

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

**TNPRD/ SUBSTATION SPECIFICATION & EQUIPMENT SECTION**

***July 2016***

## TECHNICAL DESCRIPTION TD-95/6

## 400 kV, 30 MVAR – 100 MVAR

## SHUNT REACTORS

**ATTACHMENT "A"**

**400 kV, 30 MVAR – 100 MVAR**

**SHUNT REACTORS**

**INFORMATION REQUIRED BY THE SELLER**

1. Applicable Standards : ------------------
2. Type of the reactor : ------------------
3. Rated Voltage of the reactor : --------------kV
4. Maximum Continuous Operating voltage

of the reactor : --------------kV

1. Rated Power at 400 kV : ------------Mvar
2. Rated Frequency : -------------- Hz
3. Rated Current at 400 kV : -------------- A
4. Rated Reactance : --------------
5. Method of Cooling : --------------
6. Phase Connection : --------------
7. Type of core design

(number and type of limbs) : --------------

1. Insulating oil

a. Type and manufacturer : --------------  
b. Does the oil contain any PCBs, PCTs  
 or corrosive Sulphur? : --------------  
c. Is the oil of the “inhibited transformer oil (I)”  
 class in accordance with IEC 60296? : --------------

1. Reactor identification with regard its

magnetic characteristic

(i.e. linear, non-linear, etc) : --------------

1. Ratio of zero sequence reactance to

positive sequence reactance (X0/X+)

(estimated value) : --------------

1. Average sound pressure level : -----------dB(A)
2. Mechanical Vibration Level : ----------- μm
3. Voltage Variation Capability : --------------
4. Harmonics of the current as per cent of

the fundamental

2nd : --------------

3rd : --------------

5th : --------------

1. Winding temperature rise limits for 40oC

ambient temperature (guaranteed values)

- Average by winding : -------------- °C

1. Oil (Top) temperature at 40oC ambient

temperature : -------------- °C

1. Lightning Impulse withstand voltages:

- Line windings/bushings : -------/-----kV crest

- Neutral terminal/bushing : ------/------kV crest

1. Switching impulse withstand voltages

- Line windings/bushings : -------/-----kV crest

1. Power frequency withstand voltages

(1 min, 50 Hz)

- Line windings/bushings : -------/-----kV rms - Neutral terminal/bushing : -------/-----kV rms

1. Total losses

(at reference temperature 75°C)

- At rated voltage and current : ------------ kW

(guaranteed value)

- At 105% of rated voltage : ------------ kW

1. Bushings

a. Line bushings

- Type : ------------

- Manufacturer : ------------

- Max. phase-phase operating

voltage : ------------ kV

- Lightning impulse withstand

voltage : ------------ kV

- Switching impulse withstand

voltage : ------------ kV

- 50 Hz withstand voltage

(1 minute) : ------------ kV

- Creepage distance : ------------ mm

- Rated current : ------------ A

- Cantilever withstand load : ------------ N

b. Neutral Bushing

- Type : --------------

- Manufacturer : --------------

- Max. phase-phase operating

voltage : ------------ kV

- Lightning impulse withstand

voltage : ------------ kV

- Creepage distance : ------------ mm

- 50 Hz withstand voltage

(1 minute) : ------------ kV

- Rated current : ------------ A

- Cantilever withstand load : ------------ N

c. Are the bushings interchangeable

with any other having the same type,

according EN 50458? : --------------

1. Bushing Current Transformer

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Line** | | **Neutral** |
|  | **CT** | **CT** | **CT** |
| Ratio |  |  |  |
| Burden |  |  |  |
| Accuracy class |  |  |  |
| Manufacturer |  |  |  |
| Type of protection |  |  |  |
| Secondary resistance |  |  |  |
| Magnetizing current |  |  |  |
| Knee-point voltage |  |  |  |

1. Supervisory and Protection Equipment

a. Buchholz relay

- Type : ------------

- Manufacturer : ------------

b. Oil Level indicator

- Type : ------------

- Manufacturer : ------------

c. Dial-type oil thermometer

- Type : ------------

- Manufacturer : ------------

d. Dial-type windings thermometer

- Type : ------------

- Manufacturer : ------------

e. Tank pressure relief device

- Type : ------------

- Manufacturer : ------------

- Alarm contacts : ------------

1. Are the reactor’s accessories in accordance

with the requirements of paragraph VIII.3, 4? : ------------

1. Is the reactor tank of cover bolted type? : ------------
2. Color of the reactor : ------------
3. Corrosivity category and durability  
   category of the reactor’s painting,  
   according ISO 12944 : ------------
4. Mechanical data

- Mass of core and coils : -------------- kg

- Mass of oil : -------------- kg

- Total mass of reactor : -------------- kg

- Tank type and method of

connection to the bottom plate : --------------

- Untanking weight : -------------- kg

- Over-all height : --------------

- Total shipping weight : -------------- kg

- Oil in tank for shipping : -------------- kg

- Describe with what the reactor’s

tank will be filled for transport

purposes : -------------- kg

1. Is there any restriction concerning the

test performance capability (e.g due to the

laboratory’s sufficient itself)? : --------------

1. Indicate acceptance of the specified tests

(Yes of No) : --------------

1. Is the packing accordily to the paragraph XIV

of the specification? : -------------

1. Deviation, if any, from the present

specification and the reasons thereof : -------------

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**ATTACHMENT "B"**

**400 kV SHUNT REACTORS**

**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**

1.1. Reactor initial cost

(The total initial cost will be calculated

by the Purchaser according to the

Special Terms of the Inquiry –

evaluation of the Bids): IC = …………… €

1.2. 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.X.A.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.