

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

DIG

00108-C2

Specification to

ALTERNATING CURRENT CIRCUIT BREAKERS

Substation type: 72,5 kV

0. FOREWORD

This specification has been approved by the competent authorities from Electricidad de Caracas (EDC) on August 02, 1999 for the procurement of 72,5 kV circuit breakers assigned to work at 69 kV EDC Networks.

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

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1. BASIC PRINCIPLES

- 1.1 The continued advancement of circuit breakers 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 Bidding (ICB) 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 all 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 behaviors 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 pre qualified by EDC eligible to participate.
- 1.7 The guarantee period required by EDC is 5 years. This period begins from the date of Circuit Breaker commissioning. The

Commissioning Date shall occur within a maximum of six (06) months after unloading the Circuit Breaker at a Venezuelan port.

For the duration of the Guarantee Period the Supplier will issue at one of the first-class Venezuelan banks an unconditional Performance Security to cover ten percent (10%) of the FOB Circuit Breaker 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 72,5 KV CIRCUIT BREAKERS

- 2.1 This specification describes the 72,5 kV live tank high voltage alternating current circuit breakers, trip free single pressure (Puffer type) sulfur hexafluoride (SF₆) for single pole or 3-pole high speed auto-reclosing operation on effectively grounded systems.

The 72,5 kV circuit breakers shall be three pole outdoor type, complete with all necessary accessories to make a complete operating unit. The three poles of the circuit breakers shall be coupled mechanically with the aim to obtain simultaneous three-phase operation.

- 2.2 The circuit breakers should be provided with only one interrupting chamber per phase.

Each three-phase circuit breaker assembly shall be furnished with one operating device, and with all necessary piping and equipment. All internal wiring will be installed and terminated in the housing as well as necessary means for filtering, drying, heating, controlling and retaining gas, for indicating temperatures, pressures and other necessary parameters and for initiating alarm upon the occurrence of faults. All items shall be arranged for convenient inspection and maintenance. Piping, mechanical operating linkages, electrical conditions, etc., shall include flexible runs to allow thermal expansion.

- 2.3 This specification covers alternating current circuit breakers of the following standard values of highest voltage for equipment (U_m), rated value of assigned current in continuous service and values of rated breaking current (I_C) :

31.5 kA rms/80 kA peak or 40 kA rms/100 kA peak : 3 s.

3. SERVICE CONDITIONS

3.1 Normal Service Conditions

The Circuit Breakers 72.5 standardized by EDC and all accessories shall be suitable for satisfactory operation under the following climatic conditions:

3.1.1 Altitude

Up to 1.000 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

Specific leakage distance for insulators 25 mm/kV

3.2.3 Wind Conditions

AC Circuit Breakers according to this specification shall be capable of withstanding continuous mechanical stresses equivalent to wind speed of 150 km/h, that is equivalent to a wind pressure of 1.100 N/m²

3.2.4 Seismic conditions

AC Circuit Breakers 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.

4. RATINGS

The standard ratings of the circuit breakers shall be as follows:

No.	Characteristics	Requirement
1	Rated voltage (clause 4.1 IEC 694)	72,5 kV
2	Highest voltage for equipment (U_m)	72,5 kV
3	Rated insulation level	-
3.1	LI (to earth, between poles and across open switching devices)	350 kV peak
3.2	AC (to earth, between poles and across open switching devices)	140 kV rms
4	Rated frequency	58-62 Hz
5	Rated current (A)	1250 or 2000
6	Rated short-time withstand current (kA)	31.5 or 40
7	Rated peak withstand current (kA peak)	80 or 100
8	Rated duration of short-circuit	3 s.
9	Percentage DC component	according to fig 9, page 99, IEC 56
10	Rated supply voltage for auxiliary circuits	
10.1	Direct current voltage	120 V
10.2	Alternating current voltage	240/120 V
11	Rated supply frequency of operating devices and auxiliary devices	60 Hz
12	First pole to clear factor (FPC) for terminal faults	1.5
13	Operating sequence(0-0.3s-CO-3min-CO)	Yes
14	Maximum RIV at 1MHz at 5% above U_m	<500 μ V
15	Maximum noise level at 15 m when operated to close or open the three poles simultaneously	<80 dB
16	Rated time quantities: ref: Fig. 2 and Fig 4, pages 92 and 94, IEC 56 (1987)	-
16.1	Maximum opening time	28 ms.
16.2	Maximum break time	50 ms.
16.3	Maximum arcing time	24 ms.
16.4	Maximum closing time	140 ms

