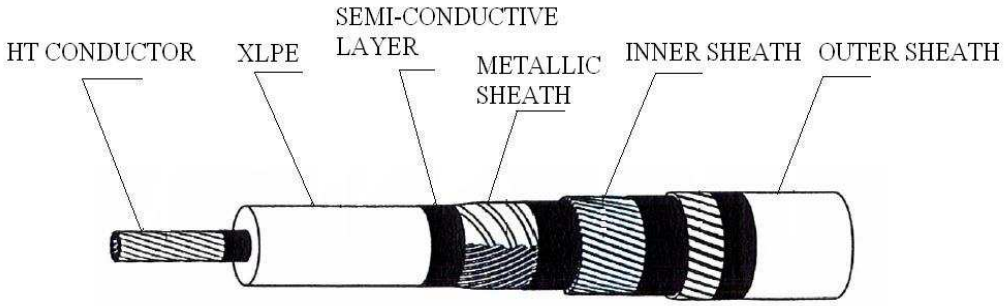

Fig. 1 A sectional View of XLPE Cable

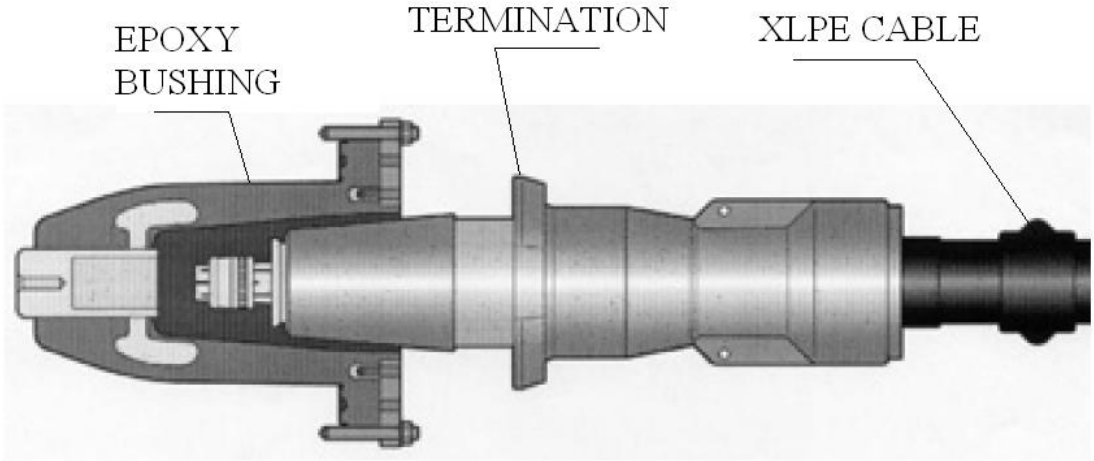

Fig. 2 A sectional View of Gas-to-cable termination

3.0

Specifications of Gas-to-Cable Termination:

DETAILED SPECIFICATIONS		
1.	Maximum System Voltage (kV, rms)	145.0
2.	Rated Primary voltage, kV (rms)	132.0
3.	Phase to ground voltage, U_0, kV (rms)	76.2
4.	Frequency, Hz	50.0
5.	Standards	IEC 60840 / IEC 60859/62271-209
6.	1.2/50 μs. Lighting Impulse With stand test voltage (kVpeak)	650.0
7.	One minute power frequency withstand test voltage of primary (kV, rms)	275.0
8.	30 Minute AC withstand test, 2.5 U_0 (kV,rms)	190.0
9.	PD level @ 1.5 U_0 in pC	@ 114 kV less than 5.0 pC
10.	DC voltage test	as per IEC
11.	Power frequency test with heat cycles	as per IEC
12.	Rated SF6 gas pressure (min) @ 20°C oF BHEL system	4.5 bar(g)
13.	Installation	Outdoor/ indoor
14.	Short circuit current of termination, kA	> 31.5
15.	Separable connectors Shall be of water proof	Yes

NOTE: All other specifications as per IEC 60840, IEC 60859 and IEC 62271-209 and revisions there of.

