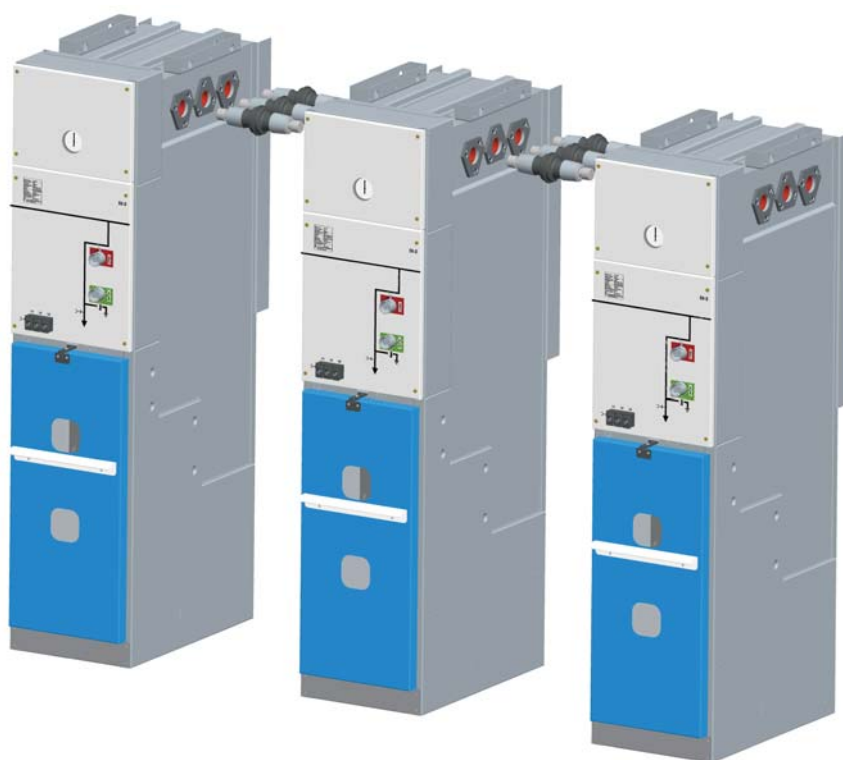




DI-2

MEDIUM VOLTAGE SWITCHGEAR

THE MODULAR AND COMPACT CONCEPT



User manual



MEDIUM VOLTAGE SWITCHGEAR, BUILT TO LAST

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ATTENTION

Medium voltage equipment, during its operation, can probably have voltage elements, motion parts and parts with high temperature. Because of this, operation of this type of equipments could have electrical, mechanical and thermal risks.

The lack of training is one of the main causes of industrial accidents. Therefore, only qualified and trained personnel according with the norm IEC-EN 50110 “ Electrical installation operation, following the Labour Risks Prevention Law and corresponding local rules will be able to work in the equipment described in this manual.

All our products are designed with a compromise of quality and security for people and equipments. Therefore, DI-2 panels have been tested against internal arc according with the standard IEC 62271-200 in order to guarantee the user’s security of these panels. Our materials quality requirements as well as the manufacturing process control and the final product control guarantee the high quality level of DI-2 panels.

SGC nv – SwitchGear Company reserves the right to introduce any appropriate modification to improve the equipment or the manufacture system without warning.

1 GENERAL CHARACTERISTICS

The equipment for medium voltage electrical energy distribution, that we present in this catalogue, are composed by cells manufactured under a metallic housing isolated in sulphur hexafluoride, SF₆.

The DI-2 system is composed of modular and compact systems of 24 and 36 kV.

Panels and its main components are manufactured in agreement with the following international standards certifications:

IEC 62271-200 “High-voltage switchgear and controlgear – Part 200: AC metalenclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV.”

IEC 60255 “Measuring relays and protection equipment.”

IEC 60265 “High-voltage switches.”

IEC 62271-1 “High-voltage switchgear and controlgear - Part 1: Common specifications.”

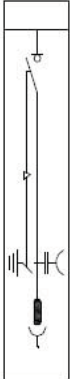
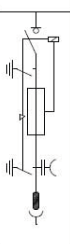
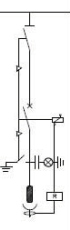
IEC 62271-100 “High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers.”

IEC 62271-102 “High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches.”

IEC 62271-105 “High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations.”

The quality requirements on the materials used in our products, as well as the manufacturing process control and the professional employees skill, they guarantee the high quality level of DI-2 cells given to our customers.

The DI-2 system is composed of the following functional units:

GENERAL DESCRIPTION	PANELS OR FUNCTIONS	UNIFILAR
DI-2 A	Incoming cubicle or cable field with load break switch	
DI-2-P	Transformer protection cubicle provided with load break switch with fuse combination	
DI-2 D	Protection cubicle with vacuum circuit breaker with integrated protection relay	

1.1 Standard conditions of service

The DI-2 panels, considered as indoor installations, fulfill with the following standard conditions of service:

Installation	Indoor
Ambient Temperature (Maximum value)	40 °C
Ambient Temperature (Minimum value)	-10 °C
Solar Radiation	Negligible.
Average Ambient Temperature measured for 24 hours.	35 °C
Maximum Altitude	2000 m.
Air Pollution.	No significant.
Average Relative Humidity measured for 24 hours.	<95%
Average Vapor Pressure of Water measured for 24 hours.	<2,2kPa
Average Relative Humidity measured for one month.	<90%
Average Vapor Pressure of Water measured for one month.	<1,8kPa
Vibrations	No significant.

*For special working conditions, please contact with the Technical-Commercial Department of SGC nv - SwitchGear Company.

1.2 Functional unit composition

The panel is composed of the following elements:

1.2.1 Metallic envelope

The metallic housing is composed of a two millimeters thick white metallic sheet AP02 according with the standard IEC-EN 10130 and are subjected to a complete process where they are degreased, stained, phosphated, passivated and given an additional rinse with demineralised water. They are automatically sprayed with polyester powder in a powder spray cabin, after which they are heated in an oven at 200°C. The complete cubicle structure has been constructed out of high-quality galvanized plates, it is resistant to corrosion and has a long life span.

The panel has one frontal door. The cover, united to the chasis with screws, allows to access to the control and operation area. The door allows to access to cable, fuse and current transformers area when it will be necessary.

1.2.2 SF₆ TANK

The tank is an enclosure compartment which has the control and operation elements and whose isolating environment is sulphur hexafluoride (SF₆). Steel sheets AISI 304 with welded reinforcements of the same material to guarantee the mechanical characteristics demanded by the constructive system, will be employed to manufacture it.

In the upper cover is located the manometer which establishes the working limits of the device (Red, Green).

Manometer scale is divided in two areas:



Green Area, working safe area.

Red Area, under this circumstance we must immediately inform SGC nv - SwitchGear Company and do not operate the cell.

MAIN DISCONNECTOR SWITCH.

The disconnecter switch with opened-closed positions is a sliding system. This

switch during the opening operation injects directly SF₆ gas, which is located inside the tank, over the area where the electric arc is produced.

The operation over the switch is carried out with an operating axis which is located in the upper side of the control. The pole motion speed is always the same and independent of the manual operation action speed of the operator.

EARTH DISCONNECTOR SWITCH.

The earth disconnector switch is a rotating system with two positions: disconnected and earthed. In the earth position, the corresponding entrance cables are to earth and therefore, directly short circuited.

In line function, grounding is simple while in protection function grounding is double and simultaneous, carrying out earth connection before and after fuses.

The closure of this disconnector is abrupt providing the disconnector with the closure power over the short circuit. In this case, poles motion speed is always the same and independent of the action speed manual operation as well as in the main switch disconnector, while the opening is depending of the operator action speed.

VACUUM CIRCUIT BREAKERS.

