



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

June 2017

SPECIFICATION No SS-135/7 **150 kV METAL OXIDE SURGE ARRESTERS WITHOUT GAPS**

I. SCOPE

This specification covers IPTO's 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 150KV SYSTEM

1.	Nominal Voltage	:	150 kV
2.	Maximum Operating Voltage (phase to phase)	:	170 kV
3.	Maximum temporary over-voltage (phase to ground)	:	144 kVrms
4.	Number of phases	:	3
5.	Rated frequency	:	50 Hz
6.	Short circuit level	:	31 kA
7.	Basic impulse Insulation level (crest)	:	750 kV
8.	Method of grounding (earthing).	:	The 150 kV 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 60099-4.

IX. ARRESTER REQUIRED CHARACTERISTICS

1.	Continuous operating voltage U_c (COV)	:	108 – 116 kVrms
2.	Rated Voltage as defined in IEC 60099-4, U_r	:	144 kVrms
3.	Rated frequency	:	50 Hz
4.	Class	:	Station
5.	Duty	:	Medium
6.	Designation	:	SM
7.	Nominal discharge current I_n (8/20 μ s)	:	10 kA peak
8.	Residual voltage at 10 kA lightning current impulse (8/20 μ s) (lightning impulse protection level, LIPL)	:	≤ 382 kV peak
9.	Residual voltage		

at 1 kA switching current impulse ($>30/60\mu\text{s}$),
(switching impulse protection level, SIPL): $\leq 299 \text{ kV peak}$

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|-----|--|---|---|
| 10. | Thermal energy rating W_{th} | : | $\geq 7 \text{ kJ/kV}$ |
| 11. | Repetitive charge transfer rating Q_{rs} | : | $\geq 1.6 \text{ C}$ |
| 12. | Rated short circuit current I_s | : | 31.5 kArms |
| 13. | External housing characteristics | | |
| | a. Insulation material of the external housing | : | Silicon rubber |
| | b. Lightning impulse voltage withstand ($1.2/50\mu\text{s}$) | : | 750 kV peak |
| | c. Power frequency voltage withstand, wet | : | 325 kVrms |
| | d. Creepage distance | : | $\geq 4250 \text{ mm}$ |
| | e. Shed profile | : | Normal or alternating |
| 14. | Method of mounting | : | Upright, vertically on a steel structure. |
| 15. | Number of units | : | One (1) or two (2) |
| 16. | Type of the surge arrester | : | without or with enclosed gas volume |
| 17. | Seal leak rate (only for arresters with enclosed gas volume) | : | $\leq 1.0 \mu\text{Pa}\cdot\text{m}^3/\text{s}$ |
| 18. | Radio interference level | : | $\leq 2500 \mu\text{V}$ at $1.05xU_c$ |
| 19. | Internal partial discharge level | : | $\leq 10 \text{ pC}$ at $1.05xU_c$ |

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 the surge counter.

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 with a minimum leakage distance of 4250 mm.

The silicon rubber shall be hydrophobic and resistant to pollution and to UV radiation.

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 each arrester shall be equipped with a terminal stud for connection to earth, through the surge counter.

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 the voltage distribution along the arrester, if this is deemed necessary by the manufacturer.

8. Arrangement of the arrester

Multi-column surge 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 in IEC 60099-4 standard. Each test can be performed on the complete arrester or on a suitable arrester section, as described in the standard.

1. Insulation withstand tests on the arrester housing, including lightning impulse test and wet power frequency test, or relevant calculations of arcing distance.
2. Residual voltage tests, including steep current impulse test, lightning impulse test and switching impulse test.
3. Test to verify long term stability under continuous operating voltage.
4. Test to verify the repetitive charge transfer rating.
5. Heat dissipation behaviour test
6. Operating duty test.
7. Power frequency voltage versus time tests, including tests with and without prior duty.
8. Short circuit tests, including high and low current tests.
9. Test to verify the bending moment of the arrester.
10. Test to verify the bending moment of the support insulators, if they are not included in previous test.
11. Seal leak rate test (only for arresters with enclosed gas volume).
12. Radio interference voltage (RIV) test or partial discharge (PD) test with measurement of internal and external discharges (without additional external shielding).
13. Test to verify the dielectric withstand of internal components, if this is not covered by the operating duty test.
14. Tests of internal grading components (if existing), including long term stability test and thermal cyclic test.
15. Weather ageing test, including salt fog test and UV light test.

B. Routine Tests

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

1. Measurement of reference voltage.
2. Measurement of lightning impulse residual voltage on the complete arresters or on each arrester unit or on a sample of one or more resistor elements from each arrester unit.
3. Internal partial discharge test (PD) on each arrester unit.
4. Leakage test on each arrester unit (only for arresters with enclosed gas volume).

