



**C.A. LA ELECTRICIDAD DE CARACAS SACA**  
**DEPARTAMENTO DE INGENIERIA GENERAL**

# **DIG**

## **00109-A2**

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**Specification to**

**ALTERNATING CURRENT DISCONNECTORS  
(ISOLATORS)  
AND EARTHING SWITCHES  
GENERAL TECHNICAL SPECIFICATION**

**Substation type: 245 kV and 72.5 kV**

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## **0. FOREWORD**

This specification has been approved by the competent authorities from Electricidad de Caracas (EDC) on August 02, 1999 for the procurement of Alternating Current Disconnectors (Isolators) and Earthing Switches assigned to work at 69 kV and 230 kV EDC networks.

This specification may be revised as required. However, any revisions must be approved by the above mentioned EDC authorities.

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## **1. BASIC PRINCIPLES**

- 1.1 The continued advancement of Alternating Current Disconnectors (Isolators) and Earthing Switches technology, combined with the expansion of EDC's operations over the last few years, justifies a complete revision of the previous technical specifications.
- 1.2 The principal objective of this specification is to:
- a) Assure through International Competitive Binding (IBC) equal opportunities for all participants. This includes those companies and organizations who follow International Electrotechnical Commission (IEC), or American National Standards Institute (ANSI) recommendations, and any others who apply National Standards such as VDE, NCF, etc. for the major part of their manufacturing programs.
  - b) Define the most reliable equipment that can meet expected realistic behaviours of the current and future EDC power system.
- 1.3 Tenderers are requested to strictly follow all of the requirements stipulated in this specification. All offers not complying with this request will be rejected.
- 1.4 Alternate proposals accompanied with proper justifications are welcome, but will be considered only after the Basic Proposal has been evaluated as the most favorable proposal.
- 1.5 Proposals will use only the metric measurement system (SI).
- 1.6 Only suppliers that have been prequalified by EDC are eligible to participate.

- 1.7 The guarantee period required by EDC is 5 years. This period begins from the date of Disconnector Commissioning. The Commissioning Date shall occur within a maximum of 6 (six) months after unloading the Disconnector at a Venezuelan port.

For the duration of the Guarantee Period the Supplier will insure at one of the first-class Venezuelan banks unconditional Performance Security to cover 10 % (ten percent ) of FOB Disconnector Price. The banker's fees for such a Performance Security will be entirely paid by the Supplier.

- 1.8 For each Tender, the Particular Technical Specifications are issued by EDC . All of EDC's specific requirements in the Particular Technical Specifications are related with numbering to certain clauses and subclauses of this document.

## **2. SCOPE: Standardized EDC Alternating Current Disconnectors (Isolators) and Earthing Switches**

- 2.1 This specification covers the design, manufacturing, testing, supply and transport, of three phase 72,5 kV and 245 kV disconnectors and earthing switches, where specified, including support insulators, bases and supporting structures, operating mechanism, operating rods, auxiliary switches and interlocks and any other material necessary for correct fixing on foundation and satisfactory operation. The 245 kV disconnectors shall be equipped with motor operating mechanisms as well as manual operating mechanisms. The 72.5 kV disconnectors will be only manually operated. Earthing switches for both types (245 kV and 72.5 kV) will be only manually operated.
- 2.2 It covers Alternating Current Disconnectors and Earth Switches of the following standard values of the highest voltages for equipment, rated current and short- circuit level:
- |         |                |                         |     |
|---------|----------------|-------------------------|-----|
| 72.5 kV | 1250 or 2000 A | 31.5/80 kA or 40/100kA  | 3s. |
| 245 kV  | 1250 or 2000 A | 40 /100 kA or 50/125 kA | 3s. |
- 2.3 It covers alternating current disconnectors and earthing switches characterized by:
- .Long operational life (minimum 25 years)
  - .Low maintenance cost (practically maintenance- free)
  - .High Operational Reliability (more than 99.95%)
  - .Comprehensive accident prevention
  - .Low space requirement
  - .Excellent corrosion protection
  - .Excellent seismic behaviour.

### **3. SERVICE CONDITIONS**

The Disconnectors and all accessories shall be suitable for satisfactory operation under the following climatic conditions:

#### **3.1 Normal Service Conditions**

##### **3.1.1 Altitude**

Up to 1000 m above sea level

##### **3.1.2 Humidity**

The relative humidity design is 90% at 40 C ambient temperature.

#### **3.2 Abnormal Service Conditions**

##### **3.2.1 Ambient temperature**

-Maximum	40° C
-Daily mean over any 24 hours	30° C
-Mean in any year	25° C
-Minimum	0° C

##### **3.2.2 Contamination Grade**

3

Specific leakage distance for insulators 25 mm/kV

##### **3.2.3 Wind Conditions**

The equipment supplied under these specifications shall be capable of withstanding continuous mechanical stresses equivalent to wind speed of 150 km/h and wind pressure of 1100 N/m<sup>2</sup>.



### 3.2.4 Seismic Conditions

Disconnectors according to this specification shall be capable to withstand horizontal earthquake acceleration of at least 0.5 g; for design purposes, 70 percent of above value should be considered for vertical ground acceleration.

### 3.2.5. Voltages of auxiliary supply

DC: 125V ; + 10%; -15%  
AC: 120/208V, 60 Hz, three poles

## **4. RATINGS AND TECHNICAL CHARACTERISTICS**

### **4.1 General**

- 4.1.1 Disconnectors shall be group operated, three pole, single throw with or without earthing switches. The 245 kV disconnectors will be suitable for horizontal mounting. The 72.5 kV disconnectors will be suitable for horizontal and vertical mounting.
- 4.1.2 Disconnectors shall be rotary horizontal, centre break type with vertical insulator columns.
- 4.1.3 Disconnectors for 245 kV shall have a power operated drive mechanism as specified further on in addition to the manual operated one. The 72.5 kV will only have manual drive.
- 4.1.4 No visible or audible corona shall be permitted with disconnectors energized at respective highest voltage for equipment (72,5 kV and 245 kV)

### **4.2 Ratings**

- 4.2.1 The specified ratings and design data of the disconnectors shall be as stipulated in Table 1 hereafter (next page).

