



INDEPENDENT POWER TRANSMISSION OPERATOR S.A.  
TNPRD/ SUBSTATION SPECIFICATION & EQUIPMENT SECTION

June 2013

## **SPECIFICATION No SS-135/5**

### **150 kV METAL OXIDE SURGE ARRESTERS WITHOUT GAPS**

#### **I. SCOPE**

This specification covers IPTO requirement with regard the rated characteristics, design features and testing of Surge Arresters for the 150kV system.

#### **II. KEYWORDS**

Arresters, Surge arresters, Lightning arresters, metal oxide resistors, surge arrester sections, surge arrester units.

#### **III. TYPE**

Metal oxide surge arresters without gaps.

#### **IV. USE**

The metal oxide surge arresters without gaps are used for the protection of 400/150/30kV auto-transformers and 150kV underground cables against switching and lightning surges.

#### **V. OPERATING CONDITIONS**

1.	Installation	:	Outdoors
2.	Ambient Temperature	:	Minimum: -25°C Maximum: +45°C
3.	Altitude	:	Up to 1000m above sea level.
4.	Other Conditions	:	Snow, ice and fog
5.	Pollution level	:	Heavy to moderate depending on location
6.	Wind speed	:	150km/h maximum
7.	Relative humidity	:	≤ 95%

## **VI. ELECTRICAL CHARACTERISTICS OF IPTO 150KV SYSTEM**

1.	Nominal Voltage	:	150kV
2.	Maximum Operating Voltage (phase to phase)	:	170kV
3.	Maximum temporary over-voltage (phase to ground)	:	144kV rms
4.	Number of phases	:	3
5.	Rated frequency	:	50 Hz
6.	Short circuit level	:	31kA
7.	Basic impulse Insulation level (crest)	:	750kV
8.	Method of grounding (earthing).	:	The 150kV system is solidly earthed

## **VII. HOW ARRESTER IS TO BE CONNECTED TO THE SYSTEM**

Phase - to - Earth.

## **VIII. STANDARDS**

The surge arresters shall conform to IEC- 60094-4 second edition Standard .

## **IX. ARRESTER REQUIRED CHARACTERISTICS**

1.	Continuous Operating Voltage $U_c$ (COV) or MCOV	:	$108 \leq U_c \leq 116$ kV rms
2.	Rated Voltage as defined in IEC-60099-4, $U_r$	:	144kV rms
3.	Rated frequency	:	50 Hz
4.	Nominal discharge current (8/20 $\mu$ s)	:	10KA, peak
5.	Maximum residual voltage at switching impulse (30/60 $\mu$ s)		
	a. At 500A	:	$\leq 287$ kV, peak
	b. At 1KA (protection level)	:	$\leq 297$ kV, peak
	c. At 2KA	:	$\leq 302$ kV, peak
6.	Maximum residual voltage at lighting impulse (8/20 $\mu$ s)		
	a. At 5KA	:	$\leq 340$ kV, peak
	b. At 10KA(lightning impulse protective level)	:	$\leq 363$ kV, peak
	c. At 20KA	:	$\leq 398$ kV peak
7.	Energy capability		
	a Line discharge class	:	3
	b Energy withstand	:	$\geq 7,8$ kJ/kV ( $U_r$ )
8.	High current impulse withstand	:	100KA, peak
9.	Short circuit withstand capability	:	31KA rms

- |     |   |   |  |
|-----|---|---|--|
| 10. | External housing characteristics                        |   |  |
|     | a. Insulation material of the external housing          | : | Silicon rubber or porcelain  |
|     | b. lightning impulse voltage withstand (1,2/50 $\mu$ s) | : | 750kV peak   |
|     | c. Power frequency voltage withstand, wet               | : | 325kV rms  |
|     | d. Creepage distance                                    | : | 4250mm   |
|     | e. Shed profile   | : | Normal or alternating  |
| 11. | Method of mounting                                      | : | Upright, vertically on a steel structure.  |
| 12. | Number of units   | : | One (1) or two (2)   |
| 13. | Type of the surge arrester                              | : | Silicon rubber arrester without or with enclosed gas volume or porcelain arrester. |
| 14. | Radio interference level                                | : | $\leq 2500\mu$ V at 1.05xUc  |
| 15. | Internal partial discharge level                        | : | $\leq 10$ pC at 1.05xUc  |
| 16. | Color of porcelain                                      | : | Grey   |

## **X. ADDITIONAL REQUIREMENTS**

1. **Surge Counter with leakage current meter**  
Each surge arrester shall be equipped with a surge counter which shall include a leakage current meter with at least five digits for both the surge counter and the leakage current meter.
2. **Support insulators**  
Four (4) support insulators for the installation of the surge counter with the leakage current meter must be provided. The support insulators must be able to withstand the long-term as well as the short-term mechanical forces affecting the arrester. They must also have adequate electrical strength so that they do not flash-over under the stress of voltage drops across the surge counter/leakage current meter.
3. **External housing of the Arrester**

The external housing of the arrester shall be of silicon rubber or of porcelain with a minimum leakage distance of 4250 mm.

