PRIMARY SUBSTATION

EXTRACTABLE, VERTICAL TRASLATION, THREE-POLE, VACUUM CIRCUIT BREAKER, Ur=24kV FOR AIR INSULATED "COMPACT" SWITCHGEAR FAMILY

	Elaborated by	Verified by	Approved by
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Revision	Data	List of modifications
0	16/09/2020	First emission

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Figures and Tables Index

1 EXECUTIVE SUMMARY

This document contains technical specification for Vacuum Circuit Breaker (VCB); service conditions, technical and constructive features, testing and supply requirement for the VCB are included.

2 SCOPE

Document applies to the vertical translation and lateral command MV three pole VCB for indoor application with nominal voltage Ur = 24kV, used in the Air Insulated "compact" Switchgear (AIS) family as described in the Volume XIX "Family of AIS "compact" ***enel*** type technical specifications collection" to be installed in primary substation.

3 LIST OF COMPONENTS

***enel* type**	**Description**
GSCM505/2	Transformer/ Bus-bar-tie (1MBO+1MBU+1MCO) VCB Ir =1600A
GSCM505/3	Transformer/ Bus-bar-tie (2MBO+1MCO) VCB Ir =1600A
GSCM505/4	Neutral maker transformer (1MBO+1MBU+1MCO) VCB
GSCM505/7	Line/auxiliary services/ capacitor bank (1MBO+1MCO) VCB
GSCM505/8	Transformer/ Bus-bar-tie (1MBO+1MBU+1MCO) VCB Ir =2000A
GSCM505/9	Transformer/ Bus-bar-tie (2MBO+1MCO) VCB Ir =2000A

Table 1 - List of components

Company	**GSCM505/2**	**GSCM505/3**	**GSCM505/4**	**GSCM505/7**	**GSCM505/8**	**GSCM505/9**
e-distribuzione (Italy)	140098		140097	140096	140095	
e-distribucion (Spain)		140715		140714		140713
e-distributie (Rumanian)						
enel Distribución Chile (Chile);			140185	140322	140323	140324
enel Distribuição Rio (Brazil);			T140125	T140124	T140123	T140122
enel Distribuição Ceará (Brazil);			T140125	T140124	T140123	T140122
enel Distribuição Goiás (Brazil);			T140125	T140124	T140123	T140122

enel Distribuição Sao Paulo (Brazil);						
enel Distribución Perú (Perù);						
Edesur (Argentine)						
Codensa (Colombia)						

Table 2 - List of material codes

4 APPLICABLE LAWS, REFENCE STANDARDS AND LIST OF REPLACED STANDARDS

4.1 International standard

IEC 62271-1	IEC 60270
IEC 62271-100	IEC 62271-304
IEC 62271-200	IEC 60137
IEC/TS 62271-210	IEC 60529
IEC 60073	IEC 60227
IEC 60695-11-10	ISO 16739
IEC 81346-2	ISO 9000
IEC 60445	ISO 12944
IEC 61810-1	ISO14000

Table 3 - International standard

Last edition of previous standards shall be utilized.

4.2 *enel* standard

- GSCG002 "Technical conformity assessment" ;
- Volume XIX rev.8 "Family of AIS "compact" ***enel*** type technical specifications collection";
- GSCM1676 "Mock-up template utilization procedure"
- Contractual Requirements for Components and Materials Quality management

4.3 Local Law and Standard

4.3.1 Italy

- D. Lgs n. 81 e s.m.i.;

- PVR001 "Gestione delle Garanzie dei Materiali di Enel Distribuzione";
- PVR006 "Codici a barre - Garanzia e Rintracciabilità dei Materiali di Enel Distribuzione";
- GUI 101 "Caratteristiche generali e prescrizioni di impiego del pallet in legno da utilizzare per imballo di trasporto"

4.3.2 Spain

- RAT, Seguridad, Declaracion de conformidad;
- R.D. 614/2001, de 8 de junio, sobre disposiciones mínimas para la protección de la salud y seguridad de los trabajadores frente al riesgo eléctrico;
- R.D. 337/2014, de 9 de mayo, por el que se aprueban el Reglamento sobre condiciones técnicas y garantías de seguridad en instalaciones eléctricas de alta tensión y sus Instrucciones Técnicas Complementarias ITC-RAT 01 a 23;
- R.D. 223/2008, de 15 de febrero, por el que se aprueban el Reglamento sobre condiciones técnicas y garantías de seguridad en líneas eléctricas de alta tensión y sus instrucciones técnicas complementarias ITC-LAT 01 a 09.

4.3.3 Rumania

- Prescriptia Energetica PE 101/85 – Normativ pentru construcţia instalaţiilor electrice de conexiuni şi transformare cu tensiuni peste 1 kV;
- GUI 101RO.

4.3.4 Chile

- Norma técnica de calidad de servicios para sistema de distribución, Comisión Nacional de Energía, Diciembre 2017;
- Norma Técnica de Seguridad y Calidad de Servicio, Comisión Nacional de Energía, Enero 2016.

