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

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TECHNICAL DESCRIPTION TD-65/4
420KV, OUTDOOR, KNEE TYPE, SINGLE POLE AC DISCONNECTOR WITH ELECTRIC MOTOR OPERATING MECHANISM AND WITH TWO (2) EARTHING SWITCHES (DESIGNATED BY IPTO S.A AS No 403.12)

I. SCOPE

This technical description covers IPTO requirements with regard the design features, rated characteristics and testing of 420 KV, single-pole, knee type AC disconnectors equipped with an electric motor operating mechanism and two(2) earthing switches.

II. KEYWORDS

AC disconnectors, disconnecting switches, isolators, knee type disconnectors, earthing switches.

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 disconnectors are to be used in the buses coupling bays and buses section bays in 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	: 20mm maximum
6. Pollution level	: moderate to heavy depending

	on location
7. Wind speed	: 150Km/h
8. Other conditions	: Snow and fog

VI. IPTO 400 KV ELECTRICAL SYSTEM CHARACTERISTICS

1. Nominal Voltage	: 400KV
2. Maximum Operating Voltage	: 420KV
3. Lightning impulse withstand voltage	: 1550KV
4. Short circuit level	: 40KA
5. Number of phases	: 3
6. Nominal Frequency	: 50 Hz
7. Earthing (grounding) method	: The 400KV system is solidly earthed (grounded)
8. Auxiliary voltages	: 220V D.C and 220V A.C. 1Φ, 400V A.C. 3Φ.

VII. DISCONNECTOR REQUIRED DESIGN FEATURES

1. Type

The disconnector shall be single-pole of knee type, with a two (2) piece folding arm (blade) and with two (2) cylindrical post insulators (column) and one rotating insulator (insulated rod). The two (2) cylindrical post (column) insulators shall be installed on a common steel base on which possible metallic supports, for the connection of each insulator's base to the disconnector's common base, to be adapted. The rotating insulator shall rotate in order to transmit the motion to the arm (blade). The disconnector shall also be equipped with two (2) integrated electrically driven earthing switches.
The layout arrangement of the disconnector and its earthing switches is shown in drawing No 403.12/2.

2. Arm (blade) function

The arm which shall consist of two pieces, in the open position shall fold upon itself in a vertical position.

3. Material of the arm (blade)

The two pieces arm (blade) of the disconnector shall be either from extra heavy tubular aluminium or extra heavy tubular aluminium alloy.

4. Characteristics of the fixed and movable contacts

a. Both the fixed and the movable (arm) contacts shall be replaceable.

b. Both contacts shall be self-cleaning and of such design so that short circuit currents increase their contact pressure.

c. The movable (arm) contacts shall be of the finger type.

d. The contacts in the closed position shall be able to withstand wind forces Seismic forces, forces exerted by the tension of conductors and also forces due

to temperature variations without being separated.

5. Type of material of the fixed and movable contacts
Both contacts shall be of silver plated copper.

6. Base frame of the insulators of the disconnector
The common steel base and the possible metallic supports for each of the two cylindrical post (column) insulators shall be made of hot dip galvanized steel. The common base shall have a height of 150mm.

7. Terminals
The disconnector shall be fitted with two (2) aluminium terminals of orthogonal shape. These terminals shall have dimensions as indicated in the attached drawing No.403.12/2.

8. Mounting of the disconnector
The disconnector shall be installed on a steel structure which shall be provided by IPTO and which is explicitly shown in drawing No. 403.12/2.

9. Earthing (grounding)
The disconnector shall be equipped with a flexible tin plated copper strip of 240mm^2 in cross section for the purpose of using it to earth the disconnector to the earthing (grounding) mat of the substation.

10. Dimensions of disconnector

a. The distance between the two (2) post (column) insulators of the disconnector shall be 4000mm (±5%).

b. The disconnector shall be installed on a steel support structure of 3000mm in height, which shall be provided by IPTO

11. Corona rings
The two cylindrical post insulators of the disconnector shall be equipped with corona rings in order to level off the electric field at the rough edges of the disconnector or to eliminate concentrated electrostatic induction at the edges of the disconnector.

12. Transmission motion system of the disconnector

a. The transmission motion system of the disconnector shall consist of a vertical bare rod and a possible insulated rod. The whole system must be suitable, along with the two (2) cylindrical post(column) insulators and their base frame, to be mounted on steel support structure (not part of the supply) of 3000mm in height, as indicated in the attached drawing No. 403.12/1 of this hereby technical description.

b. In case of accidental rod dismantling, the blade (arm) of the disconnector must not be moved from the position found.

c. The transmission motion system must be designed for smooth noiseless and precise operation, and to avoid any undesired operations.

d. The base of the rotating insulated rod must be auto lubricated and protected against corrosion and moisture.

13. Counterbalancing springs

Counterbalancing springs shall be used in order to balance the weight of the movable parts and the opening and closing of the disconnector. All counterbalancing springs must be isolated from the main path.