16.5	Maximum make time	140 ms
16.6	Maximum pre-arcing time	N.A.
16.7	Maximum reclosing time	350 ms
16.8	Close-open time	60 ms
16.9	Dead time	300 ms.
17	Creepage distance	≥ 25 mm/kV
18	Grading capacitances	<250pf/pole
19	Security factors (in function of rated operational pressure P_n)	
19.1	Porcelain	$\geq 6xP_n$
19.2	Aluminum parts	$\geq 5xP_n$
19.3	Security over pressure device	$\sim 2.5xP_n$

5. DESIGN AND CONSTRUCTION

5.1. General Principals

All material and workmanship throughout shall be of the highest quality, and in accordance with modern practices. The design shall be such that installation, replacement and general maintenance may be carried out with a minimum of time and expense.

5.1.1. The specific duties required of EDC circuit breakers are diverse. Nevertheless, the general applications can be simplified as follow:

a) Passive (still)

-Carrying or rated currents from zero to the extreme values.

-Occasionally withstand lower or higher short-circuit currents without receiving a switching command.

-Retain the insulation level, despite of the influences from within the equipment itself, and by EDC specified service conditions.

b) Active (breaking operation)

-Conduct switching operations induced by the network operator.

-Occasionally switch short-circuit currents (within a few milliseconds) whereby the switching is initiated by the network protection. This can be combined with rapid reclosing.

A life span of 25 years minimum is expected from EDC high voltage power circuit breakers.

5.1.2. The following key points influencing the reliability of 72,5 kV circuit breakers will be evaluated by EDC:

-
- Fulfillment of the technical data, comparison with the requirements, tests.
 - Internal and external high voltage insulation, creepage distances, porcelain shed forms.
 - Effect of environmental conditions.
 - Tightness of the housing, leakage rates, the sealing system.
 - Personal safety.
 - Servicing, checks, maintenance.
 - Life span of the breaking contacts.
 - Operating system, the monitoring components.
 - Monitoring components.
 - Quality control concept.
 - To carry rated current continuously at rated frequency.
 - To interrupt full terminal fault short-circuit current as many times as specified in Table 5.2-1 without derating the previous performance.
 - To fulfill $\sum I^2 t$ (accumulate short-circuit current) values in Table 5.2-1.
 - Minimum distance between live parts and ground.

TABLE 5.2-1
SHORT-CIRCUIT CARRYING CAPACITY

$U_m(\text{kV})$	72,5 kV
Number of full short circuit current interruptions between two inspections of chamber	20
$\Sigma I^2 t (\text{kA}^2\text{s})$	12000

- 5.1.3. The arc interrupting mechanism shall be designed with ample mechanical and electrical safety factors in all its parts. These parts shall consist of a minimum number of assemblies arranged for convenient installation and readily removable for repair or inspection.
- 5.1.4. The insulation of the breaking contacts of the breaker shall not be damaged when switching over voltages are applied across the breaker and the associated shunting devices while all contacts are open.
- 5.1.5. All adjustable external parts of circuit breakers shall be readily accessible with the circuit breakers installed for service.
- 5.1.6. Circuit breakers shall be so constructed that the interval between the instants when the contacts of the individual poles touch or separate shall not exceed 2 ms during a closing or opening operation.
- 5.1.7. It shall be possible to make independent adjustments to each pole of the circuit breaker.
- 5.1.8. To facilitate transport, lifting lugs, jacking pads or other handling devices, capable of supporting each unit when fully erected and ready for service, shall be provided.

5.1.9. The material of the terminals shall be aluminum or bimetallic. Provision for four conductor connectors shall be made so that the breaker can be connected in any configuration to other allied equipment.

5.1.10. No leakage of SF₆ gas shall occur under specified conditions of operation and entry of moisture or other gases shall be effectively restricted. The breaker design shall prevent liquefaction and partial condensation of moisture on the insulating parts of the breaker operating mechanism and SF₆ containers.

