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	MV RMU - UNDERGROUND SWITCHGEAR	GSCM007 Rev. 0 06-2020

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MV RMU - UNDERGROUND SWITCHGEAR


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1 SCOPE

This specification is intended to describe the characteristics required for the supply of medium voltage Ring Main Unit (RMU) consisting of:

- MV RMU circuit-breaker
- MV RMU switch disconnecter
- MV RMU transformer protection
- UP and RGDM (described in other specifications)
- Accumulators for powering remote control devices (according GSCB001 specification)

The equipment shall be designed to operate at a voltage of 24 kV or 36 kV and a frequency 60Hz effectively and non-effectively earthed neutral system, as it is intended to be used in 60 Hz network systems where Enel owned DSOs are present.

All switch components shall be assembled in a hermetically sealed, welded, stainless steel tank. RMU shall be filled with SF6 at factory site.

The supply is intended complete with RMU and the case containing the automation equipment:

- RGDM (as many as the lines feeders of the RMU)
- UP (one for RMU)
- accumulators

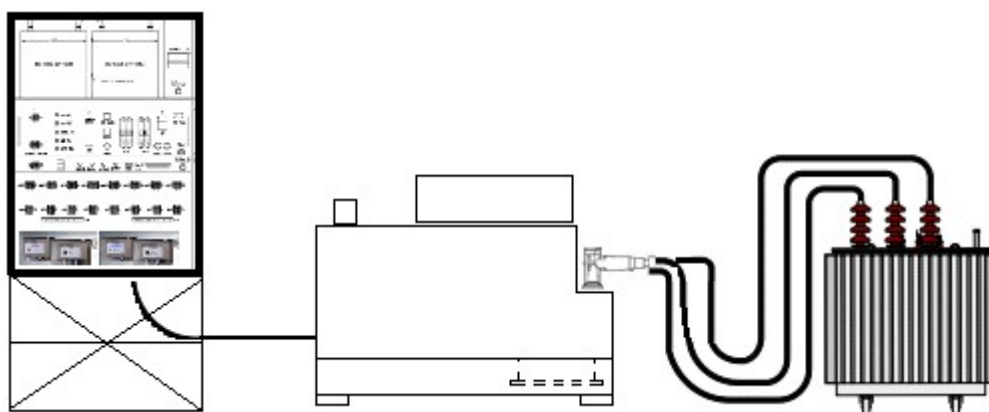



Figure 1 - installation example

1.1 Application

Gas insulated switchgear for RMU applications (underground MV lines operation and/or protection and power transformer protection) shall be able to function and operate completely immersed in water for indefinite periods.

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The equipment will be installed on the floor of an underground cabin.


1.2 Configurations and application range

BASIC EQUIPMENT	CONFIGURATIONS	I_{th}	U_n
CBL	2CBL	20 kA	24 kV
	3CBL		
	4CBL		
	5CBL		
L	3L		
	4L		
CBL + L	1CBL+1L		36 kV
	3CBL+1L		
	2CBL+1L		
	4CBL+1L		
	1CBL+2L		
	1CBL+4L		

Note:

- CBL: Circuit breaker and line disconnecter
- L: RMU Switch disconnecter

Transformer protection (if required) shall be performed with circuit breaker panels. Characteristics of the transformers will be indicated during TCA process in order to set up properly the control panel.

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2. LIST OF COMPONENTS

Type code	Description	Rated short circuit breaking current [kA]	Rated voltage [kV]
GSCM007/1	2CBL 15/24kV	20	24
GSCM007/2	3CBL 15/24V – 20kA	20	24
GSCM007/3	4CBL 15/24V	20	24
GSCM007/4	5CBL 15/24V	20	24
GSCM007/5	3L 15/24kV	20	24
GSCM007/6	4L 15/24kV	20	24
GSCM007/7	1CBL+1L 15/24kV	20	24
GSCM007/8	2CBL+1L 15/24kV	20	24
GSCM007/9	3CBL+1L 15/24kV	20	24
GSCM007/10	4CBL+1L 15/24kV	20	24
GSCM007/11	1CBL+2L 15/24V	20	24
GSCM007/12	1CBL+3L 15/24V	20	24
GSCM007/13	1CBL+4L 15/24V	20	24
GSCM007/27	2CBL 36kV	20	36
GSCM007/28	3CBL 36kV	20	36

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GSCM007/29	4CBL 36kV	20	36
GSCM007/30	5CBL 36kV	20	36
GSCM007/33	1CBL+1L 36kV	20	36
GSCM007/34	2CBL+1L 36kV	20	36
GSCM007/35	3CBL+1L 36kV	20	36
GSCM007/36	4CBL+1L 36kV	20	36
GSCM007/37	1CBL+2L 36kV	20	36
GSCM007/38	1CBL+3L 36kV	20	36
GSCM007/39	1CBL+4L 36kV	20	36
GSCM007/40	3L 36kV – 20kA	20	36
GSCM007/41	4L 36kV – 20kA	20	36
GSCM007/42	1CBL 15/24kV	20	36
GSCM007/43	1L 15/24V	20	36
GSCM007/44	2L 15/24kV	20	36
GSCM007/45	2CBL+2L 15/24kV	20	36
GSCM007/50	1L 36kV	20	36
GSCM007/51	2L 36kV	20	36
GSCM007/52	2CBL+2L 36kV	20	36

3 REFERENCE LAWS

Switchboard shall comply with local regulations according to delivery destinations.

As far as equipment delivered to Colombia RETIE - Reglamento Técnico de Instalaciones Eléctricas shall be complied.

4 STANDARDS

Standards	Edition	Standards	Edition
IEC 62271-1	See product standard	IEC 62262	2002-02
IEC 62271-100	2017-06-15	IEC 60068-2-52	2017-11
IEC 62271-102	2018-05-15	ISO 12944	2018
IEC 62271-103	2012-10	IEC 60815-1	2008
IEC 62271-105	2012-09-27	ISO 2409	2018
IEC 62271-200	2011-10-24	IEC 60447	2004-01-12
IEC 62271-201	2014-03	IEC 62271-210	2013-02
IEC 62271-304	20-08-05	EN 50181	2010-11
IEC 60282-1	2014-07-22	ISO 4042	11-10-2018
IEC 61243-5	2009-06-25	ANSI/IEEE C37.71	
IEC 60529	2013-08-29	ANSI/IEEE 386	
IEC 60034-1	2011-03-01	IEC 62271-111	

Table 2 - standard

5 SERVICE CONDITIONS

Service conditions are the normal service conditions according to 62271-200, with the following additions/modifications:


Minimum ambient air temperature for internal installation	- 15 °C
Network neutral earthing systems	Effectively earthed neutral system Non effectively earthed neutral system

Table 2: Requirements for Switchgear service conditions

The maximum reference altitude will be 1500 m, but for Colombia the maximum reference altitude is 2.700 m.

The switchboard is a device to be installed inside an underground secondary cabin that may be subject to operation submerged under a 3 meter water column up to thirty days.

The below listed reference documents shall be intended in the in-force edition at the contract date (amendments and *errata corrige* included). Unless otherwise specified, these documents are valid until

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the new editions replace them. The terms used in this document are according to the standards listed below.

6 TECHNICAL CHARACTERISTICS

6.1 Common technical specifications

Technical Specification
GSCC006
GSTR001/1 GSTR001/3
G SCT005
G SCT003
G STP011

Table 3 - Global specifications applied

(last edition of Technical Specification shall be applied unless diversely required)

The MV RMU WITH CIRCUIT-BREAKER unit is part of the protection system in MV Network, supply shall include the following approved materials and devices:

Component	Global Standard
UP2020	GSTR001/1 / GSTR002
RGDM	GSTP011/ GSCT005
ACCUMULATORS FOR POWERING REMOTECONTROLDEVICE	GSCB001

Table 4


6.2 Warranty

The equipment must be watertight and its elements shall be guaranteed to operate without maintenance. If a defect is detected the supplier must assume all the responsibilities and the corresponding costs for carrying out repairs or replacing equipment for the warranty period.

6.3 Operational characteristics of the equipment

Manual operation:

- All operations, opening, closing and grounding shall be carried out by means of a handheld operating rod.
- The crankshaft lever must be reflective to emit night vision with a reflector.
- The crankshaft lever must withstand at least 200 daN of effort, without permanent deformation or breakage.

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6.4 Technical documentation

In compliance with Enel document GSGC002 “Technical Conformity Assessment” the design documentation must include at least:

- Dimensions of the equipment;
- Type of terminals;
- Duly completed identification plate;
- Detail of the drillings of the fixing devices placed in the bases;
- Accessories specified in this specification;
- All special tools supplied by the manufacturer and necessary for the assembly, operation and maintenance of the equipment;
- Any other drawings or models deemed necessary by the applicant for the equipment technology assessment;
- Wiring diagrams;
- Dimensional and layout drawings, indicating the pressure relief device.

6.5 Technical manuals


The supplier must provide equipment manual with technical instructions such as:

- Complete instructions for the description of the operation, transport, packaging, storage, handling, installation, adjustments, operation and maintenance of the equipment;
- Maintenance guide for major defects that may occur, cause and method for locating damaged components;
- Readable schematic diagrams of all electronic and electrical circuits;
- Description of all parts of the electronic circuits, including procedures for calibration and (possible) adjustment of all control functions;
- Identification of the layout of components and test points on the printed circuit board, if applicable;
- Settings with indication of test points and quantities to be measured and of expected values;
- Special test instruments recommended for testing equipment and when testing is needed;

The manual must be written in English and in the language of the country where the equipment will be installed.

If the equipment uses any type of battery (including accumulators according GSCB001 specification), procedures for maintenance, storage and installation shall be indicated.

Information about the characteristics and properties of all lubricants used by the equipment, as well as adhesives, solvents and other chemicals used shall be added.

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7 CONSTRUCTION CHARACTERISTICS

7.1 Enclosure

RMU complete with UP must be of submersible type as they must be able to operate submerged in water for long periods.

The entire equipment shall be contained within a metal casing of submersible type and resistant to the internal arc on all sides.

The enclosure shall be constructed in such a way as to ensure an IP68 degree of protection.

The degree of protection against external mechanical impacts must be IK10 (20J).

The enclosure must be made of AISI 304 stainless steel, minimum 4 mm thick.

The equipment shall be 200 mm raised off the ground and must be provided with at least 4 fixing points of proper dimensions and resistances in order to allow the correct assembly.

Lifting rings shall be provided in the upper part of the equipment, positioned in such a way that, once lifted, it remains balanced.

Each suspension point shall withstand twice the weight of the cell and shall have the strength, size, shape and finish suitable for lifting the equipment with a wire rope up to 19 mm in diameter and move it without damaging external surfaces and bushings.

The equipment shall be equipped with a window for visual verification of the disconnection status of the line switch and of the earth switch.


It must be possible to cover these windows when they are not in use.

In the event of an internal arc, the module must keep its integrity and comply with the following conditions:

- No component can be ejected;
- The cell must not be damaged or punctured;
- Earth connections must remain intact;
- Gases escaping from the inside of the tank will not ignite nearby operator tissues;
- expansion compartment for gases shall ensure, in the event of an internal electric arc, correct outlet of the same;

7.2 Transformer Protection

In case it is specifically required one of the CBs shall operate as transformer protection. In this case the RGDM shall be managed by as to simulate a TCC (time current characteristic), properly adjustable. Below is a typical TCC curve as an example.

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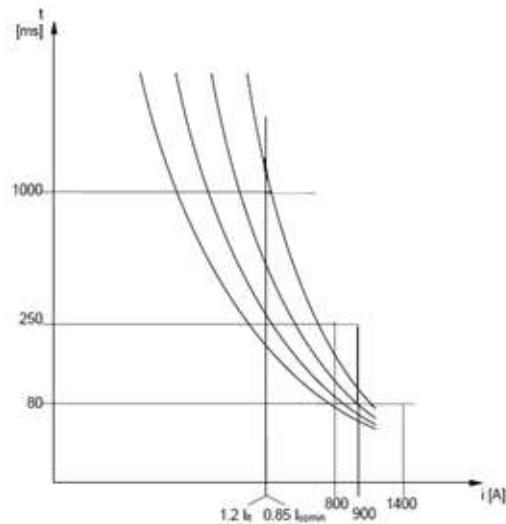


Fig. 2 – Example of Time-current characteristics

A fault interrupter (62271-111) can be allowed to protect the transformer.

7.3 SF6

The expected operating life with regard to leakage performance shall be 40 years (sealed equipment). The characteristics of the first filling gas shall meet the requirements of IEC 60376 standard. The humidity content of the first filling gas shall be less than 15 ppm in weight and, during operation, the absence of condensation at the minimum operating expected temperatures must be guaranteed. The manufacturer shall ensure that at the end of the expected life of the equipment (40 years) the gas pressure remains greater than (or equal) the minimum operating pressure p_m (minimum necessary pressure to ensure the performances prescribed for the device). In any case, the loss shall not exceed the 0.1% value in weight per year (IEC 62271-1).