14. Type of metallic materials used for the non-current parts of the disconnector.

The non-current carrying metallic parts of the disconnector can be made either of hot dip galvanized steel or stainless steel.
Cast iron can be used only in places where the applied forces are not of important magnitude. The cast iron shall also be hot dip galvanized.

15. Type of material of the connection components.

All bolts, nuts and washers which are used in current carrying parts of the disconnector shall either be of stainless steel or bronze.
All bolts, nuts and washers used in the non-current currying parts of the disconnector shall be of hot dip galvanized steel.

16. Operating Mechanism of the disconnector

a. The operating mechanism of the disconnector shall be driven by an electric motor, for the rotation of the axis via metallic gear wheels.

b. The electric motor operating mechanism shall be of the reversible motion type

c. The electric motor operating mechanism must be capable of being operated electrically locally and also capable of being tele-operated from a remote place. Furthermore, the mechanism shall include provision for manual operation in case of an emergency.
The local electrical and remote electrical command for the operation of the disconnector is given by a pulse of 200ms in duration and for this reason a latching function shall be produced to the supply circuit of the motor until the completion of the motion of the operating mechanism. In case during the execution of the motion, the supply voltage of the motor is lost (or the interlocking coil is deenenergized), then the movement of the disconnector shall be stopped and the disconnector shall remain in the position it had when it stopped. After the supply voltage is restored (or the re-energization of the interlocking coil), a new command must be given in order the movement to be completed.

d. The motor of the operating mechanism shall be 3Φ, 400V A.C, or UNIVERSAL DC commutator type of 220V DC or 1ph 230V AC (via rectifier).

e. The manual emergency operation shall be carried out via rotary motion

and reduction gear with a hand-handle which shall be removable. The electric control circuit shall be placed automatically out of service when the hand-handle is inserted for the manual emergency operation.
The parts of the handle which come in contact with the human hands shall be covered with insulating material.
The insertion of the removable hand-handle to the housing shall be possible through an opening in the outer surface of 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. The motor operated mechanism shall be equipped with a rotary selector switch which shall allow the following four (4) modes of operation:

- Position 1 : Manual operation. Operation only via the hand-handle
- Position 2 : Local operation-Local electrical control
- Position 3 : Tele-operation. Electrical operation from a remote place
- Position 4 : Off. No electrical or manual operation is allowed

The selection of any one of the above positions shall exclude the possibility of operation form in any other position. The selector switch shall be capable of being locked of the selected positions with a lock. In the off position, the disconnector is locked in this position and,

- There is no access to the opening of the housing for the hand-handle
- All voltage commands to the motor are isolated (cut-off)
- The transmission motion system is mechanically blocked from the motor towards the reduction gear.

g. No sliding disks or electrical brakes are allowed for the transmission of torque to the transmission motion mechanism or to the blade (arm) in order to cease motion at the end of the blade travel and to avoid overtravel.

h. The immobilization of the motor axis shall be controlled electrically by limit switches. For extra safety reasons only, mechanical stops may also be used.

i. The mechanism shall be equipped with limit switches which shall interrupt the operation of the electrical motor when the disconnector's blade have reach its final position in both positions (opened-closed).

j. The electrical motor operating mechanism shall be equipped with an interlocking coil, of coil voltage of 220V DC, which shall be used for electrical interlocking between the disconnector and its corresponding circuit breaker. The interlocking coil in the deenergized state shall prevent the electrical operation of the mechanism by means of an auxiliary contact, and the manual operation by means of a mechanical blocking.

k. The electric motor operating mechanism shall be equipped with the following auxiliary contacts of high reliability as to ensure the exact status of the disconnector.
- Seven (7) NO contacts of type A
- Seven (7) NC contacts of type B
- Two (2) NO contacts of type C
- Two (2) NC contacts of type D

The signal for "Disconnector is closed'' shall be given only after complete closing which means that a short circuit current can run through the disconnector, 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.

l. All control cables of the operating mechanism shall be of cross section of 1.5mm² at least and shall bear proper markings. All terminal blocks however, shall be suitable for 8 mm^2 size conductors.

m. The housing of the operating mechanism shall be either from stainless steel or hot-dig galvanized steel or aluminum alloy.

n. The degree of the protection of the housing shall be IP 42D, as per IEC-60529.

o. The operating mechanism shall be equipped with a spare terminal block of at least eight positions. The terminal block shall be suitable for 8 mm^2 size conductors.

p. The housing of the operating mechanism shall be equipped with anti-condensation heater or heaters, controlled by an thermostat.
The supply voltage to the heaters shall be 1Φ, 220V AC.

q. All electric circuits of the mechanism shall be suitable for 220V DC and shall be protected by miniature circuit breakers or fuses.

r. The housing of the operation mechanism shall allow cable entrance from its bottom (IPTO cables).

r. The housing of the operating mechanism shall be installed (mounted) on the steel support structure, which shall be provided by IPTO as indicated

in drawing No. 403.12/2.
For this reason all, bolts, nuts, brackets and any other mounting component must be part of the supply.
All connection parts, for example bolts, nuts, brackets etc must be either from stainless steel or hot-dip galvanized steel.