Maximum moisture content shall not exceed 100 ppm. Maximum permissible leakage of SF₆ per year shall not exceed 1% of total SF₆ gas volume.

The dew point of SF₆ shall not occur before the critical volume conditions appear.

The Manufacturer shall specify the type and required quantity, quality and density of gas used, and provide EDC with the necessary instructions for renewing the gas and maintaining its required quantity and quality. Gas must comply with the ASTM D2472-75 Standard.

5.1.11. Bolts or nuts which must be loosened or removed when maintaining circuit breakers shall be easily accessible with the proper tools supplied or specified by the manufacturer and they shall be adequately protected from rusting, corrosion and loosening in operation.

5.1.12. All exposed surfaces of frames, tanks, operating mechanisms etc. which would normally be painted when in service, shall be given two previous coats of rust protective paint. All exposed parts of circuit breakers shall be weather-proof.

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- 5.1.13. All moving parts shall be suitably covered and expulsion vents shall be oriented to prevent hazard to personnel or adjacent equipment.
- 5.1.14. A.C. electrical motor with sufficient capacity to operate in local conditions shall be provided..
- 5.1.15. Hydraulic or spring type (helical or spiral) operating mechanism shall be provided
- 5.1.16. The perfect simultaneous operations of all three poles must be ensured by the manufacturer
- 5.1.17. Type of overpressure security device is left for Manufacturer's selection. Its setting shall be approximately 2.5 times higher than SF₆ operating pressure and after releasing of overpressure, device must return to initial position and close access to the circuit breaker.
- 5.1.18. Absorbent will be dimensioned in such a way that its replacement will be needed only when inspection of interior of breaker chamber is required, and at the same time it must keep the contact moisture inside of breaker below 100 ppm after a maximum of 36 hours after refilling.
- 5.1.19 The frame of each pole shall be provided with a reliable grounding terminal having a clamping screw for connection to the grounding conductor. (95-120mm² copper.)

5.2 Local And Remote Control Indication

- 5.2.1 Circuit breakers shall be suitable for operation by electrical means either from the local operating cubicle installed by the Manufacturer or remotely from dispatching center or from the desk in the substation control room.

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- 5.2.2 Multiple, manually operated change-over switch labeled "Remoto" and "Local" shall be provided in each operating cubicle for establishing the point of control.
- 5.2.3 Reliable easily readable, mechanically operated indicator shall be provided on each circuit breaker to show the position of the circuit breaker.
- 5.2.4 The marking of indicator plates shall be "ABIERTO" (green) and "CERRADO" (red).

5.3 Electrical Control Features

Functional Requirements

The basic functional requirement of the control scheme for the circuit breaker shall be as follows:

- 5.3.1 The circuit breaker shall be trip-free
- 5.3.2 The circuit breaker mechanism shall make one complete closing operation including automatic cut off of the closing power after an initiating control device has operated and the first device at the control scheme has responded, even though the contacts of the initiating control device are opened before the circuit breaker closing operation is completed. This shall however not interfere with the trip free behavior of the circuit breaker.
- 5.3.3 The circuit breaker shall incorporate an anti-pump feature. This means one closing operation of the circuit breaker mechanism shall result from each closing operation of a manually operated initializing control device, even though the circuit breaker trips while the initiating control device is being held in the closed position.

The control scheme need not provide another reclosure in the event that control power is removed by casual and entirely random

occurrences, such as the opening of a control circuit to check for grounds, while the initiating control device remains closed.

- 5.3.4 When power is removed from the closing control circuit after or during an incomplete closing operation, all electrically operated devices in the control circuit shall be reset to the normal circuit breaker open position, except for those devices which require a supply of control power in order to assure their normal circuit breaker open position.
- 5.3.5 When the circuit breaker is in a closed position, the closing operation of an initiating control device shall not result in an operation of the circuit breaker closing mechanism.
- 5.3.6 When a closing operation of a circuit breaker cannot be completed successfully because of the absence of an adequate supply of stored energy all actuating devices in the control circuit shall remain in the normal circuit breaker open position when the initiating open device is operated.
- 5.3.7 The SF₆ breaker alarm shall be actuated when the gas pressure drops below the minimum operating pressure and tripping or opening lockout shall subsequently result in the event of gas pressure falling below the minimum value prescribed (CB must remain, locked in position in which pressure failure occurred).
- 5.3.8 Key interlocking. Key interlocking shall be arranged in such a way that removal of the key is not possible unless the circuit breaker is in the open position and that the closure of the breaker is not possible by any means unless the key is in position.

