



June 2011

SPECIFICATION SS-56 – TMO-1106**150KV CURRENT TRANSFORMERS****I. SCOPE**

This technical description covers PPC requirements regarding the design features, the technical characteristics as well as tests of single – phase, oil – immersed 150kV current transformers of outdoor type.

II. KEY WORDS

Current transformers, instrument transformers, measurement transformers.

III. STANDARDS

The current transformers shall conform to the latest edition of IEC/EN 60044 – 1 standard.

IV. USE

The current transformers will be used for metering and protection purposes in 150 kV incoming bays, in 150/120 kV air insulated substations and also in 400/150/30 kV extra high voltage air insulated substations.

V. OPERATING CONDITIONS

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

VI. CHARACTERISTICS OF PPC SYSTEM IN 150kV

- | | |
|--|---------|
| 1. Nominal Voltage (phase to phase) | : 150kV |
| 2. Maximum Operating Voltage (phase to phase): | 170kV |

- | | |
|------------------------------------|-----------------------------------|
| 3. Nominal frequency | : 50Hz |
| 4. Short Circuit level | : 31,5kA |
| 5. Basic Insulation level | : 750kV |
| 6. The earthing (grounding) Method | : The neutral is solidly grounded |
| 7. Number of phases and wires | : 3-phase – 3-wire system |

VII. REQUIRED DESIGN FEATURES OF THE CURRENT TRANSFORMERS

1. Type of CT

Outdoor, single – phase, oil immersed current transformer with one primary winding with two (2) sections and five (5) separate secondary windings. Each secondary winding will have its own magnetic core, as shown in Fig. 1 below:

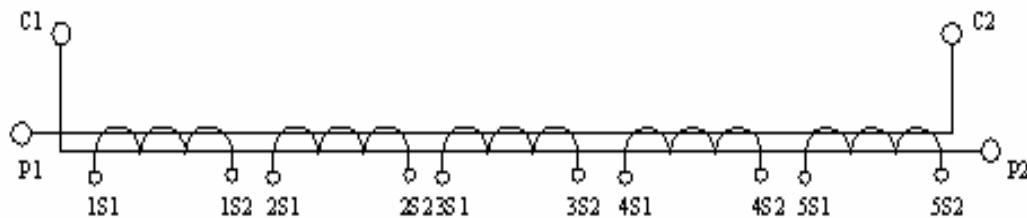


Fig. 1

2. Ratio

As indicated per item in the Request.

3. Secondary Windings

The current transformer will have two (2) secondary windings for metering purposes and three (3) secondary windings for protection purposes.

Rated burden and accuracy class for the secondary windings

Winding-1 for metering purposes	: 30VA, class 0.2S
Winding-2 for metering purposes	: 40VA, class 0.2S
Winding-3 for protection purposes	: 30VA, class 5P20
Winding-4 for protection purposes	: 30VA, class 5P20
Winding-5 for protection purposes	: 30VA, class 5P20

Limits for the ratio error and the phase displacement

Metering windings

α . Maximum ratio error	: ± 0.2 (20% - 120% I_N)
β . Maximum phase displacement	: ± 10 minutes

4. Primary winding

The primary winding shall consist of two sections as indicated in Fig 1 with a nominal current as indicated in the Request.

5. Housing (enclosure) of the CT

The housing which serves as an insulator shall be either of high quality porcelain of one piece (compact), free from cracks, flaws or defects and having even all exposed surfaces or of silicon rubber, taking the determination of the request into consideration. The porcelain housing shall comply with all relevant respects with IEC 60233 “Tests on hollow insulators for use in electrical equipment”. The silicon rubber housing shall be in accordance with IEC 61462 “Composite insulators – Hollow insulators for use in outdoor and indoor electrical equipment”.

6. Creepage distance of the Housing

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

7. 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. The use of toxic insulating agents such as PCBs or PCTs etc is prohibited.

8. Oil – expansion bellows and sealing

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

Any oil volume changes due to temperature fluctuations shall be arranged by an appropriate expansion of the bellows (metallic bellows are preferred) located on the CT head.

The sealing of the transformer shall be ensured by welding (welded type transformer) or through a suitable sealing ring (O-RING) with proven resistance to insulating oil and temperature.

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

9. Primary Terminals

The primary terminals shall be of copper, of cylindrical shape with a 30 mm diameter and with a minimum length of 80 mm. If the nominal primary current is greater than 1000 A, the diameter of the terminals shall be 60 mm and the minimum length 100 mm. The terminals shall be placed horizontally and diametrically opposite on the CT head.

10. Secondary terminals box

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 Current Transformer. The terminal box shall be dustproof and waterproof.

The secondary terminals box should have two (2) separate compartments, one for the secondary metering circuits and one for the secondary protection circuits so that they can be sealed separately. The compartments of terminals will be situated on the same side of the Current Transformer.