This vacuum circuit breaker is composed of vacuum valves for closure and opening even in conditions of lack or short circuit. In addition, an associate disconnector is included in order to isolate and separate the valves and the general bars.

The switch operating is carried out mechanically, charging springs and with closure or opening buttons.

The associate disconnector operating depends on the action of the operator.

1.2.3 Compartment of operation and control

In this compartment, opening or closure operations of main switch, earth disconnector and vacuum circuit breaker are carried out using buttons. For each case, synoptic unifilar diagram can be found in the frontal side.

In this diagram, there are position indicators of the operating elements which are totally integrated in the synoptic.



1.2.4 Compartments of cables

The cable compartment is located in the front inferior side of the panel. In this compartment are located bushings, general earth bars, clamps for power cables, fuses bases and depending of the model, current transformers.



1.2.5 Gas expansion section

The panels have a security valve for gas evacuation. There is a gas expansion section which is designed in order to eject (back and up) the gas generated in an internal arc, avoiding its effect on people, cables or equipment.



1.2.6 Fuse holders

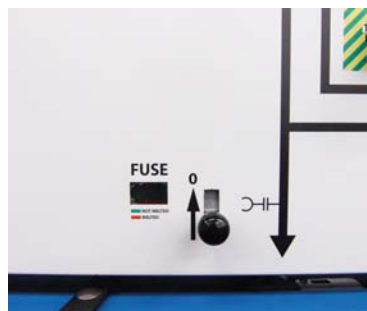
Each fuse protection function includes three fuse holders with its corresponding base covers. This set is able to work in flooding conditions because of being completely sealed by its joints.



The fuse holders are located in the gas tank. The fuse holders hold 36 kV fuses in agreement with the standard IEC-EN 60282-1.

1.2.7 Light signal of fuses state

Each fuse protection function includes a signal panel which show fuses state. When the indicator signal is green, all fuses are operatives. On the other hand when the indicator signal is red, one or more fuses are melted.



1.3 Sheet of characteristics

In the upper door of the panel is located the sheet of characteristic in which all the data about the product according with the international standard IEC 62271-200 is provided.

TYPE: Product name.

SERIAL NUMBER: Serial Number of the Panel

YEAR OF MANUFACTURE: Panel Year of Manufacture.

U_r: Rated Voltage. [kV]

U_p: Lightning Impulse Withstand Rated Voltage. [kV]

U_d: Rated Withstand Voltage at Power Frequency. [kV]

I_r: Rated Current in Constant Service. [A]

I_k/I_t Short-Time Withstand Current. [kA]

I_p: Rated Peak Withstand Current (main and earthed circuits). [kA]

f_r: Rated Frequency. [Hz]

WEIGHT OF SF₆: Isolating fluid and weight. [kg]

RATED PREASURE FOR FILLED GAS TANK: Gas Pressure in the tank [bar]

INTERNATIONAL STANDARD CERTIFICATION: The current certification for the product is IEC 62271-200

1.4 Indicator of voltage presence

In the MV cables bushings, two capacitive connectors which are connected to the voltage presence equipment are provided. This device that indicates the presence of voltage shows three signals corresponding with each of the phases, indicating the presence of voltage in each of them with flashes.

This unit is in the upper door, located over each one of the functions that include the panel. It is possible to extract it in order to be able to check in a properly manner without removing none part of the panel.

Plugging bases of the aforementioned unit are fixed to the upper door. Special care is required to remove this door. It is necessary to extract the connections from the capacitive insulators, which are located in the cables area, until the upper door.



1.5 Busbar

MAIN CIRCUIT BUSBAR

The main circuit busbars are composed of ETP solid bars or C-110 plates according with standards IEC-EN 12164 and IEC-EN 13601 respectively.

EARTH CIRCUIT BUSBAR

The earth circuit busbar located outside the SF₆ tank is composed of ETP solid copper according with IEC-EN 13601.



1.6 Interlocking and blocks

1.6.1 Interlocking

The main switch disconnecter, automatic breaker and ground disconnecter are interlocking between them.

All the functions include interlocking between the operating axis. Its function is to avoid that the operating bar may enter in one or another axis, because the position of main switch disconnecter, automatic breaker or ground disconnecter have a vertical or horizontal runners which may or not move to positions that cover or uncover the corresponding operating axis.

The interlocking carried out by each function are the following:

LINE FUNCTION:

Standard conditions of service:

1. It is not possible to open the entrance door of the cables with the ground disconnector opened.
2. It is possible to open the ground disconnector with the door of the cables opened
3. It is not possible to close the main switch with the ground disconnector closed.
4. It is not possible to close the ground disconnector with the main switch closed.

Cables testing:

1. It is not possible to open the ground disconnector without operating the cables testing device.
2. It is not possible to release the testing cables device or close the entrance door of the cables with the ground disconnector opened.
3. It is not possible to operate the main switch with the testing device of the cables operating.

PROTECTION FUNCTION

1. It is not possible to open the door(s) or fuse(s) with the ground disconnector opened.
2. It is not possible to open the ground disconnector with the door(s) of the cables or fuses opened.
3. It is not possible to close the main switch with the ground disconnector closed.
4. It is not possible to close the ground disconnector with the main switch closed.

PROTECTION FUNCTION WITH AUTOMATIC BREAKER

1. It is not possible to open the entrance door of the cables with the ground disconnector opened.
2. It is possible to open the ground disconnector with the door of the cables opened.
3. It is not possible to close the automatic breaker with the ground disconnector closed.
4. It is not possible to close the ground disconnector with the automatic breaker closed.
5. It is not possible to operate (open or close) the disconnector if the automatic breaker associated is closed.
6. It is not possible to close the disconnector if the ground disconnector associated is closed.
7. It is not possible to close the ground disconnector if the disconnector associated is closed.

CROSSING DISCONNECTOR FUNCTION

This function is not provided of interlocking.

MEASUREMENT FUNCTION

This function is not provided of interlocking.

STEP UP FUNCTION

This function is not provided of interlocking.

1.6.2 Block by means of padlock

Each position can be blocked by padlocks of 8mm maximum diameter.

Padlocking is possible on the switch disconnecter and circuitbreaker and ground disconnecter.



The door can be padlocked as well with 8mm maximum diameter padlock.



The entrance to the axis of the switch and disconnecter associated and to the automatic breaker can be blocked by means of padlock.

1.7 Electrical Characteristics

RV36 SWITCH DISCONNECTOR	
TYPE	E3
Standard certification of the panel	IEC 62271-200
Standard certification of the switch	IEC 60265-1
Installation Type	Indoor
Phase Number	3
Collecting Bars Number	Simple bar
Rated Voltage	36 kV
1,2/50 μs Lightning Impulse Withstand Rated Voltage	
To earth and between phases	170 kV-peak
At the isolating distance	195 kV-peak
Rated withstand voltage at power frequency 50 Hz 1 min	
To earth and between phases	70 kV
At the isolating distance	80 kV