4.0 **Specifications of Cable being used for termination:**

A.	**System Parameters**	
1.	Rated phase to phase voltage	132.0 kV (rms)
2.	Maximum Phase to Ground Voltage	84.0 kV (rms)
3	Rated Phase to Ground Voltage	76.2 kV (rms)
4	Frequency, Hz	50.0
5	Short circuit current of screen / sheath for 1 sec, kA	31.5
B.	**Cable design**	Single core cable.
C.	**HT Conductor Details**	
1	Material	Copper
2	Cross section, mm^2	630
3	Diameter, mm	30.2
D.	**Insulation details**	
1	Material	XLPE
2	Diameter over insulation, mm	61.5
3	Semi conducting layer	Fully bonded
4	Diameter of semi conductive layer, mm	63.9
5	Metallic sheath / screen	Yes
6	Diameter over screen, mm	81.0
7	Inner sheath with metallic screen	Yes
8	Outer sheath with metallic screen	Yes
9	Overall Diameter, mm	90.0
10	Outdoor vertical Installation	Yes

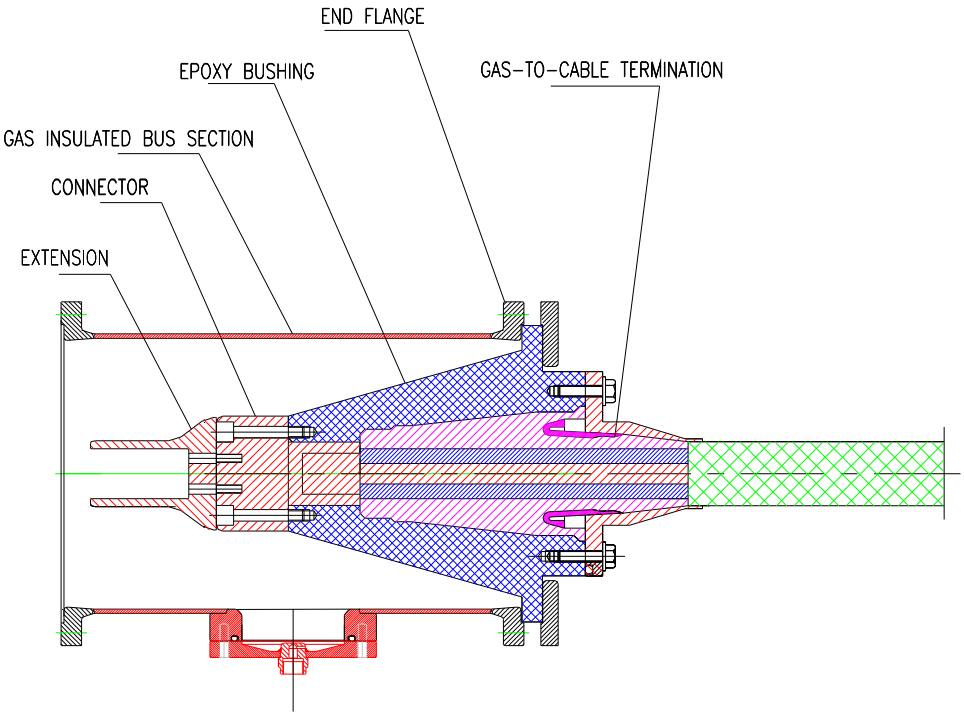

Fig. 3. An Assembly arrangement of Gas-to-Cable termination plugged in GIS.

5.0 Scope of Supply:

1. Gas-to-cable terminations along with epoxy insulator/bushing for connecting BHEL's Gas Insulated System.
2. Necessary seals/gaskets for the assembly of gas-to-cable termination.
3. Installation and pre-commission tests of Terminations at site located in Andhra Pradesh, India.
4. Necessary grounding links / screen connection for connecting cable sheath to the termination. These links shall be capable of withstanding short circuit currents under fault Conditions.
5. Cable termination dimensions and specifications shall be as per IEC 62271-209 and revisions there of.