#### **4.2.2 Temperature Rise**

The maximum value of temperature of any part of the conductor shall not exceed the values given in table V of IEC publication 129 (1984). The temperature rise shall be reduced by 5K to account increased ambient temperature specified in clause 3.

**TABLE 4.I.****THE SPECIFIED RATING AND DESIGN DATA FOR STANDARDISED ALTERNATING CURRENT DISCONNECTORS**

ITEM	DESIGNATION (Rating and Design Data)	HIGHEST VOLTAGE OF EQUIPMENT (UM)	
		72.5 kV <sub>rms</sub>	245 kV <sub>rms</sub>
1.SWITCHES			
1.1	Number of poles	3	3
1.2	Class	-25°C outdoor	-25°C outdoor
1.3	Rated normal current for service conditions	1250/2000A	1250/2000A
1.4	Rated frequency (+2%/-4%)	60Hz	60Hz
1.5	Rated short time withstand current	31.5kA/40 kA	40kA/50kA
1.6	Rated peak withstand current	80 kA/100kA	100 kA/125 kA
1.7	Rated insulation level		
	1.7.1 -LI to earth, between poles and across open switching device	350kV <sub>peak</sub>	1050kV <sub>peak</sub>
	1.7.2 -LI across isolating distance	375kV <sub>peak</sub>	1200kV <sub>peak</sub>
	1.7.3 -AC to earth,between poles and across isolating device	140kV <sub>rms</sub>	460kV <sub>rms</sub>
	1.7.4 -AC across isolating distance	160kV <sub>rms</sub>	530kV <sub>rms</sub>
1.8	Rated duration of short circuit	3s.	3s.

**2. INSULATORS**

2.1	Specific leakage distance	1812 mm	6125 mm
2.2	Material	Porcelain	Porcelain
2.3	Type	C6	C6

**3. OTHER DISCONNECTOR CHARACTERISTICS**

3.1	Max time required to open or close	N.A.	8s.
3.2	Max.RIV at 1000 kHz and $U_m/\sqrt{3}$	500 microV	500 microV
3.3	Three-phase breaking capacity (inductive, capacitive)	2A	1.5A

## **5. DESIGN AND CONSTRUCTION**

### **5.1 General**

- 5.1.1 For disconnectors and earthing switches the material and workmanship shall be of best quality and in accordance with modern practices. The design shall be such that replacement and general maintenance may be undertaken with a minimum of time and expenses. The equipment shall be designed for continuous operation at full rated capacity. Liberal factors of safety shall be used throughout the design.
- 5.1.2 The disconnectors shall remain alive and in continuous operation for periods of up to two years in the climatic conditions specified in clause 3 and without maintenance.
- 5.1.3 The transmission of motion to the blades shall be via rotating insulators.
- 5.1.4 The base shall be of galvanized steel structure, rigid and self supporting. The disconnectors shall operate satisfactorily with the base mounted on supporting structures.
- 5.1.5 The disconnectors and earthing switches (where applied) shall be arranged for three-phase operation and shall be formed by coupling together the appropriate single pole assemblies with suitable linkage such that all phases operate simultaneously.

### **5.2 Contacts, Blades and Terminals**

- 5.2.1 All disconnectors shall be equipped with adjustable, self clearing, self-aligning high pressure contacts. Bolts ends of all switches and the hinges ends of all grounding blades shall be equipped with clamp-type terminals.
- 5.2.2 The main contacts of disconnecting switches and earthing switch contacts shall be made of silver plated copper.

- 5.2.3 The disconnector contacts shall carry their rated load and short circuit current without over-heating or welding.
- 5.2.4 Corona shields/rings shall be fitted against corona discharges, when necessary.
- 5.2.5 Disconnectors and earthing switches including their operating mechanism shall be so constructed that they cannot come out of their open or closed position by gravity, wind pressure, vibrations, reasonable shocks or accidental touching of the connecting rods of their operation mechanism. Also the design of the contacts shall be such so as to prevent blade opening in the event of short circuit.
- 5.2.6 The three blades shall be suitable for three phase synchronised operation. The blades of switches of disconnectors shall be counter - balanced. All current carrying parts shall be independent of any springs, hinges or moveable pin connections.
- 5.2.7 The blades shall be made of high conductivity copper.

### 5.3 Mechanical Strength

The equipment will be installed in areas subject to possible earthquakes.

Disconnectors shall withstand without damages or maloperation, in case of the combination of the following forces:

- a) Forces produced by the equipment's own weight.
- b) Electromagnetic and mechanical forces produced over full range of equipment's operating capability.
- c) The rated mechanical terminal load not including wind forces on the equipment itself are as follows:

		<b>72.5 kV</b>	<b>245 kV</b>
In longitudinal horizontal direction (N)	/	400	1000
In transversal horizontal direction (N)	/	130	330
In vertical direction	(N) /	150	200

## d) Wind loads

1100 N/m<sup>2</sup> on all cylindrical surfaces.

1500 N/m<sup>2</sup> on all other surfaces acting in the most adverse direction

e) Earthquake induced forces giving rise to horizontal acceleration of 0.5 g acting through the center of mass of the equipment (70 % of this component is design value for vertical acceleration).

f) Individual vibration sensitive components forming part of the equipment must be able to withstand induced loads resulting from periodic vibrations giving an acceleration of 0.2 g over the frequency range of 1 Hz to 15 Hz.

The maximum stress occurring on the equipment when subject to the most onerous combination of the above listed forces a,b,c,d,e and f shall be:

-For porcelain and other brittle materials :

half of the guaranteed minimum failing stress.

-For ductile materials, either:

0.8 times the yield stress of the materials if the earthquake induced stresses are the limitation; or

0.6 times the yield stress of the material if wind induced stresses are the limitation.