The terminals shall consist of threaded stubs fitted with nuts and washers. The terminals shall be easily accessible and they shall be suitable to be wired with conductors of 4mm^2 . One grounding screw shall be available in each compartment so that it is possible to connect the neutral sides of all secondary windings to the ground.

The bottom plate of the secondary terminals box shall be easily drilled. Moreover the bottom plate of the box shall be sufficiently large and it will bear three (3) cable glands, suitable for a cable of $4 \times 4 \text{mm}^2$, $\varnothing 21 \text{mm}$.

11. Metal frame (case) parts of the CT

Apart from the primary terminals all other frame (case) metal parts shall be either of hot – dip galvanised steel or of non – corrosive metal.

12. Installation

The CT shall be suitable for installation on a steel structure.

13. Location of the active CT system

The active CT system consisting of the primary and secondary windings with the cores shall be located in the CT lower part. CTs with the active system on the head can be accepted as long as they are in accordance with the requirements of paragraph VII – 14.

14. Requirements of seismic certification

- a. Seismic certification of the CT's shall be in accordance with the IEC-61463 and IEC-60068-3-3
 - b. The CT's shall withstand the following seismic stresses:
 1. Horizontally (axes x and y) : $0.5g$ (5m/s^2)
 2. Vertically (z axis) : $0.25g$ (2.5m/s^2)
 - c. The frequency range should be from 1 Hz to 35 Hz.
 - d. Acceptable methods of seismic certification are:
 1. Qualification by vibration test or
 2. Qualification by static calculation or
 3. Qualification by dynamic analysis
 - e. Bidders are obliged to submit in their offers test reports or calculation by dynamic analysis, or static calculation.
- The approval or not of all the above lies on PPC's judgment.

15. Accessories

Each CT shall be equipped with the following:

- Oil level indicator
- Oil – filling plug
- Oil – drain plug
- Lifting lugs
- Grounding (earthing) terminal for grounding the frame (case)
- A special terminal for measuring $\tan\delta$, which shall be short – circuited during the normal operation.

VIII. REQUIRED NOMINAL CHARACTERISTICS OF THE CTs

- | | |
|---------------------------------------|-------------------------------|
| 1. Primary rated current I_N | : As indicated in the Request |
| 2. Secondaries rated current | : As indicated in the Request |
| 3. Rated Voltage (phase – to – phase) | : 150 kV |
| 4. Highest Voltage | : 170 kV |
| 5. Rated frequency | : 50 Hz |
| 6. Temperature limits | : -25 /+ 45 °C |

7. Rated continuous thermal current	: $1.2xI_N$
8. Rated output (of secondary windings)	: As indicated in the Request
9. Rated short – time thermal current (I _{th})	: 40 kA
10. Rated dynamic current (I _{dyn})	: 100 kA
11. Limits of temperature rise of the windings (immersed in oil and hermetically sealed) when they are leaked with the rated continuous thermal current	: 65 °K
12. Rated power – frequency withstand voltage	: 325 kV rms
12. Rated lightning impulse withstand voltage	: 750 kV (peak)
13. Creepage distance of the housing	: ≥ 4250 mm
14. Chopped lightning impulse withstand	: 862,5 kV
15. Partial discharge level	: $< 5pC$ at 118 kV
16. Power frequency withstand voltage for the secondary windings	: 3 kV
17. Primary terminals withstand in static load	: 3000 N
18. Dielectric dissipation factor (tan δ)	: ≤ 0.005 at 98 kV
20. Maximum height of the CTs	: 2.90 m
21. Maximum weight of the CTs	: 750 kg

IX. TESTS

All tests shall be in accordance with IEC/EN 60044 – 1 standard:

A. Routine Tests

1. Verification of terminal and rating plate markings.
2. Power – frequency withstand test for the primary winding.
3. Partial discharge measurement.
4. Power – frequency withstand test for the secondary windings.
5. Power – frequency withstand tests between the sections of primary winding and secondary windings.
6. Overvoltage test of the coils.
7. Determination of errors and polarity test (this test shall be performed after the other six (6) tests).

B. Type Tests

1. Short – time current tests.
2. Temperature rise test.
3. Lightning impulse test.
4. Wet test for outdoor type current transformers.
5. Mechanical strength test on H.V. primary terminal.
6. Determination of errors (this test shall be performed before and after the short – time current tests).

C. Special / additional Tests (on one CT of the order)

1. Chopped lightning impulse test.
2. Measurement of capacitance and dielectric dissipation factor.
3. Determination of errors and polarity test (at the end of the above tests).