For installations above 1.000 meters, the supplier must indicate the installation operating methods.

7.4 Common Characteristics

The enclosure shall have a SF6 volume less than 1500 liters and its filling, to be implemented exclusively in the factory, shall be made in order that the maximum operating relative pressure at 45 °C does not exceed 0,5 kg/cm² (49,033 kpa) and it forms a sealed pressure system (IEC 62271-200). The switchgear shall be sealed. The elements used in the factory for filling and recovering the SF₆ at the end of life shall be identified with a self-adhesive plate and protected from accidental shocks. On the plate it shall be written, in the language of the country to which it will be supplied: "*Remove the cap at the end of the switchgear's operating life only for the possible recovery of gas*". This plate shall have a yellow RAL 1021 background and the words in black RAL 9005.

The switchgear shall be manufactured in a SF₆ insulated single shell containing the busbars, the switchgear and the earthing switches.

Strains during operation and transport shall be taken into account.

The switchgear shall have an overpressure valve, equipped with a metallic disc for the protection against accidental strains, placed at a proper distance from the valve itself.

To connect the MV cable terminals, the switchgear shall be equipped with external cone bushings with capacitive voltage divider in accordance with EN 50181 (for Argentina it may be required the ANSI/IEEE 386 standard).

Bushings shall have a 630A rated normal current for the lines (type C interface shown in the technical specification GSCC006).

The RMU line shall be equipped with capacitive voltage dividers.

The switchgear shall be equipped with “safe position devices” for the indication of the real position of the main moving contacts of the switches, as required by IEC 62271-200.

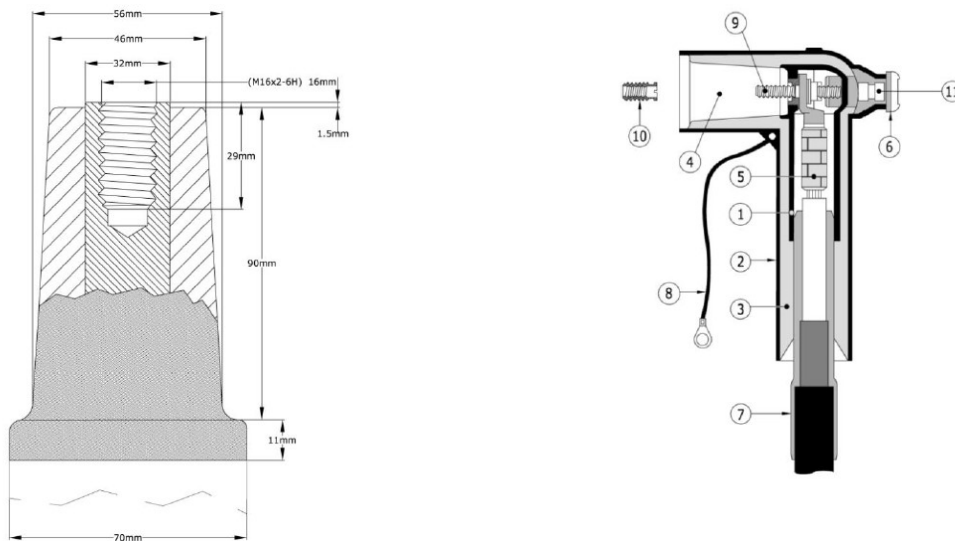



Figure 3 – example MV Cable terminal

7.4.1 RMU Characteristics

The switchgear shall be compliant with IEC 62271-200. The solutions for the insulation of switchgear shall be SF₆ (Gas alternative to SF₆ can be considered and are subject to Enel approval) gas or solid insulation (in this case the reference standard is 62271-201) with vacuum or SF₆ circuit breaker. The main characteristics are listed in table 5.


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Rated insulation level	Rated Voltage	[kV]	24	36
	Rated short-duration power-frequency withstand voltage	[kV]	50	70
	Rated short-duration power-frequency between the open contact of the SD	[kV]	60	80
	Rated lightning impulse withstand voltage	[kV]	125	170
	Rated lightning impulse withstand voltage - Across the isolating distance (switch-disconnectors and line disconnectors)	[kV]	145	195
Rated frequency		[Hz]	60	
Rated normal current :				
✓ for busbars and lines		[A]	630	
Rated short-time withstand current		[kA]	20	
Rated peak withstand current		[kAc]	50	
Rated duration of short-circuit		[s]	1	
Degree of protection :			IP68	
Internal arc test	Type of accessibility		AFLR	
	Rated arc fault current	[kA]	20	
	Rated arc fault duration	s]	1	
Rated supply voltage of closing and opening devices and of auxiliary circuits		[Vcc]	24V -15% +20%	

Table 5: Characteristics of the switchgear

7.5 Characteristics of the switch-disconnector

The switch-disconnectors must comply with IEC 62271-103 and IEC 62271-102 for the earthing switches . The control devices of the earthing switches must be separate from those of the switching device and interlocked with them. The grounding blades must have only one manual control. The movement of the triplet of the poles must be simultaneous. The nominal characteristics of the switch-disconnectors are shown in table 6.

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SD				
Rated Voltage	[kV]	24	36	
Rated normal current	[A]	630		
Rated short-time withstand current	[kA]	20		
Rated peak withstand current	[kAc]	40		
Rated duration of short-circuit	[s]	1		
Mechanical endurance class		M1		
Electrical endurance class		E3		
Rated breaking current	-of a mainly active load	[A]	630	
	- of a no-load transformer	[A]	6,3	
	- of a no-load line	[A]	10	13
	-of a no-load cable	[A]	31,5	40
	- in case of earth fault	[A]	50	
	- with cable-charging in case of earth fault	[A]	16	25
Earthing switches ES				
Rated short-time withstand current	[kA]	20		
Crest value of the rated short-time withstand current	[kAc]	40		
Rated short-circuit duration	[s]	1		
Mechanical endurance class		M0		
Electrical endurance class		E2		

Table 6: Characteristics of the switch-disconnectors and of the earthing switches

There must be no operating buttons on the equipment.

The electrical controls shall be installed in the UP near the module.

The automation interventions shall be managed by an RGDM that will be installed close to the UP.


The UP electric opening button shall be green with the words "OPEN", while the closing buttons must be red with the words "CLOSE". The pushing buttons must be protected against accidental pressure and a label shall indicate the function performed.

The switch actuation mechanism shall be independent from the force used by the operator, both for closing and opening the contacts. The contact actuation shall be equipped with an energy-activated mechanism and shall not allow the contacts to move out of position before the energy is sufficient to permit opening, closing or grounding.

For manual operation of the switch a lever shall be used.

The three-pole manual operating device of the switch disconnecter has to be dead-center overcoming, both in opening and closing, vertical, rotational or translational movement (IEC 60447).

The operation must be performed by applying a moment that does not exceed 200 Nm, and the opening and closing speed must be independent of the action of the operator.

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In case that switch-disconnectors and earthing switches are separated, the shaft of the earthing blades shall be mechanically interlocked with that of the line blades operating on the main switch disconnector shaft and not on the operating shaft.

The manual operation of the switch-disconnector must be possible at any time, regardless of the motorized operation; the insertion of the operating lever for manual operation must prevent the motorized operation. Such interlock must already act before the end of the lever engages on the tang of whatever operating shafts.

This condition can be achieved both with a mechanical mechanism (decoupling of the gear motor) and with an electric solutions (cutting engine power).

An electrical interlock should allow the motor to operate only when the grounding blades are completely open. To show the open position of the switch-disconnector, a micro-switch shall be provided. This micro switch shall be put inside the operating device protective shell and shall be able to switch small currents.

7.6 Sismic qualification level


IEC 62271-210	Severity level 1 – PGA 0,5	Class 2
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7.6.1 Circuit Breaker Characteristics

The circuit-breaker shall comply with the IEC 62271-100. The characteristics of the circuit-breaker are shown in table 7.

Rated Voltage	[kV]	24	36
Rated normal current	[A]	630	
Rated short-circuit breaking current	[kA]	20	
Rated duration of short-circuit	[s]	1	
Sequence of operations		O-0,3s-CO-15s-CO	
Circuit-breaker class		C2, E2, M2, S1	
First-pole-to-clear factor	[kpp]	1,5	
Break-time		≤ 80ms	
Rated breaking current	• Rated cable-charging breaking current	[A]	31,5
	• Rated out-of-phase making and breaking current	[A]	To see 4.106 of IEC 62271-100
Max motor absorption	[W]	300	

Table 7: Characteristics of the MV circuit-breaker

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The load break interrupter shall consist of three vacuum bottles (or equivalent SF6 based device) mechanically linked to a single spring-assisted mechanism providing three phase operation. Current interruption shall be contained within the vacuum bottles.

The circuit breaker shall operate both electrically and manually.

The electrical controls will be installed in the UP near the module.

The automation interventions will be managed by an RGDM that will be installed in the UP.

The UP electric opening button shall be green with the words "OPEN", while the closing buttons must be red with the words "CLOSE". The pushing buttons must be protected against accidental pressure and a label shall indicate the function performed.

The circuit breaker manual actuation mechanism shall be independent from the force used by the operator, both for closing and opening the contacts. The contact actuation shall be equipped with an energy-activated mechanism and shall not allow the contacts to move out of position before the energy is sufficient to permit opening, closing or grounding.

The cell shall have at least one grounding point (terminal) connected to an inner bar with at least 6 holes 13 mm in diameter and a hole spacing of 50 mm. All removable metal parts must be grounded.

The circuit-breakers will be in class E2 and must be subjected to the electrical durability test as specified in List 1 of Table 33 of the 62271-100 standard.

Testing current (percentage of rated short-circuit breaking current) %	Operating sequences	Number of operating sequences (List 1)
10	O	84
	O – 0,3 s – CO	14
	O – 0,3 s – CO – t – CO	6
30	O	84
	O – 0,3 s – CO	14
	O – 0,3 s – CO – t – CO	6
60	O	2
	O – 0,3 s – CO – t – CO	2
100% (symmetrical)	O – 0,3 s – CO – t – CO	2

Table 8– Classification of circuit-breakers as a function of electrical endurance

7.6.2 Characteristics of the line disconnectors (LD)

The manual line disconnector shall comply with IEC 62271-102. The characteristics of the line disconnectors (LD) are shown in table 8 below.

Rated normal current	[A]	630
Rated short-time withstand current	[kA]	20
Rated duration of short-circuit	[s]	1

Rated peak withstand current	[kAc]	40
Mechanical endurance class		M1

Table 9 - Characteristic of the line disconnector with command manual (LD)

The line disconnector shall only be operated manually.

7.6.3 Characteristics of earthing switches (ES)

The manual earthing switches shall comply with the IEC standard 62271-102. The characteristics of the earthing switches (ES) are shown in table 9.

Rated short-time withstand current	[kA]	20
Rated peak withstand current	[kAc]	40
Rated values of mechanical endurance for disconnectors		M1
Rated values of electrical endurance for earthing switches		E2

Table 10 - Characteristics of the earthing switch (ES)

The earthing switch shall only be operated manually and shall be independent of the force used by the operator for closing.

7.7 Functional schemes

The general functional electric schemes are shown in pictures below which show the admitted constructive solutions for T, L unit and CB unit; other possible alternative solutions are subject to Enel approval.

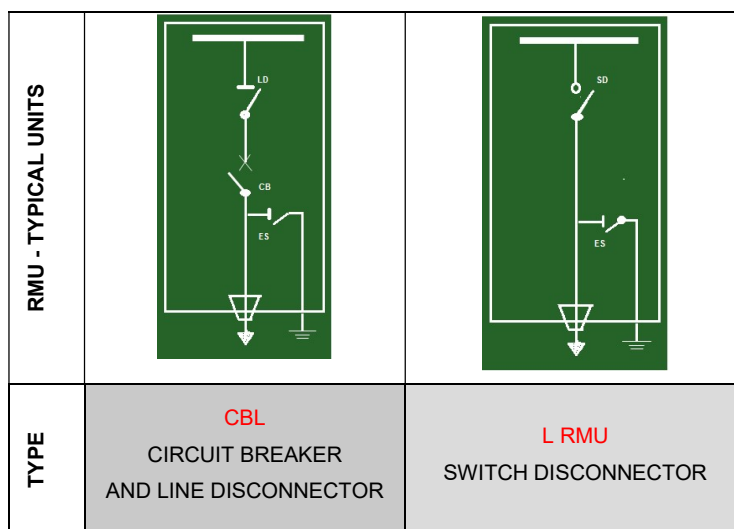









Figure 4 - General functional electric scheme

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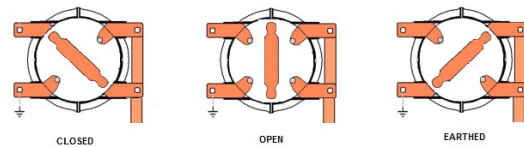
Description

	CB: Circuit Breaker vacuum
	LD: Line Disconnecter
	SD: Switch Disconnecter
	Cable
	Voltage presence detector
	ES – ES1 – ES2 : Earthing switches

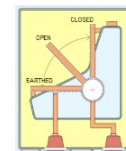
Type Solution



VACUUM CIRCUIT BREAKER



THREE POSITION SWITCH-DISCONNECTOR . ROTARY TYPE



THREE POSITION SWITCH-DISCONNECTOR .

