

## SCHEDULE-II

### TECHNICAL SPECIFICATION OF 11KV & 33KV OIL IMMERSED

#### CT:PT (METERING EQUIPMENT) UNITS

1.0 **SCOPE: -**

1.1 This specification covers design, engineering, manufacture, testing and inspection before dispatch and delivery.

1.2 The specification covers Oil immersed naturally Air cooled (type ONAN) outdoor type 11 KV and 33 KV metering equipment (ME) units which shall comprise 3 nos C.Ts conforming to IS-2705: 1992 and 1 no three phase PT conforming to IS: 3156:1992. 11 KV and 33 KV ME units shall be suitable for 50 Hz frequency & for service under the system conditions having frequency fluctuations of +/- 4% and voltage fluctuation of + 9% / -13.5%.

2.0 **STANDARDS:**

The 11 KV and 33 KV oil immersed CT: PT (metering equipment) Unit and the associated accessories shall conform in all respect to the following relevant standard specification, with latest amendment there-to: -

<b>Indian Standard specification</b>	<b>Title</b>
IS 2705: 1992	Specification for Current Transformer
IS: 3156:1992	Specification for Voltage Transformers
IS: 335:1983	Specification of Transformers Oil
IS: 2099:1986	Specification for bushing for AC voltage above 1 KV
IS:5561	Specification for terminal connector
IS:4201	Application guide for current Transformer

### 3.0 **CLIMATIC SERVICE CONDITIONS:**

The 11 KV and 33 KV oil immersed CT:PT (metering equipment) Unit to be supplied against this specification should be capable of performing and maintaining required accuracy under extreme hot, cold, tropical and dusty climate and solar radiation typically existing in the State of M.P. The 11 KV and 33 KV oil immersed CT: PT (metering equipment) Unit shall be required to operate satisfactorily and continuously under the following tropical climatic conditions:

(a)	Maximum ambient air temperature	50°C
(b)	Maximum ambient air temperature in shed	45°C
(c)	Maximum temperature attainable by the ME exposed to sun	85°C
(d)	Minimum ambient temperature	(-) 5°C
(e)	Average daily ambient air temperature	40°C
(f)	Maximum relative humidity	95%
(g)	Number of months of tropical monsoon condition	4 months
(h)	Maximum altitude above mean sea level	1000 m
(i)	Average annual rain fall	150 cms
(j)	Maximum wind pressure	150 kg/sq.m
(k)	Isoceraunic level (days per year)	50
(l)	Seismic level (horizontal accn.)	0.30 g
(m)	Permitted noise level	45.db

All the parts & surface, which are subject to corrosion shall either be made of such material or shall be provided with such protective finish, which provides protection from any injurious effect of humidity.

### 4.0 **PRINCIPAL PARAMETERS:**

11 KV and 33 KV combined CT:PT ME units shall be suitable for 50 Hz frequency & for service under the system conditions having frequency fluctuations of +/- 4% and voltage fluctuation of + 9% / -13.5%. The 11 KV and 33 KV oil immersed combined CT: PT (metering equipment) units shall be hermetically sealed and suitable for service under the system conditions as per following specific parameters:

Sl. No.	Particulars	Parameters	
		11 KV	33 KV
1.	Type of installation	Outdoor	
2.	System frequency	50 Hz ±4%	
3.	Normal System Voltage	11KV	33 KV
4.	Highest System Voltage for substantially long period	12KV	36 KV

	substantially long period		
5.	System voltage fluctuations	+ 9% & -13.5%.	
6.	System earthing	Solidly grounded	

## 5.0 **TECHNICAL REQUIREMENT:**

The 11 KV and 33 KV oil immersed combined CT:PT (metering equipment) units shall conform to the following specific parameters