VIII. EARTHING SWITCHES REQUIRED DESIGN FEATURES

1. Type
   The earthing switches shall be linked directly to the disconnector. The earthing switches shall be electrically operated but they shall also be suitable for manual operation via hand-handle in case of emergency. The earthing switches shall be single pole and shall be mounted on the disconnector as shown in the attached drawing No. 403.12/2.

2. Method of operation of the earthing switches
   Single pole, vertical operation

3. Method of mounting of the earthing switches on the disconnector
   With hinge on the base frame of the disconnector with one installed towards the side of the rotating insulator and the other towards the side of the two cylindrical post insulators, as shown in the drawing No. 403.12/2

4. Type of metals which must be used for the earthing switch
   a. All non current carrying parts of each earthing switch shall be of hot – dip galvanized steel.
   b. The contacts of the arm (blade) shall be of tin plated copper.
   c. The blade itself must be either of extra heavy aluminium or of extra heavy aluminium alloy.
   d. All the connecting materials such as bolts, nuts and washers shall be either of stainless steel or of hot – dip galvanized steel.

5. Earthing (grounding)
   At the end of the hinge of the blade (arm) and at the rod of the vertical motion transmission there shall be a flexible copper earthing strip of current capability or 40 KA which shall be used for the connection to the earthing (grounding) mat of the ehv substation.

6. Operating Mechanism of the earthing switches
   The follows are applicable to both operating mechanisms of the two earthing switches

   a. The operating mechanism of each earthing switch shall be driven by an electric motor for rotary motion via metallic gears but shall also be equipped with hand – handle for manual operation.

   b. The electric motor operating mechanism shall be of the reversible motion type

   c. The supply of the motor of the operating mechanism shall be3Φ, 400V

AC, or 220V DC or 1ph 230V AC (via rectifier).

d. The manual emergency operation shall be carried out via rotary motion and reduction gear or directly with a hand-handle which shall be removable. The electric control circuit shall be placed automatically out of service when the hand-handle is inserted for the manual emergency operation.
The parts of the handle which come in contact with the human hands shall be covered with insulating material.
The insertion of the removable hand-handle to the housing shall be possible through an opening in the outer surface of 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.

e. The electric motor operating mechanism of earthing switch must be capable of being operated electrically locally and also capable of being tele-operated from a remote place.
The local electrical and remote electrical command for the operation of the earthing switch is given with a pulse of 200ms in duration and for this reason a latching function shall be produced to the supply circuit of the motor until the completion of the motion of the operating mechanism. In case during the execution of the motion, the supply voltage of the motor is lost or the interlocking coil is deenenergized, then the movement of the earthing switch shall be stopped and shall remain in the position it had when it stopped. After the supply voltage is restored or the re- energization of the interlocking coil, a new command must be given in order the movement to be completed.

f. The motor operated mechanism shall be equipped with a rotary selector switch which shall allow the following four (4) modes of operation:

- Position 1 : Manual operation. Operation only via the hand-handle
- Position 2 : Local operation-Local electrical control
- Position 3 : Tele-operation. Electrical operation from a remote place
- Position 4 : Off. No electrical or manual operation is allowed

The selection of any one of the above positions shall exclude the possibility of operation form in any other position. The selector switch shall be capable of being locked of the selected positions with a lock. In the off position, the disconnector is locked in this position and,

- There is no access to the opening of the housing for the hand-handle

- All voltage commands to the motor are isolated (cut-off)

- The transmission motion system is mechanically blocked from the motor towards the reduction gear.

g. No sliding disks or electrical brakes are allowed for the transmission of moment to the transmission motion mechanism or to the blade (arm) in order to cease motion at the end of the blade travel and to avoid overtravel.

h. The immobilization of the motor axis shall be controlled electrically by limit switches. For extra safety reasons only, mechanical stops may also be used.

i. The mechanism shall be equipped with limit switches which shall interrupt the operation of the electrical motor when the earthing switch's blade has reached its final position in both positions (earthed–not earthed).

j . The electrical motor operating mechanism shall be equipped with an interlocking coil, of coil voltage of 220V DC, which shall be used for electrical interlocking between the earthing switch and the disconnector. The interlocking coil in the deenergized state shall prevent the electrical operation of the mechanism by means of an auxiliary contact, and the manual operation by means of a mechanical block.

k . The electric motor operating mechanism shall be equipped with the following auxiliary contacts of high reliability as to ensure the exact status of the disconnector.