Figure 5 - Example

7.8 Constructive solutions

CBL

<p>Diagram A shows a vertical busbar at the top. A 2-position vacuum circuit-breaker (1) is connected to the busbar. Below it is a 2-position line-disconnector (2). Further down is a 2-position earthing switch (ES) with closing power (4). A line-disconnector (LB) (3) is also shown. The circuit is grounded at the bottom.</p>	<p>Diagram B shows a vertical busbar at the top. A 2-position vacuum circuit-breaker (1) is connected to the busbar. Below it is a 3-position line-disconnector and earthing (2). Further down is a line-disconnector (LB) (3). A 4-position earthing switch (4) is also shown. The circuit is grounded at the bottom.</p>	<p>Diagram C shows a vertical busbar at the top. A 2-position vacuum circuit-breaker (1) is connected to the busbar. Below it is a 3-position line-disconnector and earthing (2). Further down is a line-disconnector (LB) (3). A 4-position earthing switch (4) is also shown. The circuit is grounded at the bottom.</p>
<p>A</p> <p>2-position vacuum circuit-breaker CLOSED – OPEN</p> <p>2- position line- disconnector CLOSED- OPEN</p> <p>2- Position earthing switch with closing power OPEN - EARTHED</p>	<p>B</p> <p>2-position vacuum circuit-breaker CLOSED - OPEN</p> <p>3 position line-disconnector and earthing CLOSED - OPEN - EARTHED</p>	<p>C</p> <p>2-position vacuum circuit-breaker CLOSED - OPEN</p> <p>3 position line-disconnector and earthing CLOSED - OPEN - EARTHED</p>

Figure 6 – RMU with CB possible constructive solutions for L unit electrical scheme and sequence of maneuvers

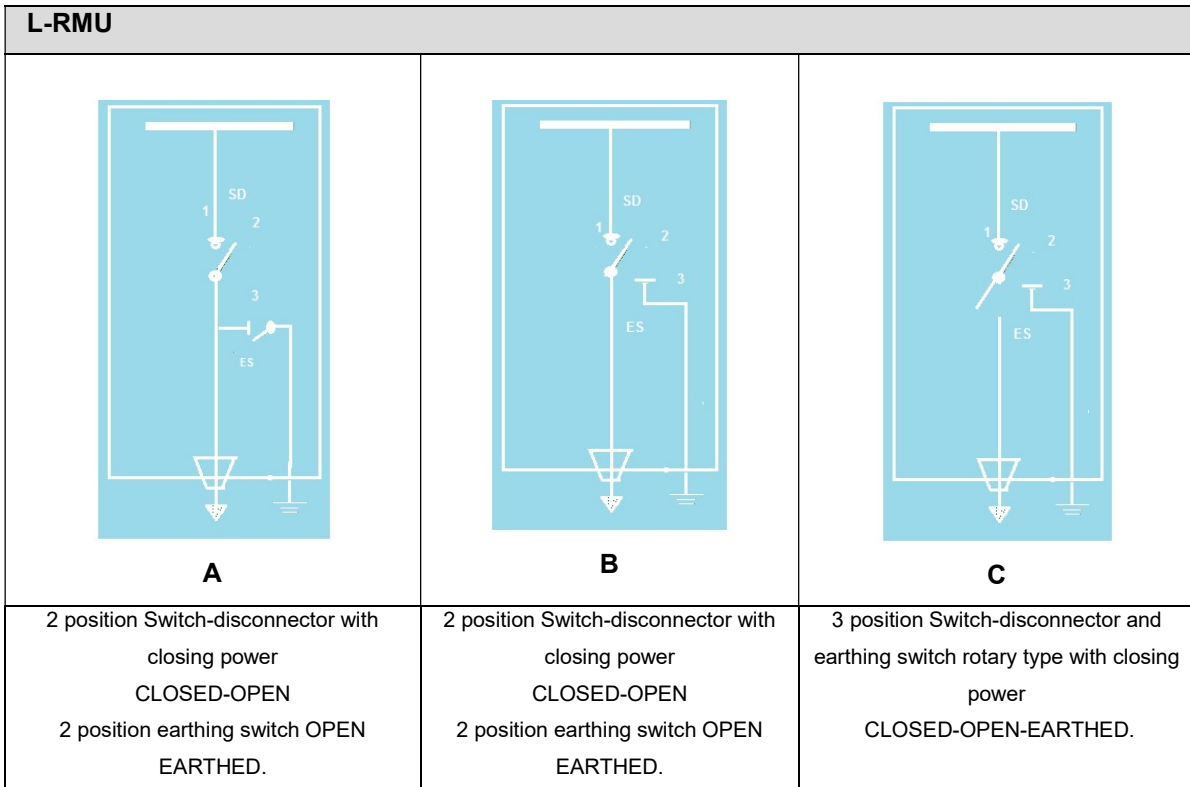


Figure 7 – RMU Possible constructive solutions for L unit electrical scheme and sequence of maneuvers

7.9 Command Panel

Each line unit has 2 possible alternative construction solutions:

- 1 MV circuit-breaker (CB) + 1 Line Disconnector (LD) + Earthing Switch (ES) ;
- 1 MV circuit-breaker (CB) + 1 integrated Line Disconnector (LD)/Earthing Switch (ES) ;


The electrical controls shall be installed in the UP and must take into account the mechanical and electrical interlocks of this specification and the characteristics indicated in the following paragraphs. The connections with the UP GSTR001/1- 3 remote control peripheral unit, the type of connector and the pin assignment shall comply with the requirements indicated in paragraph annex D. The closing and opening remote controls and the remote-signals status refer to the circuit breaker.

The manual controls of the LD and ES shall be at dead point both in opening and in closing and shall be of rotating or vertical motion type (see IEC 60447 standard). The operation direction shall be compliant with IEC 60447.

7.9.1 Unit with CB command

The following indications shall also be provided:

- status indication of the CB. The device used shall be mechanically interconnected with the mobile power contacts and the relative position shall be displayed using the following symbols:

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- black "I" letter on red background corresponding to the close position of the circuit-breaker;
- black "O" letter on green background corresponding to the open position of the circuit-breaker;



Figure 8

- Equipments to be installed in Brazil will be provided with:
 - Closure - White "L" on a red background;
 - Opening: white 'D' on a green background.



Figure 9

- status signal of the LD. The device shall be mechanically interconnected with the mobile power contacts and the position shall be displayed using the following symbols:
 - black "I" letter on red background 3000 RAL-F2 corresponding to the position of line disconnector LD closed;
 - black "O" letter on green background 6017 RAL-F2 corresponding to the position of the open LD line disconnector;



Figure 10

- status indication of the earthing switch ES. The device shall be mechanically interconnected with the mobile power and auxiliary contact, and shall be displayed using the following symbols:
 - black "I" letter on yellow background 1021 RAL-F2 corresponding to the position of earthing switch ES closed;
 - black "O" letter on gray background 7030 RAL-F2 corresponding to the position of the earthing switch ES open;



Figure 11

Language	Opening	Closing
Spanish	ABRIR	CERRAR
Portuguese	ABRIR	FECHAR

Table 10: Function of the operation

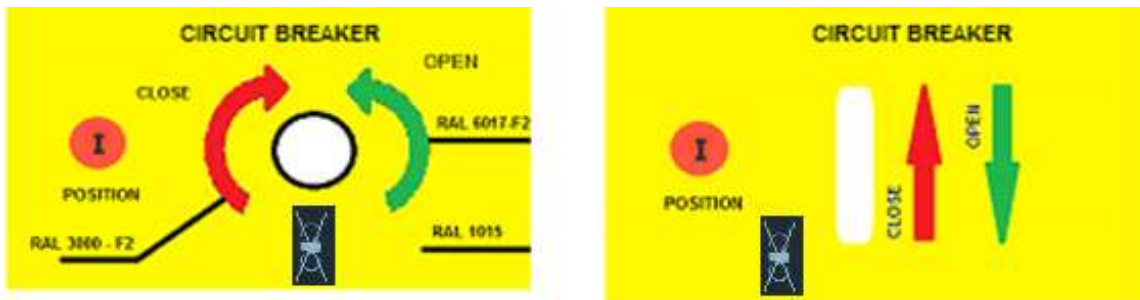


Figure 12 - Masks for the operating point of the Circuit Breaker

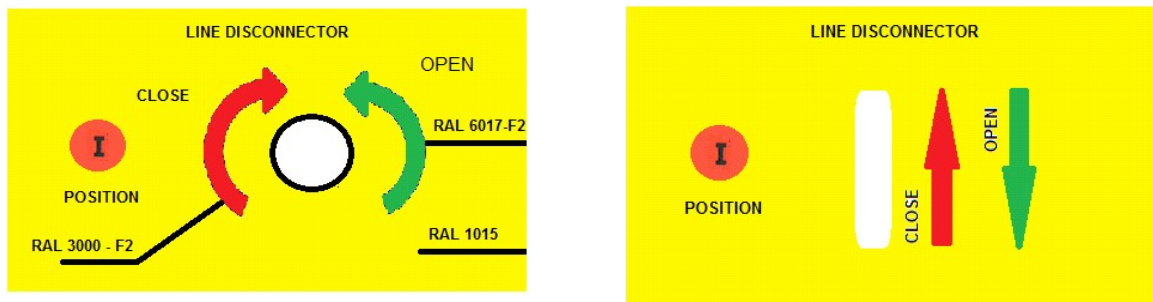


Figure 13 - Masks for the operating point of the line disconnector (see table 8 for the correct wording)

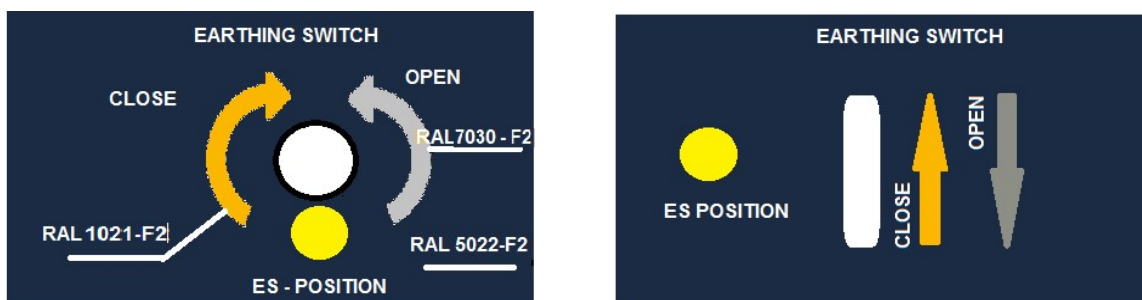



Figure 14 - Mask for the operating point of the earthing switch

There must be a window for visual verification of the disconnection status of the line switch and the earth switch.

It must be possible to cover these windows when they are not in use.

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7.9.2 Unit with CB command interlocks

The sequence of operations for putting in service the equipment, irrespective of the possible constructive solutions, shall be:

1. opening of the ES earthing switch ;
2. closing of the LD line disconnecter;
3. closing of the CB circuit breaker.

Interlocking and operating directions shall comply with the IEC 62271-200.

All switch positions are to be clearly identified and pad-lockable.

The sequence of operations for putting out of service the line shall be the reverse.

The following interlocks for figures 4A e 4B, irrespective of the possible constructive solutions, shall be provided (the complete list of interlocks is also represented in Annex A):

1. The line disconnecter can be operated only with circuit-breaker in open position; this condition shall be realized by a mechanical interlock;
2. The earthing switch can be closed only with line disconnecter in open position; this condition shall be realized with a mechanical interlock;
3. The disconnecter can be closed only with earthing switch in open position; this condition shall be realized with a mechanical interlock;
4. The circuit breaker can be operated electrically and mechanically only with the lever not inserted in any maneuvering point and with line disconnecter (LD) in the closed position (I) and the earthing switch (ES) in the open position (O); this interlock shall be carried out both electrically with a cut of the electrical controls of the circuit-breaker (using end-of-operation switches) and mechanically;

During maneuvering shall not occur interference or obstruction or interruption.

In case there aren't obstruction stoppages, when stressing the switchgears commands in the locked position with a moment of 400 Nm, the contacts of switchgears shall remain in a position where they can maintain their functionality; in case there are obstruction stoppages, it shall be verified that they cannot be removed, if not intentionally and with special tools.


Furthermore, a point must be provided where a padlock can be inserted to lock the operation of the switch-disconnector and earthing switches.

A circuit breaker shall also be installed to protect the transformer according to IEC 62271-100. The circuit breaker shall have the same technical characteristics as the line CB as shown in Table 3.