S. no	Particulars	Requirement		
		11 KV	33 KV	
1	Frequency.	50 HZ		
2	Specification of CT and PT of Metering Unit			
A	Current Transformer			
i	CT Ratio	As per schedule I	As per schedule I	
ii	Dual CT ratio for Energy Audit	300-150/5A	400-200/5A	
iii	Accuracy Class	0.5		
iv	VA burden	10 VA		
v	Power Frequency withstand voltage	28KV(rms)	70KVrms	
vi	Lightning impulse with stand voltage	75 KV (peak)	170 KV peak.	
vii	Short time thermal current rating in KA.	(i) 6.4 KA for 1 Sec. for CT having primary current up to 15 AMP for single ratio.  (ii) 13.1KA for 1Sec. for CTs having primary current above 15 AMP for single ratio.  (iii)13.1 KA for 2 Sec for dual ratio.		
B	Potential Transformer (VT)			
i	PT ratio	<u>11KV</u> 110V	<u>33KV</u> 110V	
ii	VA burden per phase	30 VA		
iii	Class of accuracy	0.5		
iv	Power Frequency withstand voltage	28 KV (rms)	70 KV (rms)	
v	Lightning impulse with stand voltage	75 KV peak	170 KV peak	
vi	Winding connection	Star/ Star	Star/ Star	
3	Maximum attainable winding temperature	85° C		
4	a	Minimum phase to phase distance	255mm	430mm

	b	Shortest distance between metal part & earth	190 mm	380mm
	c	Creepage distance of HV bushing	300mm (Min)	900mm (Min)
5		Gauge of the MS tank	- Min 5 mm for top cover and bottom - Min 3mm for tank sides	
6		Bi-metallic terminal connector with a nut, plain washer, spring washer & check nut suitable for DOG AAAC Conductor for 33 KV and for Rabbit AAAC conductor for 11 KV.	6 nos to be provided	

## 6.0 **CT: PT**

6.1 11 KV and 33 KV combined metering equipment unit shall comprise of 3 nos. CTs conforming to IS-2705: 1992 and should not exceed the current ratio error and phase displacement error as prescribed therein and 1 no. three phase PT conforming to IS-3156: 1992 and should not exceed the ratio error and phase replacement as prescribed therein. The oil characteristics shall be conforming to IS-335: 1983 & with latest amendments and upgrade, if any. The CT secondary winding shall be suitable for transformer oil filled equipment.

6.2 The primary of PTs shall be 3 phase star connected with HV side neutral floating. The primary winding has to be designed for unearthed neutral for the highest system voltage i.e. 36 KV for 33 KV and 12 KV for 11 KV. PT winding should have uniform insulation throughout from terminal to neutral end, and not the graded insulation. The 11 KV metering unit should be suitably designed for with-standing the unbalanced voltages developed due to single phasing operation during load regulatory measures in 11KV distribution system. It should be capable of withstanding the disturbance of back e.m.f., magnetic characteristic and consequential mechanical inter-play of forces, if any, under such single phasing. Secondary winding of PT should be three phase star connected with neutral brought out. On secondary side of PT four terminals shall be marked as r, y, b and n. No PT fuses are to be provided either on primary side or on secondary side.

6.3 The conductor in the secondary winding of the CT shall not be less than 14 SWG/3.24 sq.mm.

6.4 Normal current density shall not be more than 1.5 Amps/ sq.mm. in primary winding of the CT.

6.5 The primary winding shall be of adequate cross section to carry continuously the rated current plus 20% percent overload continuously.

