INDEPENDENT POWER TRANSMISSION OPERATOR **June 2011**
TRANSMISSION SYSTEM MAINTENANCE DEPARTMENT
MEASUREMENTS AND INSTRUMENTS SECTION

SPECIFICATION SS-80/3- ΕΣΧ-TMO1106

30kV INDUCTIVE VOLTAGE TRANSFORMERS (VT's) OF INDOOR TYPE

I. SCOPE

This technical description covers IPTO requirements regarding the design features, the technical characteristics as well as tests of 30kV inductive voltage transformers of indoor type.

II. KEY WORDS

Voltage transformers, instrument transformers, measurement transformers.

III. STANDARDS

The voltage transformers shall conform to the latest edition of IEC/EN 61869-1 & 61869-3 standard or other equivalent international standards.

IV. USE

The voltage transformers will be used for metering and protection purposes, for 30kV/50Mvar shunt reactors in 400/150kV substations. The voltage transformers shall be also suitable for installation on an indoor steel support stuffier.

V. OPERATING CONDITIONS

1.	Installation	: Installation of indoor type
2.	Limits of ambient temperature	: Maximum +50 ^{0}C Minimum -15 ^{0}C
3.	Altitude	: Up to 1000 m above the sea level.
4.	Pollution level	: Moderate
5.	Other weather conditions	: Humidity

VI. CHARACTERISTICS OF IPTO SYSTEM IN 30kV

1.	Nominal voltage (pole)	: 30kV
2.	Maximum operating voltage (pole)	: 36 kV
3.	Nominal frequency	: 50 Hz
4.	Short Circuit level	: 20 kA/1sec
5.	Basic Insulation level	: 170 kV
6.	Number of phases and conductors	: 3-phase system of three (3) conductors,

7. Grounding method : The neutral wire is grounded.

VII. REQUIRED DESIGN FEATURES OF THE VOLTAGE TRANSFORMERS

1. Type of the voltage transformer

Inductive voltage transformer, single–phase, with one primary winding and three (3) separate secondary windings per phase. The voltage transformers will be made of solid insulation from cyclo-acyclic epoxy resin, suitable for installation in places with high percentages of humidity, without extra filling with gas or oil. The cast must be homogeneous for security reasons.
The terminal cabinet of the secondary winding must be incorporated in the frame of the transformer. The basis of the voltage transformer will have to bear a terminal, on it, for earthing that will be of suitable construction so that the connection towards the earth cannot be disconnected involuntary.

2. Required electrical diagram of 30 kV voltage transformer

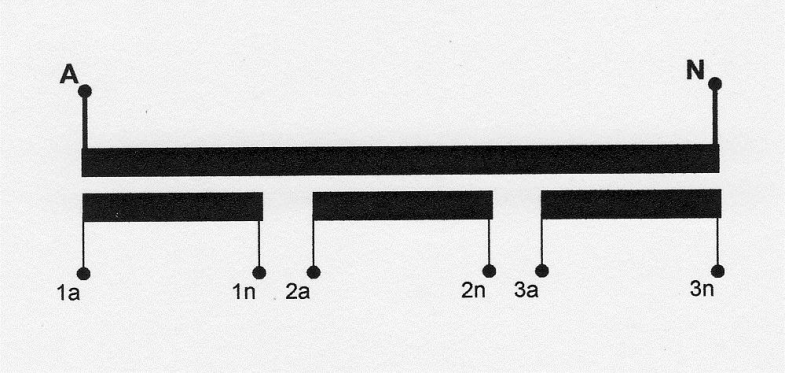

Figure No.1

3. Ratio

Single-phase: 30.000/√3 // 100/√3 - 100/√3 - **100/3** V.

4. Secondary Windings

The voltage transformer 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.

Rated burden and accuracy class for the secondary windings

Winding No I for metering purposes : 30 VA, class 0.5
Winding No II for metering purposes : 30 VA, class 0.5

Winding No III for protection purposes : 30 VA, class 3P

Total simultaneous burden for No I, No II and No III windings: 90 VA

Limits of error of ratio and phase displacement for the metering windings

Each winding must fulfil the respective accuracy requirements according to the IEC/EN 61869-3 standard for each burden within the above limit of its

rated burden, while at the same time the other windings will have a burden from 0% to 100% of the upper limits of their rated burdens.

