



**INDEPENDENT POWER TRANSMISSION OPERATOR S.A.
TSMD/ HIGH VOLTAGE EQUIPMENT SECTION**

October 2018

TECHNICAL DESCRIPTION TD-26
36 kV VACUUM OR SF6 INDOOR CIRCUIT BREAKERS

I. SCOPE

This hereby technical description covers the technical and constructional characteristics of the circuit breakers in question in addition to the testing and delivery requirements.

II. KEYWORDS

SF6 circuit breakers, vacuum circuit breakers, switching devices.

III. USE

The circuit breakers are to be used for the switching of shunt reactors of 50 MVAR, 30 kV. These shunt reactors are connected to the 30 kV tertiary winding of 400/150/30 kV autotransformers, for continuous or discontinuous operation.

IV. ELECTRICAL CHARACTERISTICS OF THE SYSTEM

- | | |
|---|-----------|
| 1. Nominal Voltage | : 30 kV |
| 2. Maximum Operating Voltage | : 52 kV |
| 3. Number of phases | : 3 |
| 4. Number of conductors | : 3 |
| 5. Short Circuit Level | : 31,5 kA |
| 6. Basic Insulation Level | : 250 kV |
| 7. Nominal frequency | : 50 Hz |
| 8. Neutral is grounded through a VT which has the following characteristics: ratio = $30/\sqrt{3}$ /0.1/ $\sqrt{3}$ kV, | |

power = 200 VA
class = 1

V. OPERATING CONDITIONS

- | | |
|------------------------|-------------------------------|
| 1. Installation | : indoors |
| 2. Ambient Temperature | : -25°C ÷ +45°C |
| 3. Attitude | : Up to 1000m above sea level |

VI. STANDARDS

All technical characteristics and testing of the circuit breakers shall be in accordance with standard IEC 62271-1, IEC 62271-100, IEC 62271-110

VII. REQUIRED CONSTRUCTIONAL CHARACTERISTICS OF THE CIRCUIT BREAKER

1. The circuit breaker shall either be vacuum or SF6 type (in accordance with IEC – 60376 standard). Furthermore the SF6 breaker shall be of puffer type or self-puffer (self-blast) or .
2. The operating mechanism of the circuit breaker shall be of the spring type. One operating mechanism per breaker (three poles).
3. The circuit breaker shall be designed for three phase operation (The three poles to be operated simultaneously).
4. The circuit breaker shall have one breaking chamber per pole.
5. Number of closing circuits : 1
6. Number of tripping circuits : 2
7. Supply auxiliary Voltage for the closing and tripping circuits : 220 V +/- 10% D.C.
8. Supply auxiliary Voltage for the spring operating mechanism : 220 V +/- 10% D.C.
9. Supply auxiliary Voltage for the condensation heaters and lighting : 230 V A.C.
10. The circuit breaker shall be mounted on a trolley with wheels as indicated in sketch SK-36 CB / rev 1. The trolley shall also be equipped with ground stabilizing mechanism and must be hot dip galvanized if it is from steel.
The trolley shall also be equipped with a reliable earthing terminal having a clamping screw for connection to an earthing conductor, suitable for the specified fault conditions as per IEC-62271-1.
11. The dimensions and arrangement of the circuit breaker shall be as depicted on the attached sketch SK-36 CB / rev 1 , and shall be installed on c.b. room width 1800mm .
12. Cast iron shall not be used in any part of the circuit breaker or its operating mechanism.
13. The circuit breaker must be equipped with position indicator to show clearly the position of the breaker (opened-closed).
14. The circuit breaker must be equipped with a SF6 density monitor (if applicable) with at least two (2) NO contact for SF6 pressure limit alarm and lockout signaling purposes.
15. The circuit breaker must be equipped with six (6) N.O. and six (6) N.C. contacts free of voltage.
16. The wiring of the various circuits of the breaker shall be carried out with a 2.5 mm² conductor. Conductors shall also bear rings with markings.