- Seven (7) NO contacts of type A
- Seven (7) NC contacts of type B
- Two (2) NO contacts of type C
- Two (2) NC contacts of type D

l. All control cables of the operating mechanism shall be of cross section of 1.5mm² at least and shall bear proper markings. All terminal blocks however, shall be suitable for 8 mm^2 size conductors.

m. The housing of the operating mechanism shall be either from stainless steel or hot-dip galvanized steel or aluminum alloy .

n. The degree of the protection of the housing shall be IP 42D, as per IEC-60529.

o. The operating mechanism shall be equipped with a spare terminal block of at least six positions. The terminal block shall be suitable for 8 mm^2 size conductors.

p. 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 1Φ, 220V AC.

q. All electric circuits of the mechanism shall be suitable for 220V DC and shall be protected by miniature circuit breakers or fuses.

r. The housing of operation mechanism shall allow cable entrance from its bottom (IPTO cables).

s. The housing of the operating mechanism shall be installed (mounted) on the steel support structure, which shall be provided by IPTO as indicated in drawing No. 403.12/2.
For this reason all bolts, nuts, brackets and any other mounting component must be part of the supply.
All connection parts, for example bolts, nuts, brackets etc must be either from stainless steel or hot-dip galvanized steel.

IX. DISCONNECTOR REQUIRED RATED ELECTRICAL AND OTHER CHARACTERISTICS

1. Number of poles	: One (1)
2. Installation	: Outdoors
3. Rated Voltage	: 420KV
4. Rated insulation levels	
a. Power frequency withstand voltage	
- Phase to earth	: 620KV rms
- Across the isolating distance	: 800KV rms
b. Rated switching impulse withstand voltages, dry	
- Across the isolating distance	: 900 (+450) KV, peak
c. Rated switching impulse withstand voltage, wet	
- Phase to earth	: 1050 KV, peak
d. Lightning impulse withstand voltage	
- Phase to earth	: 1550KV peak
- Across the isolating distance	: 1550 (+315) KV, peak
5. Rated frequency	: 50 Hz
6. Rated normal current	: 3150 A
7. Rated short-time withstand current	: 40 KA rms
8. Rated peak withstand current	: 100 KA peak
9. Rated duration of short circuit	: 3 sec
10. Rated static mechanical terminal load	
- Straight load	: 2000N at least
- Cross-load	: 660N at least
- Vertical Force	: 1500N at least
11. Thickness of ice coating for which operation shall be possible	: 20 mm
12. Type of conductors used for the connection of	

the disconnector	: Flexible
13. Mechanical endurance class	: M1 (2000 operating cycles)

X. SUPPORT INSULATORS REQUIRED CHARACTERISTICS

A. CYLINDRICAL POST (COLUMN) INSULATORS

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	: C12.5-1550
5. Switching impulse withstand voltage wet	: 1050 KV peak
6. Lightning impulse withstand voltage	: 1550KV peak
7. Height of the post insulator	: 3350mm ± 4.5 mm
8. Creepage distance	: 10500mm
9. Failing load	
a. Bending	: ≥ 12500N
b. Torsion	: ≥ 6000Nm
10. Bottom metal fitting pitch circle diameter	: 325mm
11. Maximum nominal diameter of insulating part	: 450mm
12. Top metal fitting pitch circle diameter	: 225mm

B. ROTATING (TORSIONAL) INSULATOR

1. Type	: Outdoor cylindrical hollow insulator.
2. Material of the insulator	: Porcelain
3. Color of the porcelain	: Gray
4. Switching impulse withstand voltage wet	: 1050KV,peak
5. Lightning impulse withstand voltage	: 1550KV,peak
6. Height of the insulator	: 3350mm ± 4.5mm
7. Creepage distance	: 10500mm
8. Maximum nominal diameter of the insulating part	: As determined by the design of the manufacture and this hereby requirements..
9. Failing load	
a. Torsion	: ≥2000Nm

XI. EARTHING SWITCHES REQUIRED RATED ELECTRICAL AND OTHER CHARACTERISTICS

The following are applicable to both earthing switches

1. Number of poles	: One (1)

2.	Installation	: Outdoors
3.	Rated Voltage	: 420 KV
4.	Rated insulation levels	
	a. Power frequency withstand voltage phase to earth	: 625 KV, rms
	b. Switching impulse withstand voltage phase to earth	: 1050 KV, peak, wet
	c. Lightning impulse withstand voltage phase to earth	: 1550 KV, peak
5.	Rated frequency	: 50 Hz
6.	Rated short – time withstand current	: 40 KA
7.	Rated peak withstand current	: 100 KA
8.	Rated duration of the short circuit	: 3 sec
9.	Electrical endurance class	: A+Eo
10.	Electromagnetic coupling withstand	
	a. Rated induced current	: 80 A rms
	b. Rated induced voltage	: 2 KV, rms
11.	Electrostatic coupling withstand	
	a. Rated induced current	: 1.25 A rms
	b. Rated induced voltage	: 5 KV rms
12.	Thickness of ice coating for which operation is possible	: 20 mm

XII. TESTS

The disconnector shall be subjected 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 (for the disconnector and earthing switches)

A. Disconnector Power frequency voltage test (dry).

The test voltage shall be 620 KV rms for phase to earth and 800KV rms across the isolating distance. The test conditions shall be in accordance with table 6 of IEC 62271-102 for single pale disconnector.

Alternatively, the power frequency voltage withstand test may be omitted if the dimensions between the conductive parts, across open contacts and between conductive parts and the frame – are checked by measurements. Bases for the checking of dimensions shall be the dimensional drawings which are part of the type test report, if such report exists, otherwise, this alternative option shall not be taken into consideration.