## 5.4 Operating Mechanism

### 5.4.1 General requirements

- 5.4.1.1 The disconnectors shall be equipped with a power operated and/or a manual operation mechanisms as specified in clause 2.1.
- 5.4.1.2 The disconnector operating mechanism shall be of robust construction, carefully fitted to ensure free action and shall be unaffected by the climatic conditions specified. Mechanism shall be simple and comprise of a minimum of bearing and wearing parts. The mechanism shall be housed in a waterproof, vermin proof and weatherproof enclosure complete with auxiliary switches, terminals box and cable glands. The mechanism shall be mounted on the base supporting structure and shall affect a smooth and thorough. A thermostatically controlled heater shall be provided in the operating mechanism cubicle.
- 5.4.1.3 In the event of over-torquing of the mechanism, it is required that no part of the main mechanism shall shear and allow auxiliary contacts to operate giving erroneous indications.
- 5.4.1.4 Mechanism shall be so designed that the disconnector cannot be opened by forces due to fault currents and shall be self-locking in both the open and closed positions. The mechanism shall be provided with an indicator showing the direction of rotation during opening and closing operations. It shall also have an indicating device to show whether it (the mechanism) is in the OPEN or CLOSED position.
- 5.4.1.5 The operating mechanism shall be arranged so that the disconnectors and earthing switches can be key-locked in either open or closed positions.
- 5.4.1.6 The mechanism shall be furnished with an operation counter. Provision shall also be made for grounding the operating mechanism.



5.4.1.7 Under the service conditions described in clause 3 the maximum torque required at the operating handle to open a three phase isolator at the end of five years period shall not exceed 45 Kg-meter.

5.4.1.8 The time taken for operating mechanism to complete an opening or closing operation shall not exceed 8 seconds (245 kV equipment).

5.4.1.9 Dead centre interlock shall insure no change of the switching position in case of extreme external influences such as storm, vibration, earthquake, extreme wind pressure, etc...

#### 5.4.2 Manual Operated Mechanism

5.4.2.1 Manual operating mechanism shall be designed for outdoor installation (see EDC service conditions, clause 3 ) and shall be installed in a hot-dip galvanized steel-sheet housing with a door at the front. The degree of protection shall be IP 54. A manual operation device with a crank handle shall be provided. The handles shall be mounted at a convenient height for operation from the ground level. Means shall be provided on each switch for taking up the lost motion in the blade independently.

5.4.2.2 For 245 kV equipment, provision shall be made to facilitate disengagement between power operated mechanism and manual mechanism so that power operating device will not rotate the crankhandle when the manual operation is being performed. If the disconnecter has been opened manually, it shall be possible to close it electrically or vice versa. Further, the auxiliary switches and the limit switches shall continue to function when the equipment is manually operated.

5.4.2.3 The operating handles shall have suitably insulated hand grips, with shields arranged such that operator may use both hands simultaneously.

5.4.2.4 Each operating handle having a length of 1000 mm shall be mounted about 1500 mm above ground level. This length shall limit the force needed to close or open disconnector or earthing switches.

#### 5.4.3 Power Operated Mechanism (245 kV disconnectors)

5.4.3.1 A power operated mechanism shall be required to open or close the disconnector. The mechanism shall be suitable for local as well as remote operation from the control room. The power operating mechanism shall be operated by adequate AC motor. The motor shall be operated in forward reverse direction by mechanically interlocked contactors. The voltage for the operation of mechanism and control shall be 208 volts, 60 Hz, with limits of interlocked manual operating mechanism with handle shall also be provided. In the event of control voltage failure the switching position currently reached shall be maintained (reversing operation can be performed without any problem).

5.4.3.2 The motor shall be protected by suitable thermal over-load relay to provide thermal and stalling protection. The possibility of over travel shall be adjustable for various operationing gear ratios.

5.4.3.3 Mode of Local/Remote operating shall be selected through « Local/ Off /Remote » change over selector switch housed in outdoor control cubicle.

When the change over switches are in the « Local position », it shall not be possible to operate the disconnecting switch from the control desk. When the Local/Remote switch is in the « Remote position », the disconnecting switch cannot be electrically operated locally. When change over switch is in the « OFF-Position » only manual operation of disconnector will be possible.

5.4.3.4 Any opening or closing operation once commenced, shall be completed under the action of seal-in contacts and limit switches.

5.4.3.5 Provision shall be made of locking device preventing unauthorized removal of the cover for manual emergency operation (if manual emergency operation capabilities is provided).

### 5.5 Earthing Switches

5.5.1 The line disconnectors, where required, shall be fitted with earthing switches on all the three phases.

- 5.5.2 The earthing switch blade shall be made of an aluminium tube with contact-fingers made of copper-chrome-alloy.
- 5.5.3 The earthing blades shall be counter balanced. The earthing switches shall match the main switches in design quality and workmanship.
- 5.5.4 A solderless type of copper flexible conductors ( $1 \times 120 \text{ mm}^2$  copper for 72.5 kV and  $2 \times 120 \text{ mm}^2$  for 245 kV) shall be provided on the earthing blade and connected to the grounding terminal.
- 5.5.5 Provision shall be made for padlocking the earthing switch in either grounded or open position.

## 5.6 Interlocks

- 5.6.1 The following interlocks shall be provided to ensure safe operation of the disconnecting switches with their associated circuit breaker and earthing switches:
- 5.6.2 Disconnectors shall be provided with facility for interlocking with the associated circuit breakers and other disconnectors in each circuit to prevent the possibility of making or breaking the load current, when the circuit breaker is in closed position.
- 5.6.3 An interlock between the manual drive of the disconnector and the manual drive of the earthing switches shall be provided (when main disconnector is closed, earthing switches can't close).
- 5.6.4 Cancelled

- 5.6.5 An interlock between the manual and the power operated drive shall be provided such that when the manual operation is being carried out the power operated drive shall not operate.
- 5.6.6 The above interlocking arrangements shall be effective in local as well as remote control operation.
- 5.6.7 An interlock shall be provided to prevent remote/local operation of disconnecting switches when the associated circuit breaker is under maintenance (whether open or close).
- 5.6.8 Interlocking to prevent paralleling of voltage transformers secondaries if two buses are not synchronised through bus coupler shall be provided.
- 5.6.9 The interlocking for the operating mechanism shall be electromechanical consisting of an electromagnetic coil and its armature. The interlocking shall be such that the disconnector operating rod can only be moved when the coil is energized to release its armature.
- 5.6.10 The circuit of the electromagnetic coil shall be completed by an external contact of the relevant circuit breaker and an additional auxiliary switch which shall be actuated by a hand operated spring controlled lever. The arrangement shall be such that the electromagnetic coil shall not remain energized when the breaker is kept open for long periods.
- 5.6.11 The electromagnetic coil with its armatures, terminal block and heater shall all be housed in operating cubicle as described in clause 6 and shall be rigidly fixed to the isolator base.
- 5.6.12 The Supplier shall install at least two spare auxiliary switches leaving them at disposal of EDC.