The silicon rubber shall be in accordance with IEC-61462 "Composite insulators – Hollow insulators for use in outdoor and indoor electrical equipment". Furthermore, the silicon rubber shall be hydrophobic and resistant to pollution and to UV radiation.

The porcelain housing shall comply with IEC-60233 standard "Tests on hollow insulators for electrical equipment".

**4. Terminals**

Each arrester shall be equipped with a vertical flat line terminal of 100mm x 120mm in dimensions and thickness of 12mm minimum either of Aluminum or tin-plated Copper for connection to the high-voltage system.

Similarly with a copper terminal grounding stud for connection to ground (earth).

**5. Fittings**

All metal fitting of the surge arresters shall be hot dip galvanized steel, unless they are from aluminum alloy or from stainless steel.

**6. Bolts, nuts and washers**

The bolts nuts and washers which are needed for the mounting of the arrester on a steel support structure must be part of the supply.

These bolts, nuts and washers must be of hot dip galvanized steel or stainless steel.

**7. Grading ring**

The arrester shall be equipped, on its top, with a grading ring in order to control electrostatically the voltage distribution along the arrester if it is deemed necessary by the manufacturer.

**8. Arrangement of the arrester**

Multi-column arresters are not allowed.

**9. Pressure relief diaphragm**

The arrester shall be equipped with a pressure relief diaphragm if it is required by the design of the surge arrester.

**XI. TESTS**

**A. Type tests (Design tests)**

The surge arresters shall be subjected to the following tests as described by IEC 60099-4 standard, clause 10

1. Insulation withstand tests on the arrester housing.
2. Residual voltage tests (on complete arrester or arrester sections).

3. Long duration current impulse withstand test (ether on complete arrester or arrester sections or resistors).
4. Short circuit tests.
5. Operating duty tests (on complete arrester or sections).
6. Test of the bending moment (on complete arrester or arrester units).
7. Internal partial discharge tests (on the longest unit)
8. Environmental tests  
Arresters which differ only in terms of their dimensions, and which are otherwise based on the same design and material, are considered to be the same type of arresters.  
The temperature cycling test does not apply to polymer (silicon rubber) arresters.
9. Seal leak rate test
10. Radio interference voltage (RIV) test (on the longest unit)
11. Moisture ingress test (Not applicable to porcelain housed arresters)
12. Weather ageing test (Not applicable to porcelain housed arresters).

**B. Routine Tests**

The following routine tests, in accordance with IEC 60099-4, clause 9: shall be conducted on all arresters of the order.

1. Measurement of reference voltage.
2. Residual voltage test either on the complete arrester or on one arrester unit or on one resistor element.
3. Internal partial discharge test (on each arrester unit).
4. Leakage test (on each unit).

**C. Acceptance test**

Measurement of power frequency voltage on the complete arrester at the reference current measured at the bottom of the arrester. The test shall be made on the nearest lower whole number to the cube root of the number of arresters of the order.

**XII. INFORMATION WHICH MUST BE PROVIDED BY ALL BIDDERS**

The bidder shall provide the following:

1. Outline drawings of the arrester itself, and its metal fittings parts.  
These drawings shall include a cross section view and a side view of the arrester and top view of its metal fittings.
2. Technical prospectus describing the offered surge arrester and the surge counter/leakage current meter.

3. Bidder shall provide all the technical data requested in ATTACHMENT "A" - "Information by Seller", attached to this hereby specification. Incomplete submission of ATTACHMENT "A" shall constitute sufficient reason for rejection of the offer.
4. Any type test certificates for the type test listed in this hereby specification.  
Type test certificates will be accepted only if they are fully explanatory. In other words, if the type test certificates concern resistors or units or sections and not the arrester as whole, then the following information shall be included along with the certificates.
  - a. COV ( $U_c$ ) of the individual resistor or unit or section
  - b. Rated voltage ( $U_r$ ) of the individual resistor or unit or section
  - c. Residual voltage at switching impulse at 1KA of the resistor or unit or section.
  - d. Residual voltage at lightning impulse at 10KA of the resistor or unit or section
  - e. Short circuit capability of the resistor or unit or section
  - f. A statement that the resistor or unit or section of the certificate is used in the offered arrester.
  - g. Total number of resistors or units or sections used in the offered arrester.

### **XIII. NAME - PLATE DATA**

The following minimum information shall appear on the nameplate of non-corrosive material, permanently attached to the arrester.