The CB interventions shall be managed by the RGDM that will be installed in the UP near the module. The RGDM shall be provided according to the global specification GSTP011.

7.9.3 Unit with Switchgear Command

The commands must be installed in the UP.

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There must be present:

- two buttons for electric opening and closing. The opening button must be green in the language corresponding to the country in which the equipment is to be delivered; the closing button must be red, in the language corresponding to the country in which the equipment is to be delivered. The push buttons must be protected against accidental pressure and must have an identification plate indicating their function.

It must be present on the individual cell:

- operating position for opening and closing the switch-disconnector, with the indication of the direction of travel;

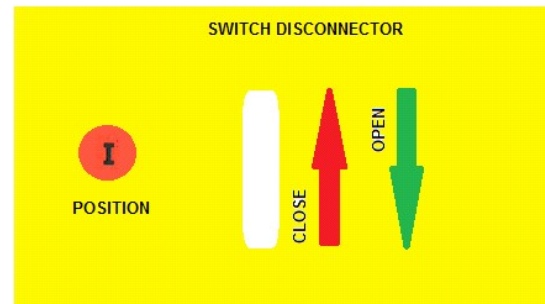
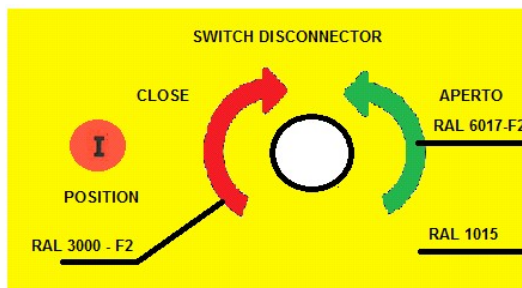


Figure 15 – Mask opening and closing of the switch-disconnector (see table 8 for the correct wording)

- operating place for the opening and closing of the earthing switch, with the indication of the driving direction;

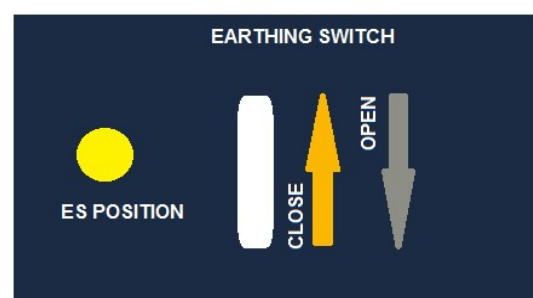
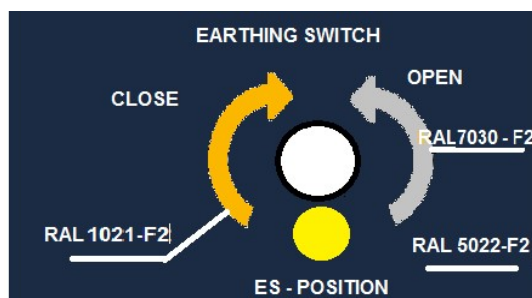


Figure 16 - Mask opening and closing of the earthing switch (see table 8 for the correct wording)

Moreover the following indications shall be provided:

- switch-disconnector signal position, through the following symbology:
 - black letter "I" red background corresponding to the close position of the switch-disconnector;
 - black letter "O" RAL F2 green background corresponding to the open position of the switch-disconnector;


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Figure 17

- earthing switch's signal position. The used device shall be mechanically interlocked with the main circuit moving contacts and the correspondent position shall be displayed through the following symbology:
 - black letter "I" RAL F2 yellow background corresponding to the close position of the earthing switch;
 - black letter "O" RAL F2 grey background corresponding to the open position of the earthing switch;

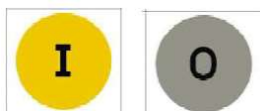


Figure 18

The signal positions shall be visible even with the protection shell is removed.

Windows shall be provided to allow visual verification of the disconnecting status of the line breaker and the line breaker operating switch. It shall be possible to cover such windows when they are not in use.

7.9.4 Interlocking and locking

The sequence of operations for putting in service the equipment shall be:

1. opening of the ES earthing switch;
2. closing the SD switch disconnecter.

Interlocking and operating directions shall comply with the IEC 62271-200.

In case there aren't obstruction stoppages, when stressing the switchgears commands in the locked position with a moment of 400 Nm, the contacts of switchgears shall remain in a position where they can maintain their functionality; in case there are obstruction stoppages, it shall be verified that they cannot be removed, if not intentionally and with special tools.

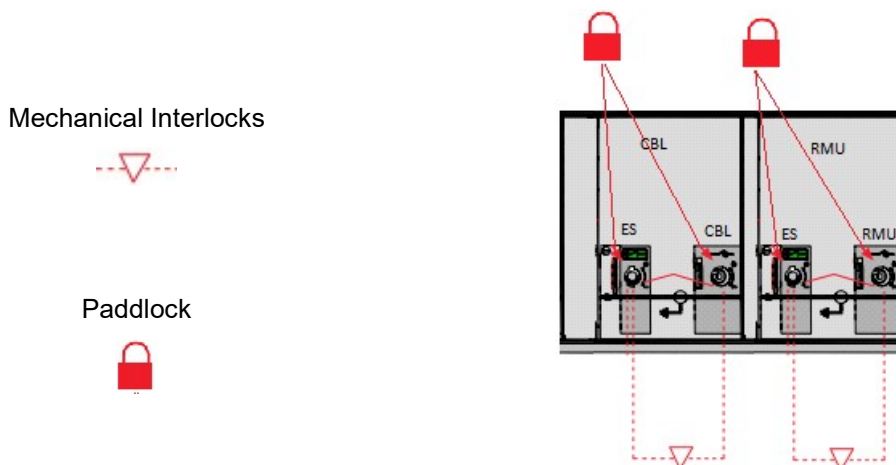


Figure 19- Paddlock

The operating elements must be interlocked with a padlock so that they cannot be operated either electrically or manually.

Padlocks type:




PADLOCKS TYPE	OPERATION	CONDITION	COMMENT
LINE CB	CBL OPEN		CB LOCKED IN LOCK
LINE RMU	RMU OPEN		RMU LOCKED IN LOCK
LINE CB AND RMU	ES CLOSED		LD AND SD LOCKED IN LOCK

Table 12

7.10 Manometer

The equipment must be supplied with a pressure gauge for SF6 gas measurement.

The manometer shall not be extractable and, in normal conditions, the pressure indication shall be between 25% and 75% of the area marked as safe. The area marked as safe shall be green RAL 6017 whereas the other area shall be red RAL 3000.

The manometer shall be mounted on the front of the panel and will be clearly visible under normal operating conditions.



Figure 20 - Manometer

7.11 Earthing Connections

The earthing of the switchgear shall be made of a copper wire whose section shall not be less than 50 mm².

The operating shafts of the switch disconnecter and of the earthing switch shall be connected to the earth (with conductors whose section shall not be less than 30 mm²) and to the other metallic objects. This connection is not necessary if the switchgear internal shaft is made of insulating material.

From the switchgear earthing point a conductor or a copper bar, shall be derived (whose section shall not be less than 50 mm²) and it shall develop along the entire length of the switchgear in correspondence of the line and transformer protection uprights; it shall be provided with a M12 bolt on which the earthing connections of the MV cable shields shall be fixed. This conductor or copper bar shall allow the connection to the secondary substation earth from both sides of the external part of the switchgear. For this reason it shall be provided with two M12 bolts .

The metal part around the bolts must not be painted.

Grounding points on the outside of the cell must have a grounding symbol.

The conductor or copper bar shall be manufactured so that it mustn't be necessary to disassemble, totally or partially, the switchgear by inserting or removing a cable and its corresponding terminal.

7.12 Capacitive Dividers and Voltage Detecting System

The capacitive dividers shall have the following characteristics (tab.1 IEC 61243-5):

Designation of the VDS	Input impedance X_c of the indicator		Load capacitance C_s of the coupling system		Electrical threshold conditions at the interface			
	X_{cmin} M Ω	X_{cmax} M Ω	C_{smin} pF	C_{smax} pF	I_{tmin} μ A	I_{tmax} μ A	U_{tmin} V	U_{tmax} V
Medium resistance MR	12	14,4	221	265	1,39	2,5	20	30

Table 13 – Characteristics capacitive dividers

The panel shall be equipped with presence / absence voltage detectors conforming to the ANNEX A specification with related capacitive dividers with features compliant with the annex B:

- cable side, for each line unit and transformer.



Figure 21 – VDS ANNEX A

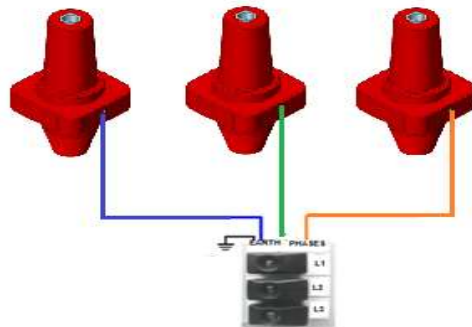


Figure 22 - Capacitive type ANNEX B

Each voltage detector system, clearly distinct for each riser, shall be surrounded by a box with the words "SIDE BARS" or "CABLE SIDE". These bushings must be covered to be protected against direct contacts.


Language	SIDE BARS	CABLE SIDE
Spanish	LADO BARRAS	LADO CABLES
Portuguese	LADO BARRA	LADO CABO

Table 14 - Function of the operation

7.13 Command Lever

Two levers shall be provided, one for maneuvering near the equipment and one for maneuvering from the platform.

The operating levers shall be constructed in accordance with paragraph 5.7 of IEC 62271-1. The levers must be made of steel (EN 10216-1), treated with electrolytic zinc plating according to ISO 2081 (FZn 12 III) and must be stamped with the name of the manufacturer preferably by moulding or, in any case, with an indelible permanent solution.

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- Degree of protection for the operating devices (even with the operating lever inserted) IP51 (see Table 3 for the standard requirement)
- Protective coating with class of corrosivity C5M-H according to ISO 12944 (see chapter 18 for the standard requirement).and insulation design according to equivalent SPS class from IEC 60815-1.
- Environmental testing: according standard IEC 60068-2-52 with method 6 -2. At the end verification of functionality shall be made according 62271-304 level 1.

Alternative solutions/tests to demonstrate the equivalent suitability in this kind of environment can be proposed by the manufacturer and are subject to Enel approval.

7.16 Nameplates

7.16.1 Rating plate

The switchgear's rating plate shall contain information on the code that the manufacturer assigns to each series of the same type. It shall contain the information required by IEC 62271-200 (table 101), IEC 62271-102, IEC 62271-100, IEC 62271-105, IEC 62869-10 and IEC 61869-11, with the following additions: manufacturer name, year of manufacture, manufacturer code, serial number, Enel code.

Sub-clause 5.10 of IEC 62271-1 is applicable with the following additions:

the nameplates shall be made of anodized aluminum with a $0.8 \div 1$ mm thickness and shall be secured with screws or rivets. They shall have borders, boxes and white or silver written on opaque black with the exception of the area intended for the company that may be of a different color; the lettering of the required data shall be punched or black printed.

The nameplates can also be adhesive printed with a laser printer; in this case the manufacturer, at the moment of the request, shall submit adequate documentation demonstrating that, after tests as prescribed for protective coatings, can keep adhesiveness, readability and resistance.


An informative nameplate with the sentence "Contains fluorinated greenhouse gases covered by the Kyoto Protocol", has to be provided.

7.16.2 Operating sequence nameplate and synoptic scheme

The switchboards are equipped with a "function sequence nameplate" on which the sequence of operations to be carried out must be indicated, respectively:

The sequence to be safely configured (grounding output).

The wiring diagram of the electrical control unit must also be included. This label must be placed on the protective shell of each control so that it is clearly visible.

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The drive shafts shall be completely integrated in the screen, thus obtaining an easy interpretation of the operation starting from the movement of the position indicators (mobile screen).

7.16.3 Signal masks on the operating places

On each line and transformer protection upright, in correspondence of each manual operating place, signal masks for the position of the devices and the indication of the movement direction for the execution of the operations shall be provided.

7.16.4 Warning nameplate for the switchgear drilling

In a location clearly visible during service, each switchgear shall have a circular nameplate indicating the prohibition to use drill, or similar tool, to avoid the perforation of the shell containing SF6 in pressure.

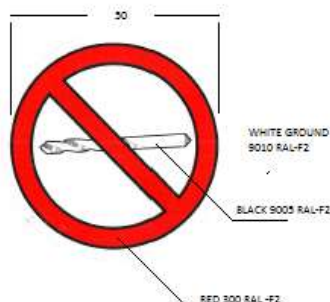


Figure 24

7.16.5 Label holder

Every upright shall have a label holder with a transparent window 120x50 mm .