17. The circuit breaker must be equipped with a three (3) position selector switch for local-remote-neutral position.
18. The circuit breaker must be equipped with an operations counter.
19. The panel of the operating mechanism must be equipped with condensation heaters which must be controlled by thermostat or hygrostat.
20. The circuit breaker must be equipped with a manual operating mechanism for opening and closing without D.C. auxiliary control voltage for maintenance and emergency purposes.
21. The circuit breaker shall be equipped with two (2) push-buttons for local closing and opening of the breaker.
22. The mains of the condensation heaters, panel lighting and D.C. motor of the spring charged mechanism shall be equipped with miniature circuit breakers for protection reasons.
23. The circuit breaker must be equipped with an antipumping circuit/relay.
24. The seals of the breaker shall be such that no leaks take place. Furthermore all seals must be robust and reliable so that as little as possible maintenance is required.
25. ADMIE's (IPTO) requirements regarding the control circuitry (+/- 220V D.C.) of the breaker shall be as shown on the attached drawing DRW SD-36.
26. The circuit breaker shall be equipped with lifting eyes for lifting and moving purposes.

VIII. CIRCUIT BREAKER REQUIRED ELECTRICAL CHARACTERISTICS

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|---|--------------|
| 1. Rated voltage | : 36 kV |
| 2. Rated frequency | : 50 Hz |
| 3. Rated current | : 2000 A |
| 4. Rated short-circuit breaking current | |
| a. A.C. component r.m.s. value | : 31,5 kA |
| b. D.C. component, % value | : 23% |
| 5. Rated short-circuit making current | : 50 kA |
| 6. Rated peak withstand current | : 63 kA |
| 7. Rated duration of short-circuit | : 3 seconds |
| 8. Rated insulation levels | |
| a. Rated power-frequency withstand voltage, 1 min | : 70 kV rms |
| b. Rated lightning impulse withstand voltage | : 170kV peak |

- | | |
|--|---------------------------------|
| 9. First-pole-to-clear factor | : 1.5 |
| 10. Rated transient recovery voltage (TRV) peak | : 62 kV |
| 11. Rated Rate of Rise (RRRV) | : 0.57 kV/ μ s |
| 12. Rated inductive breaking current | : 50 A |
| 13. Rated operating sequence | : O-0.3 sec-CO-3 min-CO |
| 14. Short circuit breaking current at 36 kV a.c. component, r.m.s. value | : ≥ 20 kA |
| 15. Making capacity | : 50kA |
| 16. The circuit breaker shall be capable of interrupting inductive currents of the range 1000-2000 A and to be capable of withstanding chopped overvoltages and restriking overvoltages as result of the switching of 50MVAR shunt reactors. | |
| 16. Rated short-time withstand current | : 31,5 kA. |
| 17. Mechanical endurance class | : M2 (10000 operations) |
| 18. Application class | : S1 |
| 19. Cable charging switching class | : C2 |
| 18. Rated break time | : ≤ 65ms |
| 19. Opening time | : ≤ 50ms |
| 20. Closing time | : ≤ 70ms |

IX. INTERRUPTING CHAMBER, BREAKER POLES, TERMINALS AND OPERATING MECHANISM.

1. The interrupting chamber shall be cast into an insulation casing , consisting of polymer –silicon rubber or epoxy resin material.
2. The circuit breaker in and out terminals shall be from aluminum with a 60x60mm footprint. Furthermore, their arrangement shall be as depicted in the attached sketch SK-36 CB / rev 1 .If any adaptors are required (e.g. tulip or finger type contacts to plate) they shall be provided and type tested by the manufacturer.
3. The three (3) breaker poles shall be arranged in a straight line formation, that is, as shown on the attached sketch SK-36 CB / rev 1 , and shall be installed in concrete walled space with a width of 1800mm .
4. The breaker's operating mechanism shall be arranged with regard to the breaker poles as shown on the attached sketch SK-36 CB / rev 1 ,.

