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TECHNICAL DESCRIPTION TD-60/1
52 KV OUTDOOR, CENTRE BREAK, 3-POLE, AC DISCONNECTOR,
WITH MANUAL OPERATING MECHANISM
(DESIGNATED BY IPTO S.A No 305)

I. SCOPE

This technical description covers IPTO's requirements with regard to the design features, rated characteristics and testing of 52 KV centre brake, 3-pole, AC disconnectors with manual operating mechanism.

II. KEYWORDS

AC disconnectors, disconnecting switches, isolators.

III. STANDARDS

The disconnector shall be in accordance with IEC-62271-102 & IEC-60694 standards. Furthermore the disconnector's cylindrical post insulators shall be in accordance with IEC-60273 & IEC-60168 standards.

IV. USE

The disconnector is to be used in the 30 KV shunt reactor bays for shunt reactor isolating purposes in air insulated (AIS) 400/150/30 KV, ehv substations.

V. SERVICE CONDITIONS

- | | |
|------------------------------|---|
| 1. Installation | : Outdoors |
| 2. Ambient temperature range | : Maximum + 45°C |
| | : Minimum - 25°C |
| 3. Altitude | : Up to 1000m above sea level |
| 4. Relative humidity | : ≤ 95% |
| 5. Ice coating | : 10mm maximum |
| 6. Pollution level | : moderate to heavy depending on location |
| 7. Wind speed | : 150Km/h |
| 8. Other conditions | : Snow and fog |

VI. IPTO's 30 KV ELECTRICAL SYSTEM CHARACTERISTICS

- | | |
|--|--|
| 1. Nominal Voltage | : 30KV |
| 2. Maximum Operating Voltage | : 36KV |
| 3. Lightning impulse withstand voltage | : 250KV |
| 4. Short circuit level | : 20KA |
| 5. Number of phases | : 3 |
| 6. Nominal Frequency | : 50 Hz |
| 7. Earthing (grounding) method | : The 30KV system is
solidly earthed (grounded)
only when the shunt reactor
is in service |

VII. DISCONNECTOR REQUIRED DESIGN FEATURES

1. Type

The disconnector shall be three-pole (phase) of horizontal centre break, having two (2) cylindrical post insulators per pole (phase). The two insulator per pole (phase) shall rotate on a weather – proof ball shape, greaseless bearings or on auto-lubricated bushes, to achieve the opening and closing function.

This three-pole (phase) disconnector, shall be operated simultaneously by a single manual operating mechanism.

2. Blades (arms) angle of rotation

The blades (arms) of the disconnector (two (2) per pole) shall pivot at 90° angle to ensure the opening and closing of the disconnector.

3. Material of the blades (arms)

The blades (arms) of the disconnector shall be either of tubular hard drawn electrolytic copper or aluminium alloy.

4. Type of material of the blades (arms) contacts

The male main contact shall consist of silver-plated copper and the female contact of finger type shall also be of silver-plated copper.

5. Characteristics of the blades (arms) contacts

The two (2) blades (arms) contacts must be self-cleaning and self-aligned.

6. Contact pressure

The contact pressure shall be ensured by the female's contact springs which shall be from stainless-steel.

7. Current characteristics of the contacts

Contact pressure shall be increased as current is increased and also by short circuit currents.

8. Material of the bolts, nuts and washers of the live parts of the disconnector

All bolts, nuts and washers of the live parts of the disconnector shall be either of stainless steel or of hot-dip galvanized steel.

9. Base frame of the insulators of the disconnecter

The two (2) insulators per pole (phase) shall be mounted on a common solid hot dip galvanized steel base, which shall have height ranging from 210mm to 270mm maximum.

10. Method of operation of the disconnecter

Three-pole operation.

11. Pole arrangement of the disconnecter

The disconnecter shall be suitable for parallel pole connection.

12. Terminals

Each pole of the disconnectors shall be fitted with two (2) copper or aluminium tin-plated or silver-plate terminals of cylindrical shape and with a diameter of Ø 30mm.