7.16.6 Warning nameplate

Equipment shall show the following labeling on the front of the switchgear according to warning sign W012 from SO7010



- Triangle background: yellow
- Arrow: black
- Plate: stainless steel, aluminum or 3 mm thick plastic
- The plate is riveted to the door plate
- For Colombia, this sign shall comply with the terms of article 11 of RETIE

Figure 25

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7.17 Low-Power Instrument Transformers (LPIT)

Each phase of each line unit (CBL, L RMU) shall be equipped with low-power instrument transformer (LPIT) compliant with technical specifications GSCT005 "Technical characteristics of LPITs with the clarifications indicated below:

For LPCT, differently from what indicated in GSCT005, the rated primary current shall be 600A.

The connection cables (one per phase, for each line unit) and the related connectors, considered an integral part of the LPIT, shall comply with the GSCT005 specification and be integrated into the equipment, exiting near the RGDM support, with sufficient length available.

The secondary terminations of the LPVT to be connected to the ground shall be connected to the compartment ground inside it.

The switchgear shall be submitted to the integrative tests as in the GSCT005 (can be proposed by the supplier, and subject to Enel approval, the performance of some type tests on LPIT "stand-alone" rather than on the complete switchboard, technically justifying their applicability to the integrated product).

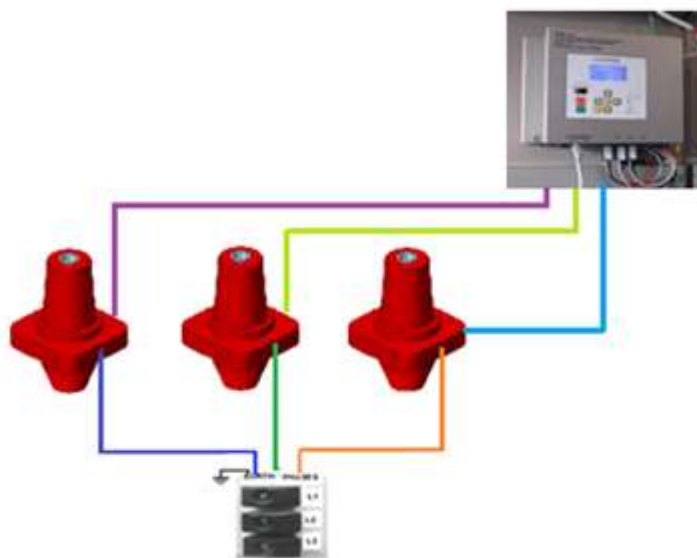



Figure 26

7.18 The Cabinet

The cabinet is part of the supply and must be IP68.

The submersible control is sealed in a stainless-steel enclosure to protect the sensitive electronic equipment and shall be accessible from the front.

The cabinet must rest on a stainless-steel rack although can also be installed on the wall.

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The dimensions must be such as to contain all the equipment provided for remote terminal unit type GSTR001/1 (UP - 8 positions) and all the RGDM and all the controls of the CB and RMU.

The cabinet must ensure an IP68 degree of protection.

The metal housing requires a 6MA grounding bolt (located on the side) to which the ground and the +24 VDC shall be connected.

The grounding braids (16 mm²) for the connection of the grounding bolts of the individual panels as well as the one on the rack container shall be included in the supply:

- 3 braids of the length of 1.5 m including 6mm cable lugs on both ends (battery compartment, power supply, and bolt)
- 1 braid with a length of 40 cm for the connection of +24Vcc to the ground, including 6mm terminals on one end only.

In addition, an anti-condensation system must be in place inside, controlled by a thermostat and humidistat powered at 220 Vac±20%.

7.19 UP Dimensions

The maximum overall dimensions of the cabinet

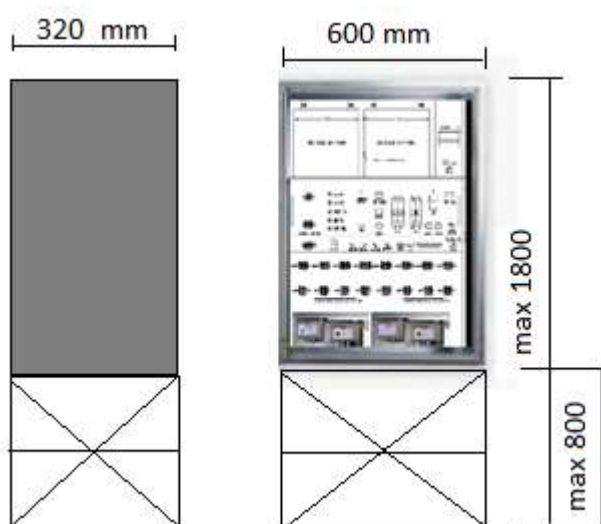



Figure 27 - Dimension cabinet

7.20 Connectors and cables

Each cable entry hole, if necessary, is equipped with a suitable cable gland that guarantees the degree of protection required for the appliance.

- Hermetic, complies with industry standard IP68;

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- Comply with fire regulations;
- Vibration and shock resistant.



Figure 28

All connection cables used for both operations (RGDM / equipment connection) and for automation must be 8 meters long.

7.21 Maintenance

The switchgear shall be maintenance free for the entire expected service life (40 years).



Figure 29

7.22 PACKAGING, HANDLING AND IMPACT INDICATORS (ShockWatch)

Packaging, transport, storage and installation/testing Par. 10.2.1. IEC 62271-102 applies.

The package shall be suitable to guarantee:


- the protection during transport (including by ship, if necessary);
- an elevation from the ground at least of 100 mm;

On the upper part of the switch, eyebolts shall be installed to allow movement by means of bridge crane, forklift or overhead crane.

The equipment shall be packed with a plastic waterproof film wrapped around it, with polystyrene panels to protect the commands.

On external side of packaging, the following information shall be present:

- 1) manufacturer name;

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- 2) manufacturing year/month;
- 4) manufacturer serial number;
- 5) Enel component codification (i.e.: GSCM007/1 - XXXXX);
- 6) contract number;
- 7) destination;
- 8) total weight;
- 9) lifting information (showing the points and the correct method of lifting);

Wooden boxes will be treated, according to international requirements for the control of pests, avoiding the compound "Pentachlorophenol" and "Creosote". The treatment must contemplate, at least: high toxicity to xylophagous organisms, high penetrability and fixation power, chemical stability, non-corrosive substances to metals or that affect physical characteristics of the wood. Each equipment shall be equipped with a shock indicator (ShockWatch).

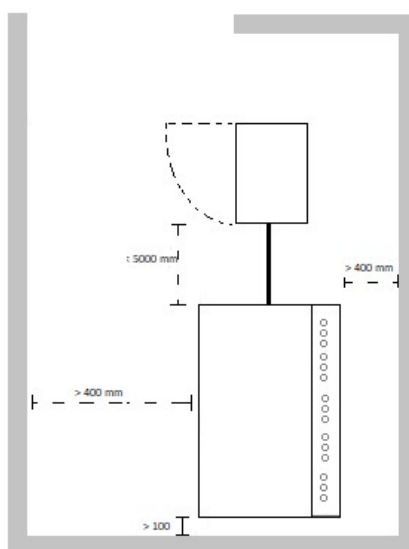
Indicators consist of labels containing a red liquid in suspension. If the device is subjected to an impact higher than a specific G level declared by the manufacturer, the impact will cause the red liquid to escape, clearly visible. The label shall be on the front of the appliance and clearly visible.



Figure 30 - ShockWatch

8 SWICHTHGEAR INSTALLATION

The picture shows the minimum distances that must be respected for the switchgear installation.




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Figure 31 - installation


9 TESTING

All tests described in the following paragraphs shall be performed on the switchgear:

Tests are divided in:

- Type tests
- Individual test;
- Routine tests;


The tests described in the following paragraphs shall be carried out on the panel according to IEC 62271-100, IEC 62271-102, IEC62271-103, IEC 62271-105 and IEC 62271-200.

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9.1 Type test

Visual inspection		
Dielectric tests	IEC 62271-200	6.2
Partial discharge test	IEC 62271-200	6.2.9.
Measurement of the resistance of the main circuit	IEC 62271-200	6.4
Temperature-rise tests	IEC 62271-200	6.5
Short-time withstand current and peak withstand current tests	IEC 62271-200	6.6
Control of the degree of protection (IP)	IEC 62271-200	6.7
Internal arc test	IEC 62271-200	6.106
Tightness tests	IEC 62271-200	6.8
Electromagnetic compatibility tests (EMC)	IEC 62271-200	6.9
Additional test on auxiliary and control circuits	IEC 62271-200	6.10
Verification of making and breaking capacities	IEC 62271-200	6.101
X-radiation test procedures for vacuum interrupters	IEC 62271-200	6.11
Mechanical operation tests	IEC 62271-200	6.102 – 6.105
Pressure withstand test for gas-filled compartments	IEC 62271-200	6.103
Tests for the verification in humid atmosphere	IEC 62271-200	62271-304 LEVEL 1
Verification of the protective coating	ISO 2409	LEVEL 0
Test to verify the protection against mechanical impacts	IEC 62262	6
Mechanical and environmental tests on switch disconnectors	IEC 62271-103	6.102
Seismic test	IEC 62271-210	5.1
Immersion Test		
Specific type tests for circuit-breaker		
Mechanical and environmental tests	IEC 62271-100	6.101
Short-circuit current making and breaking tests	IEC 62271-100	6.102 - 6.106
Critical current tests	IEC 62271-100	6.107
Single-phase and double-earth fault tests	IEC 62271-100	6.108
Out-of-phase making and breaking tests	IEC 62271-100	6.110
Capacitive current switching tests	IEC 62271-100	6.111
Electrical endurance tests	IEC 62271-100	6.112
Particular type tests for switch disconnector		
Verification of switchgear and earthing switches safe devices	IEC 62271-102	A.6.105.1.3 and A.6.105.2
Specific type test for RMU		
Dielectric tests	IEC 62271-102	6.2
Measurement of the resistance of circuits	IEC 62271-102	6.4
Temperature-rise tests	IEC 62271-102	6.5
Short-time withstand current and peak withstand current tests	IEC 62271-102	6.6
Verification of the protection	IEC 62271-102	6.7
Tightness tests	IEC 62271-102	6.8
Electromagnetic compatibility tests (EMC)	IEC 62271-102	6.9
Test to prove the short-circuit making performance of earthing switches	IEC 62271-102	6.101
Operating and mechanical endurance tests	IEC 62271-102	6.102
Operation under severe ice conditions	IEC 62271-102	6.103
Test to verify the proper functioning of the position indicating device	IEC 62271-102	6.105
Making and breaking tests on switch disconnector	IEC 62271-103	6.101

Table 16 –Type test

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9.2 Individual Test

In this specification individual tests are defined as tests specifically required by customer which exceed the type tests required from IEC standard.

9.2.1 Tests to verify the effectiveness of the protection against pollution

Referring to point 5.102 of IEC 62271-102, in absence of a safe connection to earth, to verify the effectiveness of the protection against pollution in service of the insulating materials, it shall be performed the following test:

- 1) with the switch-disconnector isolated, it shall be applied a 60 kV power frequency voltage (for 24kV RMU) or 80 kV power frequency voltage (for 36 kV RMU) between inlet and outlet, measuring the leakage current.
- 2) the switch-disconnector is then subject to the following cycle, that simulates a 10 years electrical service life to be repeated 3 times:
 - 20 openings at 100 Arms and $\cos\varphi = 0,7$
 - 8 closings at 4 kArms and $\cos\varphi = 0,15$
 - 15 closings at 3 kArms and $\cos\varphi = 0,15$
 - 10 openings at 100 Arms and $\cos\varphi = 0,7$
 - 30 closings at 200 Arms and $\cos\varphi = 0,7$
 - 37 closings at 2 kArms and $\cos\varphi = 0,15$
 - 15 closings at 1 kArms and $\cos\varphi = 0,15$
 - 15 openings at 100 Arms and $\cos\varphi = 0,7$
- 3) the switch-disconnector shall be subject to the tests of the previous point 1.

The test result is passed if there is no discharge on isolating distance and no current values above 30 mA are measured.


Tests to verify the tightness with the repeated temperature variations IEC in accordance with paragraph 7.4 of IEC 62271-100.

9.2.2 Immersion Test

For the test, equipment complete with control cabinet must be immersed in a water tank and maintained at a pressure of 0.3 bar (or 3 m water depth) for 30 days.

The purpose of the test is to verify the tightness of the equipment and its components:

- bushing;
- the pressure relief valve;
- welded tank;
- metal bellows and shaft for transmission of motion inside the tank.

