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

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TECHNICAL DESCRIPTION TD-03/4
20kV VACUUM CAPACITOR SWITCHES

I. SCOPE

This technical description covers the characteristics, design features and testing of 20kV vacuum capacitor switches.

II. KEYWORDS

Capacitors, vacuum capacitor switches.

III. STANDARDS

Unless otherwise described herein, all material, fabrication and testing shall conform to the latest revision of IEEE C37.66 standard. In case of any conflict between this technical description and standard C37.66, this technical description shall always prevail.

IV. OPERATING CONDITIONS

1.	Installation	:	Outdoor
2.	Ambient Temperature	:	Minimum (-20^{o}C) Maximum (+45^{o}C)
3.	Altitude	:	Up to 1000m above sea level
4.	Other Conditions	:	Snow and Ice
5.	Pollution Level	:	Moderate

V. USE

The capacitor switches are to be used for switching 4 Mvar, double-wye ungrounded capacitor banks. In series with the capacitor banks, damping (current limiting) reactors are used for limiting high frequency inrush currents.

VI. ELECTRICAL CHARACTERISTICS OF THE SYSTEM

1.	Nominal Voltage (phase-to-phase)	:	20kV
2.	Maximum Operating Voltage (phase-to-phase)	:	24kV
3.	Number of phases	:	3
4.	Nominal Frequency	:	50Hz
5.	Short Circuit Level	:	10kA
6.	Basic Insulation Level (BIL)	:	150kV
7.	Grounded neutral via a 12 Ω resistor.		

VII. AVAILABLE ELECTRIC AUXILIARY SUPPLY CHARACTERISTICS

1. Auxiliary A.C. Voltage: 3-phase, 4-wire, 230/400V, 50Hz

2. Auxiliary D.C. Voltage: 110V available from the station battery. (For control and signalling)

VIII. CAPACITOR SWITCH REQUIRED CHARACTERISTICS

1. Design characteristics

a. Installation: Outdoor in 150/20kV substations

b. Interrupting medium: Vacuum

c. Insulation medium: Solid, porcelain and/or polymer (no oil allowed)

d. The capacitor switch can either be a three-pole complete unit or constitute of three single-pole units, properly connected however for three-phase switching.

e. In case of a complete three-pole unit design, the three poles shall be mechanically linked, in order to achieve simultaneous operation. In case of three single-pole units design, the three poles shall have discrepancy of 90 electrical degrees maximum (5ms), in order to achieve simultaneous operation.

f. Each pole of the switch will be operated through a magnetic solenoid (no motor allowed). Manual trip of the switch will be also possible, for use in case of emergency.

g. Capacitor switch must be capable of performing at least five thousand (5.000) operations under load without maintenance.

2. Basic Rating Characteristics

a.	Rated maximum Voltage (phase-to-phase)	:	24kV rms
b.	Impulse Withstand Voltage (BIL)		
	line to ground	:	150kV peak
	across open gap of interrupter	:	125kV peak
c.	Power frequency withstand voltage, 50Hz		
	1 min dry	:	60kV rms
	10 s wet	:	50kV rms
d.	Rated continuous current	:	200A rms
e.	Rated capacitive switching current	:	200A rms
f.	Fault making current, 50Hz		
	symmetrical	:	6000A rms
	asymmetrical	:	14700A peak
g.	Withstand current	:	14700A peak
h.	Short-time symmetrical withstand current for 1 s	:	4500A rms
i.	High Frequency Transient making current	:	9000A peak
j.	Rated Transient Inrush Frequency	:	6000Hz.
h.	Creepage distance, phase to ground and between pole terminals	:	600mm.

3. Additional Design Features

a. The capacitor switch shall be of restrike class C2, according IEEE C37.66.

b. If any solid polymer is used for insulation purposes, this polymer must be environmentally safe and have proven hydrophobic properties.

IX. ACCESSORIES

1. Bushings

All bushings shall be capable of withstanding an impulse voltage of 150kV crest.

2. Terminals

All input and output terminals must be of a suitable for connection to either copper tube or copper conductor.

3. Electrical Actuators

Magnetic solenoids shall be suitable for 230V A.C., 50Hz operation, with voltage tolerance of -15%, +10%.

4. Grounding Provision

Capacitor switches with metal housing shall have provision for the connection of a ground lead.

5. Mounting Provisions

Capacitor switches shall be suitable to be mounted on metal frame (support structure) and in height of 6m maximum above ground.

6. Position Indicator

Capacitor switches shall be provided with a position indicator which clearly indicates the closed or open position. Its position shall be visible from the ground.

7. Junction Box

In case of three single-pole units design, an aluminum junction box per three single-pole units along with the required interconnecting cables between switches and junction box must be offered. Each interconnecting cable shall have length of at least 2.44m.

In case of a complete three-pole unit design, the switch shall include a terminal box. Alternatively, a junction box per switch, along with the required interconnecting cable between switch and junction box must be offered.

Each interconnecting cable shall be terminated in a suitable plug for connection to the switch.

8. Capacitor switch free contacts

The capacitor switch shall be equipped with at least two make contacts free of voltage for indication of its position.

X. NAMEPLATE MARKINGS

Each capacitor switch shall be provided with a permanent nameplate that includes the following information.

1. Manufacturer's name.
2. Type or identification number.
3. Maximum operating voltage.
4. Rated current.
5. Rated capacitive switching current.
6. Rated impulse withstand voltage.
7. Rated control voltage and range.
8. High frequency transient making current.
9. Rated transient inrush frequency.