4.3.5 Brazil

- NR-10 - segurança em instalações e serviços em eletricidade;

4.3.6 Peru

4.3.7 Colombia

- RETIE – Reglamento Técnico de Instalaciones Eléctricas;

4.3.8 Argentine

4.3.9 All European Countries

- Regulation (EU) of the European Parliament and of the Council 517/2014 of the 16th April 2014.

5 SERVICE CONDICTIONS

VCB shall be compliant with normal service conditions for indoor installation, defined in chapter 2 of IEC 62271-100, considering as minimum value of ambient temperature -5°C.

Maximum altitude shall be as defined in normal service condition (1000 m).

Constructor shall define the Ur referred to 2700 m of altitude for Colombia, (a de-rating of Ur can be considered).

Seismic level of apparatuses, functional unit switchgear and VCB shall be:

- seismic severity 2;
- acceptance class 1;

as defined in IEC/TS 62271-210.

VCB shall be compliant for installation in three-phases MV effectively and non-effectively earthed neutral system (impedance earthed neutral system, resonant earthed neutral system, arc-suppression-coil-earth neutral system).

VCB shall be compliant with design class 2 (CH; PH) of IEC 62271-304.

6 TECNICHAL CHARACTERISTICS

VCB shall be compliant with IEC 62271-100. In the following table, minimum electrical ratings for each type of VCB GSMC505 are defined.

***enel* Type**	**GSCM505/2**	**GSCM505/3**	**GSCM505/4**	**GSCM505/7**	**GSCM505/8**	**GSMC505/9**
Rated Frequency fr (Hz)	50 and 60					
Rated normal current Ir (A)	1600		630		2000*	
Maximum voltage of grid (kV)	22					
Rated Voltage Ur (kV)	24					
Rated power-frequency withstand voltage Ud (kV)	50					
Rated lightning impulse withstand voltage Up (kV)	125					
Rated short circuit breaking current Isc (kA)	16					
Rated duration of short circuit tk (s)	1					
Rated short-circuit making current & Rated peak withstand current Ip (kA)	41,6 (with d.c. time = 45 ms)					
Rated supply voltage of closing and opening devices and of auxiliary and control circuits Uop (Vdc) and rated supply voltage of auxiliary circuits Ua (Vdc)	110 and 125					
Rated operating sequence VCB for rapid auto-reclosing	O – 0,3'' – O – 15'' – CO					
Break-time (ms)	60 ÷100					
Rated first-pole-to-clear factor *kpp*	1,3 and 1,5					
Circuit breaker class	S1					
Electrical endurance class	E2					
Mechanical endurance class	M2					
Probability of restrike during capacitive current breaking class	C2					

Rated line charging breaking current I_l (A)	10					
Rated cable-charging breaking current Ic (A)	31,5					
Rated single capacitor bank-breaking current Isb (A) for 6MVAR of maximum reactive power	400					
Rated back-to-back capacitor bank breaking current Ibb (A)	NA		400		NA	
Rated back-to-back capacitor bank inrush making current Ibi (kA) fbi 4250 Hz	NA		20		NA	
IP degree IEC 60529	2X					
Command Type	B	D	C	A	B	D

Table 4 - Electrical Features

***Ir = 2000 A reachable with forced ventilation installed on functional unit switchgear.**

Ratings for back-to-back capacitor bank is not required for VCB ***enel*** types GSCM505/2/3/8/9.

7 CONSTRUCTION CHARACTERISTICS

7.1 Generality

VCB shall be extractable type, with clamps for power connections and, for its operation, only the expected electrical auxiliary voltage is allowed.

Dimension of VCB, various views and sections are in Annex A of this document.

7.2 Construction details

7.2.1 Insulated bushings

Insulated bushing allows active part of each pole of VCB to cross the septum of the functional unit switchgear that separates the bus bar compartment from the cable compartment.

In case of high levels of partial discharges due to sharp edges interfering between functional unit switchgear and VCB, suitable deflectors (such as rings embedded in the resin of the bushing) in order to reduce the intensity of the field in the area above described shall be provided.

In any case, the solution adopted shall not introduce any modification to the family of switchgear technical specifications.

7.2.2 Protection panel

VCB command shall be equipped, in front and sides, with a metallic protection (other materials shall be taken into account) panel of adequate resistance to mechanical stress and internal fault. Panel shall be without sharp corners at the edges. Panel design of lowest part of the panel shall also take in consideration the maneuverability of the handles for extraction of the VCB trolley (see paragraph 7.2.5).

7.2.3 Wheels

VCB trolley shall be equipped of 4 sliding stainless wheels suited to the guides installed inside the functional unit switchgear; the wheels shall permit the easy handling of VCB trolley.

Wheels fixing system shall be contained in the maximum width of trolley.

7.2.4 Earthing contact

VCB shall be equipped with a copper earthing contact of proper dimension to be coupled with the functional unit switchgear earthing system.