Frequency	50-60 Hz
Rated Current of Fuses Protected Output	200 A
Rated Current	400 / 630 A
Rated Short-Time Withstand Current	16/20 kA
Peak Value of Short-Time Withstand Current	40 / 50 kA _{peak}
Short Circuit Duration	1 s
Breaking Capacity	
Mainly active current	400 / 630 A
Cable-charging current	31,5 A
Earth fault current	50 A
Cable-charging under earth faults.	25 A
Line-charging current	25 A
Close loop current	40 / 50 kA _{peak}
Mechanical hardness type	M1 / M2
Degree of protection against solid foreign objects	IP2X
Degree of protection against mechanical impacts	IK08
SF ₆ Tank degree of protection	IP67
Equipment type under metallic envelope	Block
GROUND DISCONNECTOR-FUSES INPUT	
Standard certification	IEC 62271-102
Rated voltage	36 kV
1,2/50 μs Lightning impulse withstand rated voltage	125 kV-peak
Rated withstand voltage at power frequency 50 Hz 1 min	70 kV
Frequency	50-60 Hz
Short-time rated current	16 / 20 kA
Peak values of short-time withstand current	40 / 50 kA _{peak}
Short circuit duration	1s
Short circuit closing capacity	40 / 50 kA _{peak}
GROUND DISCONNECTOR-FUSES OUTPUT	
Short circuit closing capacity	2,5 kA-peak
Short-time rated current	1 kA
Short circuit duration	1s
AUTOMATIC VACUUM BREAKER	
Type	WL-36093P
Kind	C2
Standard certification of the panel.	IEC 62271-200
Standard certification of the automatic breaker.	IEC 62271-100
Installation type	Indoor
Phase number	3
Collecting bar number	Simple bar

Rated voltage.	36 kV
1,2/50 μ s Lightning impulse withstand rated voltage. To earth and between phases.	170 kV-peak
At the isolating distance	195 kV-peak
Rated withstand voltage at power frequency 50 Hz 1 min. To earth and between phases.	70 kV
At the isolating distance	80 kV
Frequency	50-60 Hz
Recovery Transitional Voltage	66 kV
TTR Nominal slope	0,57 kV/ μ s
Closing time	65 ms
Arc duration	<17ms
Approximate total time of opening	70 ms
Rated current	630 A
Short-time rated current.	20 kA
Peak values of short-time withstand current	50 kA-peak
Short circuit duration	1s
Nominal current of circuit breaker	20 kA
Short circuit closing capacity	50 kA-peak
Mechanical hardness	10.000
Degree of protection against solid foreign objects	IP2X
Degree of protection against mechanical impacts	IK08
SF ₆ Tank degree of protection	IP67
Equipment type under metallic envelope	Reinforced
GROUND DISCONNECTOR	
Standard certification	IEC 62271-102
Rated voltage	36 kV
1,2/50 μ s Lightning impulse withstand rated voltage	170 kV-peak
Rated withstand voltage at power frequency 50 Hz 1 min	70 kV
Frequency	50-60 Hz.
Short-time rated current	20 kA
Peak values of short-time withstand current	50 kA-peak
Short circuit duration	1s
Short circuit closing capacity	50 kA-peak

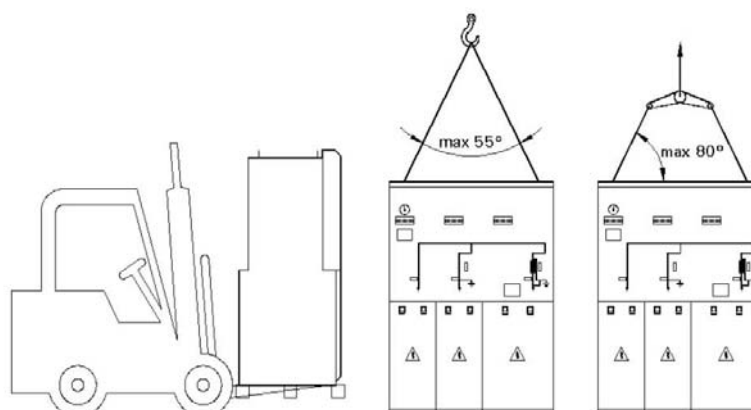
2 TRANSPORT AND OPERATION

The DI-2 panels are delivered totally plastic-wrapped and fixed in a pallet. Do not remove the packing is advised until it will be located in its final position.



Panels have to be in vertical position, on a pallet or on the floor.

A forklift truck must be used for its operation. The panel will be always located in front of the driver in order to avoid potential damages in the front. Slings or rocker arms are also valid. These are fixed to the elevator pieces, which are located in upper area of the panels, in order to pull in a vertical direction with an angle of 55° for slings and of 80° for rocker arms.



In case of forklift truck transport, it should be considered that gravity center is quite high and therefore it is easy to turn over

3 STORAGE

Conditions for storage are the following:

Vertical position.

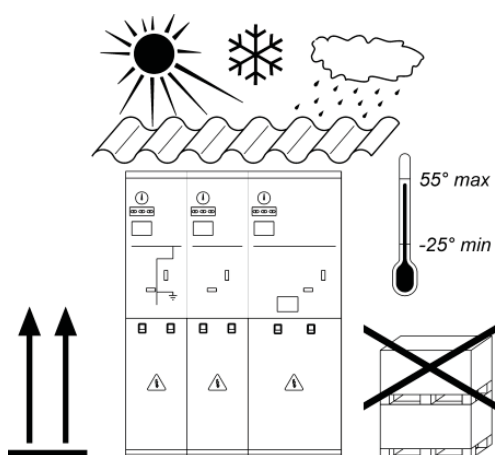
Not to pile up.

Rain protection.

Direct solar radiation protection.

Range of temperature for storage: -25 °C y 55 °C.

After time of storage and before installation, DI-2 panels must be carefully cleaned in particular all the insulating parts.



4 INSTALLATION

4.1 General tips

To transport the panel from the storage to the installation place with its original packaging is recommended.

The place of installation must have similar conditions than the storage place, in other words, the panel must be protected against rain and direct solar radiation. Temperature in the installation place must not be lower than $-10\text{ }^{\circ}\text{C}$ and higher than $55\text{ }^{\circ}\text{C}$.

The DI-2 panels are supplied with a plastic wrap protection. SGC nv - SwitchGear Company recommends a visual inspection in order to check if the panel has suffered damages in the transport. In case of verifying any type of damage, before installation, please contact with SGC nv - SwitchGear Company's technical department. From the point of view of people security, the distance to the walls or lateral panels must be of a minimum of 50 mm and to the back walls of 100 mm.

The thickness of the service corridors must be wide enough to allow an easy operation and inspection of the installations as well as free motion and transport of devices in the installation and maintenance operations.

This thickness will not be lower than the following:

Operation corridors with voltage elements in one side. 1000 mm.

Operation corridors with voltage elements in both sides. 1200mm.

Inspection corridors with voltage elements in one side. 800 mm.

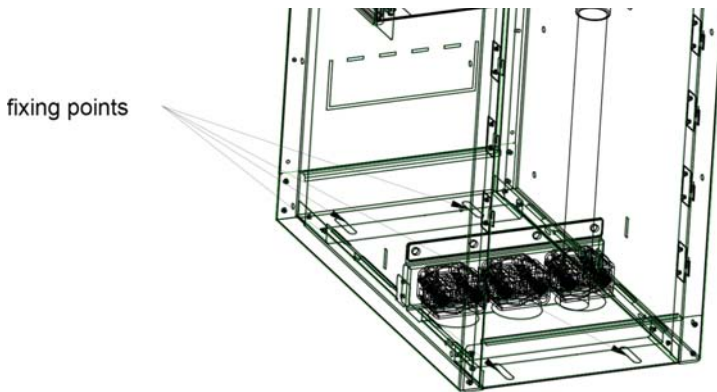
Inspection corridors with voltage elements in both sides. 1000mm.

The aforementioned values must be totally open, in other words, measured between the projecting elements such as controls, rails, etc.

NOTE. The distance between the panel ceiling and the installation place ceiling will be of a minimum of 300 mm in the traditional transformer substations. In the compact type with outside operation, this high can be of 40 mm.

4.2 Fixing

The panel must be fixed directly on the floor or different sections, therefore 4 holes of 13 mm diameter are located in its inferior part. In order to access to these positions, is required to remove the inferior doors.



4.3 Junction of panels

Union between extensible DI-2 panels in order to connect them electrically and mechanically is made by SGC nv - SwitchGear Company double connectors. This system allows the panels connection without entering in the gas compartment.

