



SPECIFICATION SS-112C – TMO-1005.1

150KV CAPACITIVE VOLTAGE TRANSFORMERS (VTs)

I. SCOPE

This hereby technical description covers IPTO's requirements regarding design features, technical characteristics and testing of single – phase, outdoor, capacitor type 150kV voltage transformers.

II. KEY WORDS

Voltage transformers, instrument transformers, measurement transformers.

III. STANDARDS

The voltage transformers shall conform to the latest edition of IEC 61869-1 and 61869-5 standard or other equivalent international standards.

IV. USE

The voltage transformers will be used for metering and protection purposes, in 150kV incoming bays in 150/20kV air insulated substations and also in 400/150/30kV extra high voltage air insulated substations.

The voltage transformers will be connected between line and ground and will be used for relaying, metering and for coupling carrier transmitting equipment to power line. Carrier equipment is not requested but only the protection device and the terminals for the carrier equipment.

V. OPERATING CONDITIONS

- | | |
|----------------------------------|------------------------------------|
| 1. Installation | : Outdoors |
| 2. Limits of ambient temperature | : Maximum +45 °C
Minimum -25 °C |
| 3. Altitude | : Up to 1000m above
Sea level. |
| 4. Pollution level | : Moderate |
| 5. Other climatic conditions | : Snow. Ice and fog |

VI. IPTO's 150KV ELECTRIC SYSTEM CHARACTERISTICS

- | | |
|---|--------------------------|
| 1. Nominal Voltage (phase to phase) | : 150kV |
| 2. Maximum Operating Voltage (phase to phase) | : 170kV |
| 3. Nominal frequency | : 50HZ |
| 4. Short Circuit level | : 31,5 kA |
| 5. Basic Insulation level (Lightning Impulse) | : 750kV |
| 6. Number of phases and conductors | : 3-phase, 3-conductors, |

7. Earthing (grounding) Method

: The neutral is solidly grounded.

VII. REQUIRED DESIGN FEATURES OF THE VOLTAGE TRANSFORMERS

1. Type of voltage transformer

Outdoor, single – phase, oil immersed capacitor voltage transformers with one primary winding and three (3) separate secondary windings.

2. Ratio

As indicated in the Inquiry.

3. Required Electrical diagram of 150kV voltage transformers

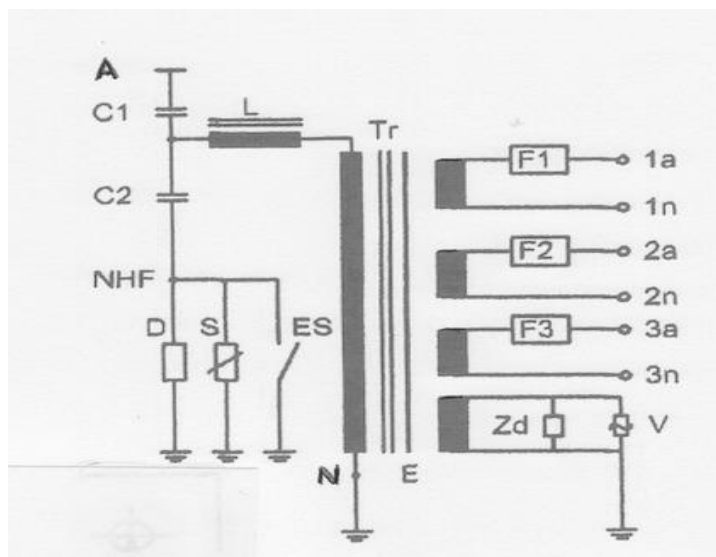


Fig. No.1

4. Secondary Windings

The VTs will be equipped with three (3) secondary windings as shown in Fig. No 1. Two of these windings will be used for metering purposes and one for protection purposes. The output power, accuracy class, limits of the voltage error and phase displacement of the secondaries shall be as indicated in the Request.

Rated output and accuracy class requirements of the secondary windings

Winding No I for metering purposes : 25 VA, class 0.2

Winding No II for metering purposes : 50 VA, class 0.2

Winding No III for protective purposes : 10 VA, class 3P

Total simultaneous burden for No I and No II: 75 VA for the class 0.2 windings

Limits of voltage error and phase displacement for the metering windings

a. Percentage voltage (ratio) error	: $\pm 0.2\%$
b. Phase displacement	: ± 10 minutes

Each winding should fulfil its respective accuracy requirements within its output range, whilst at the same time the other windings have an output of any value from 0% to 100% of the upper limit of the output range specified for the other winding.

Limits of voltage error and phase displacement for the protective winding

a. Percentage voltage (ratio) error	: $\pm 3\%$
b. Phase displacement	: ± 120 minutes

5. Primary winding

The primary winding shall be as indicated in Fig. No. 1 with the rating voltage as specified in the Inquiry.