5.4 Auxiliary Circuits

The auxiliaries which shall be provided as part of each circuit breaker assembly are described hereunder:

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- 5.4.1. The auxiliary switches shall be mechanically and directly coupled with each drive of the circuit breaker.
- 5.4.2. The auxiliary switches and circuits shall be required to carry current at least 10A, continuously. The temperature rises shall not exceed the limits specified for corresponding material minus 5K.

Auxiliary switches shall be capable of making and breaking the current of circuit to be controlled. Where auxiliary switches are associated with external equipment, detail should be provided by the Manufacturer. In the absence of such a specification, they shall be capable of making and breaking at least 2A at 120 V DC. with a short-circuit time constant of not less than 20 ms.

- 5.4.3 Extra auxiliary switches, six normally open and six normally closed, in addition to those normally provided as part of the circuit breaker operation and indication functions, shall be provided.
- 5.4.4. Heaters shall be supplied, and a two pole miniature circuit breaker shall be connected in the supply of the heater. The heaters shall be thermostatically controlled.
- 5.4.5. Spring mechanism motor thermal protection shall insure back-up protection against excessive operating of circuit breaker in case of failure of anti-pumping relay.

When coils are connected continuously to one polarity only, that polarity shall be negative.

5.5. Operating Mechanisms

5.5.1 General

- 5.5.1.1 Common (one) operating mechanism for all three poles will be used.

5.5.1.2 Hydraulic, or Spring charged operating mechanisms shall be provided. EDC prefers spring charged type operating mechanism.

5.5.2. Common requirements

5.5.2.1 The following general requirements shall be met by operating mechanisms:

5.5.2.2 The breaker operating mechanism and all breaker accessories shall operate satisfactorily under abnormal supply conditions within the range of voltage given below:

Rated voltage	Control Voltage Variations	Power supply of operating mechanism	Tripping voltage
120 V DC	100-130 V	100-140 V	80-140 V
240/120 V AC	-	±10%	-

5.5.2.3 The closing mechanism shall not prevent or delay the opening of the circuit breaker beyond the standard interrupting time for all ranges of voltages and the energy shall be removed automatically from the closing mechanisms when the closing operation is completed.

5.5.2.4 A conveniently located manual tripping device protected against accidental operation shall be provided.

5.5.2.5 Latches shall be so designed as not to require delicate or frequent adjustments.

5.5.2.6 The circuit breaker shall be so designed and constructed to operate mechanically without replacement of parts due to breakage or excessive wear or adjustments for at least 2000 operations, each consisting of a complete opening and closing of the circuit breaker.

5.5.2.7 The closing mechanism shall be recharged automatically for further operation as soon as the circuit breaker has completed a closing operation. If the closing mechanism is not fully recharged within a pre-determined time, the mechanism shall be locked out and an alarm initiated.

5.5.2.8 Each part of the mechanism shall be of substantial construction, utilizing such material as stainless steel, brass or gunmetal where necessary to prevent sticking due to rust or corrosion. The overall design shall be such as to reduce mechanical shock to a minimum and shall prevent inadvertent operation due to fault current stresses, vibrations or other causes.

A convenient means for applying lubricant shall be provided where required. The Manufacturer shall place labels on the equipment indicating the type of lubricant required.

5.5.2.9 All permanent fixed bolts, nuts and studs shall be securely locked in place to prevent loosening during operation. Blind tapped holes shall be avoided where practicable.

5.5.3. Spring charged mechanism

5.5.3.1 In agreement with sub-clause 5.5.1.2., the requirements for the spring charged mechanisms shall be as described hereunder.

5.5.3.2 The breaker shall be closed by the stored energy of charge springs.

5.5.3.3 The mechanism shall be so designed that the failure of the spring will not prevent tripping and will not cause tripping or closing.

5.5.3.4 The energy stored in motor compressed spring shall be sufficient for an OPEN-CLOSE-OPEN operation at rated short-circuit current.

