



**SPECIFICATION SS -78/3**  
**52KV SF6 OUTDOOR CIRCUIT BREAKERS**

**I. SCOPE**

This hereby specification covers IPTO's requirements with regard the technical characteristics, design features and testing of 52 KV outdoor type, SF6 circuit breakers.

**II. KEYWORDS**

Circuit breakers, SF6 circuit breakers, switching devices.

**III. STANDARDS**

All technical characteristics and testing of the circuit breakers shall be in accordance with IEC -62271 – 100 and IEC -60694 (2.2 edition).

**IV. USE**

The circuit breakers are to be used in IPTO'S extra high voltage substations for switching and fault protection of three – phase, wye connected, 36 KV, 50 MVAR shunt reactors. The shunt reactors are connected to the 30 KV delta tertiary winding of 400/150/30 KV, 280 MVA autotransformers.

**V. ELECTRICAL CHARACTERISTICS OF IPTO's 30 KV SYSTEM**

1. Nominal Voltage	: 30 KV
2. Maximum Operating Voltage	: 36 KV
3. Number of Phases	: 3
4. Number of Conductors	: 3
5. Nominal Frequency	: 50 Hz
6. Short Circuit Level	: 20 KA
7. Basic Insulation Level ( Impulse Level)	: 250 KV

- |   |  |
|---|--|
| 8. Method of Grounding ( earthing )         | : The 30KV system (shunt reactors) is grounded via a voltage transformer of 30 KV/ $\sqrt{3}$ /100/3V ratio. |
| 9. Available d.c. auxiliary supply voltage  | : 220V DC from substation battery  |
| 10. Available a.c. auxiliary supply voltage | : 220/380V AC  |

## **VI. OPERATING CONDITIONS**

- |                                  |                                |
|----------------------------------|--------------------------------|
| 1. Installation                  | : Outdoors                     |
| 2. Limits of ambient temperature | : -25° C,+45° C                |
| 3. Altitude                      | : Up to 1000 m above sea level |
| 4. Pollution level               | : Moderate                     |
| 5. Other climatic conditions     | : Snow, ice and fog            |

## **VII. REQUIRED DESIGN FEATURES OF THE CIRCUIT BREAKER**

### **1. Type of the Circuit Breaker**

SF6, live tank type, outdoor type

### **2. Interrupter technology**

Puffer or self-puffer or self-blast or self - compression or auto-expansion.

### **3. Number of Operating Mechanisms**

One (1) operating mechanism common for the three poles of the breaker and shared breaker base. Each pole shall be connected to the operating mechanism through a mechanical linkage.

### **4. Operating Mode**

Three poles operated suitable for switching and fault protection of shunt reactors.

### **5. Number of Interrupting Units ( chambers)**

One (1) interrupter unit per pole.

## **6. Gas of the breaking chamber**

The breaker shall use sulphur Hexafluoride (SF6) for insulation and arc quenching purposes. The SF6 gas shall be in accordance with IEC-60376 standard.

## **7. Operating Mechanism Characteristics**

- |   |  |
|---|--|
| a. Type   | : stored energy spring type consisting of a cabinet which includes both the driving mechanism unit and the control unit or of a control unit cabinet and a separate operating mechanism cabinet. |
| b. Type of tripping   | : Free trip as per IEC-60050 (441)   |
| c. Auxiliary supply voltages :  |  |
| 1. For the opening and closing circuits                               | : 220 V dc   |
| 2. For all other control and signaling circuits                       | : 220 V dc   |
| 3. Heating and lighting circuits                                      | : 220 V ac   |
| 4. For the motor of the operating mechanism                           | : 220 V dc   |
| 5. Tolerances of the DC supply voltage except for the tripping coil   | : +10, -15%  |
| 6. Tolerance of the dc auxiliary supply voltage for the tripping coil | : +10, -30%  |

## **8. Structure of the Circuit breaker**

The breaker shall consist basically of three (3) poles, one operating mechanism, supports and connecting rod. Each pole shall consist of a hollow insulating column (support column) and on top of it shall be located the interrupting unit housed inside an insulator.