13. Method of mounting of the disconnecter on its base frame

Each pole of the disconnectors shall be mounted on a hot-dip galvanized steel bar with both insulators to be connected to the bar through greaseless ball type bearings or auto-lubricated bushes for the purposes of the rotation.

14. Earthing (grounding)

The vertical operating rods of the disconnecter shall be equipped with flexible copper earthing strip of suitable current capability, ending in a rectangular in shape terminal which shall be used for connection to the earthing (grounding) mat of the substation.

15. Dimensions of disconnecter

- a. The distance between poles (phases) of the disconnecter (axis to axis), shall be 1200mm.
- b. The distance between the two (2) insulators of the same pole shall be 950mm ($\pm 3\%$) (axis to axis).
- c. The disconnecter shall be mounted on a steel support structure of 3m in height, which shall be provided by IPTO.

16. Transmission motion system of the disconnecter

- a. The transmission motion system of the disconnecter shall be comprised of horizontal and vertical operating rods, bearing, etc. and the whole system shall be suitable, along with the three-pole disconnecter and its base frame, to be mounted on steel support structure (not part of the supply) of 3m in height, as indicated in the attached drawing No. 305/1 of this hereby technical description.
- b. In case of vertical rod accidental dismantling, the blades (arms) of the disconnecter shall not be possible to be moved from the open to closed position or vice versa by the force of the wind or short circuits.

- c. The entire system must be designed for smooth noiseless and precise operation, and to avoid any undesired operations.
- d. All metallic parts including nuts, bolts and washers of the transmission motion system, shall be of hot dip galvanized steel or of stainless steel.

17. Operating Mechanism of the disconnecter

- a. The operating mechanism of the disconnecter shall be manually operable with a hand-handle. There shall be one common operating mechanism for the three (3) poles of the disconnecter, for the rotation of the axis via metallic gear wheels.
- b. The manual operating mechanism shall be of the reversible motion type
- c. The manual operating mechanism shall be carried out via rotary motion and metallic reduction gear with a hand-handle which can be removable or fixed.
- d. The parts of the handle which come in contact with the human hands shall be covered with insulating material
- e. If a removable handle is provided, its insertion to the housing shall be possible through an opening to the housing of the operating mechanism. This opening shall be capable of being secured with a padlock. The removable handle shall be kept inside the housing of the operating mechanism.
- f. If a fixed handle is provided, it shall be secured in both “open” and “closed” positions with the aid of a padlock
- g. The operating mechanism shall be equipped with an interlocking coil of coil voltage 220V DC, which shall be used for electrical interlocking between the disconnecter and its corresponding circuit breaker. The interlocking coil in the deenergized state shall prevent the manual operation of the disconnecter by mechanical blocking.
- h. The operating mechanism shall be equipped with the following auxiliary contacts of high reliability as to ensure the exact status of the disconnecter.
 - Two (2) NO contacts of type A
 - Two (2) NC contacts of type B

The signal for “Disconnector is closed” shall be given only after complete closing which means that a short circuit current can run through the disconnecter, while the signal for “ Disconnector is open” shall be given only after the complete opening when the isolating distance is sufficient to withstand with success the required dielectric tests.

- i. All control cables of the operating mechanism shall be of cross section of 1.5mm^2 and shall bear proper markings. The terminal blocks however, shall be suitable for 8mm^2 cross section conductors
- j. The housing of the operating mechanism shall be either of stainless steel or hot-dip galvanized steel or aluminum alloy.
- k. The degree of protection for the housing shall be IP 42D.
- l. The operating mechanism shall be equipped with a spare terminal block of at least four positions and suitable for 8mm^2 conductors in cross section.
- m. The housing of the operating mechanism shall be equipped with anti-condensation heater or heaters, controlled by a thermostat. The supply voltage to the heaters shall be 220V AC.
- n. All electric circuits of the mechanism shall be suitable for 220V DC and shall be protected by miniature circuit breakers or fuses.
- o. The housing of the operation mechanism shall allow cable entrance from its bottom (IPTO's cables).
- p. The housing of the operating mechanism shall be installed (mounted) on its own steel support structure, which shall be provided by the supplier of the disconnecter. For this reason all bolts, nuts, brackets, anchoring bolts and any other mounting component must be part of the supply. The operating mechanism's steel support structure must either be from stainless steel or hot-dip galvanized steel. All connection parts, for example bolts, nuts, brackets, etc must be either from stainless steel or hot-dip galvanized steel.

