



## SECTION – 2.15

### ELECTROMAGENETIC VOLTAGE TRANSFORMER

#### 1.0.0 INTRODUCTION

This section covers the requirements of the 132kV (HSV 170 kV) Electromagnetic Voltage Transformer.

#### 2.0.0 SCOPE OF WORK

- 2.1. The scope of work shall be include but not limited to the design, engineering, manufacture, testing inspection at manufacturer's works, packing supply, transportation, transit insurance, delivery to site of 132kV Electromagnetic Voltage Transformer. The design and engineering shall make use of most recent international standards and best design practices.
- 2.2. New line EMVTs shall be installed after shifting the existing surge arresters. The existing structures and foundations of surge arresters may be utilized after confirmation of its suitability.
- 2.3. New MPTs (3- phase) are to be installed after removal of existing CVT which is installed in R-Phase only. However, foundation and structure of all three phase CVT's are available and may be utilized after validation of its suitability
- 2.4. Bidder shall be responsible for proper operation of complete unit assembly as indicated by the factory as indicated by the factory performance test. field acceptance tests and as required by the provisions of the code.
- 2.5. Bidder shall provide number of EMVT's as per schedule given in this section.
- 2.6. EMVT GTP, various test certificate and details specification including but not limited to number, burden, accuracy class, etc mentioned in this section and in SLD is indicative and shall be finalised during detailed engineering subject to approval of STU/GETCO/ Concern competent statutory authorities and project requirement without any cost to the owner.
- 2.7. All required approvals from STU/GETCO or any other concerned statutory authority and liasioning are in the scope of the Bidder.
- 2.8. Tariff metering EMVT testing shall be carried out at a third-party NABL-accredited laboratory (other than the OEM), in accordance with the testing requirements of GETCO/SLDC/DISCOM or other applicable authorities. The NABL laboratory shall be subject to approval by GETCO/SLDC/DISCOM. Testing shall be witnessed by representatives of GETCO/SLDC/DISCOM, and specifications shall comply with the requirements of the competent authority.  
  
Post-testing, instrument transformers are typically sealed by the authorities and kept under their custody until commissioning. All necessary liasioning in this regard shall be in the scope of the bidder.
- 2.9. Commissioning testing and sealing activities at site by GETCO/SLDC/DISCOM or other applicable authorities shall be arranged by the bidder.
- 2.10. Equipment shall be procured from GETCO approved vendors only



### 3.0.0 CODES AND STANDARDS

3.1. The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the relevant IS / IEC standards including amendments, if any, except where modified and / or supplemented by this specification. Some of the applicable standards are listed below.

IEC 3156 (Part 1 TO 4)	Voltage Transformers
IEC 61869-1	Instrument transformers - Part 1: General requirements
IEC 61869-5	Instrument transformers - Part 3: Additional requirements for capacitive voltage transformers
IEC 61869-103	Instrument transformers - The use of instrument transformers for power quality measurement
IEC 60060-2	High-voltage test techniques – Part 2: Measuring systems
IEC 60270	High-voltage test techniques – Partial discharge measurements
IEC 62155	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC 60233	Tests on Hollow Insulators for Use in Electrical Equipment
IEC 60269	Low-voltage fuses
IEC 60269	Artificial pollution tests on high-voltage ceramic and glass insulators to be used on A.C. systems
IEC 60296	Fluids for electro technical applications – Unused mineral insulating oils for transformers and switchgear
IEC 60529	Degrees of protection provided by enclosures (IP code)
IS 355	Insulating Oil

#### 3.0.0 Schedule of EMVT's

The basic details of EMVT's to be installed at GIPCL 132 kV switchyard is tabulated hereunder.