## **9. Circuit breaker's control and operating mechanism cabinet**

The circuit breaker shall be equipped with a control and operating mechanism hot-dip galvanized cabinet of class protection of IP55 as per IEC-60144 which shall be located near the base of the circuit breaker's frame and which shall contain at least the following:

- a. The cabinet shall be equipped with anti-condensation heaters controlled via thermostat.
- b. The cabinet shall be equipped with a position indicator which will clearly indicate the open and close position of the circuit breaker in accordance with IEC-60694.
- c. The cabinet shall be equipped with an operations counter which shall indicate the number of operations of the breaker.
- d. The cabinet shall be equipped with a selector switch with three (3) operating positions "Off-Local-Remote" and with as many stages as needed for the control circuits of the breaker. In the "off" position no circuit breaker operation would be allowed.

The "local" position and in conjunction with two (2) push-buttons (open-close) or a control switch, will be used to control the breaker locally, that is, from the control cabinet for maintenance purpose only. When the circuit breaker is under local control, the bay associated with the circuit breaker will be out of service. The "Remote" position will be used to control (open – close) the breaker from the control building of the substation or from the system's control center and also for tripping purposes.

- e. The "off –local-remote" selector switch shall be equipped with an additional number of stages, beyond those which are normally needed for all the control circuits, which shall be used to be inserted to both positive (+) and negative (-) 220V DC buses of the control circuits.
- f. The cabinet shall be equipped with two (2) push – buttons or a two (2) position control switch for local closing and opening of the circuit breaker as all ready has been indicated above.
- g. The cabinet shall contain the following auxiliary circuit breaker contacts free of voltage :
  - Five (5) N. O.
  - Five (5) N. C.
- h. The cabinet shall be equipped with terminal blocks suitable to be wired with 2.5mm<sup>2</sup> size conductors with the exemption of the terminal blocks associated with the motor of the operating mechanism which must be suitable for 10mm<sup>2</sup> cables. The terminal blocks shall preferably be of the screw type.
- i. The cabinet shall be equipped with an anti-pumping relay as to prevent constant opening and closing in the event of simultaneously applied "Open" and "Close" commands.
- j. Number of closing and tripping circuits:
 

1. Number of closing circuits	: One (1)
2. Number of tripping circuits	: One (1)

- k. The cabinet shall be equipped with the operating mechanism of the circuit breaker.
- l. The cabinet shall be equipped with the motor of the operating mechanism with the motor's auxiliary supply voltage to be 220 V DC, with tolerance +10 %, -15%.
- m. The cabinet shall be equipped with SF6 density monitors
- n. The cabinet shall be equipped with a light bulb (lamp)
- o. The cabinet shall be equipped with a socket outlet for 220 V AC
- p. The cabinet shall be equipped with a padlock

In case the circuit breaker is equipped with two separate cabinets, one for control and one for the operating mechanism, the cabinet of the operating mechanism shall contain items k, l, m, n and a as indicated above and the control cabinet items from a to j and items n, o and p. Both cabinets shall be of IP55 protection as per IEC – 60144 and hot - dip galvanized.

#### **10. Housing of the isolating column and of the breaking chambers**

- a. The isolating housing of the breaker's columns and breaking chambers shall either be of extra strength porcelain or silicon rubber. The porcelain shall comply in all relevant respects with IEC -60233 standard "Tests on hollow insulators for electrical equipment". The silicon rubber housing shall be in accordance with IEC – 61142 standard "Composite insulators - Hollow insulators for use in outdoor and indoor electrical equipment".
- b. The creepage distance of the column and breaking chamber housing shall be as follows:
  - 1. Between live parts and earth (ground) : 25mm / KV (1300 mm)
  - 2. Across breaker terminals : 25mm / KV (1300 mm)

With the voltage used for the determination being that of 52 KV (rated voltage).