5.5.3.5 The motor shall not require more than 15 seconds to recharge the closing springs after a close-open operation.

5.5.3.6 Motors and their electrically operated auxiliary equipment for charging a spring, shall operate satisfactorily between 80% and 120% of the rated supply voltage.

5.5.3.7 Means shall be provided to prevent operation of the mechanism when maintenance work is being done.

5.5.3.8 The mechanism shall be so arranged that emergency manual charging and release of the spring is possible without electrical operation (number of turns for handle shall not be higher than 200 and approximate time of manual charging for average operative shall be no more than 2 minutes).

5.6. Outdoor Control Cubicles

5.6.1. Operating cubicle

5.6.1.1 The 72,5 kV breakers shall have only one operating cubicle situated on the central pole at a convenient height from the ground level.

5.6.2. Common requirements

5.6.2.1 The cubicle 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.

5.6.2.2 Cubicle 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 circuit breaker. Access to all compartments shall be provided by hinged doors. Bolts or carriage keys shall not be used to secure the panels or doors. All fastenings shall be integral with the panel or door and provision shall be made for padlocking. Opening in the base of the cubicle shall have minimum dimensions of 30 x 30 cm for incoming cables and

entrance shall be accomplished using glands with neoprene gaskets to fix and seal the cubicle.

5.6.2.3 Cubicle shall be well ventilated through vermin proof louvers comprising a brass gauze screen attached to a frame and secured to the inside of the cubicle. Divisions between compartments within the cubicle shall be perforated to assist air circulation.

5.6.2.4 Access doors and 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.

5.6.2.5 An anti-condensation heater of 120 V AC single phase, 60 Hz, (heaters with exterior resistance wire are not acceptable), shall be provided within the cubicle and controlled by a thermostat along with a single pole thermomagnetical breaker for heater supply. The heater should be protected against accidental touching by maintenance personnel. In addition, the cubicles shall be provided with a 120 V, 10 A single phase socket outlet of outdoor weather proof pattern according to EDC practices Fuses for this circuit shall be provided within each cubicle assembly. Lamps shall be 120 V AC with Edison type base and shall be automatically lighted when the door is open.

5.6.2.6 A copper ground busbar 6 mm x 5 mm shall be provided at the bottom of all the panels for grounding. In addition, on grounding terminal at each panel for accommodating ground conductor 95 to 120 mm² shall be provided.

5.6.2.7 An approved schematic diagram of the part of the control system local to the circuit breaker, identifying the various components within the cubicle and on the circuit breaker and referring to the appropriate drawings and erection instructions shall be affixed to the inside of the cubicle access door. The diagram shall be marked on

durable non-fading material suitable for the specified climatic conditions.

5.6.2.8 All incoming auxiliary supply cables shall be terminated directly into adequate miniature circuit breakers without intermediate terminals, and provision shall be made for looping these supplies into similar cubicles in the switchyard.

5.6.2.9 Mechanical operation counter shall be visible from outside.

5.6.2.10 Antipumping device shall be housed in this cubicle.

5.7. Gas Densimeter

5.7.1 The gas densimeter installed on circuit breaker frame is a temperature-compensated pressure measuring device with 2 sets of electrical contacts wired to terminals in the operating mechanism cabinets. One set of contacts initiates signal 1 notifying "Refill" when gas density is reduces to this point.

If the gas space is not refilled, a further reduction in density conducts to signal setpoint "CLOSE AND BLOCK". In this position trip is blocked.

5.7.2. The gas refill connector is mounted on the densimeter base plate, and set points of signal contacts in the densimeter can be checked using simple accessory "Densimeter testing equipment" without isolating the circuit breaker or dismantling the densimeter.

2 (two) densimeter testing equipment shall be supplied with all orders and should comprise at least a pressure gauge, circuit breaker valve adapter, leak tester and electrical circuit tester.

5.7.3. Adequate pressure gauge shall be fitted in the operating mechanism cabinet behind a transparent window to permit visual checks. One

gauge per pole shall be provided to ensure gas supervision (see Fig. 5.7.3-1).