6.0 Technical Inputs from Vendor:

1. Dimensional drawing of gas insulated bus section in which epoxy bushing is to be installed.
2. Detailed Dimensional drawing of end flange of gas insulated bus section for necessary sealing arrangements.
3. Detailed dimensional drawing of epoxy insulator / bushing.
4. Type of connections / shields required for insulator / bushing.
5. Detailed Dimensional drawing of Connector arrangement offered by vendor along with bushing.
6. Dimensional drawing of fixing arrangement used for bushing.
7. Details of Interconnection between BHEL's GIS and termination necessary to avoid high voltage related problems in service shall be decided before finalization of P.O.

7.0 Spare and Services:

1. The vendor shall specify cost of additional bushings as optional.
2. The vendor shall specify the services charges for installation and pre-commissioning tests as part of offer. The offer shall cover details about installation period, man hours requirement (Engineers, supervisors and helpers) etc..
3. Insulators along with a set of seals or any other spares suggested by supplier for instillation / maintenance of terminations shall be specified as optional.
4. Offer shall be made for termination with and without voltage tap arrangement.

8.0 Performance Guarantee :

Supplier shall provide Guarantee certificate for the equipment to ensure reliability of the equipment for a period of 12 months from the date of installation and commissioning.

9.0 Drawing Approval:

Outline General Arrangement (OGA) and component drawings as per Bill of Materials shall be submitted on order acceptance for approval prior to commencement of supply. Detailed drawing of the critical components like plug-in insulator / bushing , termination etc shall be submitted for approval by BHEL.

10.0 Factory Tests:

All routine tests shall be carried out on the equipment supplied and test reports shall be submitted along with the supply. A sample of test report shall be submitted along with the technical offer containing details of electrical and mechanical tests for which the gas-to-cable termination has been evaluated by the vendor.

11.0 Type Test Reports:

All type test reports pertaining to gas-to-cable termination including Power frequency, Lightning impulse, DC, Power frequency with heat cycles, Power frequency 24 hrs test, Short time current test, heat run test, thermal ageing test, etc. specified by IEC 60840 / IEC 60859/62271-209 and revisions there of. Copy of reports shall be submitted along with technical offer.

12.0 Site Testing

After installation of cable termination the vendor shall perform per-commission tests as per IEC 60840 / IEC 60859/ IEC 62271-209 and revisions there of for ensuing the reliability of terminations during service. Necessary test equipment required for commissioning of terminations shall be provided by vendor.

13.0 Installation and Commissioning:

Installation and commission of cable terminations shall be in the scope of the supply.

BHEL would arrange necessary gas insulated system and XLPE cable during cable termination by the supplier at our customer premises.

The vendor shall confirm the list of items to be supplied by BHEL prior to installation. The vendor shall also provide details about storage instructions, installation period, pre-commissioning tests after installing termination, condition monitoring details etc. along with the technical bid.

The cable termination manufacturer should ensure that during manufacture, handling, storage and installation of the cable termination, provisions shall be made to ensure that the requirements given in IEC 60694, clause 10.

14.0 Safety aspects:

The design must take care of all safety aspects related to equipment and operating personnel. The termination should have adequate and reliable gas pressure withstandability to avoid any system damage and ensure personnel safety.

15.0 Operating and Maintenance Manuals:

Supplier shall provide operation and maintenance manual covering instructions for safe handling and transport of the cable termination. The user manuals shall have detailed information about dimensions of parts of cable termination, maintenance of the equipment, trouble shooting, spare parts and methods. Contact addresses and the person for future service requirements shall be ensured.

16.0 Packing:

The termination shall be supplied in sealed condition. The insulator shall be protected and covered with moisture proof packing with requisite quantity of absorbents.

The supplier is advised to pack the equipment in air/sea worthy packing with suitable markings and vibration sensors (recording handling abuse). For marking on packing follow the marking instructions given with the purchase order.

Necessary precautions shall be taken by vendor for safe storage of material during transportation and storage at BHEL till installation and commissioning are completed even if date of installation is delayed due to unforeseen circumstances.

17.0 Qualifying Requirements:

The supplier shall be of International repute with proven record and should have supplied similar or higher rated plug-in gas-to-cable terminations for gas insulated substations, at least, for last three years. The supplier must submit along with the technical bid the references of supplies made so far and certificates of operating experience.

18.0 Any Other information:

In case of doubts please contact BHEL for clarifications. Vendor can furnish any other/additional information, considering overall requirements.