### **VIII. REQUIRED ADDITIONAL DESIGN AND OTHER FEATURES OF THE CIRCUIT BREAKER**

#### **1. Wiring requirements**

The wiring of various circuits of the breaker shall be carried out with at least 1.5mm<sup>2</sup> size conductors, unless, is differently needed by the power requirements of the circuit. Conductors must bear rings with markings.

#### **2. Lifting and handling of the circuit breaker**

The offer shall include drawings and instructions which in detail shall indicate the method or way of lifting and handling of the circuit breaker.

**3. Manual – Emergency Operation of the breaker**

The circuit breaker must be equipped with a manual mechanism or other means for opening and closing without the use of D.C. auxiliary supply voltage for maintenance and emergency situations.

**4. Circuit breaker's support structure**

Since the breaker is going to be installed on a steel support structure, the successful bidder is required to submit drawings with detail constructional information about the steel support structure. Furthermore, enough information must be provided so that the support structure's concrete steel reinforced base can be calculated. The steel support structure will not be part of the supply.

**5. Static terminal load withstand**

The circuit breaker shall be able to operate correctly when loaded by stresses resulting from connected conductors as follows:

1. Static horizontal force
  - Longitudinal : 500 N
  - Transversal : 400 N
2. Static vertical force : 500 N

**6. Wind speed withstand**

The breaker itself shall be able to withstand a wind speed of 150 km/h which corresponds to 120 kg/m<sup>2</sup> of pressure (with coefficient of dynamic pressure of 1.0). The breaker's support – structure shall withstand a wind pressure of 180 kg/m<sup>2</sup> (with coefficient of dynamic pressure =1.5).

**7. Circuit breakers terminals**

The circuit breakers terminals shall be of copper nickel plated or aluminum, rectangular in shape and with dimensions of about 100mm × 100mm × 20mm.

**8. Earthing of the circuit breaker**

The frame of the circuit breaker shall be provided with a reliable earthing terminal having a clamping screw or bolt for connection to an earthing conductor suitable for 20 KA fault current. The diameter of the clamping screw or bolt shall be at least 12mm. The connecting point shall be marked with the "protective earth" symbol.

## **IX. CIRCUIT BREAKER'S REQUIRED RATE CHARACTERISTICS**

- |   |                              |
|---|------------------------------|
| 1. Rated voltage  | : 52 KV                      |
| 2. Rated frequency  | : 50 Hz                      |
| 3. Rated normal current   | : 1250 A                     |
| 4. Rated insulations level  |                              |
| a. Rated power frequency withstand voltage (1 min)  |                              |
| • Phase to earth, between phases<br>and across open circuit breaker contacts<br>(common value)        | : 95 KV rms                  |
| b. Rated lightning impulse withstand voltage  |                              |
| • Phase to earth, between phases<br>and across open circuit breaker<br>contacts (common value)        | : 250 KV peak                |
| 5. Rated short circuit breaking current<br>a.c component, r.m.s value                                 | : 20 KA                      |
| 6. Rated transient recovery voltage for terminal faults   |                              |
| • Peak value  | : 89 KV                      |
| • Rate of rise of recovery voltage (RRRV)   | : 0.68 KV/ $\mu$ s           |
| • First – pole – to- clear factor   | : 1.5                        |
| 7. Rated transient recovery voltage for out – of – phase  |                              |
| • Peak Value  | : 133 KV                     |
| • Rate of rise of recovery voltage (RRRV)   | : 0.50 KV/ $\mu$ s           |
| • First – pole – to – clear factor  | : 2.5                        |
| 8. Rated short – circuit making current<br>(2.5 times the a.c component of<br>short breaking current) | : 50 KA peak                 |
| 9. Rated Operating Sequence   | : O -0.3s - CO –<br>3 min-CO |
| 10. Rated duration of short -circuit  | : 3 sec                      |
| 11. First - pole – to – clear factor  | : 1.5                        |
| 12. Rated short – time withstand current  | : 20KA r.m.s                 |
| 13. Rated peak withstand current  | : 50KA peak                  |