The system is composed of three connectors which are located in the bushings and sealed the joint, monitoring the electric field.

In order to carry out the proper junction between the extensible panels of the DI-2 system or the proper installation of the insulated cover for internal cone bushings protection, the following tools must be available:

- 2 Key 12-13.
- 1 13 mm Dynamometric key and 10 mm small opening.
- 1 Acetone bottle.
- 1 Clean and dry cloth.

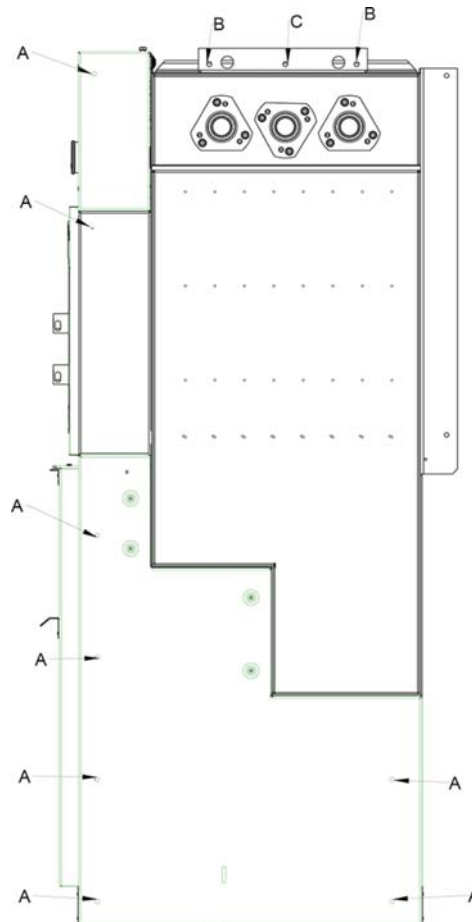
1. Locate the first panel in the corresponding position in the transformer substation.
2. Clean the internal cone bushings in both panels and the coupling connector with a clean and dry cloth.
3. Lubricate with the silicone grease that is supplied with the connector, the junction surface of the bushings and connectors.
4. Insert nylon wires (in order to evacuate air between bushing and connector) at the same time that the connectors.



5. Screw on the earth wire of the connectors with a hexagonal bolt M8x20 ISO 4017 and two washers M8 according with DIN 125.



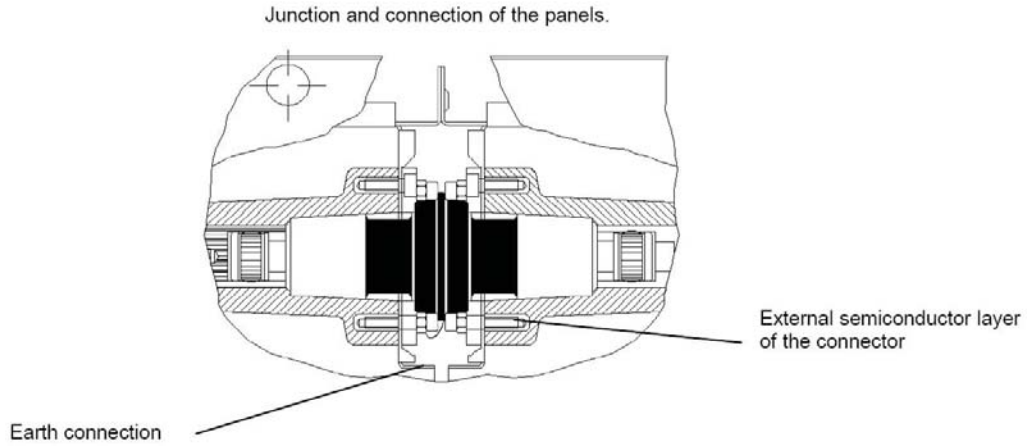
6. Fix the neoprene joint all around the panel.



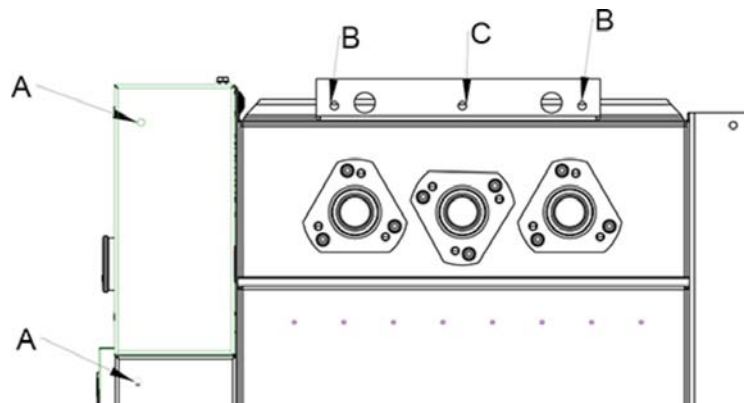
7. Remove bolts of the earth general line.



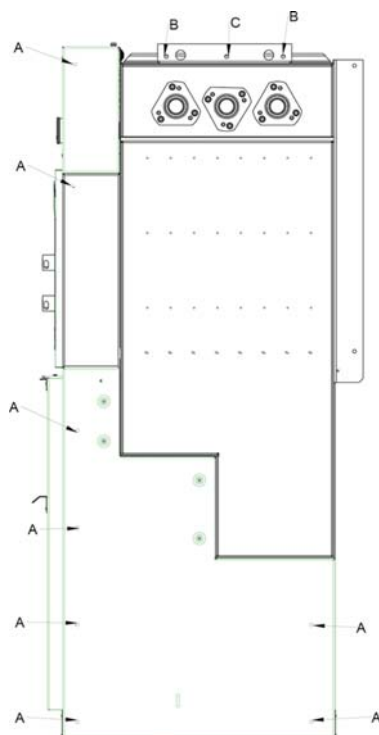
8. Move the second panel according with the figure below and remove the nylon wires.



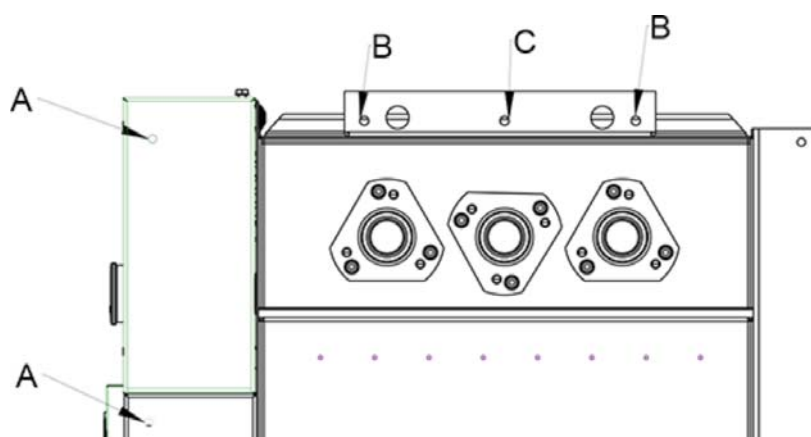
9. Join the panels in B positions as showed in the figure below using hexagonal bolts M8x60 ISO 4017, two plain washers M8 according with DIN 125 and two nuts M8 ISO 4032.



10. Join the panels in A positions as showed in the figure below, using three hexagonal bolts M8x25 ISO 4017, three plain washers M8 DIN 125 and three nuts M8 ISO 4032.



11. Join the panels in C position as showed in the figure below using an hexagonal bolt M8x25 ISO 4017 and a plain washer M8 ISO 4032.



12. Join the general earth lines of the panels.



4.4 End of panels

The extensible panels prepared for a future extensibility of the transformer substation must include insulated covers to protect the internal cone bushings.