6. Connection of the primary winding.

Phase – to – earth (single – pole)

7. Insulation housing (enclosure) of the VT

The housing which serves as insulator shall be either of high quality porcelain of one piece (compact), free from cracks, flaws or defects and grazed over all exposed surfaces of silicon rubber. The porcelain housing shall comply with the regulation IEC 60233. “Tests on hollow insulators for use in electrical equipment” and should preferably be defined of grey colour. The silicon rubber housing shall be in accordance with IEC-61462 “Composite insulators – Hollow insulators for use in outdoor and indoor electrical equipment”

The type of the insulator is determined by the requirements of the inquiry.

8. Metal frame (case) parts

Apart from the primary phase terminal all other frame metal parts of the VT shall either be of hot-dip galvanised steel or any other non-corrosive metal.

9. Creepage distance of the Housing

The creepage distance of the housing shall be ≥ 4250 mm.

10. Insulating Oil

Only mineral oil shall be used and which must be non-toxic and biodegradable. The insulating oil shall be in accordance with the latest version of IEC publication 60296, for transformer oil. The use of toxic insulating agents such as PCBs or PCT's etc is prohibited.

11. Oil – expansion bellows and sealing

The VT interior shall be filled with insulating oil and the VT shall be hermetically sealed against humidity.

Any oil volume changes due to temperature fluctuations shall be accommodated by appropriate expansion of the bellows (metallic bellows are preferred) located on the VT head. The sealing of the transformer shall be ensured by welding (welded type transformer), or through suitable sealing ring (O-RING) with proven resistance to insulating oil and temperature.

The sealing strength of the transformer shall be confirmed through the appropriate test which shall be proposed by the manufacturer.

12. Primary Terminals

The primary terminals shall be of nickel plate copper, cylindrical in shape with diameter of 30mm and length of about 100mm.

13. Spark gap

The transformers shall be equipped with an adjustable spark gap between line and ground for the protection of the insulating and in any case with a spark gap between the low voltage terminal and ground for the protection of the carrier equipment.

14. Terminal cabinets for the secondaries

The secondary winding terminals shall be located in a weatherproof hot-dip galvanized box, made either of steel or a different kind of non-corrosive metal, which will be mounted on the metallic base of the VT. The terminal box shall be dustproof and waterproof (protection degree IP55). Each compartment will have suitable hinges and will be closed without any special tool, with one or two screws, suitable for the security of the compartments.

The terminal box shall have an appropriate interlocking mechanism with the door. In case to be opened the door for maintenance must be grounded the H.V.-terminals or -wirings automatic.

For the secondary terminals' box, it should be anticipated the existence of two (2) separated compartments of the terminal box, one for the secondary metering circuits and one for the secondary protection circuits so that they can be sealed separately. The compartments will be situated on the same side of the Voltage Transformer.

The terminals shall consist of threaded stubs fitted with nuts and washers. The bottom plate of the secondary terminals' box shall be furnished without holes but has to be easily drilled. Moreover the bottom plate of it shall be sufficiently large and bear three (3) cable glands, one for each secondary terminal circuit, suitable for a cable of $4 \times 4 \text{ mm}^2$, $\varnothing 21 \text{ mm}$. The terminals shall be easily accessible and shall be suitable to be wired with conductors of 4 mm^2 . The secondary windings will be protected by fuses of at least 8A. It shall be possible to short circuit one of these fuse elements easily in the terminal compartment. It shall be possible to connect the neutral sides of all secondary windings to the ground easily. For this purpose, one grounding screw shall be available in the compartment.

In the terminal box there will be suitable devices with plastic covers to secure the measuring circuits.

15. Installation

The VT shall be suitable for installation on an outdoor steel support structure. The VT's height should be less than 2.70 m and the weight less than 700 kg.

16. Seismic requirements

- a. Seismic qualification of the VT's shall be in accordance with the IEC-61463 and IEC-60068-3-3
- b. The VT's shall be capable of withstanding the following seismic stresses:
 1. Horizontally (axes x and y) : 0,5g (5m/s²)
 2. Vertically (axe z) : 0,25g (2,5m/s²)
- c. Both directions to be assumed to reach their maximum values simultaneously.
- d. The frequency range should be 1 Hz to 35Hz.
- e. Acceptable methods of seismic qualification are:
 1. Qualification by vibration test or
 2. Qualification by static calculation or
 3. Qualification by dynamic analysis
- f. Bidders are obliged to submit in their offers, test reports or calculation by dynamic analysis, or static calculation.
Approval or not of all of the above, lies on IPTO's judgment.