14. Rated cable – charging breaking current	: 80A r.m.s.
15. Rated out –of – phase breaking current	: 5KA r.m.s.
16. Rated out – of – phase making current	: 7 KA peak
17. Mechanical endurance class	: M2 (10000 operations)
18. Electrical Endurance class	: E2
19. Restrike class during capacitive current breaking	: C1
20. Rated break time	: 3 cycles (60 ms)
21. Rated closing time	: 3.5 cycles (70 ms)
22. Rated opening time	: 2,5 cycles (50 ms)
23. Inductive breaking current capability	: 1250A
24. Switching inductive current capability	: 1250 A

## **X. TESTS**

### **A. Routine tests**

Testing shall be in accordance with IEC – 62271 – 100 and IEC -60694, (edition 2.2, 2002 – 01).

The routine testing shall include the following :

#### **1. Power frequency voltage dry test on the main circuit**

Test voltage: 95kV rms, 50Hz, for 1 minute for phase to earth and phase – to – phase and across open circuit breaker contacts.

#### **2. Tests on auxiliary and control circuits**

- Inspection of auxiliary and control circuits and verification of conformity to the circuit diagrams and wiring diagrams.
- Functional tests of all low voltage circuits.
- Verification of protection against electrical shock.
- Power frequency voltage test.

Test voltage: 1kv, 50Hz with duration of 1 sec.



### **3. Measurement of the resistance of the main circuit**

- The test current : any value between 50 A and 1250A
- The measured resistance shall not exceed 1.2  $R_u$ , where  $R_u$  is equal to the resistance measured before the temperature – rise test.

### **4. Tightness test**

### **5. Design and visual checks**

The following shall be checked:

- The language and data on the name plates.
- Identification of any auxiliary equipment.
- The color and quality of paint and corrosion protection of metallic surfaces.
- The values of the resistors and capacitors connected to the main circuit.

### **6. Mechanical operating tests**

- a. At maximum supply voltage of the operating devices and of the auxiliary and control circuits and at maximum pressure for operation.
  - Five closing operations
  - Five opening operations
- b. At specified minimum supply voltage of the operating devices and of the auxiliary and control circuits and at minimum functional pressure for operation.
  - Five closing operations
  - Five opening operations
- c. At rated supply voltage of the operating devices and of the auxiliary and control circuits and at rated pressure for the operation.
  - Five close – open operating cycles with the tripping mechanism energized by the closing of the main contacts.
  - Moreover, five open – close operating cycles O – t – C where t shall be not more than the time interval specified for the rated operating sequence. Finally for all required operating sequences all inspections, measurements and functional tests shall be performed as specified in IEC – 62271 – 100.

### **B. Type Tests**

Type tests shall be carried out in accordance with IEC – 62271 – 100 and IEC – 60694, (edition 2.2, 2002 – 01).

The following type tests are required.

## 1. Dielectric Tests

### a. Power frequency voltage tests

Test voltage

: 95 kV rms for  
1 minute applied  
phase – to – earth  
and across open  
circuit breaker  
contacts.

The tests shall be performed in dry and wet conditions.

### b. Lightning impulse voltage tests

The circuit breaker shall be subjected to lightning impulse voltage tests in dry conditions only.

The tests shall be performed with voltages of both polarities using a lightning impulse of 1.2 / 50  $\mu$ s.

The test voltage shall be

: 250 KV peak, applied  
phase – to – earth,  
between phases and  
across open circuit  
breaker contacts.

### c. Dielectric tests on auxiliary and control circuits

The test involves:

- Impulse voltage withstand and
- Power frequency voltage withstand.