7.2.5 Drag handles for trolley

VCB trolley shall be equipped with two handles positioned in the front panel, retractable by means of return springs; handles shall allow to release the two rectangular blocking pivots of the VCB trolley.

Mechanism shall be designed in order to operate correctly with functional unit switchgear interlocks.

Design of handles shall be ergonomic, safe and effortlessly for operators.

7.2.6 Accessory openings

In front of VCB, accessory openings are permitted in order to cope with various exigencies (for example to make visible signaling of springs loaded or no loaded); at least IP2X degree of protection (IEC 60529) shall be ensured.

Accessory openings shall be positioned such as to be visible by inspection through the window positioned on the door of functional unit switchgear.

7.2.7 Clamp contacts

Clamp contacts shall be designed in order to be coupled with the functional unit switchgear fixed contacts (see annex A).

Penetration of clamp in the fixed contacts shall be 30 mm as minimum values; at any case the penetration shall be adequate in order to ensure the electrical ratings of functional unit switchgear.

Clamp contacts shall have a degree of mobility to permit a correct coupling with the fixed contacts even in case of offset with respect to the bus bar.

Every group of contacts shall be equipped with independent re-entry springs in order to permit, after a disconnection of VCB from bus bar, the clamp returning to pre-connection position.

7.2.8 Lifting devices

Removable lifting devices shall be installed on VCB (for example eyebolts or similar), for the lifting of the complete VCB.

7.3 Blocking pivot

VCB shall be equipped with a blocking pivot of 20 mm diameter, rounded edges and stroke at least 20 mm (see annex A).

When the trolley is "totally relieved" and "totally lowered" (VCB connected and disconnected), the pivot will be in its more external position.

This position of pivot shall be maintained by a horizontal pressure towards external direction with respect to trolley.

The pressure shall have proper accordance with specific mechanism present on the front of functional unit switchgear (see annex A), in any case untimely maneuvers shall be avoided.

Activation of blocking pivot shall occur when it is pushed towards internal direction starting from 5 mm and to 10 mm from beginning of horizontal stroke.

Activation interval shall occur in the following conditions:

- when the trolley is in intermediate position (for example during a translation of VCB).
- when the mechanism for the command of blocking pivot has been operated (meaning that the operator is preparing for vertical translation of VCB from position of "service" to position of "disconnected" or conversely).

Activation of blocking pivot shall cause the following interlocks:

- mechanical interlock that prevent the electric command (closing) of VCB;
- mechanical interlock that causes the automatic mechanical opening of the VCB.

Blocking pivot shall be equipped with electrical signaling (electrical contact) see annex B.

7.4 Construction features of command

VCB shall be compliant with 110 Vdc and 125 Vdc rated supply voltage of closing and opening devices Uop with the tolerance described by the standard.

Connecting to ground a polarity of 110 and 125 Vdc supply is not allowed.

7.4.1 Power contacts

Power contacts movement of the VCB shall be mechanical, energy storage device shall be mechanical type (springs command).

Alternative constructive solutions for energy storage device can be take in consideration, given the respect of all functional requirements of this specification.

Charging of energy storage devices shall be obtained in two ways:

1) DC electric engine;

2) mechanical device manually activated by operator.

VCB command shall achieve the followings cycles:

- with DC engine working:
  - O – 0,3" – CO – 15'' – CO, starting by condition of circuit breaker closed and springs of closure charged;
- with DC engine out of working:
  - O – 0,3" – CO, starting by condition of circuit breaker closed and springs of closure charged;
  - CO, starting by condition of circuit breaker open and springs of closure charged;
  - O, starting by condition of circuit breaker closed and springs of closure not charged.

When VCB is close opening springs shall always be charged.

In case that, during a maneuver, opposite maneuver request appears, the memorization and actuation shall be avoided until completion of maneuver on going.

Functional conditions for release, both closure and opening (by launch and under voltage), and maximum actuating force required for restoration of mechanical device shall be as indicated in IEC 62271-100.

Cabling shall be manufactured with unipolar, flexible copper conductor, compliant with IEC 60227 with minimum section 1,5 mm^2. Conductors shall be marked at their extremity, accordance with IEC 60445 and cabling drawings.

7.4.2 Types of command

VCB shall be equipped with a three-polar command:

- Type "A" command for line, capacitor bank and auxiliary services VCB;

- Type "B" and Type "D" command for transformer, bus bar tie VCB;
- Type "C" command for neutral maker transformer VCB;

Type "A" command shall be equipped with following circuit and devices:

- Three-polar shunt closing release by launch of tension (MCO);
- Three-polar shunt opening release by launch of tension (MBO);
- Anti-reclosing device (anti-pumping) with the scope of inhibiting further closures after the first, in case there is an opening command during the initial request of closing. This device cannot be deactivated by functional inhibitions.