Substation	132 kV Bay		Core	Purpose	Class	Qty (Single Phase)	Installation Location	
GIPCL	Line-3	MPT	Core-1	MPT for Tariff Metering (ABT Meters)	0.2	3	Existing Location of CVT.	
		EMVT	Core-1	General Purpose Metering (MFM, PQM, PMU) and synchronization	0.2	3	Existing Location of SA.	
			Core-2	Spare	3P			
			Core-3	Protection ( 21, 67N, 50N, 51N, 25, 81O, 81U, 59, etc.)	3P			
	Line-4	MPT	Core-1	MPT for Tariff Metering (ABT Meters)	0.2	3	Existing Location of CVT	
		EMVT	Core-1	General Purpose Metering (MFM, PQM, PMU) and synchronization	0.2	3	Existing Location of SA.	
			Core-2	Spare	3P			
			Core-3	Protection ( 21, 67N, 50N, 51N, 25, 81O, 81U, 59, etc.)	3P			
	<b>Total Number of EMVT's</b>						<b>12</b>	

Note: For Bus-A & B, Existing Bus EMVT shall be utilised.

- The conceptual details of EMVTs to be installed at the GETCO 132 kV Grid Substation are furnished in the table below. The bidder shall provide optional costs for each type of Line EMVT in the price schedule.

Substation	132 kV Bay		Core	Purpose	Class	Qty (Single Phase)	Installation Location
GETCO (GSS)	Line-3	MPT	Core-1	MPT for Tariff Metering (ABT Meters)	0.2	3	As per GETCO Substation Requirements.
		EMVT	Core-1	General Purpose Metering (MFM, PQM, PMU) and synchronization	0.2	3	
			Core-2	Spare	3P		
			Core-3	Protection ( 21, 67N, 50N, 51N, 25, 81O, 81U, 59, etc.)	3P		
	Line-4	MPT	Core-1	MPT for Tariff Metering (ABT Meters)	0.2	3	
		EMVT	Core-1	General Purpose Metering (MFM, PQM, PMU) and synchronization	0.2	3	
			Core-2	Spare	3P		



			Core-3	Protection ( 21, 67N, 50N, 51N, 25, 81O, 81U, 59, etc.)	3P		
<b>Total Number of EMVT's</b>						<b>12</b>	

#### 4.0.0 SPECIFIC DESIGN REQUIREMENTS

- 4.1. EMVT shall be single phase oil filled hermetically sealed units with polymer insulator. For EMVT with polymer housing, the cantilever strength shall 150kg for polymer housing or 350kg for the porcelain housing.
- 4.2. EMVTs shall be provided with oil level gauge, drain plug for oil sampling & filtering, oil sight glass and power factor testing terminal. Oil sight glass shall be provided for electromagnetic unit also. The EMVT shall be adequately designed and constructed to withstand insulator-washing pressure of 3500 kPa without damage and without ingress of water or moisture into the apparatus internals, or degradation of the sealing.
- 4.3. The core shall be of high grade grain oriented non-ageing electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy.
- 4.4. Generally, Voltage Transformers offered, shall not require any maintenance apart from occasional cleaning of the insulators. The bushings used should conform to IS-5621 and should be suitable for use in heavily polluted atmosphere.
- 4.5. A suitable oil level indicator and pressure releasing arrangements will be provided on each potential transformer.
- 4.6. All ferrous parts of the Voltage transformers shall be hot dip galvanized.
- 4.7. For providing supervision against failure of fuse provided in the potential transformer secondary terminal box, additional 2 Nos. secondary terminals may be provided across the winding-I terminal.
- 4.8. All sharp corners in the potential transformer are to be rounded off suitably. The encapsulated potential transformer is impervious to Snow, Ice and significant temperature changes.
- 4.9. Voltage transformers secondaries shall be protected by MCBs for all the windings. MCB's shall be provided with auxiliary contacts for status monitoring at SAS / SCADA/EnMS. The secondary terminals of the VTs shall be terminated to the stud type disconnecting terminal blocks in the individual phase secondary boxes of degree of protection IP-55. The terminal box shall be of 3 mm thick sheet steel, IP-55, weatherproof and dust-tight, complete with gasket front access cover and removable gland plate at bottom for cable entry. Secondary terminals shall be suitable for connection to 2 x 2.5 mm<sup>2</sup> stranded copper conductors per way.
- 4.10. The electromagnetic unit shall consist of intermediate voltage transformer, compensating reactor and associated protection circuitry. The electromagnetic unit shall be housed in the base on which the capacitor unit or stack is mounted on the top.
- 4.11. The damping device, which should be permanently connected to one of the secondary windings, should be capable of suppressing the Ferro resonance oscillations.
- 4.12. The accuracy class of EMVT shall be CI.0.2 for metering and 3P for protection. The accuracy of 0.2 on secondary for all EMVTs should be maintained throughout the entire burden range on all the windings without any adjustments during operation.
- 4.13. The EMVT shall conform to the type tests and routine tests as per IEC 61869-3 & 5. Bidder shall perform all tests mentioned in IEC 61869-3 & 5 without any cost implication.