Each test shall be performed.

1. Between the auxiliary and control circuits connected together as a whole and the frame of the breaker.

2. If practicable, between each part of the auxiliary and control circuits, which in normal use may be insulated from the other parts, and the frame. The other parts being connected together.

The impulse voltage withstand value shall be 5 KV and the test shall be performed in accordance with IEC – 60255-5. The power frequency test shall be performed according to IEC – 61180-1. The test voltage shall be 2 KV with duration of 1 min.

## 2. Measurement of the resistance of the main circuit

The measurement shall be made with a d.c. by measuring the voltage drop or resistance across the terminals of the each pole.

The current during the test shall have a value between 50A and rated normal current of the breaker.

### **3. Temperature - rise tests**

- a. The test shall be made at rated normal current of the breaker in an environment substantially free from air currents and this condition is satisfied when the air velocity is  $\leq 0.5$  m/s
- b. The test shall be made over a period of time sufficient for the temperature rise to reach a stable value. This condition is declared to be obtained when the increase of temperature rise does not exceed 1 K in 1 h.
- c. The ambient air temperature during tests shall be more than + 10° C but less than + 40° C.
- d. The auxiliary equipment shall be tested at its rated supply voltage or its rated current.
- e. The temperature rise of the various parts of the circuit breaker or auxiliary equipment for which limits are specified, shall not exceed the values specified in table 3 of IEC – 60694.

### **4. Short –time withstand current and peak withstand current tests**

- a. The test current shall be equal to the a. c component of the rated short–time withstand current of the breaker.  
This peak current test shall be equal to the rated peak withstand current of the breaker.
- b. The test time shall be 3 seconds.
- c. After the test, the switchgear shall not show significant deterioration, shall be capable of operating normally, carrying its rated normal current continuously without exceeding the temperature – rise limits specified in table 3 of IEC-60964 and withstanding the voltages specified under dielectric tests.

### **5. Tightness test**

### **6. Electromagnetic compatibility test ( EMC)**

- a. The test are only for the secondary systems of the circuit breaker.  
For the main circuit of the breaker, without switching operations, the emission level shall be verified by means of the radio interference voltage test.
- b. Electronic equipment, which is part of the secondary system, shall fulfill the requirements with regards to emission, as defined in CISPR II for group II, class A equipment.

- c. Secondary systems of the breaker shall be subjected to electromagnetic immunity tests if they include electronic equipment or components. In other cases no tests are required.

The following immunity tests are specified:

- Electric fast transient / burst test with normal EMC severity class test voltages
- Oscillatory wave immunity test with normal EMC severity class test voltages.

## **7. Mechanical operation test at ambient temperature**

The mechanical operation test shall consist of 10000 operating sequences. The circuit breaker should be tested preferably as a complete multipole circuit breaker. However, for convenience or owing to limitations of the dimensions of the test bay, one single- pole unit of the circuit breaker may be tested, provided that it is equivalent to the complete multipole circuit breaker over the range of tests, for example in respect of

- reference mechanical travel characteristics
- power and strength of closing and opening mechanism
- rigidity of structure.

The circuit breaker shall be tested as follows:

Operating sequence	Supply voltage and operating pressure	Number of operating sequences
		Circuit breaker for auto – reclosing
C – ta – O- ta	Minimum	500
	Rated	500
	Maximum	500
O – t- CO- ta – C – ta	Rated	250
O = opening C = closing CO = closing followed immediately by an opening ta = time between two operations which is necessary to restore the initial conditions and/or to prevent undue heating of parts of the breaker t = 0.3 s Repetition rate of the operating sequence = 5 times		

## **8. Short – circuit current making and breaking tests**

- a. The circuit breaker shall be capable of making and breaking the specified three – phase symmetrical and asymmetrical currents between 10 % and 100 % of the rated short – circuit breaking current at rated voltage.
- b. The breaker shall be capable at making and breaking single – phase short – circuit currents between 10% and 100 % of the rated short – circuit breaking current at phase – to –earth voltage.