18. Mounting of the disconnecter

The disconnecter shall be capable of being mounted on the steel support structure of drawing No 305/2 (Steel support structure supplied by IPTO S.A)

19. Tolerances

The design of the disconnecter's arms (blades) shall be such as to allow proper contact under all conditions and even with the following tolerances which can exist of the same time.

- a. Tolerance regarding the rotation of the arms (blades) in the horizontal level: $\pm 2^\circ$
- b. Tolerance in the slope of the arms (blades) in the vertical level due to possible unparallel alignment of the insulators: $\pm 0.5^\circ$
- c. Tolerance in the height of the arms (blades): $\pm 1\text{mm}$

VIII. DISCONNECTOR REQUIRED RATED ELECTRICAL AND OTHER CHARACTERISTICS

1. Number of poles	: Three (3)
2. Installation	: Outdoors
3. Rated Voltage	: 52 KV
4. Rated insulation levels	
a. Power frequency withstand voltage	
- Phase to earth and between phases	: 95 KV rms
- Across the isolating distance	: 110 KV rms
b. Lightning impulse withstand voltage	
- Phase to earth and between phases	: 250 KV peak
- Across the isolating distance	: 290 KV peak
5. Rated frequency	: 50 Hz
6. Rated normal current	: 1000 A
7. Rated short-time withstand current	: 20 KA rms
8. Rated peak withstand current	: 50 KA peak
9. Rated duration of short circuit	: 3 sec
10. Rated static mechanical terminal load	
- Straight load	: 400N at least
- Cross-load	: 130N at least
- Vertical Force	: 500N at least
11. Thickness of ice coating for which operation shall be possible	: 10 mm
12. Type of conductors used for the connection of the disconnector	: Flexible
13. Mechanical endurance class	: M1 (2000 operating cycles)

IX. SUPPORT INSULATORS REQUIRED CHARACTERISTICS

1. Type	: Outdoor solid core cylindrical post insulators with external metal fittings
2. Material of the cylindrical post insulators	: Porcelain
3. Color of the porcelain	: Gray
4. Designation of the insulators as per IEC-60273	: C8-250
5. Power frequency withstand voltage wet	: 95 KV rms
6. Lightning impulse withstand voltage	: 250 KV peak
7. Height of the post insulator	: 560mm \pm 1 mm
8. Creepage distance	: 1200mm
9. Failing load	
a. Bending	: 8000 N
b. Torsion	: 2500 Nm
c. Tension	: \geq 78000 N

d. Compression	: ≥ 406000 N
10. Bottom metal fitting pitch circle diameter	: 127mm
11. Maximum nominal diameter of insulating part	: 215mm
12. Top metal fitting pitch circle diameter	: 127mm

X. TESTS

The disconnecter shall be subject to the following tests.

A. Routine tests

The routine tests shall be carried out on all disconnectors of the order.

1. Dielectric test on the main circuit of the disconnecter.

Power frequency voltage test

The test voltage shall be 95 KV rms for phase to earth and between phases and 110 KV rms across the isolating distance. The test conditions shall be in accordance with table 6 of IEC 62271-102.

Alternatively, the power frequency voltage withstand test may be omitted if the dimensions between the conductive parts – between phases, across open contacts and between conductive parts and the frame – are checked by measurements.

2. Dielectric test on auxiliary and control circuits of the disconnecter

The test voltage shall be 1 KV with duration of 1 minute.

3. Measurement of the resistance of the main circuit of the disconnecter

The test current shall be between 50A and the rated normal current. The measured resistance shall not exceed $1.2 R_u$ where R_u is equal to the resistance measured before the temperature rise test.

4. Design and visual checks of the disconnecter

The disconnecter shall be checked to verify that it comply with this hereby technical description.

B. Special Tests

The special test shall be carried out only on one (1) disconnecter of the order because of the assembly complexities involved.