C. Acceptance Tests

The tests shall be performed on the nearest lower whole number to the cube root of the number of arresters of the order, in accordance with IEC 60099-4.

1. Measurement of reference voltage on the complete arrester or on each arrester unit.
2. Measurement of lightning impulse residual voltage on the complete arrester or on each arrester unit.
3. Internal partial discharge test (PD) on the complete arrester or on each arrester unit.

D. Special Test

The test shall be performed once for each order, in accordance with IEC 60099-4.

- Thermal stability test on three suitable arrester sections, by repeating the thermal recovery portion of the operating duty type test.

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 data sheet describing the offered surge arrester and the surge counter/leakage current meter.
3. Bidder shall provide all the technical data requested in attachment "A", 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.
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. A statement that the resistor or unit or section of the certificate is used in the offered arrester.
 - b. 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. Serial number and year of the manufacture
3. Class, duty and designation of the arrester.
4. Continuous operating voltage (U_c)
5. Rated voltage (U_r)
6. Nominal discharge current (I_n)
7. Rated short circuit current (I_s)
8. Identification of the assembling position of the unit (for each unit of multi-unit arresters)

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. Arrester characteristics of power frequency voltage versus time, with and without prior duty. The characteristic will show the temporary overvoltage (TOV) capability of the arrester.
4. Assembly instructions for the arrester itself and for the surge counter/leakage current meter.
5. Proposed maintenance instructions (if any).

XV. PACKAGING

The arresters shall be delivered in entirely closed and robust wooden boxes of at least 20mm thickness. The boxes will be of "pallet type", with strengthened base. Each box will contain one (1) arrester and all necessary assembling material.

"ATTACHMENT A"
150 kV METAL OXIDE SURGE ARRESTERS WITHOUT GAPS

INFORMATION BY BIDDERS

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 μ s) :
 - c. Power frequency voltage withstand, wet :
 - d. Creepage distance :
 - e. Dry arcing distance :
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. Class and duty :
 - e. Designation :
 - f. Nominal discharge current I_n (8/20 μ s) :
 - g. Residual voltage at steep current impulse (1/ $<20\mu$ s) at 10 kA, excluding inductive voltage contribution :
 - h. Residual voltage at steep current impulse (1/ $<20\mu$ s) at 10 kA, including inductive voltage contribution (STIPL) :
 - i. Residual voltage at lightning

- current impulse (8/20 μ s)
- at 5 kA :
- at 10 kA (LIPL) :
- at 20 kA :
- j. Residual voltage at switching current impulse (>30/60 μ s) at 1 kA (SIPL) :
- k. Thermal energy rating W_{th} :
- l. Repetitive charge transfer rating Q_{rs} :
- m. Rated short circuit current I_s :
- n. Reference current at 20°C :
- o. Range of acceptance of reference voltage at 20°C :
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. Measuring range of the leakage current meter :
8. Number of digits of the surge counter :
9. Maximum allowable length of cable between arrester and surge counter :
10. Maximum allowable length of conductor between surge counter and earthing grid :
11. Type of material, shape and dimensions of the line terminal :
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12. Type of material and shape of the earth terminal :
13. Are all metal fitting of the arrester of hot-dip galvanized steel or of aluminum alloy or of stainless steel? :
14. Are the bolts, nuts and washers which are needed for the mounting of the arrester part of the supply? :
15. Are the bolts, nuts and washers of hot dip galvanized steel or stainless steel? :
16. Is the surge arrester equipped with a grading ring? :
17. Type of material of the grading ring :
18. Diameter of the grading ring :
19. Required radial clearance of other metallic structures from the axis of the arrester, to ensure correct operation of the arrester :
20. Is the surge arrester without or with enclosed gas volume? :
21. Percentage of enclosed gas volume to total internal volume of arrester (if applicable) :
22. Is the arrester equipped with a pressure relief diaphragm? (if applicable) :
23. Seal leak rate (if applicable) :
24. Internal partial discharge level :
25. Radio interference voltage level :
26. Cantilever strength of the surge arrester :
27. List of all internal components of the surge arrester :

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28. Technical data of any internal grading equipment, e.g. capacitors, resistors (if applicable) :
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29. Weight of the arrester :
30. Indicate the size of the earthing lead and the type of material which shall consist of :
31. Type of silicon rubber used in the proposed arrester :
32. Is the offered silicon rubber hydrophobic and resistant to pollution and UV radiation? :
33. Is the surge arrester suitable for upright vertical mounting on steel structure? :
34. Lightning impulse voltage withstand level of the support insulators :
35. Does the packaging follow the requirements of par. XV ? :