B. Earthing switch

The voltage shall be applied to the terminals of the disconnector with the base frame earthed and the earthing switches earthed. The applied voltage shall be 620 KV.

2. **Dielectric test on auxiliary and control circuits (for the disconnector and earthing switches)**
   The test voltage shall be 1 KV with duration of 1 minute.

3. **Measurement of the resistance of the main circuit (for the disconnector only)**
   The test current shall be between 50A and the rated nominal current. The measured resistance shall not exceed 1.2 Ru, where Ru is equal to the resistance measured before the temperature rise test.

4. **Design and visual checks (for the disconnector and earthing switches)**
   The disconnectors and the earthing switches shall be checked to verify that they comply with this hereby technical description.

B. Special Tests

The special test shall be carried out only on one (1) disconnector and its two earthing switches of the order because of the assembly complexities involved.

1. **Mechanical operating tests**
   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 at minimum supply voltage and five close-open operating cycles at maximum supply voltage for the disconnector. The same program shall be applied to the earthing switches as well.
   The test shall be performed on a completely assembled disconnector with its earthing switches mounted on it.

C. Type Tests

1. **Dielectric tests (for the disconnector and earthing switches)**
   In the closed position, the tests shall be performed in conditions 1, 4 and 7 of table 9 of IEE 60694. In the open position the tests shall be performed as described below:

   a. Power frequency voltage test
      - Test voltage : 620 KV rms for 1min for phase to earth.
        : 800 KV rms for 1 min across the isolating distance
        : 633 KV rms for 1 minute with the earthing switch's blade in the most unfavorable position
      - Conditions : Dry

b. Switching impulse voltage test

- Test voltage : 900 (+450) KV of both polarities across the isolating distance under dry condition.
  : 1050KV of both polarities for phase to earth under wet conditions.
- Switching impulse shape : 250/2500μς

c. Lightning impulse voltage test

- Test voltage : 1550KV peak of both polarities for phase to earth
  : 1550 (+315) KV peak across the isolating distance
- Lightning impulse shape : 1.2/50μs
- Conditions : Dry

2. Test on auxiliary and control circuits (for the disconnector and earthing switches)

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 performed between the auxiliary and control circuits connected together as a whole and the frame of the disconnector. The test shall be carried out separately for the auxiliary and control circuits of the disconnector and separately for those of the each earthing switch

3. Radio interference voltage (r.i.v) test

The test shall be applied as follows:

a. In closed position (both disconnector and earthing switches) between terminals and earthed frame
   Level of radio interference at 267 KV : ≤ 2500μV

4. Temperature-rise test (for the disconnector only)

- Test current : 3150A
- 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

5. Short-time withstand and peak withstand current test (for disconnector and earthing switches)

- Short-time test current : 40 KA rms
- Peak withstand test current : 100 KA peak
- Test frequency : 50 Hz ± 10%
- Test duration : 3 sec

6. Operating and mechanical endurance tests (for the disconnector only)

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 disconnector but in opposite directions, without voltage on or current through.

7. Operation test under severe ice conditions (for the disconnector and earthing switches)

The test shall be conducted with class 20 of ice coating (20mm of ice coating)

8. Test for electromagnetic coupling for induced current and voltage (earthing switches only).

- Induced current : 80A rms
- Induced voltage : 2KV rms

9. Test for electrostatic coupling for induced current and voltage (earthing switches only).

- Induced current : 1.25A rms
- Induced voltage : 5KV rms

XIII. TESTS FOR THE DISCONNECTOR'S INSULATORS

The disconnector manufacturer is obliged to present to the ADMIE 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 switching impulse withstand voltage test.
3. Wet power – frequency withstand voltage test
4. Mechanical failing load test

XIV. NAMEPLATES

The nameplates for the disconnector, for the earthing switches and for operating mechanisms, shall be of non-corrosive material, visible from ground and shall bear the following information:

	Disconnector	Earthing switches	Operating Mechanisms of the D/S and E/S
Manufacturer	√	√	√
Type	√	√	√
Serial Number	√	√	√
Year of Manufacture	√	√	√
Rated Voltage	√	√	
Rated Lightning Impulse withstand voltage	√	√	
Rated switching impulse with tand voltage	√	√	
Rated duration of short circuit	√	√	
Rated supply voltage of auxiliary circuits			√
Mechanical endurance class	√		
Electrical endurance class		√	
Mass	√	√	√

XV. DATA WHICH MUST BE SUBMITTED BY ALL BIDDERS

1. Outline drawing of the disconnector along with its earthing switches, in which the physical dimensions of the disconnector plus the earthing switches 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 judgment.

5. A drawing indicating the disconnector on its base frame with complete dimensions.

6. A preliminary drawing indicating mounting of the disconnector and its earthing switches, along with their operating mechanisms on the steel support structure, which shall be supplied by IPTO. Failure to comply with this request will result in rejection of the offer.