XI. TESTS

The following tests shall be carried out for the capacitor switches in accordance with the latest revision of IEEE C37.66.

A. Production (Routine) Tests.

1. Power frequency voltage withstand test, 50Hz:
   60kV for 1 min dry
2. Control wiring check tests.
3. Manual operation.
4. Electrical operation.
5. Dielectric test on control wiring, 50Hz:
   1500V, 50Hz for 1 min.

B. Design (type) tests.

1. Insulation (Dielectric) tests.

a. Impulse withstand test voltage shall be a 1.2x50μs impulse, with a peak value of 150kV (line to ground) and 125kV (across open gap of the vacuum interrupter).

b. Power frequency, 50Hz or 60Hz, withstand voltage test of 60kV with test duration of 1 min for the try test and 50kV with test duration 10 s for the wet test.

2. Short - Time Current test.

Test current, 50Hz or 60Hz :
4500A rms, symmetrical for 1 s

3. Rated Fault-Making Current tests.

a. Test current, 50Hz or 60Hz:
   6000A rms symmetrical

b. Test current:
   14700A peak asymmetrical at 50Hz or
   15000A peak asymmetrical at 60Hz

4. Operating Duty test.

The test shall consist of 1200 operations. The switch will be classified with restrike class C2. Test current at 50Hz or 60Hz.

5. Temperature Rise test.

Test current at 50Hz or 60Hz.

6. Radio Influence Voltage (RIV) test.
The limit of conducted radio influence voltage is 500μV at 1.0MHz. Test voltage at 50Hz or 60Hz.

7. Mechanical Life test.
Capacitor switches shall be tested for 50.000 operations at no load.

XII. DATA TO BE SUPPLIED BY BIDDER

1. Bidders must provide all information requested by "ATTACHMENT A" attached to this hereby technical description. Failure on the Bidder's part to comply in this respect will be taken as reasonable ground for the rejection of the offer.

2. Bidders are required to submit, along with the offer, drawings showing the outline dimensions of the capacitor switch for erection purposes as well as any information, sketches and data necessary for a complete description of the capacitor switch and related equipment offered.

3. Providing that a contract has been awarded, the seller shall furnish three (3) copies for approval and five (5) copies of final approved drawings before the shipment of the capacitor switches:

   These drawings shall consist of the following:
   a. Capacitor switch outline drawing.
   b. Bushing outline drawing if not included in the outline drawing.
   c. Wiring diagram and connection diagram.
   d. Drawing indicating how the capacitor switch will be mounted to the support structure.

XIII. SPARE PARTS

Bidders must submit a list of spare parts along with item prices if it is deemed necessary.
The purchaser reserves the absolute right of not to purchase any spare parts or to determine which parts the Seller shall furnish on the basis of the unit prices set forth in the list.

XIV. PACKING

The switches 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 wooden box will include nine (9) single-pole switches or three (3) three-pole switches and all necessary assembling material (if applicable).

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"ATTACHMENT A"

INFORMATION REQUIRED BY THE SELLER

Failure to comply may constitute reason for rejection of the offer.

1. Type and manufacturer of the capacitor switch :.....

.....

2. Applicable Standards :.....

3. Single-pole units or three-pole unit? :.....

4. Three-phase operation (YES or NO): .....

5. Does the switch include vacuum interrupters? (YES or NO) : .....

6. Does the switch include only dry insulation? (YES or NO) : .....

7. Rated maximum Voltage (phase-to-phase): ..... kV rms

8. Rated Frequency : ..... Hz

9. Impulse Withstand voltage (BIL) line to ground : ..... kV peak

across open gap of interrupter : ..... kV peak

10. Power Frequency Withstand Voltage, 50Hz
1 min dry : ..... kV rms

10 s wet : ..... kV rms

11. Rated Continuous Current : ..... A rms

12. Rated Capacitive Switching current : ..... A rms

13. Fault Making Current, 50Hz symmetrical : ..... A rms

	asymmetrical	:	..... A peak
14.	Withstand Current	:	..... A peak
15.	Short-time symmetrical withstand current for 1 s	:	..... A rms
16.	High Frequency Transient making current	:	..... A peak
17.	Rated Transient Inrush Frequency	:	..... Hz
18.	Restrike class of the switch	:	.....
19.	In case of three-pole unit design, are the poles mechanically linked?(YES or NO)	:	.....
20.	In case of three single-pole units design, which is the maximum discrepancy between the poles?	:	..... electr. degrees
21.	Insulator material	:	.....
			.....
22.	Creepage distance phase to earth	:	..... mm
	between pole terminals	:	..... mm
23.	Position indicator (YES or NO)	:	.....
24.	Does the switch include one solenoid actuator, one per pole? (YES or NO)	:	.....
25.	Solenoid auxiliary voltage	:	..... V A.C.
26.	Auxiliary voltage tolerance (%)	:	.....
27.	Are junction boxes included in the offer? (YES or NO)	:	.....
28.	Are interconnecting cables between switch and junction box included in the offer?	:	.....
29.	Is manual trip possible? (YES or NO)	:	.....
30.	Mechanical data Total mass of capacitor switch	:	..... kg
	Overall height	:	..... m

	Colour of the capacitor switch	:	.....
31.	Indicate acceptance of the specified tests (YES or NO)	:	.....
32.	Type and shape of terminals	:	.....
33.	Number of free contracts for indication of the switch's position	:	.....
34.	Will the package of the switches follow the requirements of par. XIV of this hereby specification?	:	.....
35.	Deviations, if any, from the present specification and the reasons thereof	:	.....
			.....
			.....
			.....