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After 30 days, the following tests will be repeated on the equipment removed from the water:

- industrial insulation test of 50/70 kV for one minute without discharge.
- opening and closing operations at the rated voltage of the equipment

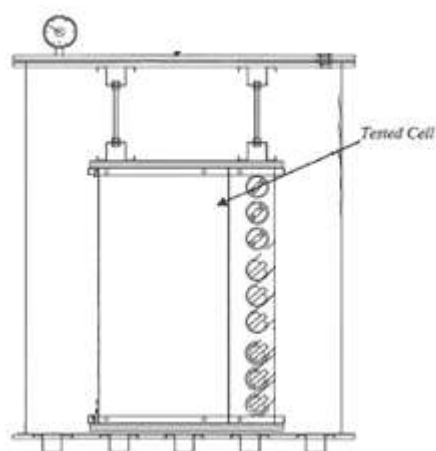


Figure 32

9.2.3 Internal Arc and overpressure valve

The equipment is IAC AFLR classified. The type of accessibility must be type A in accordance with point AA.2.2 of standard 62271-200 (special accessibility conditions)

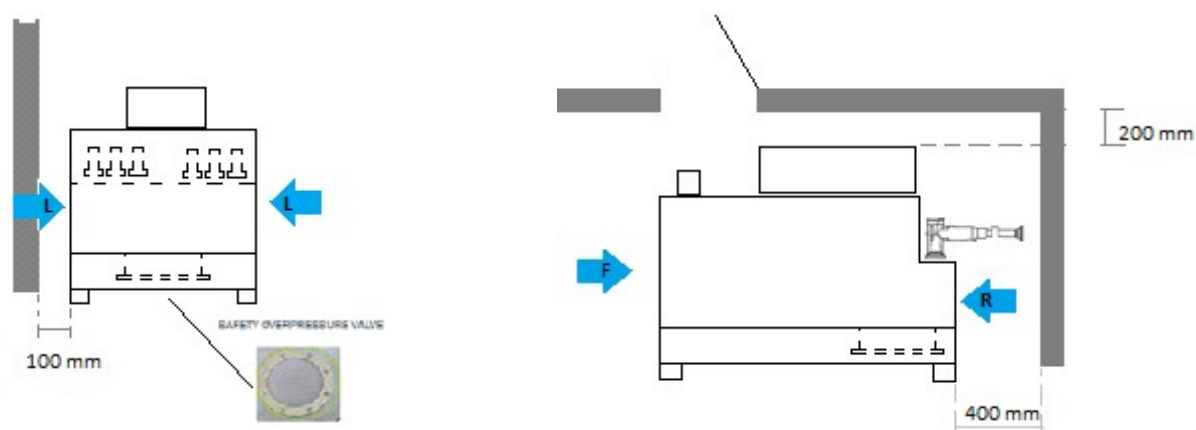



Figure 33

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9.3 Routine tests plan

All the routine tests indicated in the following table shall be carried out by the supplier on all the samples prepared for the commissioning. For each piece that belongs to the prepared batch, the supplier shall prepare a test report with the results of the tests performed.


The routine tests shall be repeated by the supplier, under the Distribution Companies surveillance, on a sample chosen randomly among those ones of the batch that has already been successfully tested by the supplier. The tests shall be carried out on samples defined by the sampling plan below

At the end of the commissioning, within the measurement uncertainty, there shall not be differences between the measured values and those ones in the acceptance ranges of the approved test values.

In case of commissioning attended by the Distribution Companies, the entire batch will be rejected if the results of one of any test is negative.

A	1 sample for type
B	At least 1sample for type(serial number Enel/Endesa/LATAM) prepared for commissioning with at least 3 total samples, and in these selected samples have to be tested a total of 3 modules for each type (CBL,LRMU,AT,M)
D	Test to be certified on single units by the supplier
K	If the samples is constructed as a unique tank, these test can be executed on the complete tank with the same Sampling plan indicated for the modules

Table 17 - Sampling plan

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N.	Test	Standard	Sampling plan		
			CBL	L RMU	AT
1	Visual inspection (a)				
2	Dielectric test on the main circuit (g) (K)	IEC 62271-200 – 7.1		B	B
3	Tests on auxiliary and control circuits (b)	IEC 62271-200 – 7.2	B	B	B
4	Measurement of the resistance of the main circuit (e) (K)	IEC 62271-200 – 7.3	B	B	B
5	Tightness test (D)	IEC 62271-200 – 7.4	D	D	D
6	Design and visual checks (a)	IEC 62271-200 – 7.5	A	A	A
7	Partial discharge measurement (i)	IEC 62271-200 -7.101	D	D	D
8	Mechanical operation tests (c) (K)	IEC 62271-200 -7.102	B	B	
9	Tests of auxiliary electrical, pneumatic and hydraulic devices (K)	IEC 62271-200 – 7.104	B	B	
10	Tests on voltage detecting system	IEC 62271-200 -7.105	B	B	B
11	Verification of proactive coating	ISO 2808	B	B	B
12	Dielectric test on the main circuit (g)	IEC 62271-100 -7.1		B	
15	Tightness test	IEC 62271-100 – 7.4	B		
16	Design and visual checks (a)	IEC 62271-100- 7.5	B		
17	Mechanical operating tests (d)	IEC 62271-100 – 7.101	B		
18	Dielectric test on the main circuit (g)	IEC 62271-102 § 7.1	B		
23	Mechanical operating tests (c)	IEC 62271-102 § 7.101	B	B	
24	Verification of earthing function	IEC 62271-102 § 8.102	B	B	B
25	Check of VT and CT routine tests		A	A	


Table 18 - Testing plan

a	Including the verification of the enclosures' degree of protection (IP).
b	1 kV power frequency testing voltage (10 kV for trip coil) during 1 seconds.
c	perform 5 manual maneuvers of the SD (transformer) measuring the speed of the main contacts in opening and closing and 5 manual operations of the earthing switch Es (line) and of the earthing switches ES1 - ES2 (transformer) measuring the speed of the pristin contacts in closure. During the maneuvers verify all the mechanical interlocks provided.
d	5 closing and 5 opening operations at Vmin (24 Vcc-15%) and Vmax (24 Vcc + 20%). At Vn (24 Vcc) perform 5 C-O cycles and 5 Ot-C-O cycles (IEC 62271-100 § 101). In the last cycle of every sequence, measure the operation times, the absorption current of the coils and of the spring charging motor. All the measured times and maximum values of absorption shall be included in the limits specified by the Manufacturer and, in any case, they shan't be outside the ± 15% of the reference values obtained during the type tests. The contact speed must not vary by 15% of the average values measured during the type tests for the approval of the appliances.
e	Test to be performed on the same configuration used during the homologation process.
g	The test shall be performed with the operating devices closed and on the sectioning distance.
h	Perform the thickness verification with sampling plan "B" and the adherence verification on one sample only.
i	Test to be certified on single units by the supplier

Table 19 - Additional information

10 SUPPLY REQUIREMENTS

Each switchgear shall be supplied with:

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- Two Command lever
- Installation and operation manual in the language of the Country in which the switchgear has to be delivered, in compliance with provisions of 62271 series standards (including indication about SF6 end-of-life management and methods of recovery of gas SF6, see chapter 13 of 62271-1);
- A connection cable for each motorized upright equipped with connectors for connection between the equipment and the UP peripheral unit.
- MV terminal kits for 240 mm² cables in aluminum (24/36 kV) for each line according to global specification GSCC006 Rev. 3.

Outside the box containing the equipment, the following indications shall be reported with clearly legible characters:

- name of the Distribution Company;
- name of the supplier;
- description of the product;
- code assigned by the supplier;
- type code and serial number of the Distribution Company;
- gross weight.

In case of switchgear delivered to Colombia, the manufacturer shall include the mandatory RETIE certificate in the TCA dossier.

10.1 Derogations from these requirements

Any exceptions to these provisions, concerning the adoption of techniques and / or construction features other than those prescribed in this document should be explicitly requested.

In this case, ENEL reserves the right to prescribe the performance of tests in addition.

In any case, these exceptions can only be granted by Enel.

11 ANNEX A VOLTAGE PRESENCE INDICATORS

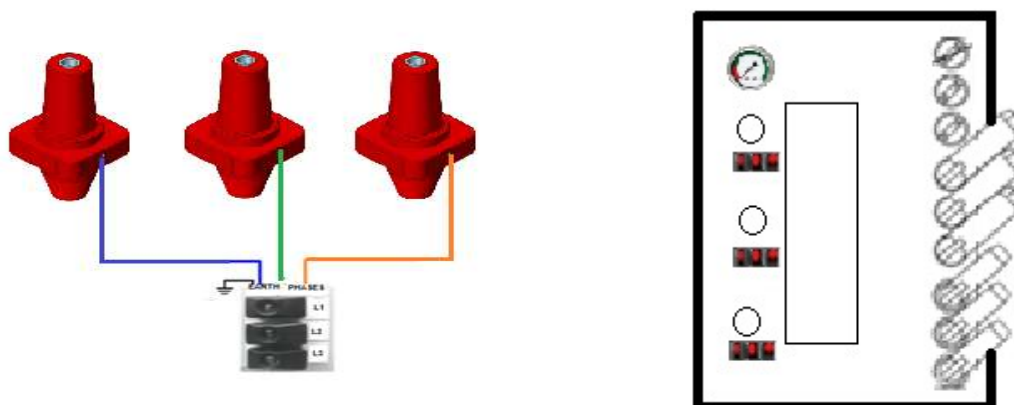


Figure 34 – wirin example

11.1 PURPOSE OF APPLICATION

The Annex is applicable to unipolar voltage detector systems with capacitive coupling to live parts. They are used to detect the presence or absence of operating voltage on AC systems with voltages from 11.4 kV to 36 kV and frequencies to 60 Hz.

11.2 COMMON INTERNATIONAL STANDARDS

IEC 62271-206

IEC 61243-5

11.3 SPECIFICATIONS

The voltage detector system must be of separable type according to EN 61243-5. The hand-held indicator must be connected to a fixed coupling system by means of an interface



Figure 35 – Voltage presence indicators

The system will be of the MR type (other systems can also be evaluated) defined by a maximum threshold voltage of 30V and a corresponding current of 2.5µA at 60Hz at the interface.

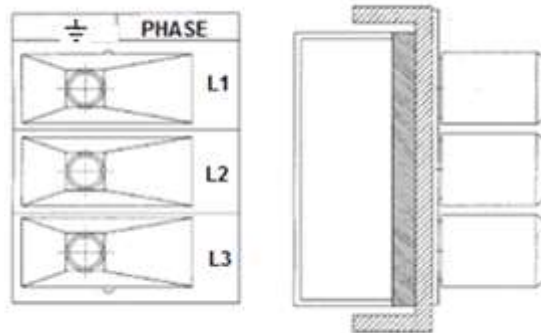


Figure 36 – interface and indicator

The device will be contained in a box protected from water. The presence of the head will be visible through a window.

11.4 INTERFACE

The interface must ensure correct electrical contact between the connection conductor and the connection terminal. The contact points must be protected against corrosion. The interface must be equipped with sockets in accordance with Table 2 of EN 61243-5 and arranged according to it.

The test points shall ensure correct electrical contact.

The contact points shall be protected against corrosion and shall consist of a single socket in accordance with Table 2 of EN 61243-5.