XVI. DATA WHICH MUST BE SUBMITTED BY THE SUCCESSFUL BIDDER

1. Complete schematic and wiring drawings of the disconnector and earthing switches, for approval before the construction of the disconnector.

2. Complete physical drawings of the disconnector and earthing switches, indicating all dimensions details, for approval before the construction of the disconnector.

3. A drawing indicating the disconnector on its base frame.

4. Maintenance and assembly instructions in detail for the disconnector and earthing switches.

5. A drawing indicating mounting of the disconnector and its earthing switches, along with their operating mechanisms, on the steel support structure, which will be supplied by IPTO.

XVII. WARRANTY

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

XVIII. 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. Live parts of the earthing switch in a separate wooden box.

4. Operating rods of disconnector and earthing switch tied together in a separate wooden box.

5. Disconnector's operating mechanism in a separate wooden box.

6. Earthing switch's operating mechanism in a separate wooden box

or alternatively

items 2, 3 and 4 as listed above in a robust wooden box and the insulators in a separate robust wooden box, the operating mechanism of the disconnector in a separate robust wooden box and the two (2) operating mechanisms of the earthing switches in a separate robust wooden box.

ATTACHMENT "A"
420 KV, OUTDOOR, KNEE TYPE, SINGLE POLE , AC DISCONNECTOR WITH ELECTRIC MOTOR OPERATING MECHANISM AND WITH TWO (2) EARTHING SWITCHES (403.12)

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. Indicate the number of pieces which the arm (blade) of the disconnector consists of :..…..……...

5. Are the fixed and movable (arm) contacts replaceable :……..

6. Are both the fixed and movable contacts self-cleaning and of such design so that short circuit currents increase their contact pressure? :……..

7. Are the movable contact of the finger type :……..

8. Can the contacts in the closed position withstand wind forces, seismic forces, forces exacted by conductors and also forces due to temperature variations without being separated ? :……..

9. Type of material of the fixed and movable contacts :……..

10. Indicate height of the steel base frame? :..……..……..……

11. Is the base frame of the discon-nector of hot-dip galvanized steel? :……

12. Type of material of the terminals of the disconnector and their dimensions :……

……..

13. Indicate method of mounting of the disconnector on its base frame :……

…….

…….

14. Describe how the disconnector is earthed :……

…….

…….

…….

15. Indicate the distance between the two column insulators of the disconnector :……...

16. Are the two column insulators of the disconnector equipped with corona rings :……

17. Indicate the components of the transmission motion system of the disconnector :……

……

……

18. In case of accidental rod dismantling, can the blade (arm) remain in the position found? :……..

……

19. Is the transmission motion system smooth and noiseless and of precise operation? :……..

20. Is the base of the rotating insulated rod auto lubricated and protected against corrosion and moisture? :……..

21. Is the disconnector equipped with counter balancing springs ? :…….

22. Are the balancing springs isolated from the main path? :…….

23. Type of material of the non-current carrying parts of the disconnector :……..……..

24. Type of material of the connection components :……..

25. Disconnector's operating mechanism characteristics

a. Is the operating mechanism of the disconnector electric motor operated? :…….
Are metallic gear wheels used for the rotation of the axis? :…….

b. Is the electric motor operating mechanism of the reversible motion type? :…….

…….

c. Can the electric motor operating mechanism be capable of being operated electrically locally and also electrically from a remote place? :……

……

d. Does the electric motor operating mechanism include provision for manual operation in case of emergency via hand-handle? :……..

e. Is the supply circuit of the electric motor equipped with latching capability in order for the operating mechanism to complete its motion given the fact that the command pulse is 200ms in duration? :……..

……...

……

……

f. Is the motion of the disconnector stopped when the supply voltage to the electric motor is lost or the interlocking coil is deenergized? :……..

……..

g. When the motion of the disconnector is stopped due to voltage supply loss to the electric motor, does the disconnector remain in the stopped position until a new command for motion is given? :……..

……..

……..

h. Indicate the supply voltage for the electric motor :……..

i. Is the manual emergency operation carried out via rotary motion and reduction gear with a hand-handle? :……..

……..

……..

j. Is the hand-handle removable? :……..

k. Is the electric control circuit of the operating mechanism placed automatically out of service when the hand-handle is inserted for the manual emergency operation? :……..

……..

l. Are the parts of the hand-handle which come in contact with the human hands covered with an insulating material? :……..

……..

m. Can the opening in outer surface of the housing of the mechanism in which the hand-handle is inserted be secured with a padlock? :……..

n. Can the removable hand-handle be kept inside the housing of the operating mechanism? :……..

……..

o. Is the motor operated mechanism equipped with a rotary type selector switch of four positions as described in paragraph VII-16-f? :…….

…….

p. Does the offered disconnector and its electric motor operating mechanism comply with the requirement of paragraph VII-16-g? :…….

…….

…….

q. Indicate compliance with paragraph VII-16-h? :…….

…….

…….

r. Is the electric motor operating mechanism equipped with limit switches which shall interrupt operation of the motor and the disconnector's blade, when the blade has reached its final position? :…….