Type "B" and type "C" commands shall be equipped with same devices of type "A" plus the following command device:

- Three-polar opening under-voltage release (MBU) that can be deactivated with a selector positioned on front of command (see par. 7.5.3). Operation of activation and/or deactivation shall not produce untimely maneuvers.

Type "D" command shall be equipped with same devices of type "B" replacing three-polar opening under-voltage release with:

- Second three-polar shunt opening release by launch of tension (2°MBO).

For more details see annex B

7.4.3 Inhibit circuits

Circuits and/or devices shall be considered that must inhibit command of closing when there is at least one of follow events:

- not enough energy for maneuver of closing (springs not charged);
- activation of blocking pivot (activation of blocking pivot when VCB is closed shall cause the opening of VCB);
- command and/or maneuverer of opening on going;

- under-voltage release active when under-voltage coil is not energized for absence of Vdc or for fault conditions (only for types "B" and "C").

Inhibition shall automatically end only after the conditions that had caused its activation disappeared.

Untimely inhibitions due to mechanical stress and vibrations present during the VCB maneuvers shall be avoided.

7.4.4 Devices to be installed on front of VCB

Devices to be installed on front of VCB, shall be visible also when the VCB is in operating position inside functional unit switchgear.

Following devices compliant to IEC 60073 shall be installed:

- CB commands symbology:

Operation	All countries except Brazil (according with IEC 60073)	Brazil (according with NR10)
Closing	White (green is permitted)	White "L" on Red background
Opening	Black (red is permitted in all countries excluded Perù)	White "D" on Green background

  - opening button permits the opening maneuver of CB without using electric circuits. This button shall be equipped with protection again accidental bumps;
  - closing button permits the closing of CB only when the energy maneuver is full. This button shall be operable and visible only once the carter (protection panel) of command has been removed;

- position indicator of VCB, the device used shall be mechanically connected with VCB power mobile contacts compliant with paragraph 5.12 of IEC 62271-200. VCB position shall be visualized with symbology defined by table below:

Position	All countries except Brazil (according with IEC 60073)	Brazil (according with NR10)
Close	Black "I" on white background	White "L" on Red background

Open	White "O" on black background	White "D" on Green background

- manual device for restoring the energy for maneuver, actuation sense shall be indicated on the command panel. For operator's safety the use of this device shall inhibit the restoring of energy by DC engine;
- bistable selector for activation and de-activation of under-voltage release (only for "B" and "C" types of command) with clear indication of its state.
- energy storage device state indicator:

  a) Yellow color, for energy storage device charged (see figure below);

  b) White color, for energy storage device uncharged (see figure below).

- opening operation counter of VCB, five digits, un-resettable.

Commands and signalizations shall be understandable and interpretable with VCB carter (protection panel) removed.

7.5 Auxiliary devices

Auxiliary devices of VCB shall be compliant with IEC 62271-100.

VCB shall be compliant with 110 Vdc and 125 Vdc rated supply voltage of auxiliary circuits Ua with the tolerance described by standard.

Connecting to ground a polarity of 110 and 125 Vdc supply is not allowed.

7.5.1 Auxiliary contacts of VCB

Auxiliary contacts of circuit breaker shall be mechanically joint to principal contacts.

Electrical features of auxiliary contacts shall be compliant with the class 1 table 6 of IEC 62271-1 ed.1

7.5.2 Anti-reclosing device (anti-pumping)

If the device is designed with relays, these shall be compliant with IEC 61810-1 with electric life of 100.000 maneuverers.

Relays shall be of extractable type, with insertion on the base, having frontal sockets fixed by screws and protection degree at least IP2X compliant with IEC 60529.

Auxiliary contacts of relays shall be compliant with the class 1 table 6 of IEC 62271-1 ed.1.

7.5.3 Bistable selector for under voltage release

Bistable selector shall be equipped with auxiliary contacts, closed when under voltage device is activated whose features shall be compliant with the class 1 table 6 of IEC 62271-1 ed.1.

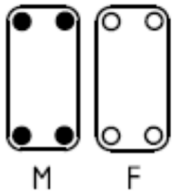
7.6 Electric schemes and connectors

Command circuits shall be designed according with drawings of annex B:

The circuits shall be mounted on the fixed part of the connector with male contacts (PINS), installed on the right part of VCB (installation on the top of VCB is also admitted, as long as the VCB trolley travel of 280 mm is guaranteed without mechanical interference.),

VCB connector shall be compliant with functional unit switchgear connector.

In order to avoid incorrect insertion of VCB inside of functional unit switchgear, the connectors shall be polarized as indicated below.

Type of command	Polarization
A	

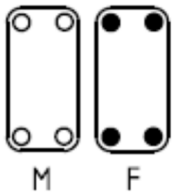
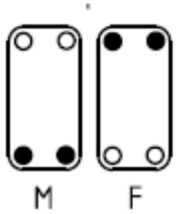
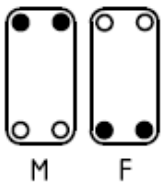
B	
C	
D	

Table 4 - Polarization of connectors

VCB shall be equipped with "PINS" (M indicated in the previous table) male contacts.

