

**INDEPENDENT POWER TRANSMISSION OPERATOR S.A.**

**TNPRD/ SUBSTATION SPECIFICATION & EQUIPMENT SECTION**

July 2019

**SPECIFICATION SS-52/18**

**8 MVAR – 50 MVAR, 157.5kV SHUNT REACTORS**



















**ATTACHMENT “A”**

Information by Seller

1. Type : …………………………..

2. Rated power at rated voltage 157.5kV : ……………….…… Mvar

3. Maximum continuous operating voltage : ……………………… kV

4. Rated current of the reactor at 157.5kV : …………………………..

5. Applicable standards : …………………………..

6. Rated frequency : ……………………… Hz

7. Type of core : …………………………..

8. Connection of windings : …………………………..

9. Lighting impulse withstand voltage

a. At line-end : …………………………..

b. At neutral-end : …………………………..

10. Power frequency withstand voltages

(1min, 50Hz)

a. At line-end : ………………. kV rms

b. At neutral-end : ………………. kV rms

11. Level of winding insulation : …………………………..

12. Temperature rise limits

a. For windings : …………………………..

b. For the oil : …………………………..

13. Ratio of the zero-sequence reactance to

the positive-sequence reactance (X0/X+)

(estimated value) : …………………………..

14. Voltage variation without exceeding the

temperature rise limits : …………………………..

15. Harmonics of reactor current at rated voltage

a. Third harmonic : …………………………..

b. Fifth harmonic : …………………………..

c. Seventh harmonic : …………………………..

16. Average sound pressure level : ………………………dB(A)

17. Vibration levels at rated voltage : ………………………μm

18. Normal frequency of reactor : …………………………..

19. Total losses

(at reference temperature 75°C)

a. At rated voltage and current : ………………… kW

(guaranteed value)

b. At 105% of rated voltage (Umax) : ………………… kW

20. Cooling method : …………………………..

21. Have the reactors been designed to employ

linear magnetization characteristics with

voltage equal to 1.2 of their rated voltage?: …………………………..

22. Bushings

a. Line-end bushings

- Type and manufacturer : …………………………..

- Max. phase-phase operating voltage : …………………kV rms

- Rated current : ………………………A

- Lightning withstand level : ……………………… kV

- 1 minute - 50Hz Power frequency

withstand voltage : ………………. kV rms

- Minimum creepage distance : …………………….. mm

- Cantilever withstand load : …………………….. N

- Range of spill-gap settings : …………………….. mm

b. Neutral-end bushing

- Type and manufacturer : …………………………..

- Max. phase-phase operating voltage : …………………kV rms

- Rated current : ………………………A

- Lightning withstand level : …………………………..

- 1 minute - 50Hz Power frequency

withstand voltage : ………………. kV r.m.s.

- Minimum creepage distance : …………………….. mm

- Cantilever withstand load : …………………….. N

c. Are the bushings interchangeable

with any other having the same type,

according EN 50458? : …………………………..

23. Bushing current transformers

a. Line-End

- Ratio : …………………………..

- Continuous thermal current : …………………………..

- Burden : ………………………VA

- Accuracy class : ………………………….

b. Neutral-End

- Ratio : …………………………..

- Continuous thermal current : …………………………..

- Burden : ………………………VA

- Accuracy class : …………………………..

24. Type and manufacturer BUCHHOLZ

- Installation : …………………………..

- Characteristics of alarm contacts : …………………………..

- Characteristics of tripping contacts : …………………………..

25. Is the reactor equipped with oil level

gauge with low level alarm contacts? : …………………………..

26. Type and manufacturer of the oil

temperature measurement instrument : …………………………..

- Characteristics of alarm contacts : …………………………..

- Characteristics of tripping contacts : …………………………..

27. Type and manufacturer of the winding

temperature measurement instrument

- Characteristics of alarm contacts : …………………………..

- Characteristics of tripping contacts : …………………………..

28. Type and manufacturer of the pressure

relief device : …………………………..

29. Is the reactor tank of cover bolted type? : …………………………..

30. Accessories and features of the reactors

according to paragraph VI-5 : …………………………..

31. Reactor oil

a. Type and manufacturer : …………………………..

b. Does the oil contain PCBs, PCTs  
 or corrosive sulphur? : …………………………..

c. Is the oil of the “inhibited transformer oil (I)”  
 class in accordance with IEC 60296? : …………………………..

32. Are the terminals of line bushings

made of 30 mm diameter copper rods? : …………………………..

33. Has the reactor Silica Gel breather on the oil

conservator or the expansion tank? : …………………………..

34. Color of the reactor : …………………………..

35. Corrosivity category and durability  
 category of the reactor’s painting,  
 according ISO 12944 : …………………………..

36. Approximate mechanical data

a. Transfer weight : ……………………… kg

b. Total weight : ……………………… kg

c. Core and coils : ……………………… kg

d. Case and fittings : ……………………… kg

e. Oil : ……………………… kg

f. Untanking weight (heaviest piece) : ……………………… kg

g. Overall height : ………………………. m

h. Height over case : ………………………. m

i. Untanking height (with bushings) : ………………………. m

37. Acceptance of specified tests : …………………………..

38. Is the packing according to the

paragraph XI of the specification? : …………………………..

39. Deviations if any from the present

specification and the reasons thereof : …………………………..

…………………………..

…………………………..

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**ATTACHMENT “B”**

**CAPITALIZATION OF LOSSES**

For the capitalization of losses, the method of EN 50629, Annex E is used, adapted for reactors.

1. Reactor initial cost and losses:

a. Reactor initial cost

(The reactor total initial cost will be

calculated by the Purchaser

according to the Special Terms

of the Inquiry – evaluation of

the Bids) : IC = ……………….. €

b. Total losses at rated voltage and

current, at reference temperature

75°C (guaranteed value) : Pk = …………….…. kW

2. Reactor total ownership cost:

The capitalized losses (CL) and the total cost of ownership (TCO) of the reactor will be calculated from the above mentioned data and the following mathematical types. In these types, the losses are expressed in kW and the costs are expressed in €.

CL = 5827 ∙ Pk

Capitalized Losses (CL) = ……………………… €

TCO = IC + CL

**Total ownership cost (TCO) = ……………………… €**

3. Penalty for losses excess:

With regard to total losses, a reactor is considered as successfully inspected if the losses at rated current and reference temperature 75°C ascertained during inspection (relevant routine test, par.VII.1.3) do not exceed the losses guaranteed by Seller, by more than the maximum accepted tolerance of 10%, according to IEC 60076-6. Otherwise the reactor shall be rejected. The measurement uncertainty is not taken into account, according to IEC 60076-19.

On each successfully inspected reactor, any difference in the losses versus the guaranteed ones (without tolerance), shall be negative or zero. If such difference is positive, meaning the losses ascertained during inspection exceed the guaranteed ones (without tolerance), a penalty shall be imposed on the Seller consisting of the difference CL’ – CL. CL is calculated from the mathematical type stated above and the guaranteed losses value, whereas CL’ is calculated from the same mathematical type as CL and the measured losses value during inspection.

If the difference CL’ – CL is negative the Seller is not entitled to any additional payment, whereas if this difference is positive the penalty shall be imposed.