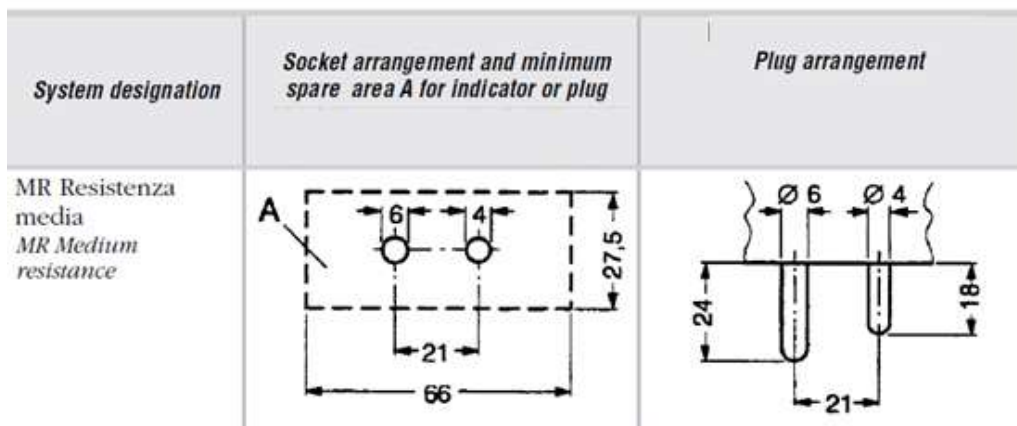


Figure 37 - dimensional characteristic of interface

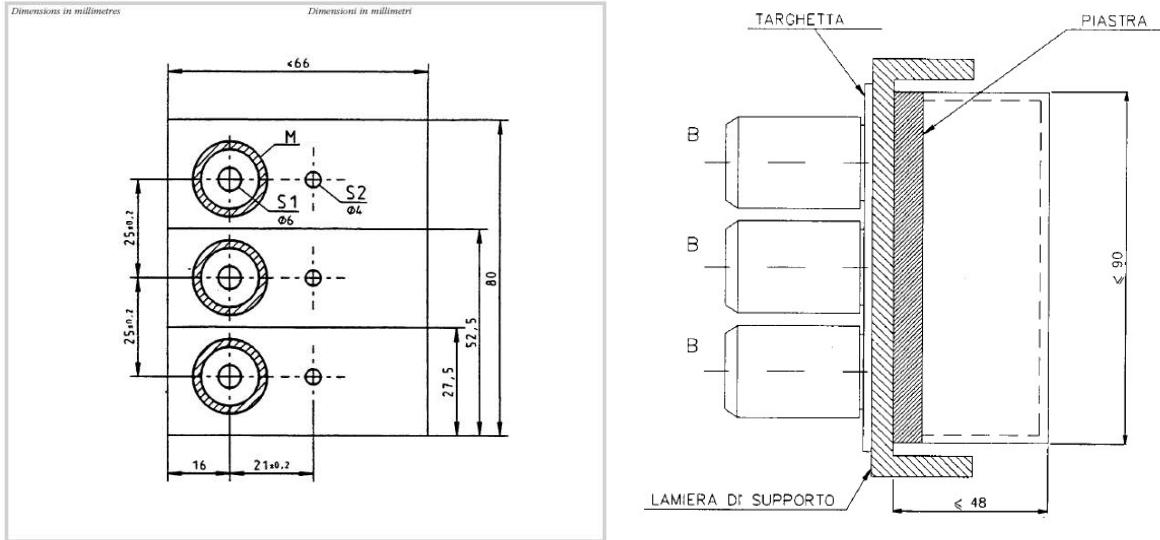


Figure 38 – Socket MR

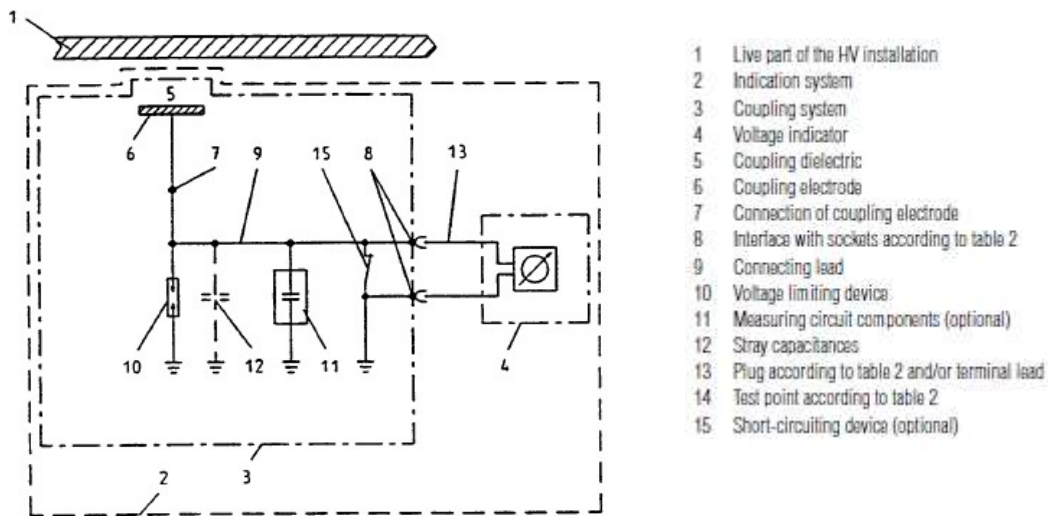


Figure 39 – Voltage detecting system

The insulation resistance of voltage measuring parts to earth must be at least 120 MΩ.

To provide protection for operators against the presence of operating voltage on the interface or the test point, it shall be ensured that any insulation failure of the coupling dielectric will necessarily cause a permanent earth fault.

The voltage of the limiting device must comply with point 4.5.4 of IEC 61243-5.

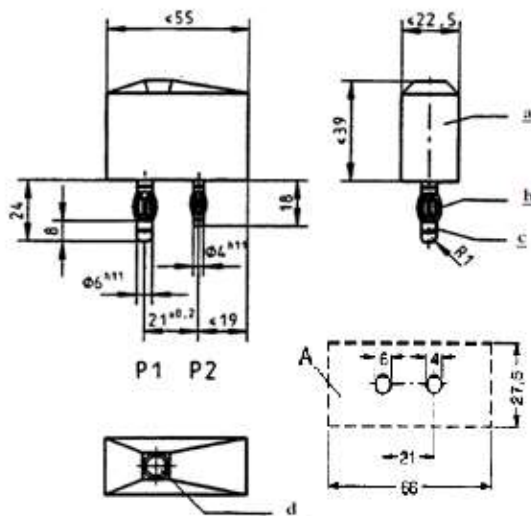
11.5 INDICATOR

The indicators shall be constructed in accordance with point 4.9 of EN 61243-5.

The indicators shall be designed to indicate the presence of AC voltage with a nominal frequency range to 60 Hz. They shall not have flexible terminal connections.

The indicators shall be visual and indoor-type without built-in power supply and shall have the following technical characteristics:

- The indication "presence of voltage" must appear when the voltage between the phases and earth is between 45% and 120% of the rated voltage and must not appear if this voltage is less than 10% of the rated voltage.
- The indicators must provide a safe indication of the voltage status or phase concordance.
- The repetition frequency must be at least 1 Hz for phase-to-ground voltages equal to or greater than 45% of the rated voltage or for a measuring voltage equal to or greater than U_{tmax} .
- For a phase-to-ground voltage less than 10% of the rated voltage and in the case of a measurement voltage less than U_{tmin} , the indication must be "no voltage", with no active signal for the indicators.



Voltage indicator MR, main dimensions

CAPTION

- a Metallic housing
 - b Elastic contact
 - c Metallic tip
 - d Indicating element
 - P1 Earthed pole
 - P2 Pole with signal
- The housing is metallic and connected to P1

Figure 40 - dimension


11.6 OPERATING CONDITIONS

The operating and storage conditions are as follows:

- ambient temperature: - 25 to + 55 °C
- atmospheric pressure: 86 kPa to 106 kPa.:
- relative humidity: over a period of 24h, < 95%

11.7 MARKING

The following markings shall be legibly affixed to the interface, in characters at least 3 mm high:

- Capacitive interface symbol (fig. 4 IEC 61243-5) 
- Symbol of the detection system (MR);
- On each interface: phase designation of the busbar side and also the earth symbol \perp (fig. 5 IEC 61243-5).

Group Enel	
Enel Distribución Colombia	L1 – L2 - L3
Enel Distribución Perú	L1 – L2 - L3
Edesur	L1 – L2 - L3
Endesa Distribución Eléctrica	L1 – L2 - L3
Enel Distribución Chile	L1 – L2 - L3
Enel Distribuição Ceará	L1 – L2 - L3
Enel Distribuição Rio	L1 – L2 - L3
Enel Distribuição Goiás	L1 – L2 - L3
Enel Distribuição São Paulo	L1 – L2 - L3

Table 20

Country	Marking on indicators
Spanish	LATO BARRAS
Portuguese	LADO BARRA

Table 21

The indications must be clearly visible even with the indicators inserted.

Each indicator must contain the following markings in characters at least 2 mm high:

- IEC 61243-5;
- Symbol of the detection system (MR);
- Identification of the phases as in the table,
- Manufacturer;
- Year of production;
- Rated frequency if different from 60HZ;
- Type or serial number.

11.8 INSTRUCTION FOR USE

The VDS must be accompanied by instructions for use which include: instructions for use, maintenance, storage, transport, assembly, voltage range for safe indication, function and use tests (according to Annex B of EN 61243-5).

12 ANNEX C CHARACTERISTICS OF THE ELECTRICAL COMMAND

12.1 Electric motor

The circuit breaker mechanism for energy storage shall be driven by an electric motor, suitable for continuous service, having the following characteristics:

Supply voltage	[V _{cc}]	24 +20% -15%
Power consumption at full speed	[W]	≤ 300
Ratio between nominal power and absorbed power		≥ 1,4
Degree of protection		≥ IP68
Other characteristics		IEC 60034-1

Table 22 - Characteristics of the electric motor

12.2 Electric command Circuit Breaker

The CB command must have the following functional characteristics:

- the motorization circuit must not absorb any current when it is in the stand-by state;
- the excitation time of the electric control must be such as to provide self-latching with a command pulse lasting no more than 300 ms;
- when the power supply to the motor circuit is missing, the fallout of all self-retainers must be verified;
- In case of padlock insertion power supply to electric maneuvers shall be cut out.


An electrical interlock must allow the operation of the motor only when the earth blades are completely open.

In case of manual control of the line or earthing switches, the insertion of the operating lever must prevent the electrical and manual controls of the switch; this interlock must as soon as the lever goes to engage the socket of any of the shafts.

12.3 Electric command Line Disconnecter

The electrical control of the LD must implement an operating cycle by means of a gearmotor of the dead point exceeding type with the following functional characteristics:

- the stability of the position of the SD contacts must be ensured until the dead center has been exceeded;
- if, during any maneuver, a power failure should occur before the dead center is exceeded, the system must allow the kinematic mechanism to be reset so that the operating lever can be inserted and, if the carter is removed springs must discharge;

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- when the power supply to the motor circuit is missing, the self-retainers must fall;
- the motorization circuit must not absorb any current when it is in the stand-by state;
- the energizing time of the electric control must be such as to guarantee self-latching with a command pulse lasting no longer than 300 ms;
- power supply must be cut so as to prevent, in addition to manual operations, also electric ones.

An electrical interlock must allow the motor to operate only when the ground blades are completely open.

In the case of manual control, the insertion of the operating lever must prevent the operation of the motorization; this interlock must act as soon as the lever goes to engage the socket.

This condition can be achieved with both a mechanical solution (decoupling of the gearmotor) and an electric one (cutting of the motor supply).

12.4 Connections

The energy for the motorized control is supplied by a special power supply housed in the peripheral unit for remote control of the secondary substations (GSTR002).

Inside the power supply, both the direct current sorting for the motors ($\pm M$) and the auxiliaries ($\pm A$) and the centralization of the remote controls and signals for all the compartments of the switchboard are carried out. The supply circuits for the motors ($\pm M$) and for the auxiliaries ($\pm A$) shall remain separate and isolated from each other and are protected by different bipolar protections in the power supply.


For the wiring between the motorized control and the power supply (line upright) a multipolar cable shall be provided, as indicated in figure 32, equipped at the ends with the flying parts of the connectors described in figure.

On both edges of the cable a mark of a PVC strap shall be applied on which the indication of the number and the denomination of the compartment to which they refer will be affixed during installation. For remoting of the status of the SD in the transformer protection mounting opening position, a 2x1.5 mm² LV cable with a length of 8 m shall be provided. This cable shall be wired from the auxiliary contact towards the outside of the trolley without interposed connection. At the end of the cable "SD-TF" shall be indicated the supplier shall provide appropriate protection against possible damages to these connections deriving from the handling and transport of the compartment.

For the unit with circuit-breaker function the total resistance (LV cable + coil) of open and close command circuit shall be between 5 and 5000 Ω .

The characteristics of the cables shall be the following:

Rated insulation voltage	[V]	300/500
--------------------------	-----	---------

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cable training (line upright)	n	11
cable training (transformer protection upright)	n	2
length	[m]	8 +0,2
Outer diameter (on insulation) of cores	[mm]	≤ 3
Flexible string conductors of annealed non-tinned copper		
PVC insulation of quality R2		
Distinction of cores by marked numbers (according to CEI EN 50334) match the numbers marked with those identifying the connector pins		
Rz quality PVC sheath		
Fire non-propagation characteristics according to IEC 20-22		

Table 23 - Characteristics of the external cable

12.5 Internal wiring

For internal wiring shall be used wire sections suitable for the correct operation of the equipment.

The end of each connection shall be equipped with pre-insulated terminals suitable for the type of connection required (faston, cylindrical, eyelet, etc.), identification marks, as well as reference to the wiring diagram.

Each cable passage hole shall be equipped with a suitable cable gland.

12.6 Connectors

In order to interface the circuit of the electric control with the power supply, the fixed part of a circular connector, of the type shown in figure, shall be provided, on which the flying part provided at one end of the connection cable mentioned in point B.2 shall be inserted.

The coupling of the parts, facilitated by polarization guides, shall be ensured by means of a quick-release screw ring nut.

The flying part of the rectangular connector provided at the other end of the cable shall be of the type shown in figure 56. The coupling with the fixed part shall be facilitated by polarization guides and secured by means of elastic locking appendices.

Both the fixed and the flying parts shall be made of insulating material with dielectric characteristics.

The fixed part of the connector shall be accompanied by a cap (anti loss type); the flying ones shall have cable clamps.

The fixed connector shall be installed on the front of the control.