- c. The breaker shall be capable of switching the capacitive current of 80 A at a voltage level of  $52\text{KV} / \sqrt{3} \times 1.2 = 36 \text{ KV}$  (for direct single – phase laboratory test).
- d. The applied voltage, current, transient and power frequency recovery voltages may all be obtained from a single power source (direct tests ) or from several sources where all of the current, or a major portion of it, is obtained from one source, and the transient recovery voltage is obtained wholly or in part from one or more separate sources ( synthetic tests). Synthetic testing shall be in accordance with IEC– 60427.

## **9. Out – of – phase making and breaking tests**

- a. This test shall be carried preferably in a single – phase test circuit.
- b. The out – of – phase making current shall be 7 KA peak.
- c. The out – of – phase breaking current shall be 5KA r.m.s
- d. The applied voltage and the power frequency recovery voltage shall have the following value :
  - Applied voltage and the power frequency recovery voltage : 75 kV rms at breaking current of 5 KA.
- e. The transient recovery voltage shall be 133 kV peak.
- f. The test - duty shall be OP2 with operating sequence CO – O – O and breaking current of 5 KA

## **10. Cable – Charging current switching test**

- a. The cable – charging breaking current shall be 80A rms at a test voltage of  $52 \text{ KV} / \sqrt{3} \times 1.2 = 36 \text{ KV}$
- b. Capacitors may be used to simulate screened and belted cables.
- c. The cable – charging breaking current test shall be carried out according to C1 restrike class capability (C1 classification of a breaker means low probability of restrike during capacitive current breaking).

## **11. Electrical Endurance tests**

The electrical endurance capability of the breaker shall be demonstrated by performing the basic short circuit test series consisting of test duties T10, T30, T60, T100s and T100a without intermediate maintenance.

## **12. Static terminal load tests**

The static horizontal force withstand shall be:

Longitudinal	: 500 N
Transversal	: 400 N
The static vertical force shall be	: 500 N

Ice coating and pressure shall be in accordance with IEC – 60694.

Calculations can be used to prove the circuit breakers capability to withstand the stresses instead of tests.

## **13. High temperature tests**

High temperature = +45°C.

# **XI. NAMEPLATES**

The circuit breaker and its operating mechanisms shall be equipped with name plates of no corrosive material, which shall bear on them the following information.

### **A. Circuit Breaker**

1. Manufacture
2. Type designation and serial number
3. Rated voltage, in KV
4. Rated lighting impulse withstand voltage in KV
5. Rated frequency in Hz
6. Rated normal current in A
7. Rated duration of short circuit in sec
8. Rated short circuit breaking current in KA
9. DC component of the rated short circuit breaking current in %
10. First –pole – to clear factor
11. Rated out –of – phase breaking current in KA
12. Rated cable – charging breaking current in A
13. Rated filling pressure for interruption in MPa
14. Rated filling pressure for operation in MPa
15. Mass of the breaker in kg
16. Rates operating sequence
17. Year of manufacture
18. Temperature class
19. Relevant standard with date of issue

### **B. Operating mechanism**

1. Manufacturer
2. Type designation and serial number
3. Rated supply voltage of closing and opening devices
4. Rated supply voltage of auxiliary circuits
5. Relevant standard with date of issue

## **XII. DATA WHICH MUST BE SUBMITTED BY ALL BIDDERS**

1. Outline drawing of the breaker, in which the physical dimensions of the breaker are clearly depicted.
2. Brochures, technical pamphlets and any other information which is deemed necessary for the technical evaluation process.
3. All bidders are required to answer all items of Attachment A. Failure to comply or partial filling of the attachment will constitute sufficient reason for rejection of the offer.
4. Any test certificates for the type tests of the offered equipment specified in this hereby specification. Acceptance or not of these certificates lies on IPTO's judgment. In any case, for the technical evaluation purposes, IPTO reserves the right to demand from the Bidders to confirm any stated values of specific technical features by the submission of related test certificates. Congruency failure between values will be a reason for the offer's rejection.
5. A preliminary drawing for the steel support structure of the circuit breaker.
6. A drawing indicating method of lifting of the circuit breaker.