## 7.0 **COMBINED CT: PT TANK**

- 7.1 The metering equipments shall be contained in a weather proof out door double pole mounting type M.S. tank with 6 nos. of 11 KV / 33 KV weather proof bushings with Brass stud as per rating of combined CT: PT (metering equipment) units.
- 7.2 3 nos. bushings on incoming and 3 nos. bushings on outgoing terminals i.e. (Main side & load side), with M and L marking embossed on the top cover of MS tank to identify incoming and outgoing terminals of the metering unit, shall be provided.
- 7.3 The tank should be given three coats of rust preventing paint and finished with light grey No.631-IS-5 on all external surfaces. The internal surface of the tank shall be painted with two coats of a suitable oil-insoluble paint.
- 7.4 The ME shall be supplied complete with duly filled Transformer oil conforming to IS:335-1982 with latest amendment thereof. The test certificate of oil being used shall be provided at the time of inspection. The oil in the ME shall be filled under vacuum. Oil drain valve or sampling cock or non return type oil filling valve provided to facilitate factory processing shall be sealed before dispatch of MEs.
- 7.5 The ME shall be hermetically sealed and shall be provided with a oil conservator, having oil level gauge, of adequate size to facilitate expansion/ contraction of oil due to change in temperature. The total volume of conservator shall be such as to contain 10% quantity of the oil. Normally minimum 3% quantity of the total oil shall be contained in the conservator. The volume above the oil level in the conservator tank shall be filled with Nitrogen gas conforming to commercial grade as per IS:1747:72.
- 7.6 A pressure release safety device suitable for operation at a pressure of 0.4 to 0.5 Kg/sq.cm. shall be provided at the top of the conservator tank
- 7.7 An explosion vent diaphragm shall be provided opposite side of the ME secondary terminal box which should operate at a pressure of 0.6 to 0.8 Kg/sq.cm. The manufacturer has to produce the test/calibration certificate for proper operation of the device at the defined pressure.
- 7.8 The pressure of Nitrogen gas, pressure release device and explosion vent diaphragm shall be properly coordinated.
- 7.9 The ME shall be fitted on HV side with outdoor type porcelain bushings of appropriate voltage & current. These bushings shall conform to IS:2099:1986. Further, sealing arrangement shall be such that oil should

not leak out from the bushing/ME tank. For gasket joints, wherever used, nitrile butyl rubber gaskets/neoprene or any other improved material shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression. It should be ensured that the quality of gaskets used between the joints and also for mounting of oil level indicator will be of best quality to avoid leakage of oil. The quality of gasket should be selected keeping in mind the ambient temperature of 50°C. The end turns insulation of PT HV winding towards bushing side should be appropriately enhanced. The dimensions and electrical characteristics of the bushing shall be in accordance with relevant ISS and its subsequent amendments, if any. The minimum electrical clearance between phases and phase to earth shall be provided as specified in relevant ISS.

- 7.10 The insulating materials for winding between HV & LV between interlayer of the winding and for end turn shall be as per relevant ISS. However, end turns have to be provided with enhanced insulation and lead connecting the bushing shall be provided extra insulation of fiber glass sleeve.
- 7.11 The metering equipment shall have a built-in secondary terminal box. Entry of cable into the box on the dual ratio metering unit shall be through one no. gland & check nut. Metallic cable gland to suit 12 core 2.5 Sq.mm armoured copper cable shall be supplied with ME. For single ratio ME, entry of the cable shall be through GI pipe of size (1.25" dia) 40mm dia, therefore one no. cable entry to suit 40mm dia. GI pipe shall be provided.
- 7.12 In single ratio MEs, the location of the secondary terminal box shall be with top fitting cover and the level of the cover shall be aligned with top cover of ME. For Dual ratio MEs, the secondary box may be provided on side wall of the tank with side cover. The ratio changing arrangement (for dual ratio ME only) should be provided on secondary side. The top of the tank will have slope to drain the rainwater. The fixing of conservator on to the top cover of metering unit shall be such as to avoid the collection of air pockets inside tank.
- 7.13 Top cover flange of metering unit should be provided with holes for proper sealing arrangement at all four corners of the tank and cover. Secondary terminal box cover should have 8 nos. nuts & bolts with hole for sealing arrangement. For this, 8 nos. holes should be provided on the cover & flange of secondary terminal box at the corners & middle of each face for fixing nut bolts.
- 7.14 The metering unit shall be provided with non-detachable anodised aluminium name plate showing position of the terminals, their marking, connection diagram along with the information as specified in IS: 2705 and IS: 3156 i.e. type, voltage ratio, CT ratio, rated burden, class of

accuracy, sr. no. of unit, order no. & date, month and year of dispatch etc. of metering unit. Further, MS plate size 125 x 125 mm be got welded on width side of metering unit for fixing of the nameplate.