1. Manufacturer's name or trade mark, type and identification of the arrester.
2. Year of the manufacture.
3. Continuous operating voltage ( $V_c$ ).
4. Rated voltage ( $U_r$ ).
5. Rated frequency
6. Nominal discharge current.
7. Short circuit current capability
8. Lightning impulse protective level

### **XIV. INFORMATION TO BE SUPPLIED BY THE SUCCESSFUL BIDDER**

1. Complete outline drawings (cross view and side view) of the surge arrester and top view its metal fittings for approval (3 sets) prior to the construction of the surge arrester.
2. Drawing of the surge counter/leakage current meter.
3. Assembly instructions for the arrester itself and for the surge counter/leakage current meter.
4. Proposed maintenance instructions (if any).

### **XV. PACKAGING**

The arresters shall be delivered packed in wooden robust boxes containing one (1) arrester per box.

AG/em/9.5.95  
AG/ak/30.9.96  
AG/ak/30.5.99  
AG/pm/27.8.2004  
IIð/pm/AG/March 2006

**"ATTACHMENT A"**

**150 kV METAL OXIDE SURGE ARRESTERS WITHOUT GAPS**

INFORMATION BY BIDDERS

Failure to comply shall constitute sufficient reason for rejection of the offer.

1. Type of offered surge arrester : .....
2. External housing characteristics
  - a. Insulation material of the external housing : .....
  - b. Lightning impulse voltage withstand (1,2/50 $\mu$ s) : .....
  - c. Switching impulse voltage withstand (250/2500 $\mu$ s) : .....
  - d. Power frequency voltage withstand, wet : .....
  - e. Creepage distance : .....
  - f. Shed profile : .....
3. Number of units of which the surge arrester consists of : .....
4. Surge arrester required characteristics
  - a. Continuous operating voltage (COV)  $U_c$ : .....
  - b. Rated voltage,  $U_r$  : .....
  - c. Rated frequency : .....
  - d. Nominal discharge current (8/20 $\mu$ s) : .....

e. Maximum residual voltage at switching impulse (30/60µs)

- at 500 A : .....
- at 1 kA : .....
- at 2 kA : .....

f. Maximum residual voltage at lightning impulse (8/20µs)

- at 5 kA : .....
- at 10 kA : .....
- at 20 kA : .....

g. Energy capability

- Line discharge class : .....
- Energy withstand : .....

k. High current impulse withstand : .....

i. Short circuit withstand capability : .....

5. Is the surge arrester equipped with a surge counter which also includes a leakage current meter? : .....

6. Are four (4) support insulators provided for the installation of the surge counter/leakage current meter? : .....

7. Is the silicon rubber external housing in accordance with IEC-61462 standard? : .....

8. Type of material, shape and dimensions of the line terminal : .....  
.....

- .....
9. Type of material and shape of the ground (earth) terminal : .....
10. Are all metal fitting of the arrester of hot-dip galvanized steel or of aluminum alloy or of stainless steel? : .....
11. Are the bolts, nuts and washers which are needed for the mounting of the arrester part of the supply? : .....
12. Are the bolts, nuts and washers of hot dip galvanized steel or stainless steel? : .....
13. Is the surge arrester equipped with a grading ring? : .....
14. Type of material of the grading ring : .....
15. Diameter of the grading ring : .....
16. Is the surge arrester of the silicon rubber housed without or with enclosed gas volume? (if applicable) : .....
17. Type of the enclosed gas (if applicable) : .....
18. Temporary over-voltage capabilities of the arrester
- For 1 second : .....
- For 10 seconds : .....
19. Internal partial discharge level : .....
20. Radio interference voltage level : .....
21. Bending moment of the

- surge arrester : .....
- 22. List all internal components of the surge arrester : .....  
.....  
.....  
.....  
.....
- 23. Weight of the arrester : .....
- 24. Indicate the size of the grounding (earthing) lead and the type of material which shall consist of . : .....
- 25. Maximum residual voltages at steep impulse  
at 10 kA : .....
- at 20 kA : .....
- 26. Is the arrester equipped with a pressure relief diaphragm? :  
.....
- 27. Type of silicon rubber used in the proposed arrester (if applicable) :  
.....
- 28. Type of material of the name-plate of the arrester : .....
- 29. Is the offered silicon rubber hydrophobic and resistant to pollution and UV radiation? (if applicable) : .....
- 30. Measuring range of the leakage current meter : .....
- 31. Total number of surges which the surge counter is capable of registering : .....

- 32. Is the surge arrester suitable for upright vertical mounting on steel structure? : .....
- 33. Color of the porcelain (if applicable) : .....
- 34. Number of digits of the surge counter / leakage current meter : .....
- 35. Basic impulse voltage insulation level of the support insulators : .....
- 36. Type of material of the tube on which the silicon rubber is attached to? : .....