Provision shall be made in the design for the installation of an additional set of 8 auxiliary switches if required for future development.

## 5.7 Bearings

- 5.7.1 Bearings at the base (pedestals) and top end shall ensure smooth rotation of the disconnectors. All bearing shall be contained in the weatherproof housing providing ability for maximum axial and lateral loading with minimum friction. The bearings shall require no maintenance or lubrication (permanent lubrication- maintenance free). Either ball bearing or roller bearings shall be used.

## 5.8 Auxiliary contacts and equipment

- 5.8.1 For signaling of disconnector and earthing switch position two separate sets of auxiliary switches shall be provided each comprising of at least eight normally open and eight normally closed contacts, these shall be capable of carrying a current of at least 16 Amperes and shall be housed in the outdoor control cabinet as described in clause 6.
- 5.8.2 Signaling of the closed position shall not take place unless it is certain that the moveable contacts will reach a position in which the rated normal current, the peak withstand and the short-time withstand current can be carried safely.
- 5.8.3 Signaling of the open position shall not take place unless the moving contacts have reached a position such that the clearance between contacts is at least 80 percent of the isolating distance.
- 5.8.4 A common signalling device for all the poles of disconnector or earthing switch shall be arranged in such a way that the signal is given only, in the case of all poles of the disconnecting or earthing switch are having a position in accordance with clause 5.8.2 and 5.8.3
- 5.8.5 The auxiliary switches shall be positively driven in both directions.

- 5.8.6 The insulating materials of auxiliary switches and terminals of auxiliary circuit which are to be used under outdoor conditions shall be ceramics or other non-hygroscopic materials.

## 5.9 Terminal Heads

The terminal heads shall be vertical 125 mm in length and 60 mm in dia. They shall be silver plated or tin plated copper.

## 5.10 Earthing terminals

Two number earthing terminals of diagonally opposite positions shall be provided . Each terminal shall be capable of carrying full short-circuit current and suitable for accommodating 1x95 mm<sup>2</sup> or 1x120 mm<sup>2</sup> copper earthing lead. The frame of each disconnector and earthing switch shall be provided with earthing terminals marked with an adequate symbol.

## 5.11 Galvanizing

All steel and malleable iron parts shall be hot dipped galvanized in accordance with BS 729 (1971) « Hot dip galvanized coatings on iron and steel articles » or similar standards.

Hot dip galvanized of metal including the threads, bolts and screwed rods , shall be carried out after all machining, bending, cutting, drilling, punching, marking, and welding operations have been completed.

Nuts shall be tapped up to 0.5 mm. over-size after galvanizing and the threads should be lubricated by a water resisting rust inhibiting oil.

## 5.12 Painting

The painting of surface to be painted shall commence within a short time of the completion of the surface preparation . A priming coat of pointing containing a rust inhibitor shall be applied to the exterior surfaces followed by an undercoat and a finishing coat. The painting system used shall gave a minimum total dry thickness of 0.15 mm. with no porosity. The finishing coat shall be highly resistant to oil or weathering.

The Manufacturer shall furnish the painting method he intends to adopt for approval of EDC. In particular he shall specify the nominal value of the thickness of each coat.

Painting shall be completed before the routine tests. Finished painted surface shall be properly protected against possible damage during transportation and erection. Manufacturer should supply a sufficient quantity of touch-up paint.

### 5.13 Anticorrosion Precautions

Equipments shall be constructed with such materials and be finished in such a way that corrosion is minimized.

The following precautions must be taken:

- Current carrying parts shall be made from non-ferrous metal.

- All surfaces shall be self-draining wherever practicable and all air filled enclosures, such as terminal boxes, shall have an insect-proof drain hole.

- Materials and combination of materials used in the construction of the equipment shall be selected and arranged to prevent galvanic corrosion.

- Aluminium and Aluminium alloys, whether used for current carrying or structural purposes, shall be corrosion resistant, even in salt atmosphere.

- Ferrous parts shall be either hot dip galvanized or painted.

The Anticorrosion Precautions and Quality Control Chart shall be submitted by Manufacturer for EDC approval.

### 5.14 Gaskets

The gasket material used by Manufacturer shall be clearly indicated in the Bid. This material is subject to EDC approval.

### **5.15 Bases and supporting structure**

Each single pole assembly shall be supplied mounted on a separate base suitable for attachment to the supporting structure. The base should be sufficiently rigid to prevent flexing during the operation of the disconnector.

Additional cross bracing spacers shall be provided if necessary, between adjacent bases of each 3-phase assembly to prevent relative movement between them.

The design of the base shall discourage birds from nesting therein. Supporting structure shall be tubular or lattice type.

All bases shall be made of galvanized steel and shall be identically drilled for attachment to the supporting structure.



## **6. OUTDOOR CONTROL CUBICLE**

Metal-clad operating cubicles of suitable size shall be provided to house the disconnector operating mechanism, auxiliary switches, control apparatus, control cables terminations and other necessary mechanical and electrical control apparatus and auxiliary equipment.