Female switchgear connector is not included in the supply.

7.7 Manuals

Constructor shall produce the VCB manual compliant with chapter 10 and 11 of IEC 62271-100.

Minimum time of maintenance shall be 60 months. The maintenance shall not include the substitution of main components as vacuum bottle, springs, poles, closing and opening release and electronic parts.

Following points shall be defined in the manual:

- safe and easy method for vacuum bottle check;
- measuring procedure for typical parameters like resistance of main circuits, open and close time, current absorption and all parameters defined in the par. 8.2.7 and 8.2.8 (normally check during routine tests and maintenance operation).

7.8 Nameplate

VCB shall be equipped, on frontal side and visible position, with a nameplate where data indicated by IEC 62271-100 par.5.10 shall be listed (included the mass).

Also on the nameplate shall be included the followings indications:

- ***enel*** type;
- ***enel*** material code;
- Barcode compliant with ***enel*** relevant specification (in the case of not enough space on the nameplate, barcode could be insert out of nameplate)

7.9 Protective coatings

The carpentry shall have a protective coating compliant with ISO 12944 with the following features:

- Durability:
  - Very High (VH) more than 25 years;
- Atmospheric corrosion category:
  - C5;
- RAL
  - 7030 or 7031 or 7035 RAL-F2;

Alternative values of atmospheric corrosion category are allowed but class 2 of IEC62271-304 shall be guaranteed.

Use of painting cycles or alternatively, electrolytic galvanizing on items that are not part of the load-bearing structure of the trolley is allowed.

8 TESTING

Type and routine test shall be performed in compliance with IEC 62271-100, IEC 62271-1 and IEC 62271-200 and the clarifications indicated in the followings paragraphs.

Technical conformity assessment (TCA) process shall be compliant with GSCG002.

Electronic type A documentations shall be "BIM compliant" according ISO 16739.

Functional unit switchgears with TCA in force necessary for all type and routine tests shall procured by Constructor.

8.1 List of test

8.1.1 List of type test

Type test	Reference
Constructive features and interlock functionality verifications	Par. 8.2.1
Mechanical operation tests	Par. 8.2.2; Par. 6.102 of IEC 62271-200
Dielectric tests: • Power-frequency voltage tests for main circuit; • Lightning impulse voltage test; • Partial discharge; • Power-frequency voltage tests for auxiliary circuit.	Par. 8.2.3; Par. 6.2 of IEC 62271-100; IEC 60660; IEC 60137.
Measurement of the resistance of the main circuit	Par.8.2.4 Par. 6.4 of IEC 62271-100
Temperature-rise tests	Par. 8.2.5 Par. 6.5 of IEC 62271-100
Short-time withstand current and peak withstand current tests	Par. 8.2.6 Par. and 6.6 of IEC 62271-100
Additional tests on auxiliary and control circuits and check of electric scheme	Par. 8.2.7 Par. 6.10 of IEC 62271-100
Environmental tests and mechanical endurance test (M2 class)	Par. 8.2.8 Par. 6.101 of IEC 62271-100
Tightness tests	Par. 8.2.9 Par. 6.8 of IEC 62271-100

Short-circuit current making and breaking tests	Par. 8.2.10 Par. from 6.102 to 6.106 of IEC 62271-100
Single-phase tests Double-earth fault tests;	Par.8.2.10 Par. 6.108 of IEC 62271-100
Critical current test (if defined);	Par. 8.2.10 Par. 6.107 of IEC 62271-100
Capacitive current switching tests (C2 class): • Line-charging current breaking tests • Cable-charging current breaking tests • Single capacitor bank switching tests • back-to-back capacitor bank switching tests	Par. 8.2.10 Par. 6.111 of IEC 62271-100
Electrical endurance tests (E2 class)	Par. 8.2.11 Par. 6.112 of IEC 62271-100
X-radiation test	Par. 6.11 of IEC 62271-1 ed.1
EMC test	Par. 8.2.12 Par. 6.9 of IEC 62271-100
Degree of protection verifications	Par. 6.7 of IEC 62271-100
Protective coating verifications	ISO 12944
Ageing and humidity test	Par. 8.2.13 IEC 62271-304
Flammability tests	Par. 8.2.14 IEC 60965-11-10
Seismic test	Par. 8.2.15 IEC TS 62271-210

Table 5 - Type Test

8.1.2 List of routine test

Routine test	Reference
Type correspondence verifications	Par. 8.3.1 Par. 7.1 of IEC 62271-100
Protective coating verifications	ISO 12944
Electric scheme verifications	Par. 8.3.2
Dielectric test on the main circuit	Par. 7.1 of IEC 62271-100
Dielectric tests on auxiliary and control circuits	Par. 7.2 of IEC 62271-100

Measurement of the resistance of the main circuit	Par. 8.3.3 Par. 7.3 of IEC 62271-100
Mechanical operation tests and interlock functionality	Par. 8.3.4 Par. 7.101 of IEC 62271-100 Par. 7.102 of IEC 62271-200
Documental verification for partial discharge for organic material insulator	Par. 8.3.5

Table 6 - Routine test

8.2 Type tests

Type tests shall be performed on VCB fully equipped as for ordinary use.