5. The sketch is indicative. Only overall and contact dimensions are restrictive.

X. TESTS

A. ROUTINE TESTS

The routine tests include the following tests in accordance with IEC-62271-1 και 62271-100.

1. Power frequency voltage withstand dry tests on the main circuit. 70kV rms, 50 Hz, 1 minute
2. Voltage withstand test on control and auxiliary circuits. 2000V, 50 Hz, 1 minute.
3. Measurement of the resistance of the main circuit. The measured resistance shall not exceed $1.2 \times R_u$, where R_u is equal to the resistance measured before the temperature-rise test.
4. Mechanical operating tests.
 - a. at specified maximum supply voltage and pressure (if applicable).
 - five closing operations
 - five opening operations
 - b. at specified minimum supply voltage and pressure (if applicable).
 - five closing operations
 - five opening operations
 - c. at rated supply voltage and pressure (if applicable).
 - five close-open operating cycles with the tripping mechanism energized by the closing of the main contacts.
 - moreover five open-close sequence O-t-C where $t=0.3$ secFinally, all testing, inspections and measurements shall be carried out, as specified by standard IEC-62271-1 και 62271-100, after the execution of the above mentioned operating sequences.

5. Design and visual checks.

B. TYPE TESTS

1. Dielectric tests

- a. Lighting Impulse Voltage test : 170 kV peak
- b. Power frequency voltage test : 70 kV rms, 50 Hz, 1 min
- c. Tests on auxiliary and control circuits : 2000 V rms, 50 Hz, 1 min.

2. Temperature - Rise Tests

3. Measurement of the resistance of the main circuit

4. Short-time withstand current and peak withstand current tests

- a. 31,5 kA for 3 seconds (short-time)
- b. 63 kA for 3 seconds (peak)

5. Mechanical and Environmental Tests

6. Mechanical Operation Test at ambient air temperature

7. Low and High Temperature Tests

8. X-radiation test procedure for vacuum interrupters

8. Breaking and Making Tests

9. Basic short-circuit test-duties

10. Single-phase short-circuit test

11. Shunt reactor current switching tests (IEC 62271-110 & IEC 62271-306)

11. Capacitive current switching tests

a. cable-charging breaking current test: 50 A

XI. DATA WHICH MUST BE PROVIDED BY EACH BIDDER

1. Each offer must be accompanied by breaker physical drawings which shall depict the dimensions and arrangement of the circuit breaker offered, along with its trolley.
2. Each bidder is required to submit all necessary data, information and technical pamphlets so that the technical evaluation of the breaker can be accomplished.
3. Each bidder is required to fill and answer all items of "Attachment A". Failure to comply or partial filling of "Attachment A" will constitute sufficient reason for rejection of the offer.
4. Each bidder, in his economical offer, must include the cost of routine tests in the price of the breaker.
5. The cost of type tests must not be included in the price of the breaker, but in the economical offer, the cost of each of the specified type tests must be clearly indicated.
6. Each bidder can submit along with his technical offer and any type test reports that he may have from certified or other laboratory for all specified type tests of this hereby technical description. These type test reports will be evaluated by the buyer at his own judgment.

XII. DATA WHICH MUST BE PROVIDED BY THE SUCCESSFUL BIDDER

1. Complete schematic and wiring drawings for approval before the breaker's construction.
2. A block functional diagram of the breaker for approval before the breaker's construction.
3. Outline drawing indicating dimensions arrangement and terminal details of the breaker for approval before the breaker's construction.
4. Technical pamphlets describing in detail the breaker and its operation.
5. Assembly and erection instructions and maintenance technical pamphlets in accordance with

standard IEC - 62271-1 και 62271-100.

XIII. WARRANTY

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

XIV. SPARE PARTS

The supplier must submit a list of spare parts which, based on his opinion, are required for the total number of the order. The price of each spare part must be indicated in the economical offer. The list of the proposed spare parts shall also be included in the technical offer without, however, the prices. The buyer maintains always the right to decide if to buy all the proposed spare parts or a part of them or to buy none of them.