5. **Terminal cabinet for the secondary windings**
   It should be allowed the existence of a terminals cabinet for the secondary windings. The cabinet shall be large enough and it will bear two (2) cable gland suitable for a cable of 4x4mm^2, ø21mm. The terminals must be easily accessible and suitable to be wired with conductors of cross-section 4mm^2. It should be possible that the neutral side of all secondary windings is connected to the ground easily. For this reason must be available at least one grounding screw.
   The cabinet will be dustproof and waterproof and it will close, without any special tool, with screws suitable for its security.

6. **Primary winding**
   The primary winding will have to be suitable for a voltage of 30kV and shall be so constructed as to withstand the effect of surges and ensure uniform impulse voltage distribution throughout the winding. The primary winding shall be fully insulated.

7. **Connection of the primary winding**
   Single-phase: Phase-to-earth

8. **Primary Terminals**
   The primary terminals will have to be made of nickel plate copper with a suitable bolt for the connection a cable until 10 mm².

9. **Insulating material of the voltage Transformer**
   The insulating material will be compact, with smooth surfaces, without cracks, flows or defects.

10. **Creepage distance of the housing**
    The creepage distance of the housing will have to be suitable for the uninterrupted operation of the voltage Transformers indoors with high percentages of humidity.

11. **Metal parts of the voltage Transformer**
    Apart from the primary terminals, all other metal parts of the voltage Transformer shall be made either of hot–dip galvanised steel or of non-corrosive metal.

12. **Installation**
    The voltage Transformer shall bear holders for its easy transportation and shall be also suitable for installation on an indoor steel support stuffier.

VIII. REQUIRED ELECTRIC RATED CHARACTERISTICS OF THE VOLTAGE TRANSFORMERS

1. **Rated voltage** : 30 kV
2. **Maximum operating voltage** : 36 kV
3. **Rated frequency** : 50 Hz
4. **Transformation Ratio** : 30.000/√3 // 100/√3-100/√3-100/3 V
5. **Number of secondary windings** : 3

6. Partial discharge limit	:	≤20 pC
7. Power frequency withstand voltage for the secondary windings	:	3 kV (r.m.s.)
8. Rated lightning impulse withstand voltage for the phase (pole) of the primary terminal	:	170 kV (peak value)
9. Chopped lightning impulse withstand	:	195 kV (peak value)
10. Power frequency withstand voltage of the primary grounded terminal	:	3 kV (r.m.s.)
11. Rated power frequency withstand voltage of the phase (pole) of the primary terminal.	:	70 kV (r.m.s.)
12. Limits of the temperature rise in the windings.	:	75^0K
13. Temperature limits	:	-15 / +50^0C
14. Rated voltage factor	:	1.2 continuous 1.5 for 30 seconds

IX. TESTS

All tests shall be conducted in accordance with IEC/EN 60044-2 standard.

A. <u>Type tests</u>

1. Temperature rise test.
2. Short – circuit withstand capability test.
3. Lightning impulse test.
4. Chopped lighting impulse test.
5. Determination of errors.

B. <u>Routine tests</u>

1. Verification of plate and terminal markings.
2. Power frequency withstand test for the primary winding.
3. Partial discharge measurement after the dielectric test.
4. Power frequency withstand tests among the secondary windings.
5. Power frequency withstand tests among the parts of the secondary windings.
6. Determination of errors and polarity test (This test will be carried out last in the raw).