8.2.1 Constructive features verifications and interlock functionality verifications

For this verification a mechanical simulation of functional unit switchgear is necessary.

Mechanical simulation of functional unit switchgear and VCB (mock-up template) shall be manufactured by constructor in compliance with ***enel*** drawings and specifications; verification of the template accuracy is in charge of constructor.

Annual check of mock-up template with portable 3D automatic meter shall be performed by constructor.

Portable 3D automatic meter shall have at least 1 mm of precisions.

The right interlock functionality, listed in this document and its annexes, shall be also checked with the mock-up template, procedure described in GSCM1676 shall be followed. Furthermore, nameplates shall be verified in compliance with paragraph 7.8.

8.2.2 Mechanical operation tests

Test shall be performed on VCB installed inside functional unit switchgear, in compliance with the paragraph 6.102 of IEC 62271-200.

Correct insertion, vertical translation, correct LV connector position of VCB trolley shall be checked.

8.2.3 Dielectric tests

Tests shall be performed on VCB installed inside functional unit switchgear completed of MV cables and terminations, in compliance with paragraph 6.2 of IEC 62271-100.

Check of PDS shall be compliant with IEC 60270, with the following recommendations in compliance with IEC 60660 and IEC 60137:

- inception and extinction voltage level of PDS shall be recorded;
- Measuring circuit shall be capable of detecting an intensity of discharge of at least 2 pC;
- Level of partial discharge shall not exceed 100 pC at 1,05 Un.

8.2.4 Measurement of the resistance of the main circuit

Test shall be performed on VCB installed inside functional unit switchgear, in compliance with paragraph 6.4 of IEC 62271-100.

With reference to figure 1, for each phase the following measurements shall be performed:

a) R1: between busbar and cable connection terminal (points A-B);

b) R2: between busbar and inferior connection terminal of circuit breaker, without inferior clamp (points A-C);

c) R3: between cable connection terminal and superior connection terminal of VCB, without superior clamp t (point B-D);

d) R4: between superior and inferior connection terminal of VCB, without inferior and superior clamps (points D-C);

For each phase the following conditions shall be checked:

$$R1 - R2 \leq 10\ \mu\Omega;$$

$$R1 - R3 \leq 10\ \mu\Omega.$$

average value, for each phase, of measurement carried out during the check a) and d), shall be adopted as referring value for the routine tests.

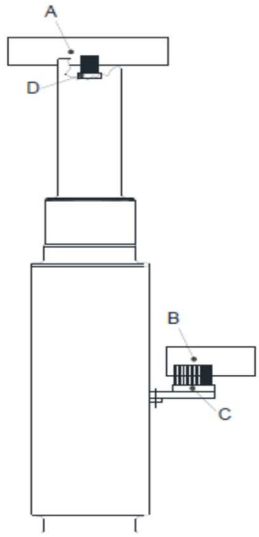


Figure 1 - Points of measurement of resistance of main circuit

8.2.5 Temperature-rise test

Tests shall be performed in compliance with paragraph 6.5 of IEC 62271-100, and in the meantime on a transformer VCB GSCM505/8 or /9 and line VCB GSCM505/7, installed inside their functional unit switchgear.

After temperature-rise test, measurement of resistance of main circuit at ambient temperature shall be performed.

Measured values shall not exceed 1.2 time the values measured during the test a) and d) of par. 8.2.3.

8.2.6 Short-time withstand current and peak withstand current tests

Test shall be performed on VCB installed inside functional unit switchgear, in compliance with paragraph 6.6 of IEC 62271-100.

8.2.7 Tests on auxiliary, control circuits and signaling and check of electric scheme

Conformity of electrical schemes on VCB with respects to approved drawings shall be checked.

Correct functionality of all commands, of all blocks and for all signals and their conformity with prescriptions listed in this document and its annexes shall be checked.

The test on auxiliary and control circuits and signaling shall be performed in compliance with paragraph 6.10 of IEC 62271-100.

For the opening releases (launch and under-voltage) and for closing releases, all absorption curves shall be recorded (made available in COMTRADE format), and maximum values of absorption (without rush value) and operation times shall be listed, at the followings conditions:

- nominal voltage;
- 110% of nominal voltage;
- 70% of nominal voltage for opening releases;
- 85% of nominal voltage for closing releases.

Features of under-voltage release shall be checked in accordance with IEC 62271-1 ed.1 parag. 5.8.4 and in the conditions following indicated:

- ambient temperature;
- with VCB at -5 °C for at least 4 hours with release devices powered .