## **XIII. DATA WHICH MUST BE SUBMITTED BY THE SUCCESSFUL BIDDER**

1. Complete schematic and wiring drawings of the breaker for approval before the construction of the breaker (3 sets).
2. Complete physical drawings of the breaker indicating all dimension details of the breaker for approval before the construction of the breaker (3 sets).
3. Technical brochures describing in detail the breaker itself, its operating mechanism and its operation
4. Detail drawings of the breakers steel support structure so that IPTO can construct it and also to be able to construct its concrete steel reinforced base.
5. Maintenance and assembly instructions in detail.
6. A drawing indicating method of lifting of the breaker.

**XIV.     WARRANTY**

The supplier must provide a warranty of three (3) years, beginning from the date of delivery of the circuit breaker for damages by faulty design or by unreliable components or by combination of the two.

**XV.     PACKING**

Each circuit breaker must be delivered with its operating mechanism packaged inside of an entirely closed, robust, wooden box, pallet type of at least 20mm thickness, with additional protection for the operation mechanism, suitable for marine transportation. All of the parts inside will be numbered and easily identifiable.

**XVI.**     The circuit breaker must be delivered with the appropriate, for its operation, quantity of SF<sub>6</sub> gas.



**ATTACHMENT "A"**  
**52KV SF6 OUTDOOR CIRCUIT BREAKERS**

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

1. Type and manufacture : .....
2. Ambient temperature range : .....
3. Type of interrupter technology : .....  
.....  
.....
4. Number of operating mechanisms : .....  
.....
5. Operating mode : .....  
.....
6. Number of interrupting units : .....  
.....
7. Type of gas used in the breaking chamber : .....
8. Is the SF6 gas in accordance with IEC – 60376? : .....
9. Type and description of the operating mechanism : .....  
.....  
.....  
.....
10. Auxiliary supply voltages
  - a. For the opening and closing circuits : .....
  - b. For all other control and signaling circuits : .....
  - c. For the heating and light circuits : .....
  - d. For the motor of the operating mechanism : .....

11. Describe the basic elements of the circuit breaker's structure : .....
- .....
- .....
12. Is the circuit breakers control and operating mechanism cabinet in accordance with the requirement of paragraph VII – 9 –a to p : .....
- a. If no, indicate deviations : .....
- .....
- .....
- .....
13. Is the circuit breaker equipped with two separate cabinets ? One for control and the other for the operating mechanism ? : .....
- .....
- a.If yes, then does the control cabinet contain items a to j and n to p of paragraph VII – 9 ? : .....
- .....
- And does the operating mechanism cabinet contain items k, l ,m, n and a of paragraph VII – 9 ? : .....
- .....
14. Type of housing of the isolating column and of the breaking chamber and indicate compliance with the relevant IEC standard : .....
- .....
- .....
- .....

15. Creepage distance of the isolating column and breaking chambers housing
  - a. Between live parts and earth : .....
  - b. Across breaker terminals : .....
16. Size of wires ( cables ) used in the circuits of the breaker's operating mechanisms : .....  
.....
17. Is a drawing provided in which the method of the breaker lifting is indicated ? : .....
18. Are special tools needed for the lifting of the breaker? : .....
19. Can the breaker be operated without the use of the D.C. auxiliary supply voltage? : .....
20. Static terminal load withstand capability
  - a. Static horizontal force  
Longitudinal : .....
  - Transversal : .....
  - b. Static vertical force : .....
21. Wind speed and pressure capability of the breaker
  - a. Wind speed in km/h withstand : .....
  - b. Pressure in  $\text{kg/m}^2$  withstand with coefficient of dynamic pressure 1.0 : .....
22. Wind pressure withstand capability of the breaker's steel supporting structure : .....
23. Material, shape and dimensions of the circuit breaker's terminals : .....  
.....  
.....