The proper installation of such insulated covers must be carried out according with the following instructions:

1. Clean carefully the bushing internal faces.
2. Lubricate with the silicone grease that is supplied in the kit, the insulate silicone body and in the bushing internal faces.
3. Insert the insulate silicon body of the cover in the bushing with the clamp in order to remove the air.



4. Remove the clamp when the cover is located at the bottom of the bushing.
5. Fix the sheet screwing three bolts.



4.5 Grounded equipment

When the cell is fixed on its final location, it must be earthed by connection of the side plates to the general earth line of the transformer substation.



Note.- It is an essential condition of security for the equipment to be earthed.

4.6 Connection of cables

Service line of medium voltage, outputs to transformers and other panels are carried out by cables.

Junction operations of the connectors to the cables will be carried out by qualified personnel who are duly trained and follow the instructions of the connector manufacturer in detail.

In the DI-2 system of panels, cables for line function and automatic protection must use 630 A connectors.

For protection functions, cables must be manufactured with plug-in connectors of 250 A.

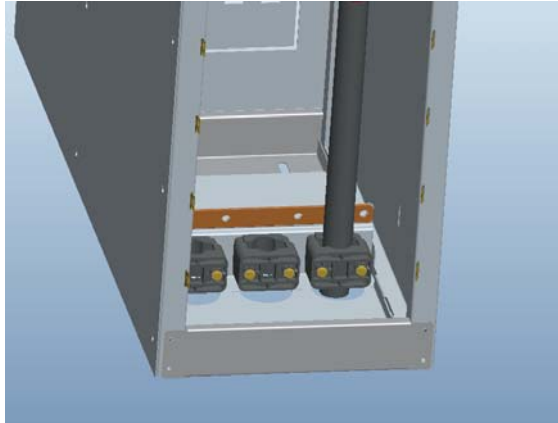
4.6.1 Installation steps

In order to connect the cables, follow the instructions taking into account that shield is not a protection against direct contacts. It is totally forbidden to handle the connectors with voltage although these were shielded.

When there is a system with voltage and in the upper busbar a reserve panel with voltage and without cables in the inferior bushings is left; insulated covers for the bushings or connection of the ground disconnector blocking this position with a lock or padlock is required.

Sequence of steps:

1. Connect the ground disconnector.
2. Remove the door of the cables.
3. Remove the bushing protection, clean with a dry cloth and lubricate all the contact surface of the cable with silicone grease supplied with the connector.
4. Connect the terminals on the frontal bushings.
5. Fix the first clamp.
6. Lean the cable on the clamp, move and tighten the next clamp against the cable and block it in this position.



7. Repeat this action with the rest of the cables.
8. Connect the earth wires of the cables and the terminals to the general earth line of the panel.
9. Put the door in its position.

4.7 Fuses

A fuse inserted in an electric circuit is devoted to protect this circuit and its associated elements permanently. The manner in which the fuse will work, not only depend of the manufactured precision but also of its proper manufacture.

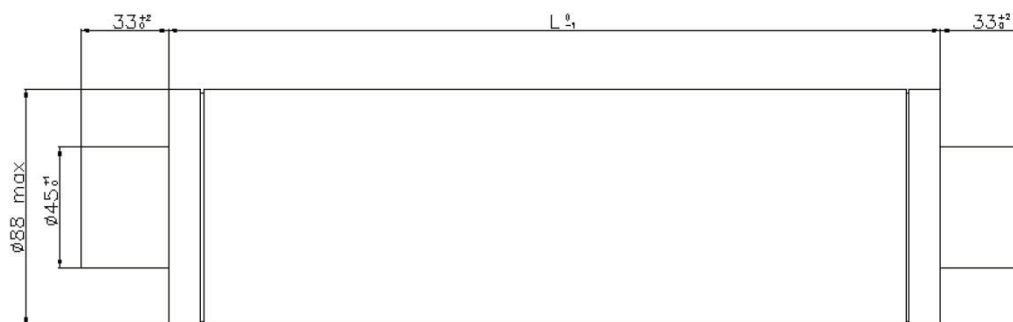
The fuse cartridge will be stored in its original packaging up its use. Before its operation, it must be checked that all fuse cartridge do not have a fall or knock which could break some of its internal conductors.

4.7.1 Fuse selection

To select an appropriate fuse of rated voltage 24 or 36 kV, the following considerations are taken into account:

All the fuses implemented in the DI-2 panels must be manufactured in agreement with IEC 60282-1 and with the following dimensions:

kV	L
24	442
36	537



Fuse rated current is generally higher than normal current of service, therefore, rated current will be chosen in agreement with the rated power and voltage of the transformer according with the following table:

Power kVA	Rated Voltage kV					
	25-28		30-36			
Transformers current A						
10						
15	0.35		2			
20	0.46		2	0.4		2
25	0.57	0.64	2	0.5		2
50	1.15	0.64	4	1	0.64	4
75	1.73	1.6	6	1.4	0.64	6
100	2.3	2	8	1.9	1.6	6
125	2.9	2	8	2.4	2	8
160	3.7	3	10	3.1	2	8
200	4.6	4	12.5	3.8	3	10
250	5.7	5	12.5	4.8	4	12.5
315	7.3	7	16	6	5	16
400	9.2	7	20	7.7	7	20
500	11.5	10	25	9.6	7	20
630	14.5	10	32	12.1	10	25
800	18.5	15	40	15.4	10	32
1000	23.1	20	50	19.2	15	40
1250	28.9	25	63	24	15	50
1600	37	30	80	30.8	25	63
2000	46.2	40	100	38.5	30	80
2500	57.7	50	125	48.1	40	100

Fuses losses should not be greater than 50 W, when working at the current corresponding with maximal charge of the transformer. Without this information, when working in the air, should be at 50 % of its rated current.

Inaccurate selection of the fuse rated current may deteriorate fuses, contacts or metallic housings of the panel.

4.7.2 Fuse substitution

Substitution tasks can be carried out with the equipment connected or not. The cables door of the protection function should be opened. This forces the main switch disconnecter to be opened. The grounded disconnecter which earthed both terminals of the fuse should be closed. This implies that the upper busbar would have current.

It is recommended to replace the three fuses of the three-phase circuit though fuses of one or two phases were still working unless, it is certainty known that no over current were circulating through the no fused fuses.

Sequence of steps:

1. Remove the door of the cables in order to access to the fuse holders. The main switch should be opened.
2. Close the grounded disconnecter.
3. Open the cables door.



4. Lift the handle of the fuse holders and pull in order to remove it.



5. Remove the rail of the fuse holder.



6. Remove the fused fuse, avoiding to rest the fuse holder on a surface that could get dirty the holder or the contact.
7. Insert the rail fuse holder sliding.



8. Reset the fuse holder striker up to block it in this position.



9. Place the fuse holder sliding up to the holder limit and put down the handle checking that it is blocked in this position.

10. Close the door of the cables.

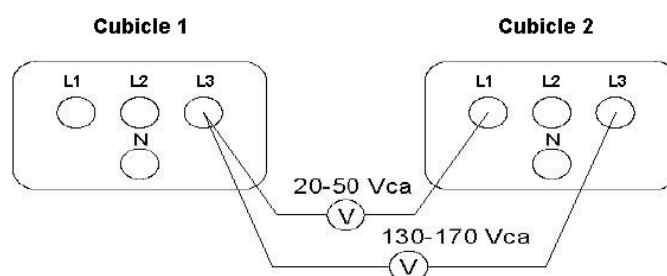
11. Start the panel.

4.8 Phases consistency

Once the medium voltage panels are fixed and connected in the transformer substation, its correct connection has to be verified, checking the consistency of the phases.

It is possible to measure the consistency of the phases with a multimeter of input impedance higher than $20\text{M}\Omega$ ($20\text{K}\Omega/\text{V}$ scale of 1000V)

Considering that the measurement range will be the following:



Between a phase and neutral of the same base $\sim 110\text{ Vac}$.