Absorption curves of electrical engine shall be recorded and maximum values of absorption (without rush value) and recharge time of springs shall be recorded, at the followings conditions:

- nominal voltage;
- 110% of nominal voltage;
- 85% of nominal voltage;

maximum values of DC engine absorption (without rush value) shall not exceed 3A.

The values, with respective tolerances recorded during this test, shall be insert in a type A document , called "values declared by Constructor".

8.2.8 Mechanical and environmental tests (M2 class)

Tests shall be performed in compliance with paragraph 6.101 of IEC 62271-100, on the same VCB specimen installed inside functional unit switchgear, at ambient temperature,

low temperature (T_L= - 5°C) and high temperature (T_H=+45°C), with following clarifications:

- Ambient temperature test:
  - Arithmetic average of characteristics as listed at point b) of par. 6.101.2.5 of the IEC 62271-100 shall be taken as reference for routine tests;
  - All parameters registered (reference parag.6.101.2.5 letter b IEC 62271-100) in the same power supply conditions, after each cycle of 2000 maneuvers, shall remain inside the tolerance indicated by constructor. For opening and closing time, maximum and minimum value measured in the same power supply conditions before and after each cycle of 2000 maneuvers, shall not differ by more than 20% (with reference to minimum value).

Humidity test shall be covered by the test at paragraph 8.2.13

8.2.9 Tightness tests

Tightness test shall be performed in compliance with paragraph 6.8 of IEC 62271-100, on all the exemplars of circuit breaker that have performed the mechanical and environmental tests of the par. 8.2.8.

8.2.10 Short-circuit current making and breaking tests

Test shall be performed on VCB installed inside functional unit switchgear, in compliance with paragraphs from 6.102 to 6.106 and paragraphs 6.107, 6.108 and 6.111 of IEC 62271-100.

8.2.11 Electrical endurance tests (E2 class)

Test shall be performed on VCB installed inside functional unit switchgear, in compliance with paragraph 6.112 of IEC 62271-100, VCB subjected to test shall be able to sustain one of the cycles of the lists 1, 2 and 3 of Table 33 par.6.112.2. of IEC 62271-100.

Constructor will choose the list of execution in type test phase.

As described in par.6.112.2. of IEC 62271-100 after testing, in order to check the state of VCB, the dielectric tests considering 100% of rated values shall be performed.

8.2.12 EMC test

Test shall be performed on VCB installed inside functional unit switchgear, in compliance with par. 6.9 IEC 62271-100.

8.2.13 Ageing and humidity test

Test shall be performed on VCB in compliance with IEC 62271-304 with design class 2.

8.2.14 Flammability tests

Test shall be performed on an exemplar for each insulation elements in organic material present on VCB. Test shall be performed in compliance with prescriptions of IEC 60965-11-10 considering the materials as V-0 type.

8.2.15 Seismic test

Test shall be performed in compliance with IEC TS 62271-210, for transformer VCB (GSCM505/8 or GSCM505/9) and line VCB (GSCM505/7), installed inside their functional unit switchgears.

8.3 Routine tests

The routine tests are indicated in the table 6, these tests shall be carried out by the constructor on all the specimen prepare for the commissioning.

For each piece belonging to the prepared batch, the supplier shall prepare a test report with the results of the tests performed.

The routine tests shall be repeated under ***enel*** surveillance according to conditions stated in the "Contractual Requirements for Components and Materials Quality management" document.

For routine tests reference values and acceptability ranges defined in the TCA Report, type A documents (GSCG002) shall be considered.

Routine tests shall be performed on VCB fully equipped as for ordinary use.

8.3.1 Type correspondence verifications

Test shall be performed on VCB in compliance with the paragraph 7.1 of IEC 62271-100, following verifications shall be performed:

a) Visual examination in order to check the absence of external imperfections and constructive defects;

b) Dimensional and constructive verification, with mock-up template of functional unit switchgear conformity to ***enel*** drawings and specifications, according procedure described in the GSCM1676 shall be ensured;

c) Constructive features check with drawings schemes and pictures of the approved type A documentations.

8.3.2 Electric scheme verifications

For the execution of this test the constructor shall make available (also printed in convenient size paper) the electrical schemes of circuit breakers approved during TCA phase.

Conformity of the electrical drawings and electrical schemes implemented on VCB shall be checked.

Efficiency of anomaly/ block signals present shall be checked too.

8.3.3 Measurement of the resistance of the main circuit

Measurement shall be performed in compliance with par. 7.3 of IEC 62271-100, measures shall be executed with methods indicated in par. 8.2.4 at letters a) and d), checking that measured values do not exceed 1.2 time the values of reference measuring obtained during type test.

8.3.4 Mechanical operating tests and interlock functionality

Test compliant with paragraph 7.102 of IEC 62271-200 shall be performed on VCB installed inside functional unit switchgear.

Test compliant with paragraph 7.101 of IEC 62271-100 shall be performed on VCB fully equipped as for ordinary use.