### **6.1 Construction Requirements**

- 6.1.1 The cubicles shall be self supporting, vermin proof, dust proof and weather proof. Suitable door gaskets made of rubber shall be provided to prevent the ingress of moisture, etc.
- 6.1.2 Cubicles shall be made of galvanized steel sheet of 3 mm minimum thickness and shall be of rigid construction and shall include any supporting steel work necessary for mounting on the disconnector supporting structure. Access to all compartments shall be provided by hinged doors. Bolts or carriage keys shall not be used to secure the panel or door and provision shall be made for pad locking. Openings in the base of cubicles shall have minimum dimensions of 20 x 20 cm for incoming cables and entrance shall be accomplished using glands with Neoprene gaskets to fix and seal the cubicle.
- 6.1.3 Cubicles shall be well ventilated through vermin proof louvres comprising a brassgauze screen attached to a frame and secured to the inside of the cubicle.
- 6.1.4 Access doors or panels shall be glazed where necessary to enable instruments to be viewed without opening the cubicle. Arrangement of equipment within the cubicle shall be such that access for maintenance or removal of any item shall be possible with the minimum disturbance.

- 6.1.5 An anti-condensation heater of 120 VAC single phase , 60 Hz , shall be provided within the cubicles and controlled by a thermostat along with a single pole switch for heater supply. In addition cubicle shall be provided with 208 V, 10 A, single phase three pin socket outlet of weatherproof pattern and fuses for this circuit shall be mounted within the cubicle.

Means for the interior lighting shall be provided within each cubicle assembly. Lamps shall be 120 V AC with Edison base and shall be automatically lighted when the door is opened.

- 6.1.6 A copper ground busbar 6 mm x 50 mm shall be provided at the bottom of the cubicle for earthing. In addition one earthing terminal for accommodating earth conductor of 95 mm<sup>2</sup> or 1 x 120 mm<sup>2</sup> shall also be provided.
- 6.1.7 An approved schematic diagram of the parts of the control system local to the disconnector identifying the various components within the cubicle and referring to the appropriate drawings and erection instructions shall be fixed to the inside of the cubicle access door. The diagram shall be marked on durable non-fading material suitable for the specified climatic conditions.
- 6.1.8 All incoming auxiliary supply cables shall be terminated directly into switch fuse isolators without intermediate terminals and provision shall be made for looping these supplies into similar cubicles in the switchyard.

## 6.2. Wiring

- 6.2.1 The wiring shall be such that individual components of the applicable control circuits shall be electrically grouped and terminated in physically separate groups.
- 6.2.2 The terminals of the control circuit components specified in clause 6.2.1 and the heater circuits shall be readily accessible, closely grouped, and conveniently arranged for making connections between control circuits group and for external wiring.

- 6.2.3 Wiring between devices and terminal blocks shall be carried in trough or in neatly formed packs which shall be tied or otherwise secured at frequent intervals to prevent undue stresses on equipment or connections. Connections across portions which are hinged or otherwise movable shall be made with flexible wire, formed to distribute the bending motion. No connections shall be made with wire smaller than  $2.5 \text{ mm}^2$ . Ends of each wire shall be identified by a ferrule or plastic label securely attached to the conductor with no possibility of detachment under normal handling. Stacking of more than two wires on terminals will not be permitted.
- 6.2.4 No wires shall be tied or joined between terminal points. Electrical wiring and instruments shall be so located that leakage of water cannot effect them.
- 6.2.5 Where ever possible internal wiring shall be looped from connection to connection and checking relays and indication lamps shall be wired in such a manner that discontinuity of the loop or sub-loop will be indicated.
- 6.2.6 All metallic cases of instruments, control apparatus etc. mounted on cubicles ,shall be provided with an accessible copper tail to facilitate connection by means of bare copper conductors of not less than  $2.5 \text{ mm}^2$  section to the nearest earth bar.
- 6.2.7 The cable shall have an insulation degree not lower than three (tested at 2 kV against ground) and shall be resistant to flame propagation.
- Extra flexible cable shall be used for connections to equipment on hinged frames.
  - Fuses shall be provided in incoming power supplies to the panel.
  - The external connections shall be laid in conduits.
- Cables shall be colored as follows: Red, Yellow, Blue (ac phase connections), Black- (ac neutral connection); green- (ground connections); Grey- (dc circuits).

#### 6.2.8 Circuit insulation level shall be as follows:

- AC 2 kV r.m.s.
- LI 5 kV peak

### 6.3. Terminal Blocks

Terminal blocks shall be of modular type, mounted at an easily accessible position approximately 30 cm from the base and shall be equipped with barriers, terminals strips and colour coded strips. Furthermore, terminal blocks shall be made off material which is self extinguishing or resistant to flame propagation and mounted on spring retained, metal guides shall be earhted.

The AC,DC circuits shall be physically segregated in groups. The AC 120/208 Volts circuit terminals will be fitted with non inflammable, transparent plastic covers to prevent accidental contact with live parts. Each incoming and outgoing conductor shall be connected to an individual terminals.

Each terminal block shall have an individual marking strip which shall be engraved with the circuit disignations of the terminal which shall also be shown on the wiring diagrams. One spare marking strip shall be provided for each terminal block. Approximately 25 percent extra terminals shall be provided on each block for terminating spare conductors and for future changes. In case of hinged panels matching terminal blocks shall be provided on both sides of the hinged section.

Adjacent rows of terminal blocks shall be spaced at least 15 cm from each other. Each terminal block shall be mounted to give an easy access to terminations and to enable ferrule numbers and labels to be read without difficulty.

- DC supply    +10%
- 15%
- AC supply     $\pm 10\%$

## **7. NAME PLATE**

Disconnectors shall be provided with name plate, which shall be mounted in a visible position. If a disconnector or earthing switch consists of several independent poles, each pole shall be provided with a name plate for combined operating device and disconnector. It may be sufficient to use only one combined name plate for both parts. The entries on the name plate shall be indelibly marked and shall include the following data:

- a) Manufacturer's name
- b) Designation and Type
- c) Serial Number
- d) Year of Manufacture
- e) Rated Voltage
- f) Rated Frequency
- g) Rated lightning impulse withstand voltage (LIWV)
- h) Rated power frequency withstand voltage (ACWC)
- i) Rated normal current
- j) Rated short-time (three seconds) withstand current
- k) Rated auxiliary voltage
- l) Rated mechanical terminal load
- m) Total weight in Kg.

The plate shall be made of stainless steel or other approved incorrodible metal and fixed by stainless steel screws. All inscriptions shall be in Spanish.