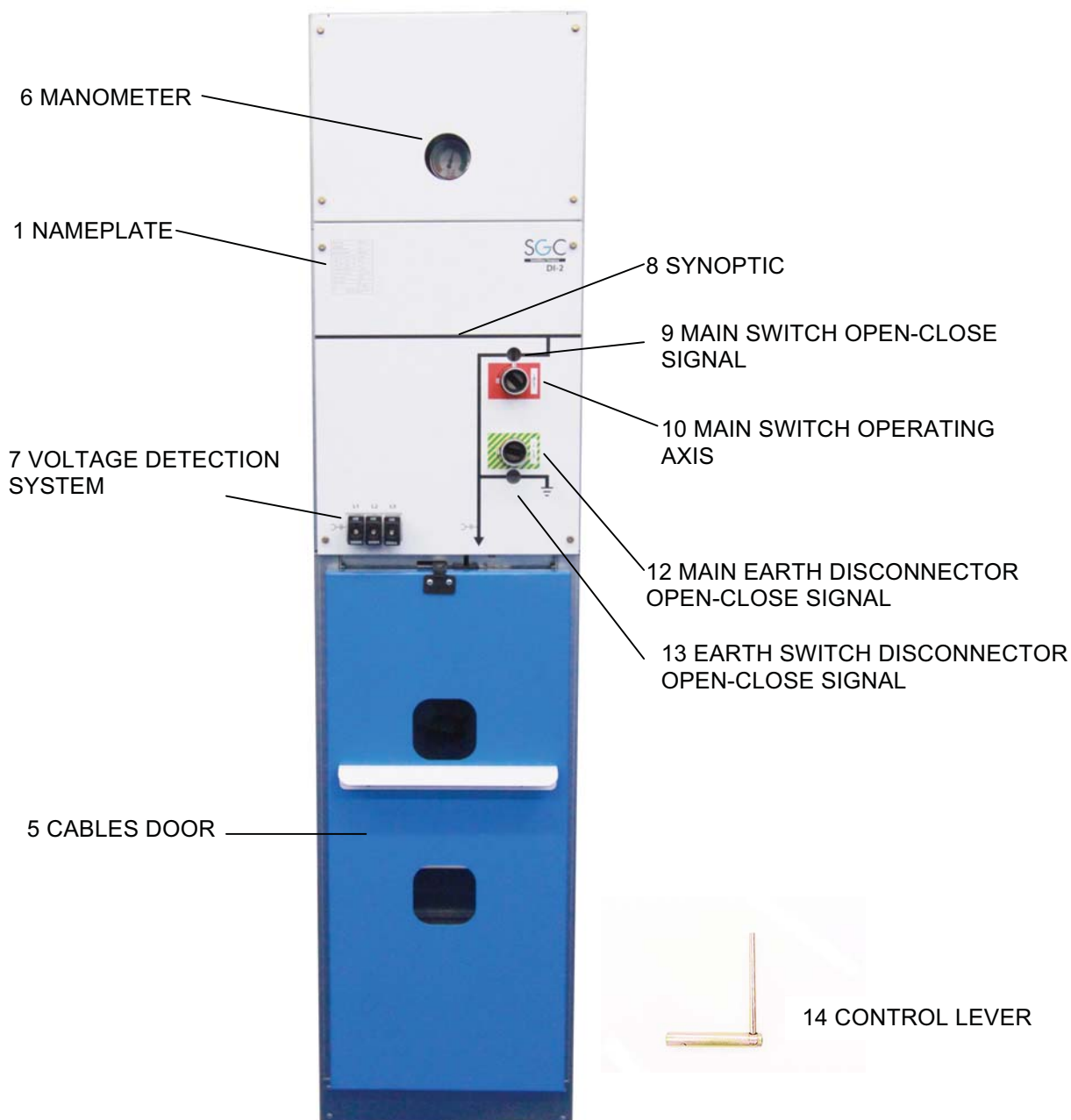
Between different base phases $< 50\text{ Vac}$.

Between different phases $> 130\text{ Vac}$.

5 OPERATING SECUENCY

Note: Before operating, it must be checked that manometer pressure is located in the green area, according with the panel pressure, showed in the sheet of characteristics. When the voltage indicators are switched off, it must be checked that are working correctly.

5.1 Line function



NOTE. - Be a blockage that impedes operating on the disconnector switch with the cables door (5) open and / or earth switch closed.

DISCONNECTOR SWITCH CLOSE

1. Close the access cover to cables (5).
2. Open the earth switch disconnecter.
3. Check the opening in the earth switch disconnecter gauge (13).
4. Put the control lever (14) in the control embrasure (10) and turn clockwise to close the disconnecter switch.
5. Check the close in the main switch open-close signal (9).

SWITCH DISCONNECTOR OPEN

1. Put the control lever (14) in the control embrasure (10) and turn counterclockwise to open the switch disconnecter.
2. Check the opening in the main control switch open-close signal (9).

CHECK VOLTAGE ABSENCE.