- 4.14. Bidder to provide detailed Datasheet of Electromagnetic Voltage Transformer mentioning all technical parameters as per relevant IEC/IS standard.

#### **Windings**

- 4.15. All primaries of potential transformers will be connected in phase to neutral with the neutral point solidly earthed. The neutral of the system is also solidly earthed. Suitable link may be provided in between the neutral and earth.
- 4.16. All potential transformers for phase to ground connection shall be provided with winding rated for  $110/\sqrt{3}$  for winding - I, II and III.
- 4.17. Electrolytic copper shall be used for both primary and secondary windings.
- 4.18. The secondary terminal will be brought out in a compartment on one side of the potential transformer for easy access. . Cable entry with glands shall be provided on the bottom of the secondary box for entry of 3 Nos. 2 core 4 sq.mm cable. Suitable electrolytic copper wire should be used for windings.

#### **Primary Terminals**

- 4.19. The primary terminals shall be of heavily tinned electrolytic copper of 99.9% conductivity/Aluminum. The minimum thickness of tinning shall be 15 microns. The primary terminal on the tank shall be not less than 80mm length and 30mm dia.

#### **Secondary Terminals**

- 4.20. The secondary terminals shall be brought out in a weather proof terminal box. Firstly the connections will be terminated in an internal board and then the same shall be brought out in a Junction box size 750mm Height, 600mm Width, 325mm Depth The terminal box shall be provided with removable gland plate.
- 4.21. The terminal box shall be dust and vermin proof. Suitable arrangement shall be made for drying of air inside the secondary terminal box. The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with use of normal tools and measuring instruments such as tong type milliammeters. The outer cover of secondary terminal box shall have provision for sealing by way of insertion of wire in the bolt hole. A drawing indicating the above arrangement may please be furnished along with the offer.
- 4.22. Secondary terminal studs shall be provided with at least three nuts and adequate plain and spring washers for fixing the leads. The studs, nuts and washers shall be of brass, duly Nickel plated. The minimum outside diameter of the studs shall be 6 mm. The length of at least 15mm shall be available on the studs for inserting the leads. The horizontal spacing between centers of the adjacent studs shall be at least 1.5 times the outside circum dia. of the nuts.
- 4.23. Insulating oil to be used for instrument transformers shall be of EHV grade and shall conform to IS-335 / IEC - 60296.

#### **Oil Level Indicators**

- 4.24. Voltage Transformers supplied with Nitrogen cushion for compensation of oil volume variation shall be provided with prismatic type oil sight window at suitable location so that the oil level is clearly visible to naked eye to an observer standing at ground level. If metal bellow is used for the above purpose a ground glass window / bellow level indicator shall be provided to monitor the position of metal bellow. Oil minimum and maximum level may be engraved and painted.