C. <u>Special / additional tests (in one VT of the order)</u>

1. Chopped lightning impulse test.

X. MARKINGS

A. Terminal markings

The markings in the terminals will have to be as shown bellow:

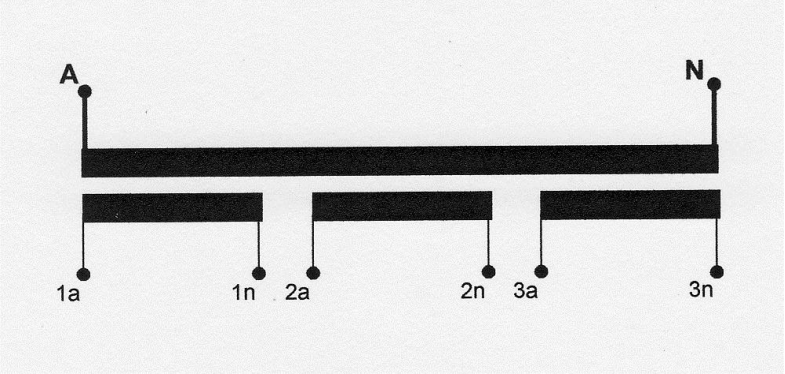

Fig. No.2

B. Plate markings

Each voltage Transformer shall bear a plate made of non – corrosive material. The plate will be easily read and will be have at least the following information:

1. Manufacturer's name.
2. Type, serial number and year of manufacture.
3. Rated voltage of primary and secondary winding.
4. Rated frequency.
5. Rated insulation level.
6. Rated output power and corresponding accuracy class of the secondary windings.
7. Maximum voltage.
8. Rated voltage factor and corresponding rated time.
9. Drawings related to the ratio change and the connection of secondary windings.

XI. SUBMITTED DATA BY BIDDERS

1. All bidders will have to give in all the technical data requested in the "ATTACHMENT A" of the current specification, as well as any proposed divergence from the present specification, giving an explanation for the existence of these divergences. Failure on bidder's part to comply with this request will be regarded as being a significant reason for the rejection of the offer.
2. Technical brochures and instruction notes of the offered voltage Transformers, which will be instrumental in the technical evaluation process.
3. Outline drawings showing the dimensions of the voltage Transformer, the terminal markings as well as any other information, drawings and data necessary for the complete description of the proposed voltage Transformers.
4. Any certificates for the type tests or the additional tests as specified in the present specification. Their acceptance or not lies on the judgment of IPTO.

XII. GIVEN DATA BY THE SUCCESSFUL BIDDER

After the signature of the contract the successful bidder, prior to the current Transformers production, will have to submit three (3) sets of drawings for approval, prior to the voltage Transformers construction. 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 marking drawings. The drawings of external drawings (dimensional) will have to include all necessary information so that IPTO can test the voltage Transformer support, as they are going to replace the so far existing voltage transformers.

XIII. PACKING

The voltage Transformers will have to be packed inside robust wooden boxes. Each wooden box will have two (2) voltage Transformers.

«ATTACHMENT A»

30kV INDUCTIVE VOLTAGE TRANSFORMERS (VT's) OF INDOOR TYPE

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

ITEM ……../PIECES …….

1. **Type and manufacturer:** .....
2. **Ratio:** .....
3. **Connection:** .....
4. **Rated frequency:** .....
5. **Number of secondary windings:** .....
6. **Rated output power and accuracy class of the secondary winding I for metering purposes:** .....
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7. **Rated output power and accuracy class of the secondary winding II for metering purpose:** .....
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8. **Rated output power and accuracy class of the secondary winding III for protection purposes (overvoltage factor 1.5):** .....
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   .....
9. **Temperature category:** .....
10. **Rated voltage factor**
    1.2 continuously: .....
    1.5 for 30 seconds: .....
11. **Limits of temperature rise of winding:** .....
12. **Limits of voltage error and phase displacement** .....
    a. **For the metering purposes winding I**
       1. **Percentage of voltage error:** .....
       2. **Phase displacement:** .....

b. For the metering purposes winding II

1. Percentage of voltage error: .....

2. Phase displacement: .....

c. For the protection purposes winding III

1. Percentage of voltage error: .....

2. Phase displacement: .....

13. Power frequency voltage withstand of the primary winding: .....

14. Lightning impulse voltage withstand of the 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. Type of Housing: .....
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20. Description of the primary terminals: .....
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21. Description of the terminal cabinet of the secondary windings: .....
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22. Description of the metal parts of the frame: .....

23. Description of the accessories: .....

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24. Are the terminals in the cabinet of the secondary windings suitable for wiring with a 4mm^2 conductor?: .....

25. Total weight of the Transformer: .....