1. To check the voltage absence the voltage indicators must be off (7).

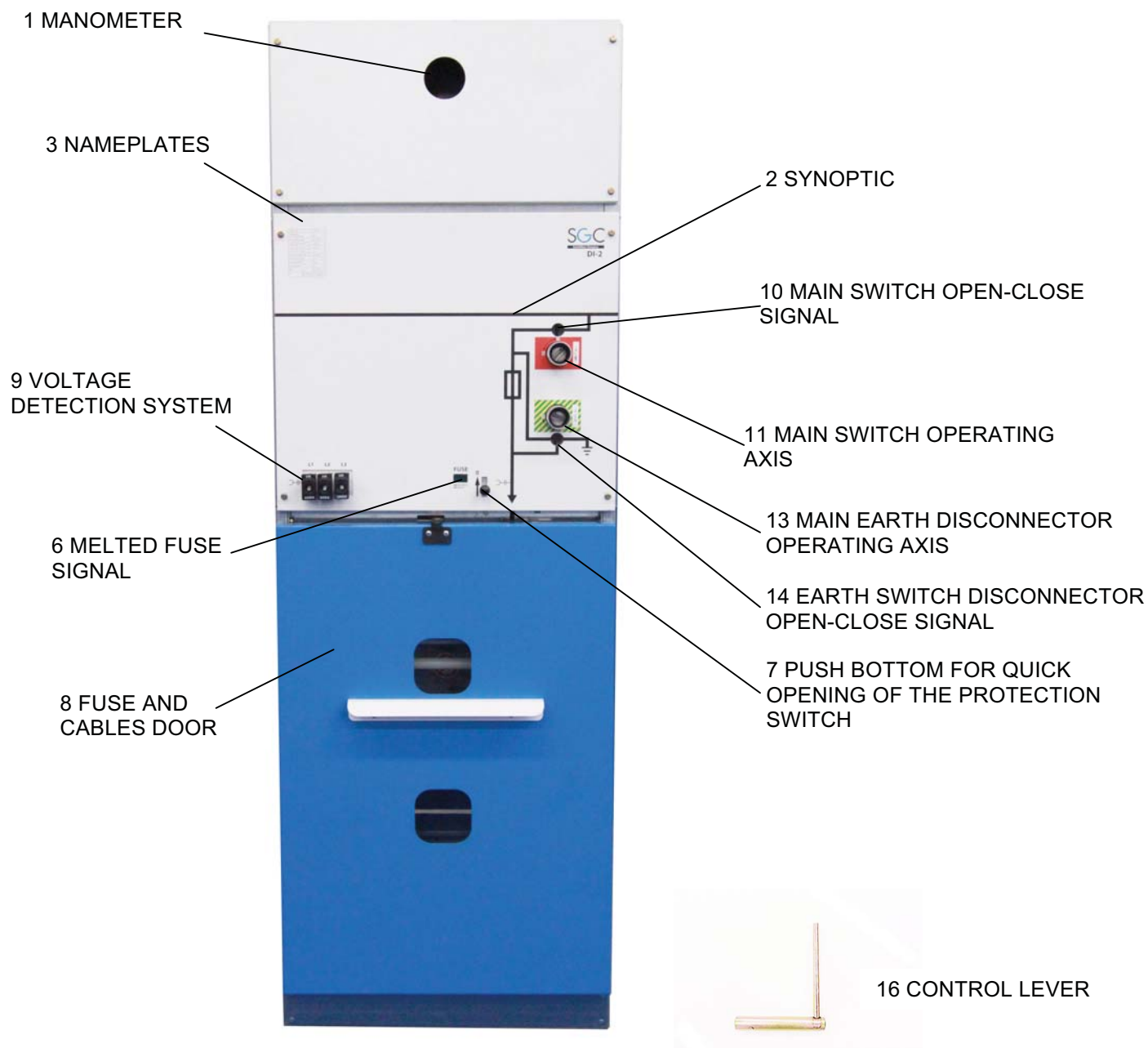
EARTH SWITCH DISCONNECTOR CLOSE

1. Open the switch disconnecter.
2. Check voltage absence.
3. Put the control lever (14) in the control embrasure (12) and turn clockwise to close the disconnecter switch.
4. Check the close in the main switch open-close signal (13).

EARTH SWITCH DISCONNECTOR OPEN

1. Put the control lever (14) in the control embrasure (12) and turn counterclockwise to open the earth switch disconnecter.
2. Check the open in the earth switch disconnecter open-close signal (13).

5.2 Protection function



NOTE.-Be a blockage that impede operating on the disconnector switch with the cables and fuses door (8) open and / or earth switch closed.

DISCONNECTOR SWITCH CLOSE

1. Close the access cover to cables and fuses (8).
2. Open the earth switch disconnecter.
3. Check the opening in the earth switch disconnecter gauge (14).
4. Put the control lever (16) in the control embrasure (11) and turn counterclockwise to resetting the equipment.
5. Put the control lever (16) in the control embrasure (11) and turn clockwise to close the disconnecter switch.
6. Check the close in the main switch open-close signal (10).

SWITCH DISCONNECTOR OPEN

1. Put the control lever (16) in the control embrasure (11) and turn counterclockwise to open the switch disconnecter or operating the push bottom for the quick opening of the protection switch (7).
2. Check the opening in the main control switch open-close signal (10).

CHECK VOLTAGE ABSENCE.

1. To check the voltage absence the voltage indicators must be off (9).

EARTH SWITCH DISCONNECTOR CLOSE

1. Open the switch disconnecter.
2. Check voltage absence.
3. Put the control lever (16) in the control embrasure (13) and turn clockwise to close the disconnecter switch.
4. Check the close in the main switch open-close signal.

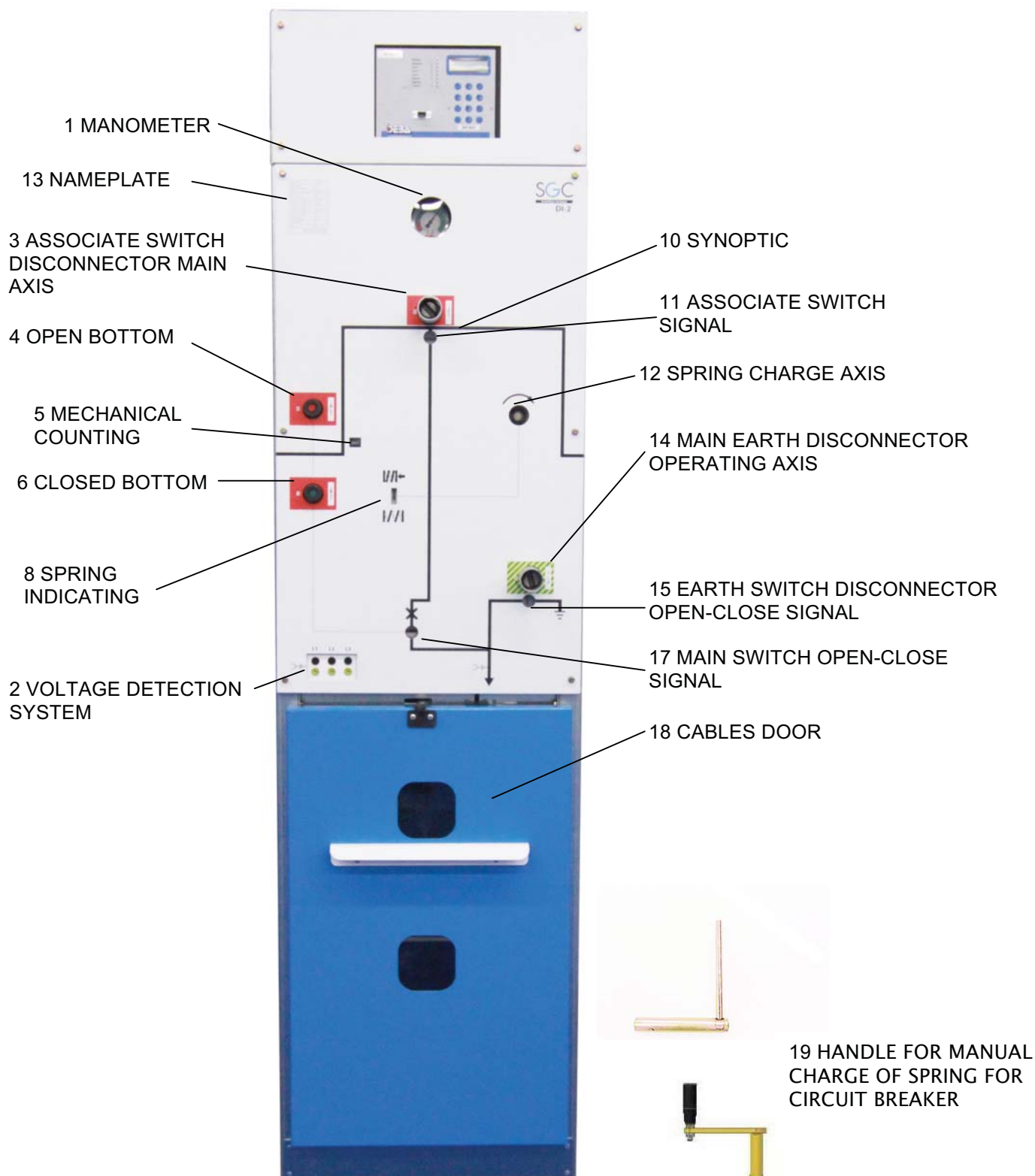
EARTH SWITCH DISCONNECTOR OPEN

1. Release the control embrasure of earth switch disconnecter (13) with the vertical blockage (12) and closing the cables door (8).
2. Put the control lever (16) in the control embrasure (13) and turn counterclockwise to open the earth switch disconnecter.
3. Check the open in the earth switch disconnecter open-close signal (14).

FUSES ACCESS

1. Open the switch disconnecter.
2. Check the voltage absence.
3. Close the earth switch disconnecter.
4. Open the fuse and cables door (8) moving the horizontal blockade device (15).

5.3 Circuit breaker function with protection relay



Nota.- Be a blockage that impedes operating on the earth switch disconnector with the disconnector switch or associate switch disconnector closed or cables door open.

DISCONNECTOR SWITCH CLOSE.