5.8. Gas Refill Unit

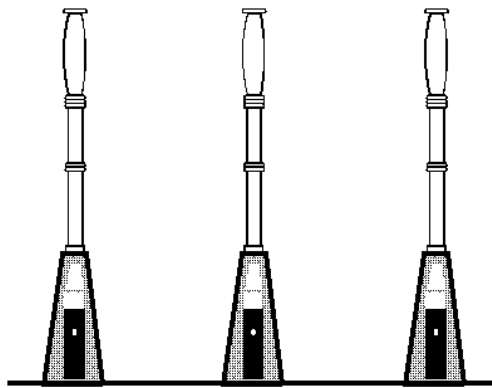
The Manufacturer should supply with each order 1 (one) gas refill unit composed of: pressure gauge, valve adapter, filling tube coupler and safety valve.

The connector for the gas refilling equipment should be located in an easily accessible place of the circuit breaker.

5.9 Checks Of Contacts Condition

The Manufacturer should supply for each lot of 25 (twenty-five) circuit breakers at least one external diagnosis set according to this practice permitting extension of reconditioning intervals (TBTM = Time between two maintenance).

FIG. 5.7.3-1 MONITORING OF GAS AT THE THREE POLES



6. TESTS

6.1 Routine Tests

The routine tests are for the purpose of revealing faults in material or manufacturing. They do not impair the properties and reliability of a test object. These tests shall be carried out on each apparatus manufactured. By agreement, any routine test may be made on site.

The routine tests given in this standard comprise:

- a) Power frequency voltage dry tests of the main circuit.
- b) Power frequency voltage tests on control and auxiliary circuits.
- c) Measurement of the resistance of the main circuit.
- d) Mechanical tests with measurement of characteristic opening and closing times.

6.2 Type Tests

The type tests are for the purpose of proving the characteristics of the circuit breakers, their operating devices and their auxiliary equipment.

The type tests are:

- a) Dielectric tests including lightning impulse tests (Li), power frequency voltage withstand tests, artificial pollution tests, partial discharge tests and power frequency voltage withstand tests on auxiliary and control circuits.
- b) Radio interference voltage (R.I.V.) test.

- c) Temperature-rise tests.
- d) Measurement of resistance of the main circuit.
- e) Short-time withstand current and peak withstand current tests.

All the above tests shall be made in principle on complete circuit breaker (filled with the specified types and quantities of SF₆ at specified pressure), on its operating devices and its auxiliary equipment. Where single pole testing is permitted in certain cases, it is indicated in the relevant clauses.

The results of all type tests shall be recorded in type-test reports containing sufficient data to prove compliance with this specification, and sufficient information shall be included so that the essential parts of the switchgear and control gear tested can be identified.

General information concerning the supporting structure of the switching device or enclosed switchgear, of which device forms an integral part, shall be included in the type-test report.

Information regarding the operating devices employed during the tests shall, where applicable, be recorded in the type-test report.

6.3 Special Test

- a) Noise level test certificate shall be submitted by Tenderers.
- b) Life endurance test certificate shall be submitted by Tenderers.

7. SUPPORT STRUCTURES

Strengthened version of supporting structures provided for high earthquake withstand (including all bolts, washers and nuts) will be furnished by the Supplier.

Materials used and dimension of structure shall correspond to approved seismic design of circuit breakers.

The Manufacturer shall supply for each unit adequate anti-seismic dampers.

8. NAMEPLATES

- 8.1 The 72.5 kV circuit breakers and their operating devices shall be provided with nameplates which contain the necessary information specified in the relevant EDC standards.
- 8.2 The nameplates shall be weather-proof and corrosion-proof.
- 8.3 If the switch gear and control gear consist of several independent poles, each pole shall be provided with a nameplate.
- 8.4 For an operating device combined with a switching device, it may be sufficient to use only one combined nameplate. If the operating device is removable, it shall have a separate nameplate.
- 8.5 72,5 kV circuit breakers shall be provided with nameplates which contain at least the following information:
- Name of Manufacturer.
 - EDC order (number).
 - Type of breaker.
 - Type of operating mechanism.
 - Year of manufacturing.
 - Serial number.
 - Rated voltage.
 - Rated current.

- Rated short-circuit behavior (rated short-time withstand current; rated peak withstand current; rated duration of short-circuit).
- Rated supply voltage of closing and opening devices and of auxiliary circuits.
- Rated operating sequence
- Weight of heaviest transport package gross (with transport components of 3 poles).
- Weight of heaviest installation component, net.
- Rated / maximal / minimal / gas pressure.