## **8. TESTS**

### **8.1. Tests on Components**

- 8.1.1 Before being fitted on equipment, all components shall be subject to routine tests at the supplier's or subsupplier's factory, provided by the relevant standards.

A detailed test report proving the successful passing of such tests shall be provided.

### **8.2 Tests on Insulators**

- 8.2.1 The tests on insulators shall be carried out in accordance with IEC 168 (1988) « Test in indoor and outdoor post insulators of ceramic material or glass systems with nominal voltages greater than 1000 V » or adequate to other standards.

#### **8.2.2 Type test**

To be carried out on one insulator of every switch and type to be supplied, before beginning sample and routine tests:

Dry lightning impulse withstand voltage test.

Wet power frequency withstand voltage test.

Test for mechanical strength.

Test for deflection under load.

#### **8.2.3 Sample Tests for each type of insulator**

The number to be tested shall be in accordance with table in Clause 23 Section 4 of IEC 168 (however it shall not be less than two).

The following tests shall be made:

a) Check of dimensions:

- b) Temperature cycle test.
- c) Porosity test.
- d) Galvanizing test.
- e) Mechanical strength tests.

The tests a), b), and d) shall be made on each insulator, and tests c) and e) on one insulator.

#### 8.2.4 Routine Tests

These shall be carried out on all insulators.

- Visual examination.
- Mechanical routine test.

### 8.3. Disconnectors and Grounding Switches

The tests shall be carried out in accordance with IEC 129 (1984) « Alternating current disconnectors and earthing switches » or adequate other standards.

#### 8.3.1 Type Tests

The tests shall be carried out on one unit of each type of disconnector and grounding switch, before beginning the routine test. The following tests shall be made:

- a) Test to verify the insulation level, including withstand tests at power-frequency voltage on auxiliary equipment.
- b) Test of Temperature Rise (disconnectors only).
- c) Test to prove the capability of disconnectors and earthing switches to carry the rated peak withstand current and the rated short-time withstand current.

- d) Tests to prove satisfactory operation and mechanical endurance.
- e) Test to prove satisfactory operation at maximum air temperature.
- f) Test on insulators.
- g) Measurement of radio interference level.
- h) Test of painted and galvanized surfaces.

The test of painted and galvanized surfaces shall be made in the following manner:

### 8.3.2 Painted Surfaces

The tests shall be carried out by checking both thickness and adhesion of the films.

The paint thickness shall be measured in five points of the painted surfaces chosen at random and performed by employing a « Paint Inspection Guide ». The mean values of each coat shall not be lower than the nominal value declared by the supplier. No value of total film thickness shall be lower than the value specified by Manufacturer.

Film adhesion shall be verified by the cross-cut method according to DIN Standard 53151-1970 or adequate standard.

The test shall be made in five points chosen at random on the painted surfaces, the degree of alteration shall not be higher than GT1.

### 8.3.3 Galvanized Surfaces

The tests shall be carried out in accordance with BS 729 (1971) » Hot dip galvanized coatings on iron and steel articles » or adequate standard.



### 8.3.4 Routine Tests

The tests shall be carried out on 20 percent of the supply-minimum two of each type of disconnector and grounding switch (except the test of painting which shall be made on all disconnectors and grounding switches).

The following tests shall be made:

- Power frequency voltage dry tests of the main circuit.
- Voltage test on control and auxiliary circuit.
- Measurement of the resistance of the main circuit.
- Mechanical operating tests.
- Painted and galvanized surfaces tests.

The tests may be carried out on disconnectors and grounding switches using a jig without insulators that represents the appropriate switch configuration.

The jig shall have approximately the same stiffness as the insulators that will be used in service.

## **9. CRITERIA FOR THE ACCEPTANCE OF DISCONNECTORS AND EARTHING SWITCHES**

### **9.1. Tests on Components**

All routine tests shall have a positive result within the tolerances where applicable.

The negative result of one test shall not imply the rejection of the supply but only of the failing component , unless the Contractor is in a position to remedy the mentioned failure in a reasonable time.

### **9.2. Type Tests**

If any of the Type Test has shown a negative result EDC may consider to accept the repetition of the tests if the Manufacturer proposes to modify within a reasonable period of time the design of disconnector or grounding switch and to repeat , at manufacturer's expenses, all type tests.

### **9.3. Routine Tests**

All routine tests shall give a positive result within the tolerances where applicable.

If the negative result of a test is harmful to the operation of the disconnector or grounding switch, each unsound disconnector or grounding switch shall be replaced or repaired entirely at the expense of the Contractor.

## **10. DRAWINGS AND DESCRIPTIVE DATA**

### **10.1. Drawings and data to be submitted with the tender**

- 10.1.1 The information listed in clause 11 « Schedule of Technical Data » shall be supplied with the Tender , duly filled in.
- 10.1.2 Descriptive data, literature, drawings and photographs fully describing the characteristics and constructional features of the disconnectors and earthing swithes, to enable the EDC to evaluate the quality and service performance of the equipment. This shall specifically cover all the requisite details regarding the current carrying parts, with contacts and terminal heads, along with necessary drawings. A complete component list shall also be furnished indicating the position of each component duly cross referenced with the drawings, along with material used and quantity.
- 10.1.3 Detailed literature and dimensional drawings fully describing the working of the operating mechanisms. The literature shall also describe the interlocking features incorporated therein along with the following drawings and diagrams:
- a) Main diagram illustrating the electrical interlocking between the disconnector and the circuit breaker.
  - b) Drawing illustrating the mechanical interlocking between the line disconnector and earthing switch.
  - c) Drawing illustrating the interlocking arrangement between manually and power operated drive mechanism.
- 10.1.4 A set of drawings illustrating the general layout and outline dimensions of the disconnectors and earthing switches, in fully arranged and erected condition, demonstrating open as well closed position, and details necessary for the design of foundation. The details of termial bolt for high voltage connection and earthing terminals shall also be included.

10.1.5 Schematics and wiring diagrams illustrating the power and control circuits of power operating mechanism.

10.1.6 Large scale drawings along with a list of components indicating description, material used and quantity per pole of the following components:

Note: The position of each component/accessory shall be duly cross referenced with the relevant drawing.