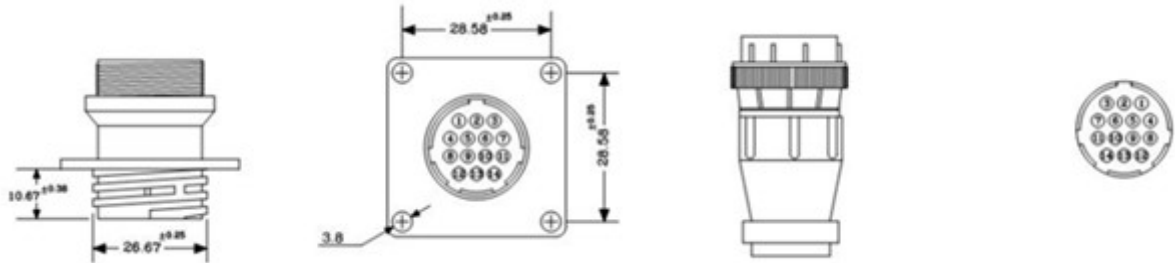


Figure 41 - Connector

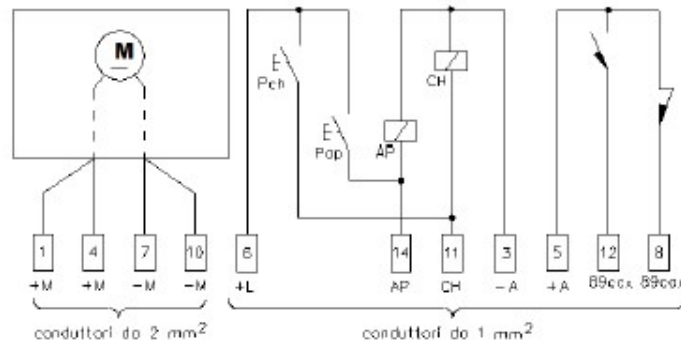


Figure 42 - electric scheme of the CB command

2		Not used	9		Not used
3	- A	Common (-24 VDC) commands	10	- M	Power supply (-24 Vcc) engine
4	+ M	Power supply (+24 VDC) motor	11	CH	Remote control of closing
5	Com TS	Common Telesignals LCB	12	89ccx	Telesignal LCB Closed
6	+ L	Alim. (+24 Vcc) local commands	13	89 LD	LD Closed
7	- M	Power supply (-24 VDC) motor	14	AP	Remote control of Opening

Table 24 - Use of the motor-side connector pin

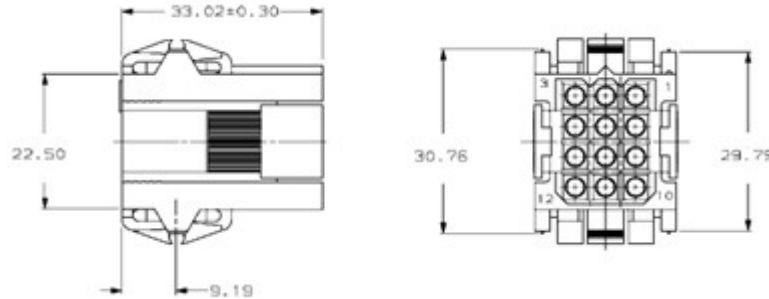


Figure 43 - Device connector on the Peripheral Unit side

1	+ L	Local commands (+24 Vcc)	7	AP	Opening Remote Control
2	+ M	Power supply (+24 VDC) motor	8	CH	Closing remote control
3	+ M	Power supply (+24 VDC) motor	9	89cax	Telesignal LCB OPEN
4	89ccx	Telesignal LCB chiuso	10	- M	Power supply (-24 VDC) motor
5	Com TS	Telesignal state LCB	11	- M	Power supply (-24 VDC) motor
6		Not used	12	- A	Common (-24 Vcc) commands

Table 25 - Connector features on the Peripheral Units side

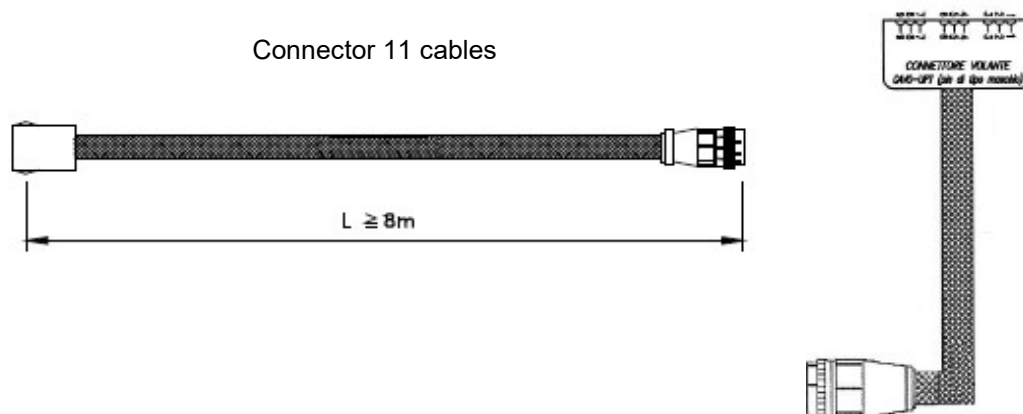



Figure 44 - Connection cable between motorization and Peripheral Unit for uprights line

12.7 Command coil parameters

The opening and closing coils, connected to the mechanical system for the opening and closing of the CB poles, shall have an instantaneous maximum peak absorption of no more than 5 A. Each coil both

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for opening and closing, shall be equipped with a system to dampen overvoltage caused by sudden variation of the coil current. The device shall be connected between the negative polarity of the 24 Vdc auxiliary power supply of the compartment and the input terminal for the open and close command. The device can be of the linear type (capacity type) or non linear type (diode type).

13 ANNEX E INTERLOCKS CHECKING

Transformer protection unit interlock check-in

Status	Disconnecter	Circuit Breaker	Earthing	Allowed	Forbidden	Impossible
0	OPEN	OPEN	OPEN	0,1,7	5	2,3,4,6
1	OPEN	OPEN	CLOSED	0,1,6		2,3,4,5,7
2	CLOSED	OPEN	CLOSED			
3	CLOSED	CLOSED	OPEN	3,7	5	0,1,2,4,6
4	CLOSED	CLOSED	CLOSED			
5	OPEN	CLOSED	OPEN	0,5	3	1,2,4,6,7
6	OPEN	CLOSED	CLOSED	1,6	5	0,2,3,4,7
7	CLOSED	OPEN	OPEN	0,3,7		1,2,4,5,6

Table 25 - Circuit breaker unit - Interlock check-in

Status	Switch disconnecter	Earthing	Allowed	Forbidden	Impossible
0	OPEN	OPEN	0,1,2		3
1	OPEN	CLOSED	0,1	3	2
2	CLOSED	OPEN	0,2	3	1
3	CLOSED	CLOSED			

Table 26 -RMU line unit – Interblock chech-in

 Non reachable status


In order to check the correct functioning of the interlocks, it shall be necessary to verify their operation according tables.

Terminology:

Allowed: Status that is possible to reach from the current status.

Forbidden: Status that is impossible to reach from the current status as a result of the operation of the interlocks

Impossible: Status that is physically impossible to reach from the current status.

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14 ANNEX F – Type Code

TYPE CODE	DESCRIPTION	EDESUR	ENEL DISTRIBUCÃO RIO CEARÁ GOIÁS	ENEL DISTRIBUCÃO SÃO PAULO	ENEL DISTRIBUCION CHILE	ENEL DISTRIBUCION COLOMBIA	ENEL DISTRIBUCION PERU'
GSCM007/1	MV UNDER SWITCHGEAR 2CBL 15/24kV – 20kA		T140058	325101	140130		
GSCM007/2	MV UNDER SWITCHGEAR 3CBL 15/24V – 20kA		T140046	325102	140140	140174	
GSCM007/3	MV UNDER SWITCHGEAR 4CBL 15/24V – 20kA		T140056	325103	140141	140173	
GSCM007/4	MV UNDER SWITCHGEAR 5CBL 15/24V – 20kA		T140047	325112	140154	140172	
GSCM007/5	MV UNDER SWITCHGEAR 3L 15/24kV – 20kA	0109-0442	T140055	325125	140155	140156	140160
GSCM007/6	MV UNDER SWITCHGEAR 4L 15/24kV – 20kA		T140054	325126	140153	140157	140162
GSCM007/7	MV UNDER SWITCHGEAR 1CBL+1L 15/24kV - 20kA		T140053	325114	140152	140171	140161
GSCM007/8	MV UNDER SWITCHGEAR 2CBL+1L 15/24kV – 20kA				140151	140170	140159
GSCM007/9	MV UNDER SWITCHGEAR 3CBL+1L 15/24kV – 20kA		T140052	325107	140150	140169	
GSCM007/10	MV UNDER SWITCHGEAR 4CBL+1L 15/24kV – 20kA		T140029	325115	140149	140168	
GSCM007/11	MV UNDER SWITCHGEAR 1CBL+2L 15/24V – 20kA		T140028	325116	140148		140158
GSCM007/12	MV UNDER SWITCHGEAR 1CBL+3L 15/24V – 20kA		T140051	325117	140147		
GSCM007/13	MV UNDER SWITCHGEAR 1CBL+4L 15/24V – 20kA		T140050	325127	140146		
GSCM007/27	MV UNDER SWITCHGEAR 2CBL 36kV – 20kA		T140026	325118			
GSCM007/28	MV UNDER SWITCHGEAR 3CBL 36kV – 20kA		T140059	325119		140167	
GSCM007/29	MV UNDER SWITCHGEAR 4CBL 36kV – 20kA		T140024	325120		140166	
GSCM007/30	MV UNDER SWITCHGEAR 5CBL 36kV – 20kA					140184	
GSCM007/31	MV UNDER SWITCHGEAR 3L 36kV – 20kA						
GSCM007/32	MV UNDER SWITCHGEAR 4L 36kV – 20kA						
GSCM007/33	MV UNDER SWITCHGEAR 1CBL+1L 36kV – 20kA					140183	
GSCM007/34	MV UNDER SWITCHGEAR 2CBL+1L 36kV – 20kA					140182	
GSCM007/35	MV UNDER SWITCHGEAR 3CBL+1L 36kV – 20kA					140181	
GSCM007/38	MV UNDER SWITCHGEAR 4CBL+1L 36kV – 20kA					140180	
GSCM007/37	MV UNDER SWITCHGEAR 1CBL+2L 36kV – 20kA						
GSCM007/38	MV UNDER SWITCHGEAR 1CBL+3L 36kV – 20kA						
GSCM007/39	MV UNDER SWITCHGEAR 1CBL+4L 36kV – 20kA			325140			
GSCM007/40	MV UNDER SWITCHGEAR 3L 36kV – 20kA		T140025	325138			
GSCM007/41	MV UNDER SWITCHGEAR 4L 36kV – 20kA			325139			
GSCM007/42	MV UNDER SWITCHGEAR 1CBL 15/24kV – 20kA			325122			
GSCM007/43	MV UNDER SWITCHGEAR 1L 15/24V – 20kA			325123			
GSCM007/44	MV UNDER SWITCHGEAR 2L 15/24kV – 20kA			325124			
GSCM007/45	MV UNDER SWITCHGEAR 2CBL+2L 15/24kV – 20kA			325128			
GSCM007/50	MV UNDER SWITCHGEAR 1L 36kV – 20kA			325136			
GSCM007/51	MV UNDER SWITCHGEAR 2L 36kV – 20kA			325137			
GSCM007/52	MV UNDER SWITCHGEAR 2CBL+2L 36kV – 20kA			325141			

Table 27 – Type Code



MV RMU - UNDERGROUND SWITCHGEAR

GSCM007
Rev. 0
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<u>Line disconnectors (SL) specific characteristics:</u>		
- Rated normal current	630 A	
- Rated short-time withstand current	20 kA	
- Rated duration of short circuit	1 s	
- Number of mechanical operations	M1	
<u>Line unit earthing switches (ST) specific characteristics:</u>		
- Rated short-time withstand current	20 kA	
- Rated short-circuit making current	40 kA	
- Rated duration of short circuit	1 s	
- Number of mechanical operations	M1	
- Earthing switch class	E2	
RMU		
<u>Switch-disconnector specific characteristics:</u>		
- Rated normal current	630 A	
- Rated short-time withstand current	20 kA	
- Rated duration of short circuit	1 s	
- Number of mechanical operations	M1	
- Electrical endurance classification	E3	
- Rated breaking current:		
- of a mainly active load	630 A	
- of a no-load transformer	6,3 A	
- of a no-load line	13 A	
- of a no-load cable	40 A	
- in case of earth fault	50 A	
- with cable-charging in case of earth fault	25 A	
<u>Earthing switches ES</u>		
- Rated short-time withstand current	20 kA	
- Crest value of the rated short-time withstand current	40 kA	
- Rated short-circuit duration	1 s	
- Mechanical endurance class	M0	
- Electrical endurance class	E2	
Documentation to be attached to the check-list		
Drawing with overall dimension including support		
List of deviations to technical specifications		
Type of bushing		

Table 28 – Technical checklist