- 7.15 The gaskets used should be of best quality having a thickness of 3 mm or more. The information about the gasket material used for the metering unit should be mentioned in the offer. The tank shall be of robust construction having thickness of top and bottom sheet of minimum 5mm and all the sides of tank made up of minimum 3 mm sheet. The welded joints of the metering unit shall be strengthened by providing 25 x 25 x 3mm angle all along the welded length and welded properly inside the tank. All joints of the tank and fitting shall be oil tight. The tank shall be reinforced by welded angle of size 25 x 25 x 3mm on the entire outside wall on the edge of the tank to form two equal compartments. One face of reinforcement angle should be continuous welded with the tank surface such that other side of the angle forms inverted "L".
- 7.16 The mounting of the bushing on the metering equipment should be in oblique plane particularly in case of single ratio metering unit. CT primary and secondary terminals shall be marked clearly as indicated in Annexure-C of IS: 2705, the terminal marked P1 of primary and S1 of secondary in case of current Transformer and corresponding in case of PT shall have the same polarity at any instant.

On secondary side of PT, four terminals shall be marked as r, y, b and n. The metering unit shall have the following:-

- (i) Riveted Rating and Diagram plate.
- (ii) 2 Nos. welded lifting lugs of MS plate 4 mm thick.
- (iii) 2 Nos. base mounting channels size 75 x 40 mm across length of metering unit.
- (iv) 2 Nos. earthing terminals with lugs.
- (v) Provision of 6 nos. Bi-metallic clamps suitable for AAAC Dog conductor for 33 KV and AAAC Rabbit conductor for 11 KV. The terminal connector shall conform to the latest version of IS:5561. In respect of terminal connectors following should be ensured.
  - a. The terminal connector should be made of A6 Aluminium Alloy and manufactured by gravity die-cast.
  - b. All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges should be rounded off.
  - c. No part of clamp shall be less than 12 mm thick

- d. The bimetallic strips/sleeves shall be minimum 2 mm thick
- e. All nuts/bolts/washers shall be of stainless steel.
- f. The conductor should be tightened by minimum 4 bolts. Conductor hold must not be less than 50 mm.

## 8.0 **Earthing:**

The assembly comprising of chassis, frame work and the fixed parts of the metal casing of the combined CT:PT metering equipment shall be provided with two separate earthing terminals in accordance with clause 5.2 of IS:3156 (part-I)

## 9.0 **TESTS:**

### 9.1 **TYPE TEST**

The design of metering unit shall be type tested for short time current test, temperature rise test, lightning impulse test, accuracy test, high voltage power frequency voltage withstand test as per IS-2705/1992 and IS-3156/1992 (with latest amendment) from CPRI, ERDA or any other NABL accredited lab.

### 9.2 **ROUTINE TEST**

Each of completely assembled metering unit shall be subjected to the following routine tests at the manufacturer's works in accordance with the details specified in IS:2705 and IS:3156 :-

- a. Verification of terminal marking and polarity test of CT and PT of metering unit
- b. Power frequency dry withstand test on primary winding of CT and PT of metering unit.
- c. Power frequency dry withstand test on secondary winding of CT and PT of metering unit.
- d. Over Voltage inter turn test on CT of metering unit.
- e. Determination of errors or other characteristics according to requirements and class of accuracy of CT and PT of combined Metering Equipment.
- f. Induced voltage test on PT of metering unit.
- g. Break down voltage test of transformer oil.

- h. Pressure test on tank of metering unit at 0.8 kg./sq.cm.
- i. Ratio & phase angle error test of CTs of metering unit.
- j. Insulation Resistance test with 1 KV megger.

10.0 **Guarantee:**

The MEs shall have to be guaranteed for a period of 18 months from the date of supply or 12 months from the date of use, whichever is earlier. During performance guarantee period, if any defect is observed in MEs, the same shall have to be replaced by the supplier free of cost within 30 days of intimation.

Superintending Engineer (P- II)

O/o CMD, MPPKVV Co. Ltd.,

Jabalpur