…….

…….

s. Is the electric motor operating mechanism equipped with an interlocking coil which shall be used for electrical interlocking between the disconnector and its corresponding circuit breaker? :..……

……

……

t. Voltage of the interlocking coil? :……

u. Can the interlocking coil in its deenergized state prevent the electrical operation of the mechanism via an auxiliary contact and the manual operation by a mechanical block? :……

……

……

v. Indicate the number and type of the auxiliary contacts of the electric motor operating mechanism :……

……

……

……

……

w. Size of control cables used in the wiring of the operating mechanism :……

x. Material of the housing of the operating mechanism and degree of protection as per IP :…….…….

……..

y. Is the operating mechanism equipped with a spare terminal block of eight positions ? :…….…….

z. Is the operating mechanism housing equipped with anti-condensation heaters, controlled by a thermostat ? :…….

a1. Is the housing of the operating mechanism suitable for bottom entrance of cables? :…….

b1. Are all necessary bolts, nuts, washers and brackets provided for the mounting of the housing of the operating mechanism? :…….

c1. Is the manual operation carried out via rotary motion and reduction gear? :……..

..…….

d1. Are the circuits protected by miniature circuit breakers or fuses? :…….

e1. Supply voltage of the anti-condensation heaters :…….

f1. Auxiliary voltage of the circuits of the operating mechanism :…….

g1. Can the rotary selector switch be secured in its four positions with the aid of a lock? :……

……

h1. Are all terminal blocks suitable for 8mm^2 size conductors? :……

i1. Are the bolts, nuts and washers which are required for the mounting of the housing of the operating mechanism from stainless steel or hot dip galvanized steel? :……..…….

..…….

26. Disconnector's characteristics

a. Numbers of poles :……

b. Installation :……

…….

c. Rated voltage :……

d. Power frequency withstand voltages

- Phase to earth :……...
- Across the isolating distance :……...……

e. Switching impulse withstand voltage

- Phase to earth :……..……...
- Across the isolating distance :……

f. Lightning impulse withstand voltages

- Phase to earth :……...
- Across the isolating distance :……...……

g. Rated frequency :……...……

h. Rated normal current :…….….

c. Rated short-time withstand current :……..

j. Rated peak withstand current :……..

k. Rated duration of short circuit :……..

l. Rated static mechanical terminal load

- Straight load :……....
- Cross load :……
- Vertical force :……

m. Thickness of ice coating for which operation is possible :……

n. Mechanical endurance class :……

27. Solid core post (column) Insulators characteristics

a. Are the insulators of the outdoor, solid core, cylindrical post insulator type, with external fittings ? :…….……

b. Type of material of the cylindrical solid core post insulators ? :……..

c. Color the porcelain? :……...……...

d. IEC-60273 designation of the insulators :……..

e. Power frequency withstand voltage, wet :……..

f. Switching impulse withstand voltage, wet :…….……

g. Switching impulse withstand voltage dry :……..

h. Lightning impulse withstand voltage :……..

m. Height of the post insulator :……..

n. Minimum creepage distance :……..

l. Failing load

- Bending :……..
- Torsion :…….
- Tension :…….
- Compression :…….

m. Bottom metal fitting pitch circle diameter :……...

n. Maximum normal diameter of the insulating part :……..

o. Top metal fitting pitch diameter :……..

28. Rotating (tortional) insulator characteristics:

a. Type :…….

…….

b. Material of the insulator :……

c. Color of the porcelain :…….

d. Power frequency withstand voltage :…….

e. Switching impulse withstand voltage, wet :…….

f. Switching impulse withstand voltage dry :…….

g. Lighting impulse withstand voltage :…….

h. Height of the insulator :……

i. Creepage distance :…….

j. Maximum diameter of the insulating part :……

k. Failing load

- Bending :…….
- Torsion :…….

l. Tension strength :……..

m. Compression strength :…….

n. Designation as per IEC 60273 :……..

29. Total weight of the disconnector :…….....

30. Anti-condensation heater data

a. Rated voltage :……...

b. Power consumption :……...

31. Interlocking coil data

a. Rated voltage :……...

b. Power consumption :……...

32. Distance between the rotating insulator and its nearest column insulator :……..

……

……

33. Are the three (3) insulators of the pole of the disconnector mounted on a common base frame? :……...

34. Does the two pieces arm (blade) of the disconnector folds upon itself in a vertical position ? :……

……..……...

35. Distance between the two (2) column insulators of the disconnector :……..

36. Is the disconnector equipped with two (2) earthing switches? :……

37. Type of the earthing switches :…….

……..

38. Method of operation of the earthing switches :……

39. Method of mounting of the earthing switches on the disconnector :……

……

40. Kind of metals used in the non-current carrying parts of the earthing switches :……

……..……..

……

41. Kind of metal used in the contacts of the arm (blade) of the earthing switches :…….……..

……

..…..……

42. Kind of metal used in the arm (blade) of the earthing switches :……

....……

43. Kind of metal used in the connecting parts (bolts, nuts etc) of the earthing switches :……

……

….……

44. Describe the method of earthing of the earthing switches :……

…..…….…….