- a) Rotating contact
- b) Main blade
- c) Earthing switch
- d) Rotating shaft indicating basic construction alongwith joining clamps
- e) Stationary contact member
- f) Power operated/hand operated driving mechanism for main blades as well as earthing switch.

10.1.7 Descriptive literature and drawing giving type, design and material of main bearing.

10.1.8 Drawing and schematic arrangement of terminals

10.1.9 Schematic showing arrangement of common signalling for disconnector switches and earthing switches.

10.1.10 Description of the means provided on each disconnecting switch and earthing switch for taking up the lost motion in the operating mechanism and for adjusting the travel of each blade independently.

10.1.11 Outline drawing of the control cubicle.

10.1.12 Booklet describing the maintenance measures to be taken under normal service conditions. The manufacturer shall specify the number of operations after which different parts of the disconnector and earthing switch shall be subjected to maintenance.

- 10.1.13Erection manuals describing the assembly, mounting and adjustment instructions.
- 10.1.14Details regarding replacement of parts which are subject to deterioration such as contacts etc.
- 10.1.15Necessary dimensions, weights and dynamic forces for the design of the foundation.
- 10.1.16Type and routine test reports in respect of similar disconnectors and earthing switches.
- 10.1.17Type and routine test reports of post insulators.
- 10.1.18Recommended list of spare parts and special tools.
- 10.1.19A list of contracts placed and deliveries made for the disconnectors offered against this Tender. The list shall also indicate quantity, the year when the deliveries were made along with the name and full address of the Agency to whom supplies were made.

## 10.2. Approval Drawings

The following approval drawings shall be submitted by the Contractor and get approval from EDC prior to manufacture.

-Drawings showing the outline dimensions of the disconnectors in physically erected condition demonstrating open as well as closed positions alongwith a cross referenced list of various parts. The drawings shall indicate main ratings of the disconnector as well as dynamic forces. They shall also include details of terminal bolt and terminals for earthing.

-Drawing showing the detail and locations of operating mechanism, auxiliary switch boxes and all accessories, etc.

-Drawings showing the mechanical and electrical interlocking.

- Schematic and wiring diagrams of power operated mechanisms.
- Large scale drawings alongwith a list of components in respect of items mentioned in clause 10.1.6 above.
- Necessary dimensions, weights and dynamic forces for the design of the foundation.
- Schematic and terminal arrangement drawing for the auxiliary switches.
- Schematic showing arrangement of common signalling for disconnector switches and earthing switches.
- Rating plate drawing.
- Drawing illustrating the out-door control cubicle details



- 11a) Across the isolation distance kV peak-----
- 
- 11b) To earth and between poles and across  
open switching device Kv rms-----
- 12) N.A.
- 13) Max RIV at 1 Mhz with disconnector  
energized at  $U_m/1.73$  to ground. Microvolt-----
- 14) Capacitive and inductive current  
breaking capacity A-----
- 15) Rated short-time withstand current :
- a) 3 sec kA-----
- a) 1 sec kA-----
- 16) Rated peak withstand current kA-----
- 17) Rated short circuit making current  
(for earthing switches only) kA-----
- 18) Insulators
- 18a) Type -----
- 18b) Manufacturer -----
- 18c) No. of units per stack -----
- 18d) Power frequency withstand voltage
- Dry 1 min. kVrms-----
- Wet 10 sec. kV rms-----
- 18e) Impulse withstand voltage kV peak-----
- 18f) Maximum RIV at 1 MHz  
( $U_m/\sqrt{3}$ ) Microvolt-----
- 18g) Specific leakage distance mm-----



18h)Ultimate strength at the top of insulator stack:

-Cantilever	N-----	-----
-Tension	N-----	-----
-Torsion	N.m-----	-----
-Compression	N-----	-----

18i)Maximum cantilever load on any isolator at point of contact resulting from operation

N-----

18j)Bolt circle diameter

mm-----

18k)Diameter of each hole

mm-----

18l)Material

-----

18m)Colour

-----

19 )Minimum clearances in air:

19a)Between poles

mm-----

19b)To earth

mm-----

19c)For isolating distance

mm-----

20)Main Contacts Data

20a)Normal contact pressure in fully closed position

N-----

20b)Maximum wiping contact pressure

N-----

20c)Facing material of contacts

-----

21)Operating Mechanism

21a)Type of operating mechanism:

-For Disconnector

-----

-For Earthing Switch

-----

21b) Rated supply voltage of the operating

mechanism V-----

21c) Current required by motor at rated

supply voltage to operate the isolator:

-Starting A-----

-Running A-----

-Stalled A-----

21d) Maximum torque of operating motor Nm-----

-

21e) Power required by:

-Motor W-----

-Heater W-----

21f) Rated voltage of heater V-----

21g) Output shaft's angle of rotation V-----

21h) Maximum operating time for:

-Opening Sec-----

--Closing Sec-----

21i) Interlocking Coil:

-Voltage rating V-----

-Consumption W-----

21j) No. of operations permitted between

two maintenances -----

21k) Maximum torque for manual operation Nm-----

22) Operating Rod

22a) Diameter mm-----

22b) Length mm-----

22c) Weight Kg-----

## 23)Terminals (also attach drawing)

23a)Material -----

## 23b)Type of terminals of the main circuit

(flat or round) -----

23c)Size of terminals                      mmxmmxmm-----

## 24)Auxiliary Switches

24a)Type -----

## 24b)For disconnector:No. of contacts

N.O. contacts -----

N.C. contacts -----

Reversible contacts -----

Adjustable contacts -----

## 24c)For earthing switch: -----

Number of N.O.contacts -----

-Number of N.C.contacts -----

24d)Voltage rating                      V-----

24e)Continuous current rating                      A-----

24f)Breaking current rating                      A-----

24g)Contact material -----

25)Wind load (design value)                      N/mm<sup>2</sup>-----

## 26)Mechanical Terminals load:

26a)Straight load                      N-----

26b)Cross load                      N-----

## 27)Cross section of copper connection

between the rotation shaft and the frame

of earthing switch                      mm<sup>2</sup>-----

28) Mass of complete disconnector

28a) With earthing switch Kg-----

28b) Without earthing switch Kg-----

29) Mass of Operating Mechanism Kg-----

30) Maximum Shipping weight Kg-----

31) Dimensions:

31a) Phase to phase spacing

-With arcing horns (if any) mm-----

-Without arcing horns mm-----

31b) Isolating distance mm-----

31c) Total height above base channel mm-----

31d) Approximate dimension in open position (attach drawing):

-Overall height mm-----

-Overall length mm-----

-Overall width mm-----

31e) Approximate dimensions in

closed position (attach drawing) mm-----

31f) Maximum shipping dimensions mmxmmxmm-----

## **12. SPARE PARTS**

### **12.1 General Conditions**

- 12.1.1 The requirements of spare parts are as listed in clause 12.5 and shall be delivered alongwith the first consignment of the Disconnectors.
- 12.1.2 All spare parts shall be new, unused and strictly interchangeable with the parts by which they are intended to be replaced, and shall strictly conform to the relevant specifications.
- 12.1.3 The Tenderer shall attach to this list:
- A list with the prices of the supplementary spare parts, which he deems necessary to stock.
  - A list with prices of the spare parts necessary when alternatives are offered, while preparing the list of the supplementary spare parts, the Tenderer shall keep the contents of clause 12.5. in view.

### **12.2. Estimation of requirements**

- 12.2.1 The list of the spare parts has been prepared keeping in view the following concepts:
- Replacement required in due course of time due to wear and tear of the requirement under normal working conditions.
  - Replacement required due to accidents, malfunctioning of the equipment or any other emergencies.
  - Replacement of the great sensitive parts such as gaskets, due to severe service conditions.

### 12.3. Spare parts book

12.3.1 For each separate piece of equipment the manufacturer shall give a spare parts book. This spare parts book shall contain an assembly drawing of the equipment which shall show all parts of the equipment separately marked, designated and referenced. The book shall also contain sketches of each part with the part number and the designation of the part.

The material of the part shall also be indicated. The sketches and lists of parts shall be cross-indexed with the assembly drawings. The spare parts book shall present information in a simple manner so that non-technical personnel may be able to indent these spare parts. The lists of spare parts required shall be made with reference to the spare parts book.

### 12.4. Packing

12.4.1 The spare parts shall be treated and packed for long storage under the service conditions specified in clause 3 . Each spare part shall be clearly marked or labelled on the outside of its packing with its description and purpose, and, when more than one spare part is packed in a single case or container, a general description of its contents shall be shown on the outside of container, and a detailed list enclosed. All cases, containers or other packages shall be marked and numbered in an approved manner for purposes of identification.

12.4.2 All cases, containers or other packages are liable to be opened for examination and packings shall be designed to facilitate opening and thereafter repacking.

**12.5 . List of spares (optional)**

The following spare parts as applicable shall be required for each group of 20 Disconnectors of same characteristics and ratings.

---

No	Description	Quantity
<hr/>		
1.	3-phase set of male and female contacts for disconnectors	1 set
2.	3-phase set of male and female contacts for earthing switches	1 set
3.	Motor operated mechanism complete (245 kV)	1 set
4.	Pedestal insulators	3 units
5.	Auxiliary switches for earthing switches	1 set
6 .	Auxiliary switches for disconnectors	1 set
7.	Motor of each type used	1 unit
8.	Heater	1 set
9.	Limit switches	1 set
10.	Thermal Relay	1 unit
11.	Contractor and fuses of each type used	1 set
12.	Resistor, diodes and switches	1 set
13.	Motor clutch	1 unit
14.	Motor brake	1 unit

---

**12.6. Instruction Manual**

One copy of Instruction Manual, in Spanish language, for erection, commissioning, operation and maintenance enclosed in thick polythene bag, shall be placed in the main casing of each Disconnector. An identification tag to this effect shall be provided outside the crate.

### **13. SPECIAL TOOLS**

Special tools shall be supplied which shall be required for the purpose of maintenance of disconnectors and earthing switches. A complete list of such tools shall be provided by tenderers.



## **14. INSTALLATION**

Disconnecting and grounding switches shall be assembled, installed on structures and connected as shown on the Drawings. Prior to assembling, the EDC will inspect each switch for possible damage during shipment or transport.

Assembly shall be performed as described in Manufacturer's instruction book and under the supervision of Manufacturer's erecting engineers.

The Contractor shall furnish all bolts, nuts, wedge washers, lock washers and other materials required for installation. Switches shall be so installed that contacts will be properly aligned and connecting rods and shafts will not bind, to permit operation by one man. Structures shall be connected to grounding systems.

Operating mechanism for motor operated disconnectors shall be installed and tested in accordance with Manufacturer's instructions or as directed by EDC.

Disconnecting and grounding switches shall be shop painted and, after installation, the Contractor shall repair all damaged painted surfaces as directed by EDC.

## **15. COMMISSIONING**

After erection and before putting switches into service the following checks and measurements shall be made on each switch:

- a) Verification of operating settings lock-out relays;
- b) Verification of discrepancy between single phase units;
- c) Verification of conformity between main and auxiliary contract;
- d) Verification of operating time of auxiliary contacts;
- e) Power requirements by motor;
- f) Voltage tests on control and auxiliary circuits. Power frequency voltage 2000 V r.m.s. value shall be applied for one minute;
- g) Measurement of the resistances of the main circuit. The resistance measured in the closed position shall not exceed 1.2  $R_u$  where  $R_u$  is the resistance measured during the corresponding type test;
- h) Mechanical operating tests. The number of mechanical operating cycle prescribed for routine tests shall be made with same procedures;
- i) All other checks prescribed by Manufacturer.

## **16. SPACING AND CLEARANCES**

Table 16-1: Minimum spacings and clearances requested by EDC for different operational voltage levels.

Table 16-1 MINIMUM SPACING AND CLEARANCES (mm)

ITEM	DIMENSION	72.5KV	245KV
1.	Spacing between adjacent poles (centerline to centerline) (mm)	1800	4000
2.	Minimum net air clearance phase in open and closed position (mm)	1200	2500