## 24. Rated characteristics

a. Rated voltage	: .....
b. Rated frequency	: .....
c. Rated normal current	: .....
d. Rated power frequency withstand voltage Phase to earth, between phases and across open circuit breaker contacts	: .....
e. Rated lightning impulse withstand voltage Phase to earth, between phases and across open circuit breaker contacts	: .....
f. Rated short circuit breaking current a.c. component, rms value	: .....
d.c. component, % value	: .....
g. Rated transient recovery voltage for terminal faults Peak value	: .....
Rate of rise of recovery voltage (RRRV)	: .....
First – pole – to – clear factor	: .....
h. Rated transient recovery voltage for out-of-phase	
• Peak value	: .....
• Rate of rise of recovery voltage (RRRV)	: .....
• First-pole-to clear factor	: .....
i. Rated short – circuit making current	: .....
j. Rated operating sequence	: .....
k. Rated duration of short circuit	: .....
l. First –pole – to – clear factor	: .....
m. Rated short – time withstand current	: .....
n. Rated peak withstand current	: .....
o. Rated cable – charging breaking current	: .....
p. Rated out – of – phase breaking current	: .....

q. Rated out – of – phase making current	: .....
r. Mechanical endurance class	: .....
s. Electrical endurance class	: .....
t. Restrike class	: .....
u. Rated break time	: .....
v. Rated closing time	: .....
w. Rated opening time	: .....
27. Inductive breaking current	: .....
28. Switching inductive current	: .....
29. Dead time between closing and opening or vise – versa	: ..... .....
30. Simultaneity difference between poles ( ON/OFF)	: ..... .....
31. Is the circuit breakers frame equipped with an earthing terminal as described in paragraph VIII – 8	: .....
32. Type of main contacts	: .....
33. Material of the main contacts	: .....
34. Arc quenching medium ( SF6)	
a. Rated pressure of SF6 in bar or MPa	: .....
b. SF6 alarm pressure in bar MPa	: .....
c. SF6 lockout pressure in bar or MPa	: .....
d. SF6 loss – rate /year	: .....
e. Mass of SF6 for the entire breaker	: .....
f. Minimum SF6 operating pressure	: .....

35.	Number of auxiliary free contacts	: .....
		.....
36.	Number of tripping coils	: .....
37.	Number of closing coils	: .....
38.	Power consumption	
	a. Closing coil (D.C.)	: .....
	b. Trip coil (D.C.)	: .....
	c. Heaters	: .....
	d. Light bulb	: .....
39.	Spring type operating mechanism data	
	a. Motor voltage	: .....
	b. Motor power when running	: .....
	c. Voltage operating tolerance	: .....
	d. Motor power during starting	: .....
40.	Weight of the entire breaker complete with SF6	: .....
41.	Weight of the entire breaker complete with SF6 and all fittings as in service	: .....
42.	Is the breaker of the live tank type?	: .....
43.	IP class protection of breaker's control and operating mechanism cabinet	: .....
		.....
44.	If applicable, IP class protection of	
	a. Control cabinet	: .....
	b. Operating mechanism cabinet	: .....
45.	Type of tripping as per IEC – 60050 (441)	: .....
46.	Dimensions of the breaker	: .....
47.	Tolerances of the auxiliary dc supply voltage of the tripping coil	: .....

48. Is the circuit breaker delivered filled with the appropriate for its operation quantity of SF<sub>6</sub> gas? : .....
49. Is each circuit breaker to be packaged in accordance with the paragr. XV of this hereby specification? : .....