45. Characteristics of the operating mechanism of the earthing switches

The following concerns both operating mechanisms of the two earthing switches

a. Is the operating mechanism of the earthing switch electric motor operated? :…….
Are metallic gears used for rotary motion? :…….

b. Is the electric motor operating mechanism of the reversible motion type? :…….

…….

c. Can the electric motor operating mechanism be capable of being operated electrically locally and also electrically from a remote place? :……

……

d. Does the electric motor operating mechanism include provision for manual operation in case of emergency via hand-handle? :……..

e. Is the supply circuit of the electric motor equipped with latching capability in order for the operating mechanism to complete its motion given the fact that the command pulse is 200ms in duration? :……..

……...

……

f. Is the motion of the earthing switch stopped when the supply voltage to the electric motor is lost or the interlocking coil is deenergized? :……..

……..

……..

g. When the motion of the earthing switch is stopped due to voltage supply loss of the electric motor, does the earthing switch remain in the stopped position until a new command for motion is given? :……..

……..

……..

……..

h. Indicate the supply voltage for the electric motor :……..

i. Is the manual emergency operation carried out via rotary motion and reduction gear with a hand-handle? :……..

……..

……..

j. Is the hand-handle removable? :……..

k. Is the electric control circuit of the operating mechanism placed automatically out of service when the hand-handle is inserted for the manual emergency operation? :……..

……..

l. Are the parts of the hand-handle which come in contact with the human hands covered with an insulating material? :……..

……..

m. Can the opening in outer surface of the housing of the mechanism in which the hand-handle is inserted be secured with a padlock? :……..

n. Can the removable hand-handle be kept inside the housing of the operating mechanism? :……..

……..

o. Is the motor operated mechanism equipped with a rotary type selector switch of four positions as described in paragraph VIII-6-f? :…….

……

p. Does the offered earthing switch and its electric motor operating mecha-nism comply with the requirement of paragraph VIII-6-g? :…….

……

……

g. Indicate compliance with paragraph VIII-6-h :…….

……

……

r. Is the electric motor operating mechanism equipped with limit switches which shall interrupt operation of the motor and the motion of the earthing switch's blade, when the blade has reached at its final position? :…….

……

……

……

s. Is the electric motor operating mechanism equipped with an interlocking coil which shall be used for electrical interlocking between the earthing switch and its disconnector? :……

……

..……

t. Voltage of the interlocking coil :……

u. Can the interlocking coil in its deenergized state prevent the electrical operation of the mechanism via an auxiliary contact and the manual operation by a mechanical block? :……..

……

……

v. Indicate the number and type of the auxiliary contacts of the electric motor operating mechanism :……

……

……

……

……

w. Size of control cables used in the wiring of the operating mechanism :……

x. Material of the housing of the operating mechanism and degree of protection as per IP :…….…..…….

…….……..

y. Is the operating mechanism equipped with a spare terminal block of six (6) positions ? :…….

z. Is the operating mechanism housing equipped with anti-condensation heaters, contro-lled by a thermostat ? :…….

a1. Is the housing of the operating mechanism suitable for bottom entrance of cables? :…….

b1. Are all necessary bolts, nuts, washers and brackets provided for the mounting of the housing of the operating mechanism? :…….…….

c1. Is the manual operation carried out via rotary motion and reduction gear?:……..

..…….

d1. Are the circuits protected by miniature circuit breakers or fuses? :…….

e1. Supply voltage of the anti-condensation heaters :…….

f1. Auxiliary voltage of the circuits of the operating mechanism :…….

g1. Can the rotary selector switch be secured in its four positions with the aid of a lock? :……

h1. Are all terminal blocks suitable for 8mm^2 size conductors ? :……

i1. Power of the anti-condensation heaters :…...……

j1. Power of the interlocking coil :…….……

k1. Are the bolts, nuts and washers which are required for the mounting of the housing of the operating mechanism made of stainless steel or hot-dip galvanized steel? :……

46. Earthing switches electrical and other characteristics.

The following concerns both operating earthing switches

a. Number of poles :……

b. Installation :……

c. Rated voltage :……

d. Rated insulation levels.

1. Power frequency withstand voltage phase to earth. :……
2. Switching impulse withstand voltage phase to earth. :……
3. Lightning impulse withstand voltage phase to earth. :……

e. Rated frequency :……

f. Rated short – time withstand current :…….

g. Rated peak withstand current :…….

h. Rated duration of the short circuit :…….

i. Electrical endurance class :……..

j. Electromagnetic coupling withstand

1. Rated induced current :……

2. Rated induced voltage :……

k. Electrostatic coupling withstand

1. Rated induced current :……

2. Rated induced voltage :..……..……

l. Thickness of ice coating for which operation is possible :……..

47. Total weight of the disconnector with its base frame and the two (2) earthing switches. :……

……..

48. Total weight of the disconnector's operating mechanism :……

……..

49. Total weight of each earthing switch's operating mechanism :……

……..