9. SCHEDULE OF TECHNICAL DATA

N.B.: Reply to this schedule binds the Tenderers financially and otherwise. In case of non respect of these guaranteed values, the circuit breaker may be rejected.

The following information, as applicable, shall be furnished with the tender for each type of circuit breaker:

No.	General	Units	72,5 kV
01.	Manufacturer's name and address		
02.	Type of circuit breaker		
03.	Type of designation		
04.	Class		
05.	Number of poles		
06.	Suitability of three phase/single	yes/no	
07.	Standard specification to which manufactured with year of publication		
08.	Test report certificates:		
	- Issuing Institute/Authority		
	- Number and date		
09.	Max. ambient temperature for continuous service	°C	
010.	Contamination Grade	-	
011.	Withstand of mechanical stress corresponds to wind speed of	km/h	
012	Seismic conditions (horizontal and vertical)	g	
	Ratings		
1.	Rated voltage	kVrms	
2.	Rated insulation level	kVpeak	
3.	Rated frequency	Hz	
4.	Rated continuous current	A rms	
5.	Rated peak short circuit breaking current	kA peak	

6.	Rated asymmetrical short circuit breaking current	kA	
7.	Rated DC component	%	
8.	Rated symmetrical short-circuit breaking current	kA	
9.	Rated short time current for 1 s	kA	
10.	Rated short time current for 3 s	kA	
11.	Rated making current	kA	
12.	Maximum pole speed from first to last pole to clear	m/s	
13.	Rated operating sequence		
14.	Rated out-of-phase breaking current	kA	
15.	Out-of-phase switching duty at 180° (% of symmetrical)	%	
16.	Line charging breaking capacity		
	a) at normal system voltage		
	- Rated current	A	
	- Over-voltage factor		
	b) at 110% system voltage		
	- Rated current	A	
	- Over-voltage factor		
	c) at 125% normal system voltage		
	- Rated current	A	
	- Over-voltage factor		
17.	Cable charging breaking capacity		
	- Rated current	A	
	- Over-voltage factor		
18.	Small inductive breaking capacity		
	- Rated current	A	
	- Over-voltage factor		
19.	Single capacitor breaking capacity		
	- Rated current	A	
	- Over-voltage factor		
20.	Maximum RIV at 1 MHz at 5% above maximum voltage	μV	
	Performance Data		
21.	Range of control and auxiliary supply voltages		
	a) Control -- Maximum/minimum	V DC	

	b) Operating mechanism max/,min	V DC- AC	
	c) Tripping voltage - max/min	V DC	
22.	Tolerance in operating time	%	
23.	Maximum closing time	ms	
24.	Maximum break time	ms	
25.	Rated make time (from energisation of the closing coil to the instant when the current begins to flow in the main circuit)	ms	
26.	Rated dead time		
	a) Minimum close-open time	ms	
	b) Dead time	ms	
27.	Maximum arcing duration	ms	
28.	Maximum pre-arcing time	ms	
29.	Rated reclosing time (between arc extinction in all poles in the opening operation and first establishment of current in any pole in the subsequent closing operation)	ms	
30.	Maximum opening time (from energisation of trip coil to contact parting)	ms	
31.	Maximum total break time for 0 to 25% of rated breaking capacity	ms	
32.	Maximum total break time for 25 to 100% of capacity	ms	
33.	Range of adjustment for reclosing time	ms	
34.	Maximum time interval between first and last pole for 3-pole operation	ms	
35.	Rated permissible tripping delay	ms	
36.	Additional time for breaking the resistor current, if applicable	ms	
37.	Time from contact touching to contact parting during close-open operation	ms	
38.	Speed of contact travel through arcing zone	m/s	