17. Accessories

Each VT shall be equipped with the following:

- Oil level indicator, visible from distance.
- Oil – filling plug
- Oil – drain plug
- Lifting and jacking lugs
- A special terminal for measuring $\tan\delta$ which shall be short – circuited during normal operation.

VIII. REQUIRED RATING CHARACTERISTICS OF THE VTs

1. Rated frequency	: 50 HZ
2. Ratio	: As indicated in the Request.
3. Number of Secondary Windings.	: 3
4. Minimum length of creepage path	: 4250 mm
5. Partial discharge level	: ≤ 5 pC at 118 kV

- | | |
|---|--|
| 6. Power frequency withstand voltage for the secondary windings | : 3 kV (r.m.s.) |
| 7. Rated lightning impulse withstand voltage for the phase (pole) of the primary terminal | : 750 kV (peak) |
| 8. Chopped lightning impulse withstand | : 862,5 kV (peak) |
| 9. Power frequency withstand voltage of the primary neutral (to earth) terminal | : 3 kV (r.m.s.) |
|
 | |
| 10. Rated power – frequency withstand voltage of the phase (pole) of the primary terminal. | : 325 kV (r.m.s.) |
| 11. Limits of the temperature rise of the windings. | : 65° K |
| 12. Temperature category. | : -25 / +45° C |
| 13. Static loading withstand | : 1000 N |
| 14. Dielectric dissipation factor (tanδ). | : ≤0.005 at 98 kV |
| 15. Rated voltage factors | : 1.2 continuous
1.5 for 30 seconds |
| 16. Transmitted overvoltage peak value limit at 223.26KV. | : 1.6 KV |
| 17. Radio interference voltage level. | : ≤2500 μV at 108 kV |

IX. TESTS

All testing shall be in accordance with IEC 61869-1 & 61869-5 standard:

A. Type tests

1. Temperature rise test at rated thermal burden.
2. Chopped impulse test.
3. Lightning full wave impulse test.
4. Wet test for outdoor type voltage transformers at 325 kV for 1 min.
5. Transient response test.
6. EMC Radio interference voltage measurement.
7. Short – circuit withstand capability test.
8. Ferro – resonance test.
9. Determination or errors.
10. Tightness design test of capacitor units.
11. Mechanical strength test on H.V. primary terminal.

B. Routine tests

1. Verification of terminal and rating plate markings.
2. Power – frequency withstand dry tests on primary winding at 325 kV for 1 min.
3. Measurement of partial discharges after the power frequency test (§ii.2).
4. Measurement of dielectric dissipation factor (acceptance <0.5%) after the power frequency test (§ii.2).
5. Power – frequency withstand test on electromagnetic unit.
6. Power – frequency withstand test on low voltage terminal.
7. Power – frequency withstand test on secondary windings.
8. EMC Radio interference voltage measurement.
9. Winding resistance measurement.
10. Determination of errors and polarity test.

C. Special Tests (on one VT of the order)

1. Chopped lightning impulse test.
2. Measurement of capacitance and dielectric dissipation factor.
3. Determination of errors.

X. MARKINGS

A. Terminal markings

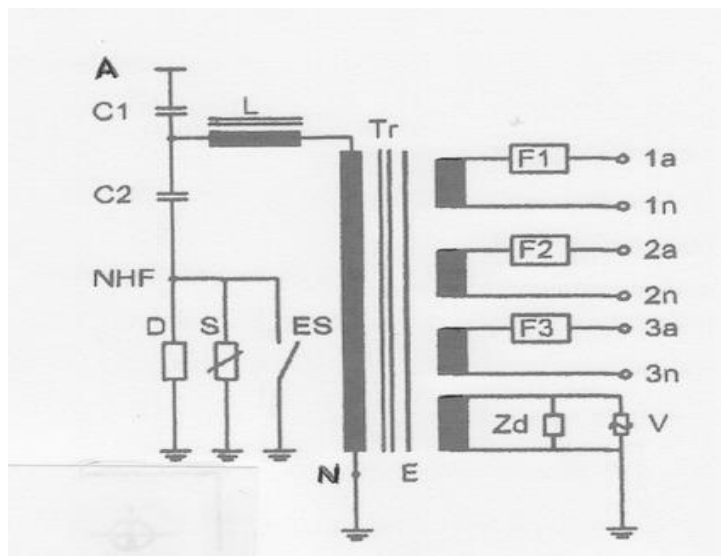


Fig. No.2

B. Rating plate markings

All VT's shall bear a rating plate of non – corrosive material with the following markings, which will be easily read:

1. The manufacture's name.
2. Type, serial number and year of manufacture.

3. Rated primary and secondary voltage.
4. Rated frequency.
5. The rated insulation level
6. Rated output and corresponding accuracy class of secondary windings
7. Highest voltage.
8. Rated voltage factor and corresponding rated time.