X. MARKINGS

A. Terminal Markings

The terminal markings shall be as indicated below:

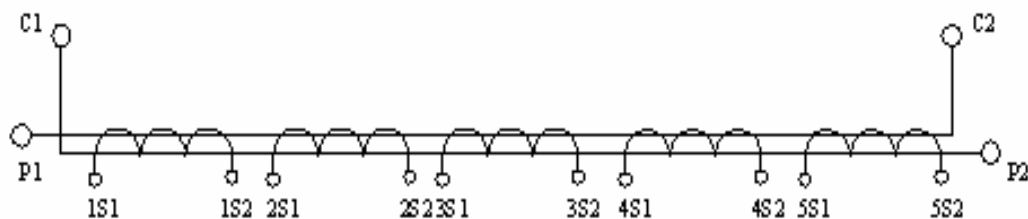


Fig. No. 2

B. Rating Plate markings

All CTs shall bear a plate of non – corrosive material with the following markings:

1. The manufacturer’s name.
2. Type, serial number and year of manufacture.
3. Rated primary and secondary current.
4. Rated frequency.
5. Rated output and corresponding accuracy class for the secondary windings.
6. The highest voltage.
7. The rated insulation level.
8. The rated short – time thermal current.
9. The rated dynamic current.

XI. DATA TO BE SUBMITTED BY BIDDERS

1. All bidders must provide all information requested in “ATTACHMENT A” of this specification. Failure on bidder’s part to comply with this request will be regarded as being a sufficient reason for the rejection of the offer.
2. Technical leaflets and instruction notes of the offered CTs, which will be instrumental in the technical evaluation process.
3. Technical data and characteristics for the oil used in the CTs.
4. Drawings showing the external dimensions of the offered CT and other necessary information, including the terminal markings.
5. Any certificates for the type tests or the special tests as specified in this specification as well as the seismic certification (§ VII.14).
The approval or not will lie on PPC’s judgment.
6. Guarantee period (“good operation” guarantee of at least three (3) three years and five (5) years for sealing reasons from the date of delivery).

XII. DATA TO BE SUPPLIED BY THE SUCCESSFUL BIDDER

After the signature of the contract, the successful bidder will have to submit three (3) sets of drawings for approval, prior to the CTs construction, as well as a complete sample per item for test and approval. The set of drawings will have to include a detailed drawing of the external dimensions, a detailed base drawing, drawings of electrical wirings and terminal markings drawings. The drawings of external drawings (dimensional) will have to include all necessary information so that PPC can test the current Transformer support.

XIII. PACKING

The CTs shall be packed inside robust wooden boxes, having one (1) CT per box.

“ATTACHMENT A”
150kV CTs

Data that must be provided by all bidders. Failure to comply will be regarded as being a sufficient reason for the rejection of the offer.

ITEM.../PIECES.....

1. Type and manufacturer :
2. Ratio :
3. Rated output and accuracy class for the secondary windings
FOR THE FIRST WINDING
 - Rated current :
 - Rated output :
 - Accuracy class (measuring class) :
 - Rated security factor $F_s \leq$:FOR THE SECOND WINDING
 - Rated current :
 - Rated output :
 - Accuracy class (measuring class) :
 - Rated security factor $F_s \leq$:FOR THE THIRD WINDING
 - Rated current :
 - Rated output :
 - Accuracy limit factor :
 - Accuracy class :FOR THE FOURTH WINDING
 - Rated current :
 - Rated output :
 - Accuracy limit factor :
 - Accuracy class :

FOR THE FIFTH WINDING

- Rated current :
- Rated output :
- Accuracy limit factor :
- Accuracy class :
- 4. Type of housing of CT :
- 5. Creepage distance of the housing :
- 6. Type of insulating oil :
- 7. Type of oil – expansion bellows and sealing :
- 8. Is the sealing of the transformer ensured by welding
(welded type transformer) or through a suitable sealing
ring “O-RING” ; :
- 9. Description of primary terminals in detail :
- 10. Description of secondary terminals box :
- 11. Description of the frame metal parts :
- 12. Installation :
- 13. Location of the active system of the CT :

14. As long as the active part is located on the head of the CT, are seismic test certificates or anti-seismic studies provided? :
15. Description of accessories :
:
:
:
:
16. Rated primary current :
17. Rated voltage of CT :
18. Highest voltage of CT :
19. Rated frequency :
20. Temperature limits :
21. Rated continuous thermal current :
22. Rated short – time thermal current :
23. Rated dynamic current :
24. Limits of temperature rise of windings :
25. Rated power – frequency withstand voltage :
26. Rated lightning impulse withstand voltage :
27. Chopped lightning impulse withstand voltage :
28. Partial discharge level :
29. Power frequency withstand voltage for the secondary windings :
30. Primary terminals withstand in static load :
31. Indicate the CT terminal markings :
32. Is the number of secondary windings of the offered CTs the same as the one that is specified in the Request, where each secondary winding has its own magnetic core? :
33. Are the secondary terminals of screw type and suitable to be wired with a 4 mm² conductor? :

34. Dielectric dissipation factor \leq/
/Is there a terminal for measuring $\tan\delta$? :
35. Overall weight of the CT including the oil :
36. Weight of the oil :
37. Height of the CT :
38. Expected internal resistance of the CT :