XV. PACKING

Each circuit breaker must be delivered packaged inside a robust wooden box which must also provide protection against water and humidity.

XVI. The circuit breaker must be delivered filled with the appropriate, for its operation, quantity of SF₆ gas (if applicable).

XVII. NAMEPLATE INFORMATION

In the nameplates of the circuit breakers, the following information must be included:

1. Manufacturer.
2. Type designation and serial number.
3. Rated voltage in kV.
4. Rated lightning impulse withstand voltage in kV.
5. Rated frequency in Hz.
6. Rated current in A.
7. Rated duration of short circuit in seconds.
8. Rated short-circuit breaking current in kA.
9. First-pole-to-clear factor.
10. Rated cable-charging breaking current in A.
11. Rated gas pressure for interruption in MPa or bar (if applicable).

12. Total weight of the breaker in Kg.
13. Rated operating sequence.
14. Year of manufacture.
15. Temperature class.

ATTACHMENT "A"

1. Type of the offered circuit breaker :
2. Rated voltage :
3. Rated frequency :
4. Rated current :
5. Opening time of the breaker :
6. Breaking time during fault :
7. Closing time of the breaker :
8. Rated short-circuit breaking current
 - A.C. component rms value :
 - D.C. component percentage value :
9. Rated short-circuit making current :
10. Rated peak withstand current :
11. Rated duration of short-circuit :
12. Rated power-frequency withstand voltage 1 min. :
13. Rated lightning impulse withstand voltage :
14. First-pole-to-clear factor :
15. Rated transient recovery voltage for terminal faults :
16. Rated Rate of Rise (RRRV) :
17. Rated cable charging breaking current :
18. Rated operating sequence :
19. Temperature class :
20. Is the offered circuit breaker suitable for interrupting inductive currents of the range of 1000-2000 A? :

21. Are the overall and contact dimensions as in sketch SK-36 CB? :
22. Type of the operating mechanism :
23. Is the offered breaker suitable for simultaneous operation of the three (3) poles? :
24. Number of breaking chambers per pole :
25. Number of closing circuits :
26. Number of tripping circuits :
27. Auxiliary supply voltage for the closing and tripping circuits :
28. Auxiliary supply voltage for the motor of the operating mechanism :
29. Auxiliary supply voltage for condensation heaters and lighting :
30. Power of the motor of the operating mechanism :
31. Is the breaker mounted on a trolley? :
32. Type of metal of the trolley :
33. Is the trolley equipped with an earthing terminal? :
34. Is the breaker equipped with a position indicator showing the opening and closing status of the breaker? :
35. Is the breaker equipped with a gas density monitor? (if applicable) :
36. SF6 Pressure data (if applicable)
 - SF6 rated pressure in MPa or bar :
 - SF6 alarm pressure in MPa or bar :
 - SF6 lockout pressure in MPa or bar :
 - Mass of SF6 :
37. Number of auxiliary contacts free of voltage :

38. Is the wiring done with 2.5 mm² conductors? :
39. Is the breaker equipped with a selector switch
for local-remote-neutral operation? :
40. Is the breaker equipped with operations counter? :
41. Is the breaker panel equipped with condensation
heaters controlled by thermostat or hygostat? :
42. Is the breaker equipped with opening and closing
mechanism which operates without auxiliary
supply voltage? :
43. Is the breaker equipped with two push-buttons
one for local closing and one for local opening
of the breaker? :
44. Are the mains of the operating mechanism motor
and the condensation heaters protected by
miniature breakers? :
45. Are the ADMIE's requirements regarding the
control circuits based on DRW SD-36 met? :
46. Are seals leakage free? :
47. Total weight of the circuit breaker :
48. Type of material which surrounds the breaking
chamber :
49. Distance between terminals :
50. Power of the closing coil :
51. Power of the opening coil :
52. Power of the condensation heaters :
53. Material of terminals :
54. Is the circuit breaker delivered filled with the
appropriate for its operation quantity of SF₆ gas
(if applicable) ? :