#### **MEASUREMENT OF CAPACITANCE AND TAN DELTA**



- 4.25. The 132kV Voltage Transformer shall be provided with suitable test tap for measurement of capacitance, tan delta as well as partial discharges, in factory as well as at site. Provision shall be made of a screw on caption, when not in use. A suitable caution plate shall be provided duly fixed on the cover of the secondary terminal box indicating the purpose of the test tap and necessity of its solid earthing as per prescribed method before energizing the Potential Transformers.

#### **Temperature Rise**

- 4.26. The Potential Transformers shall be designed to limit the temperature rise of windings to 55°C above the ambient temperature specified in the GTS. The temperature rise at 1.1 times rated primary voltage when applied continuously at rated frequency and at rated burden shall not exceed the limits specified above and the temperature rise at 1.5 times rated primary voltage when applied for 30 seconds starting from previous suitable operating conditions at rated frequency and rated burden shall not exceed the above temperature limits by more than 10°C.

#### **Assembly**

- 4.27. During manufacture strict quality control should be adopted. The equipment should be dried under vacuum in the hot chamber. Voids should be avoided to minimise partial discharges. Suitable transformer oil should be filled up under vacuum immediately after drying is over. Oil filling and drain plugs may be provided.

#### **Junction Boxes**

- 4.28. Absolutely vermin proof fabricated from M.S. sheet of thickness 3mm minimum junction boxes are to be supplied one each along with for a set of 3 Nos. Potential Transformers (other than Metering EMVT's). Junction Boxes shall have minimum size 750mm Height, 600mm width and 325mm depth. Boxes have to be provided with belt/rubber beddings and doors opening with wing nuts for locking.
- 4.29. It should be painted with aluminium paint outside and grey paint inside. It should be provided with stud type terminal blocks with lock nuts and washers. Boxes should have necessary provision with cable glands for connecting 6 Nos. 4 Sq.mm 6 core cable and 2 Nos. 4 Sq.mm 8 Core cables. All sharp corners should be rounded off. Boxes should have sufficient working spaces for easy working and spares for each wiring. A spare terminal block with 24 terminals may be provided in the Junction Boxes.
- 4.30. Junction boxes shall not be used for tariff metering EMVTs (MPTs). All cables from each single-phase EMVT's shall be directly routed and terminated at the metering panel/cubicle, without any intermediate joints, to ensure measurement integrity and compliance with metering requirements.

### **5.0.0 TESTS**

Minimum requirement of testing is mentioned hereunder. However, bidder to comply all requirement of STU/GETCO.

#### **Type Tests**

- Lightning Impulse Voltage Test.
- Multiple chopped lightning impulse test. (IEC-60044-1 Clause-9.1)
- High Voltage power frequency wet withstand voltage Test.
- Short time current test.
- Temperature rise test.



- Determination of errors or other characteristics according to the requirements of the appropriate designation and accuracy class as per individual parts of IS: 2705.
- IP-55 Test on Secondary Terminal Box.

#### **Routine Tests**

- Appearance and Dimensional Check.
- Verification of Terminal Marking and polarity.
- Verification of all individual parts / components of the Current Transformer so as to ensure to have complied the above specification.
- Measurement of Insulation Resistance.
- Power Frequency Dry Withstanding Test on Primary and Secondary winding included.
- Primary intersections.
- Over – Voltage Inter-turn test.
- Partial discharge Test
- Knee point voltage and Excitation current measurement for 'PS' class cores.
- Secondary winding resistance measurement.
- Determination of errors.
- ISF Test
- Leakage Test.
- Magnetization Characteristics of the Current Transformers.
- Turn ratio error on 'PS' class cores.
- Measurement of capacitance.
- Measurement of tan delta at 0.3, 0.7, 1.0 and 1.1  $\mu\text{m}/\sqrt{3}$
- Creepage Measurement Test

#### **Test Witness**

- Tests shall be performed in presence of employer representative if so desired. The Bidder shall give at least seven (07) days' advance notice of the date when the tests are to be carried out.