XI. DATA TO BE SUBMITTED BY BIDDERS

1. Bidders shall supply all the technical data requested in attachment “A”, attached hereto, as well as any proposed departures from the present specification and the reason therefore. Failure on bidder’s part to comply with this request will be taken as sufficient reason for rejection of the offer.
2. Technical pamphlets and brochures of the offered voltage transformers, which will help the technical evaluation process.
3. Technical data for the oil used in the voltage transformers.
4. Outline drawings showing overall dimensions of the VT, drawing indicating terminal markings as well as any information, sketches and data necessary for a complete description of the proposed voltage transformers.
5. Any type test certificates for the type and special tests specified in this hereby specification.
Acceptance or not of these certificates lies on the judgment of IPTO S.A.

XII. DATA TO BE SUPPLIED BY THE SUCCESSFUL BIDDER

After the signing of the contract, the successful bidder shall furnish three (3) sets of drawings for approval prior to the VTs construction. The drawing shall include outline dimensional drawing, detail base drawing, wiring and terminal marking drawings. The outline drawing shall include all necessary information, which will enable IPTO to construct the VT’s support steel structure.

XIII. PACKING

The VTs shall be packed inside robust wooden boxes, one (1) VT per box.

XIV. WARRANTY

The Supplier must provide a warranty for “Good Operation” of four (4) years beginning from the date of delivery of the VTs.

“ATTACHMENT A”

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ITEM/PIECES

Data to provided by all bidders. Failure to comply will constitute reason for rejection of the offer.

1. Type and manufacture :.....
2. Ratio :.....
3. Connection of primary winding :.....
4. Rated frequency :.....
5. Number of secondary windings :.....
6. Rated output and accuracy class of the
secondary winding I for metering
purpose :.....
.....
7. Rated output and accuracy class of the
secondary winding II for metering
purpose :.....
.....
8. Rated output and accuracy class
of the secondary winding I for
protection purpose (rated voltage
factor 1.5) :.....
.....
.....
.....
9. Temperature category :.....
10. Rated voltage factors
Continuous 1.2 :.....
.....

	1.5 for 30 seconds	:	.....
		:
	11. Limit of temperature rise of windings	:	.....
	12. Limits of voltage (ratio) error and phase displacement	:	.....
	a. For the metering purpose winding I		
	1. Percentage voltage (ratio) error	:	.....
	2. Phase displacement	:	.....
	b. For the metering purpose winding II		
	1. Percentage voltage (ratio) error	:	.....
	2. Phase displacement	:	.....
	c. For the protection purpose winding		
	1. Percentage voltage (ratio) error	:	.....
2.	Phase displacement	:	.....
	13. Power frequency voltage withstand of the phase primary winding	:	.....
	14. Lightning impulse voltage withstand of the phase primary winding	:	.....
	15. Power frequency withstand voltage for the earthed primary terminal	:	.....
	16. Power frequency withstand voltage for the secondary windings	:	.....
	17. Partial discharges permissible level		
	18. Chopped lighting impulse withstand Voltage	:	.....
	19. Radio interference voltage	:	.....
	20. Transmitted overvoltage peak value limit	:	.....
	21. Dielectric dissipation factor	:	.....
	22. Static loading withstand [N]	:	.....
	23. Type of Housing	:	.....
		:
		:
		:

- 24. Is the sealing of the transformer ensured
by welding (welded type transformer)
or through ‘‘O-RING’’?** :.....
- 25. Creepage distance of the housing** :.....
- 26. Description of the primary terminals** :.....
.....
.....
.....
- 27. Description of the terminal box
of the secondaries
Deviations from the specification
(§ VII-5), if any, to be stated** :.....
.....
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.....
- 28. Description of the metal frame (case)
parts** :.....
.....
.....
- 29. Description of sealing and of bellows** :.....
.....
.....
- 30. Description of oil (if applicable)** :.....
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.....
.....
- 31. Description of accessories (if applicable)** :.....
.....
.....
- 32. Are the terminals in the box of the
secondaries of the screw type and suitable
to be wired with 4mm²size conductors?** :.....

33. Are the phase and neutral secondary leads protected by fuses and links respectively? :.....
34. Where are the above fuses and links installed? :.....
:.....
35. Total weight of the VT (including oil) :.....
36. Total height of the VT :.....
37. Weight of oil :.....
38. Is the porcelain housing of gray colour? :.....
39. Does the supplier provide a warranty according to paragr. XIV? :.....
40. Are the VTs equipped with spark gaps? :.....