39.	Total number of possible operations (life time of operating mechanism) if stipulated maintenance is performed	No.	
40.	Number of operations after which maintenance is needed under normal conditions or operation	No.	
41.	Whether breaker suitable for independent pole operation	(yes/no)	
42.	Number of switching operations required for	No.	
	a) Full short circuit capacity (100%)	No.	
	b) Half short circuit capacity	No.	
	c) Quarter short circuit capacity	No.	
	d) Normal rated current capacity	No.	
43.	Permissible loading of breaker terminal		
	a) Horizontal	kN	
	b) Vertical	kN	
	c) Longitudinal	kN	
44.	Insulator column		
	a) Type	-	
	b) Manufacturer	-	
	c) Number of units per column	No.	
	d) Diameter of insulator	mm	
	e) Phase to phase clearance	mm	
	f) Creepage distance phase to phase	mm	
	g) External striking distance		
	- phase to phase	mm	
	- phase to ground	mm	
	h) Ultimate strength of columns		
	- Cantilever	N	
	- Tension	N	
	- Torsion	N.m	
	- Compression	N	
45.	Type of contacts		
	a) Material		
	b) Type or plating		
	c) Thickness of plating material	μm	
	d) Contact pressure	kP	
	e) Dimensions of contact (LxWxH)	mm	

	f) Current density on contacts at rated continuous current	A/mm ²	
46.	Total number of auxiliary contact		
	a) normally open (N.O.)	No.	
	b) normally closed (N.C.)	No.	
47	Number of spare auxiliary contacts		
	a) normally open (N.O.)	No.	
	b) normally closed (N.C.)	No.	
	Number of reversible switches	No.	
	Number of adjustable switches	No.	
48.	Minimum clearance between moving and stationary parts with the circuit breaker in the open position	mm	
	Operating Mechanism		
49.	Type of operating mechanism	-	
50.	Method of opening mechanism	-	
51.	Method of closing mechanism	-	
52.	Charging motor in the operating mechanism		
	a) Rated voltage	V	
	b) Total power consumption	W	
	c) Stalled current	A	
	d) Thermal magnetic protection	(yes/no)	
53.	Number of close-open operations possible with the stored energy	No.	
54.	Heater		
	a) Voltage	V	
	b) Power	W	
	Spring Charge Mechanism		
55.	Time required for the motor to recharge the closing spring	s	
56.	Number and description of safety alarms provided	a) b) c)	
	SF₆ Operation Requirements		
57.	Normal SF ₆ pressure at 20°C	bars	
58.	Normal operating pressure	bars	
59.	Maximum SF ₆ operating pressure	bars	
60.	Minimum SF ₆ operating pressure	bars	

61.	Number of operations for SF ₆ stored at circuit breaker without need of recycling	No.	
62.	SF ₆ pressure monitoring		
	a) Opening of safety valve	bars	
	b) Actuation of low pressure alarm		
	- Stage I	bars	
	- Stage II	bars	
	c) Reclosing lockout	bars	
	d) Closing lockout	bars	
	e) Tripping lockout	bars	
	f) Leakage of SF ₆ gas per year per circuit breaker	m ³ x10 ⁻³ / year	
	Weight, Dimensions And Miscellaneous		
63.	Overall height	mm	
64.	Overall width	mm	
65.	Overall length	mm	
66.	Maximum shipping dimensions of largest item (LxWxH)	mm	
67.	Minimum phase spacing	mm	
68.	Minimum ground clearance	mm	
69.	Minimum creepage distance between live terminals	mm	
70.	Minimum creepage distance between phase to ground	mm	
71.	Creepage distance across capacitors, if applicable	mm	
72.	HV terminal studs (attach drawings)	mm x mm x mm	
73.	Impact vertical loading per pole	kN	
74.	Horizontal loading of operating mechanism	kN	
75.	Impact vertical loading of operating mechanism	kN	
76.	Mass per pole of circuit breaker	kg	
77.	Mass of SF ₆ per pole at atmospheric pressure, where applicable	kg	
78.	Mass of supporting steel structure	kg	

79.	Total mass of complete circuit breaker	kg	
80.	Circuit breaker outline drawing number	-	
81.	Circuit breaker designed for:		
	a) Wind velocity	km/h	
	b) Icing	mm	
	c) Earthquake (horizontal ground acceleration).	g	
82.	Foundation loading		
	a) Load for which the foundation is to be designed (this figure is the sum of weight plus impact expressed in terms of static force)	kN	
	b) Uplift for which the foundation should be designed	kN	
	c) All loads, forces and moments acting at the top of the foundation (including forces due to operation of the equipment)	kN	

10. LIST OF DEVIATIONS FROM EDC SPECIFICATIONS

In this list Tenderers shall indicate all deviations of their design versus EDC requirements and justify these deviations.