1. Mechanical operating tests of the disconnecter

The tests shall be performed without voltage or current flowing through the main circuit. The test program shall consist of five close-open operating cycles.

The test shall be performed on the entire disconnecter fully assembled.

C. Type Tests

1. Dielectric tests

- a. Power frequency voltage test
 - Test voltage : 95 KV rms for 1min for phase to earth and between phases
: 110 KV rms for 1 min across the isolating distance
 - Conditions : Dry and wet
- b. Lightning impulse voltage test
 - Test voltage : 250 KV peak of both polarities for phase to earth and between phases
: 290 KV peak across the isolating distance
 - Lightning impulse shape : 1.2/50 μ s
 - Conditions : Dry

2. Test on auxiliary and control circuits

- a. Impulse voltage withstand test
 - Test voltage : 5KV
- b. Power frequency voltage withstand test
 - Test voltage : 2KV for 1min

Each of the above tests shall be performed between the auxiliary and control circuits, connected together as a whole, and the frame of the disconnector.

3. Temperature-rise test

- Test current : 1000A
- Test frequency : 50 HZ +2%, -5%
- Test duration : Up to the time at which the increase of temperature rise does not exceed 1K in 1h

4. Short-time withstand and peak withstand current test

- Short-time test current : 20 KA rms
- Peak withstand test current : 50 KA peak
- Test frequency : 50 Hz \pm 10%
- Test duration : 3 sec

5. Operating and mechanical endurance tests

The mechanical endurance test shall consist of 2000 close-open operations with 50% of the rated static terminal load applied at both sides of the disconnectors but in opposite directions, without voltage on or current through.

6. Operation test under severe ice conditions

The test shall be conducted with class 10 of ice coating (10mm of ice coating)

XI. TESTS FOR THE DISCONNECTOR'S INSULATORS

The disconnector manufacturer is obliged to present to the IPTO inspector, when the inspector is at the manufacturer's premises for the inspection and testing of the disconnectors, the following routine, sample and type test insulator certificates. Type test certificates are not required to be presented, if they have been submitted in the technical offer of the inquiry and have been found to be satisfactory.

All tests shall be in accordance with IEC-60168.

A. Routine tests

1. Visual inspection
2. Mechanical tests
The tests shall consist of:
 - a. Bending test and
 - b. Torsion test

B. Sample tests

Sample tests shall be carried out after the routine tests on a few numbers of insulators of the order selected, at random.

1. Verifications of dimensions
2. Temperature cycle test (This prior to the mechanical failing load test)
3. Mechanical failing load test (Bending, tensile, torsion and compression)
4. Porosity test
5. Galvanizing test

C. Type Tests

1. Dry lightning impulse withstand voltage test
2. Wet power – frequency withstand voltage test
3. Mechanical failing load test

XII. NAMEPLATES

The nameplates for the disconnect and operating mechanism, shall be of non-corrosive material, visible from ground and shall bear the following information:

	Disconnect	Operating Mechanism
Manufacturer	✓	✓
Type	✓	✓
Serial Number	✓	✓
Year of Manufacture	✓	✓
Rated Voltage	✓	
Rated Lightning Impulse withstand voltage	✓	
Rated normal current	✓	
Rated duration of short circuit	✓	
Rated supply voltage of auxiliary circuits		✓
Mechanical endurance class	✓	
Electrical endurance class		
Mass	✓	✓

XIII. DATA WHICH MUST BE SUBMITTED BY ALL BIDDERS

1. Outline drawing of the disconnecter and of the steel support structure of the operating mechanism, in which all the physical dimensions of the disconnecter and support structure are clearly depicted.
2. Brochures, technical pamphlets and any other information which is deemed necessary for the technical evaluation process.
3. All bidders are required to answer all items of **Attachment “A”**. Failure to comply or partial filling of the attachment will constitute sufficient reason for rejection of the offer.
4. Any test certificates for the type tests specified in this hereby technical description.
Acceptance or not of these certificates lies on IPTO’s judgment.
5. A drawing indicating the disconnecter on its base frame with complete dimensions.
6. A preliminary drawing indicating mounting of the disconnecter, along with its operating mechanism on their steel support structures. Failure to comply with this request will result in rejection of the offer.