1. Close the access cover to cables and release the control embrasure of earth switch disconnecter.
2. Open the earth switch disconnecter.
3. Check the opening in the earth switch disconnecter signal.
4. Release the control embrasure of associate switch disconnecter with the vertical blockage.
5. Put the control lever in the control in the control embrasure and turn clockwise to resetting the equipment.
6. Check the close in the associate switch disconnecter signal.
7. If It's necessary charge the completely the springs putting the spring lever in it control embrasure and turn counterclockwise completely.
8. To close the automatic breaker push the closed bottom.
9. Check the close in the asóciate switch signal.

SWITCH DISCONNECTOR OPEN.

1. Pus the open bottom to open the switch disconnecter.
2. Check the opening in the switch disconnecter signal.
3. Release the control switch embrasure of associate switch signal.
4. Put the control lever in the control in the control embrasure and turn counterclockwise to open the switch disconnecter.
5. Check the opening in the associate switch signal.

CHECK VOLTAGE ABSENCE.

1. To check the voltage absence the voltage indicators must be off.

EARTH SWITCH DISCONNECTOR CLOSE

1. Open the switch disconnecter and the associate switch disconnecter.
2. Check voltage absence.
3. Release the control embrasure of earth switch disconnecter with the vertical blockage.
4. Put the control lever in the control embrasure and turn clockwise to close the disconnecter switch.
5. Check the close in the main switch open-close signal.

EARTH SWITCH DISCONNECTOR OPEN

1. Release the control embrasure of earth switch disconnecter with the vertical blockage and closing the cables door.
2. Put the control lever in the control embrasure and turn counterclockwise to open the earth switch disconnecter.
3. Check the open in the earth switch disconnecter open-close signal.

6 TEST OF CABLES

The line functions in the modular and compact system include a mechanism which allows to carry out the test of the cables.

SEQUENCE OF OPERATIONS:

1. Open the switch.
2. Close the ground disconnector.
3. Open the acces cover to the cables.
4. Open the ground disconnector.
5. Carry out the test of cables.
6. Close the ground disconnector
7. Move the horizontal interlocking slide in order to release the mechanism of cable test.
8. Open the ground disconnector.
9. Close the switch.

7 LOCATION OF THE CURRENT COLLECTOR

In the remote control panels, the current collector for phases is located in the cables door of each line function, as well as the divided core current collector for homopolar



8 SECURITY

High voltage switchgear is only considered safe when it has been installed in agreement with the required installation rules and used and maintained according with the instructions of this guide.

8.1 Security elements

The installation place must fulfill with the security requirements in agreement with the legislation currently in force, having the following security elements:

- Isolating foot stool.
- Medium voltage insulated gloves.
- Safety helmet.
- Protective shield.
- Fire extinguisher of 89B minimum efficiency.
- Warning signs of danger.
- Emergency phone numbers.
- Poster with the five golden rules for working without voltage:
 - o Insulate the whole assembly from the active parts.
 - o Ensure the assembly against possible accidental connections.
- Check that the assembly is with no-voltage.
- All possible voltage sources affecting the work area must be in earth and short-circuit position.
- Delimit working areas by placing the right safety signs.

8.2 User security cautions

The user should:

- Restrict the access to the installation for trained and authorized people.
- Train regularly operators and rest of the personnel in relation with risks and security requirements, including the local rules.
- Keep the equipment in right conditions and updated in relation with technical rules, especially interlocking and protection devices.
- Select equipment which minimizes risks derivate of personnel inaccurate operation (for instance, grounded disconnecter in lines, motorized operating axis for allowing remote control).
- Coordinate the protection system with properties of the product (for instance, do not carry out resets with internal faults).
- Make earthed procedures considering the reference difficulty and the understanding of complex regulations and the switchgear operation.
- Equip clearly the equipment for an easy identification of the individual devices and gas compartments.
- Especially for maintenance, reparation or extension:
 - o Assure that the maintenance works, reparation and extension will be carried out only for trained personnel.

- Provide a security and protection plan. Indicate the responsible of planning, implement and fulfill the security and protection rules.
- Before starting, check the interlocks and the protection devices.
- Pay special attention to the manual operations, especially when the switchgear has voltage.
- Inform before operating to the personnel who may stay close to the switchgear (for instance with a siren or light signal).
- Signpost emergency exits and keep areas free of obstacles.
- Train the personnel in how to work in safe way in the switchgear and what to do in an emergency situation.

9 MAINTENANCE

Maintenance of this type of installations must be carried out by qualified personnel according with the law in force in order to install and operate voltage equipments.

The DI-2 panel systems have a lifespan higher than 30 years, as long as the installation will be made according with this manual. In addition accurate fuses and cables must be used and connectors must be perfectly made and installed.

The electrical and mechanical tests carried out in high quality national and international laboratories guarantee the accurate operation of the disconnector elements.

It is recommended to carry out the following actions.

Once a year and without disconnecting the panel, it will be checked:

SF₆ gas pressure.

Manometer pointer located in the green area.

If the pointer is located in the red area, please contact with SGC nv – SwitchGear Company's technical-commercial department and do not operate the panel.

If the pointer is close to the red area, the service will be normal but a new inspection must be made in a maximum of three months. However, it should be reported to SGC nv – SwitchGear Company's technical-commercial department who will give the appropriate instructions.

Operation of voltage indicators.

To check the operation of voltage indicators, panel signals must be disconnected of its base and to supply with testing terminals with a minimum voltage of 30 Vca between phase and neutral and each one of the phases. It should be checked that each one of the three signals are flashing. It can be connected either of phase and neutral because there is no polarity.

In case of one or more light signs do not shine; this unit must be replaced for an original one.

The voltage indicator can be replaced if needed. In this case, screws which are fixing the upper door and others located at left and right side of the indicator must be removed.

Subsequently, switch the indicator back connector off without disconnecting the line voltage.

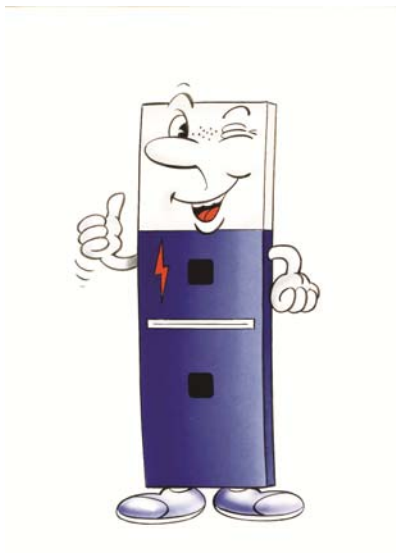
10 SPARE PARTS

SGC nv - SwitchGear Company original spare parts are required if some replacement is needed. Fuses replacement must be made with SGC nv - SwitchGear Company fuses, following the instructions given in this manual. Any kind of replacement or change must be made by SGC nv - SwitchGear Company authorized personnel. SGC nv - SwitchGear Company suggests having, in the installation place of the DI-2 panels, the following spare parts: three fuses and an operating axis.

11 ENVIRONMENTAL INFORMATION

The DI-2 panel systems are metal enclosed manufactured with SF₆. Sulphur hexafluoride (SF₆) is a gas with excellent dielectric properties which allow rapid electric arc extinction and therefore it has been widely used in medium voltage switch and panels

SF₆ is a greenhouse gas effect whose Atmospheric Warming Potential (AWP) is of 22.200 units. Therefore, its releasing must be controlled and reduced according with the laws in force in each country and requirements of the Kyoto Protocol. Until now, there is no gas which can replace the SF₆ despite of research efforts carried out. In consequence, there is a global responsibility of rational and responsible use of this product. Therefore, SF₆ must be recovery for recycling and treatment at the end of product useful life, avoiding its releasing to the atmosphere. This extraction must be carried out by qualified personnel.



THE SPECIALIST IN **MEDIUM VOLTAGE SWITCHGEAR**