### **Test Certificates**

- Certified reports of all the tests carried out at the works shall be furnished in four (4) copies for approval of the employer.
- The equipment shall be dispatched from works only after receipt of employer written approval of the test reports.
- Type test certificate on any equipment, if so desired by the employer, shall be furnished. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design.

#### Maintenance responsibility during Guaranteed Availability Period

- During the Guaranteed Availability Period, Supplier shall take continual actions to ensure guaranteed availability and shall make available all the necessary resources such as specialist personnel, spare parts, tools, test devices etc. for replacement or repair of all defective parts and shall have prime responsibility for keeping the system operational

All type test report as per the applicable standards shall be submitted.

### **6.0.0 GUARANTEED PARTICULARS**

Electrical and mechanical characteristics shall be guaranteed by the bidder. In case of failure of materials to meet the guarantee, M/s Employer shall have the right to reject the material. Guaranteed Technical particulars are to be submitted by the successful bidder during detailed engineering along with submitted drawings / documents.

### **7.0.0 WARRANTY**

All the equipment included in the scope shall satisfy the warranty of 12 months from the date of Commissioning, or 18 months from delivery at site whichever later.

### **8.0.0 QUALITY CONTROL**

Bidder shall submit the MQAP, FAT and FQP for all the replaced electrical equipment.

### **9.0.0 DOCUMENTS REQUIRED TO BE SUBMITTED BY BIDDER AT TIME OF PROPOSAL:**

- a. Quality assurance plan.
- b. Material test certificates.
- c. Technical data sheets for all equipment covered.
- d. Installation drawings and manuals for all equipment/ systems.
- e. Current UL/ FM certificates



#### 10.0.0 DOCUMENTS REQUIRED TO BE SUBMITTED AFTER AWARD OF CONTRACT:

- a. Detailed design / drawing submission schedule including erection, testing & commissioning schedules.
- b. Operation and maintenance manual for all equipment.
- c. Technical data sheets for all equipment covered.
- d. Detailed write-up, Layout drawings and equipment drawings etc.
- e. Detailed write-up for shop tests and site performance tests.
- f. Test certificates for type/ routine and standard acceptance tests.
- g. As-built drawings for all equipment/ systems supplied under this contract and all buildings/ structures/ works executed under this contract incorporating all changes/ modifications up to the time of commissioning / handing over to the Owner.
- h. Materials test certificates and performance test certificates for all equipment tested at works.
- i. Drawings/ data required to be submitted to statutory authorities.
- j. Any other document/ details as required as per approved QAP.

#### 11.0.0 TECHNICAL PARTICULARS:

Sl. No.	Description	Particulars
<b>A</b>	<b>General</b>	
1	Type of Voltage transformer	Outdoor type
2	Rated frequency	50 Hz
3	Voltage transformer ratio	132 kV / 110 V
4	System fault level	31.5 kA for 1 sec
5	System neutral earthing	Effectively earthed
6	Temperature rise	As per IEC 60044
7	Number of terminals in junction box	As per requirement
8	One minute power frequency withstand voltage	
I	Between LV terminal and earth	-10 kVrms for exposed terminal -4 kVrms for terminal enclosed in weatherproof box
II	For secondary winding	3 kV rms
9	Rated voltage factor	1.2 continuous, 1.5 for 30 sec
10	Rated system voltage	132 kV rms
11	Highest System Voltage	170 kV
12	Creepage distance	31mm/kV



SI. No.	Description	Particulars
I	1.2/50 micro-sec. impulse	650 kVp.
II	One minute power frequency withstand voltage	275 kV rms
13	Rated Primary Voltage	$132/\sqrt{3}$ kV
14	Rated Secondary Voltage	$0.110/\sqrt{3}$ kV
15	Minimum corona extinction voltage	105 kV rms
16	Rated voltage factor	1.2 continuous & 1.5 for 30 secs.