XIV. DATA WHICH MUST BE SUBMITTED BY THE SUCCESSFUL BIDDER

1. Complete schematic and wiring drawings of the disconnecter, for approval before the construction of the disconnecter.
2. Complete physical drawings of the disconnecter, indicating all dimensions details, for approval before the construction of the disconnecter.
3. Complete physical drawing of the steel support structure (frame) of the disconnecter’s operating mechanism and also drawing indicating how this steel support structure shall be erected and how the housing of the operating mechanism shall be mounted on it.
4. A drawing indicating the disconnecter on its base frame.
5. Maintenance and assembly instructions in detail for the disconnecter.
6. A drawing indicating mounting of the disconnecter, along with its operating mechanism, on their steel support structures.

XV. WARRANTY

The supplier must provide a warranty of two (2) years, beginning from the date of delivery of the disconnector, for damages by faulty design, or by unreliable components, or by combination of the two.

XVI. PACKING

Each disconnector must be delivered packaged as follows:

1. Insulators in a separate wooden box.
2. Live parts of the disconnector in a separate wooden box.
3. Operating rods of disconnector tied together in a wooden box.
4. Disconnector's operating mechanism in a separate wooden box.
5. Operating mechanism's steel support structure in a separate wooden box

or alternatively,

items 2, 3 and 4 as listed above in a robust wooden box and items 1 and 5, each in a separate robust wooden box.

ATTACHMENT “A”
52 KV OUTDOOR, 3-POLE, CENTRE BREAK, AC
DISCONNECTOR WITH MANUAL OPERATING MECHANISM

All bidders must provide the following data. Failure to comply in full, shall constitute sufficient reason for rejection of the offer.

1. Type :.....
:.....
2. Manufacturer :.....
:.....
3. Ambient temperature range during operation :.....
4. Is the disconnector equipped with manual operating mechanism? :.....
5. Disconnector's blade's (arms) angle of rotation :.....
6. Type of material of the disconnector's blades (arms) :.....
7. Type of material of the blade's (arm's) male contact :.....
8. Type of material of the blade's (arm's) female contact :.....
9. Are the blades (arms) contacts self-cleaning and self-aligned ? :.....
10. Are the blade's (arm's) female contact of the finger type? :.....
11. Are the blades (arms) contacts of such design, that short- circuit currents, increase their contact pressure? :.....
12. Is the blade's female contact equipped with stainless-steel springs so that contact pressure is ensured? :.....
13. Type of material of bolts, nuts and washers of the live parts

- of the disconnecter :.....
14. Type of material of the base frame
of the diconnector :.....
15. Is the base frame of the disconnecter
hot-dip galvanized ? :.....
16. Indicate height and overall dimensions
of the disconnecter's base frame :.....
:.....
17. Operation method of the disconnecter :.....
:.....
:.....
18. Indicate pole arrangement of the
disconnecter :.....
:.....
19. Indicate method of mounting of the
disconnecter on its base frame :.....
:.....
:.....
:.....
20. Describe how the disconnecter is
earthed :.....
:.....
:.....
:.....
21. Does the transmission motion system
of the disconnecter, meet the require-
ment of paragraph VII-16 of this
technical description? :.....
:.....
:.....

.....

22. Disconnecter's operating mechanism characteristics

- a. Is the operating mechanism of the disconnecter manual and operable by hand-handle? :.....
- b. Number of operating mechanisms for the three-phase disconnecter :.....
- c. Is the manual operating mechanisms of the reversible motion type? :.....
- d. Are the parts of the hand-handle, which come in contact with the human hands, covered with insulating material? :.....
- e. Is the manual operating mechanism equipped with a removable or a fixed handle? :.....
- f. If the manual operating mechanism is equipped with a fixed handle, is this handle secured in the open and closed position with a padlock? :.....
- g. If the manual operating mechanism is equipped with a removable handle, then is the opening in which the handle is inserted, secured with a padlock ? :.....
- h. Is the operating mechanism equipped with an interlocking coil & with coil voltage of 220V DC? :.....
- i. Can manual operation be prevented by mechanical means when the interlocking coil is in the deenergized state? :.....
.....
- j. Number and type of auxiliary contacts :.....
.....
.....

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- k. Size of control cables used in the wiring of the operating mechanism :.....
- l. Material of the housing of the operating mechanism and degree of protection :.....
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- m. Is the operating mechanism equipped with a spare terminal block? :.....
- n. Is the operating mechanism housing equipped with anti-condensation heaters, controlled by a thermostat? :.....
- o. Is the housing of the operating mechanism suitable for bottom entrance of cables? :.....
- p. Are all necessary bolts, nuts, washers and brackets provided for the mounting of the housing of the operating mechanism? :.....
- q. Is the manual operation carried out via rotary motion and metallic reduction gear? :.....
- r. Are the circuits protected by miniature breakers or fuses? :.....
- s. Supply voltage of the anti condensation heaters :.....
- t. Auxiliary voltage of the circuits of the operating mechanism :.....
23. Is the disconnecter a three-pole with two insulators per pole disconnecter? :.....
24. Type of material and dimensions of the disconnecter terminals :.....
-

25. Disconnectors' characteristics

- a. Numbers of poles :.....
- b. Installation :.....
.....
.....
- c. Rated voltage :.....
- d. Power frequency withstand voltages
 - Phase to earth and between phases :.....
 - Across the isolating distance :.....
- e. Lightning impulse withstand voltages
 - Phase to earth and between phases :.....
 - Across the isolating distance :.....
- f. Rated frequency :.....
- g. Rated normal current :.....
- h. Rated short-time withstand current :.....
- i. Rated peak withstand current :.....
- j. Rated duration of short circuit :.....
- k. Rated static mechanical terminal load
 - Straight load :.....
 - Cross load :.....
 - Vertical force :.....
- l. Thickness of ice coating for which operation is possible :.....
- m. Mechanical endurance class :.....

26. Insulators characteristics

- a. Are the insulators of the outdoor, solid core, cylindrical post insu-

- lator type, with external fittings? :.....
- b. Type of material of the cylindrical solid core post insulators? :.....
- c. Color of the porcelain? :.....
- d. IEC-60273 designation of the insulators :.....
- e. Power frequency withstand voltage, wet :.....
- f. Lightning impulse withstand voltage :.....
- g. Height of the post insulator :.....
- h. Minimum creepage distance :.....
- i. Failing load
- Bending :.....
 - Torsion :.....
 - Tension :.....
 - Compression :.....
- j. Bottom metal fitting pitch circle diameter :.....
- k. Maximum normal diameter of the insulating part :.....
- l. Top metal fitting pitch circle diameter :.....
27. Total weight of the disconnecter with its frame base per pole and also per three poles :.....
-
28. Minimum clearances in air
- a. Between poles :.....
- b. To earth :.....
- c. For isolating distance :.....

29. Do the two insulators per pole (phase) of the disconnector rotate on a weather-proof ball shape greaseless bearing, or on auto-lubricated bush? :.....

30. Can the disconnector be installed on the steel support structure as indicated in drawing No. 305/2? :.....

31. Anticondensation heater data
- a. Rated voltage :.....
- b. Power consumption :.....
32. Interlocking coil data
- a. Rated voltage :.....
- b. Power consumption :.....
33. Rated current of the auxiliary contacts :.....

34. Distance between poles (phases) of the disconnector :.....
35. Distance between insulators of the same pole of the disconnector :.....
36. Is a steel support structure for the operating mechanism of the disconnector provided? :.....
37. Is the operating mechanism's support structure made form stainless steel or hot-dip galvanized steel? :.....

38. Are the anchoring bolts of the above
steel support structure part of
the supply? :.....

39. Are all terminal blocks suitable
for 8mm² size conductors? :.....

40. Indicate tolerances in relation
to paragraph VII-19 of this
hereby technical description
and confirm that proper contact
can be achieved under these conditions :.....
.....
.....
.....