For the opening releases (launch and under-voltage) and for closing releases, all absorption curves shall be recorded, and maximum values of absorption (without rush value) and operation times shall be listed, at the followings conditions:

- nominal voltage;
- 110% of nominal voltage;
- 70% of nominal voltage for opening releases;
- 85% of nominal voltage for closing releases.

Absorption curves of electrical engine shall be recorded and maximum values of absorption shall be listed (without rush value) recharging time of springs shall be recorded at the nominal voltage.

Maximum values of DC engine absorption (without rush value) shall not exceed 3A.

All measured times and maximum values of absorption shall be inside the limits prescribed by constructor; at any case they shall be not over the ± 10% of reference values measured during type tests.

Under-voltage release and blocking pivot shall be checked.

For each typology of VCB shall be checked that blocking pivot action provokes:

- Circuit breaker opening;
- Inhibition of electric command.

Correct functionality of interlocks listed in this document and its annexes shall be checked.

The right interlock functionality, listed in this document and its annexes, shall be also checked with the mock-up template, procedure described in GSCM1676 shall be followed.

8.3.5 Documental verification for PDS for organic material insulator

Constructor shall submit test reports of PDS measures performed on VCB, according par. 8.2.3 of this specification.

9 Supply requirements

VCB shall be supplied in single package, in order to ensure a proper protection during the transportation and storage.

Inside the package followings elements shall be supplied:

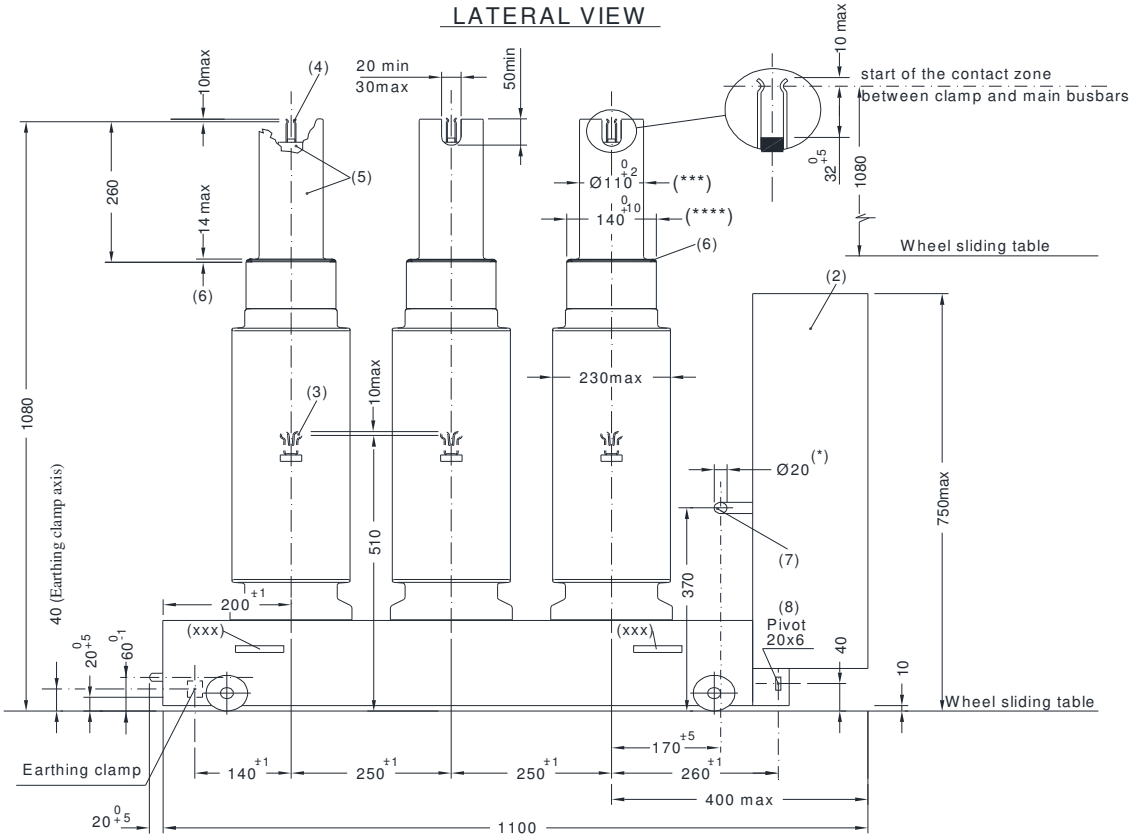
- VCB completely equipped;
- All accessories necessary for the complete installation and commissioning of VCB;
- Functional and cabling schemes;
- Installation, operation and maintenance manuals;
- Manual device for energy restore of springs of VCB;
- Any other device eventually needed for the operation VCB.

Out of the package followings indications shall be present:

- ***enel*** DSO;
- Name of supplier;
- Description of product;
- ***enel*** material and type code;
- Constructor type code and serial number;
- Gross weight.

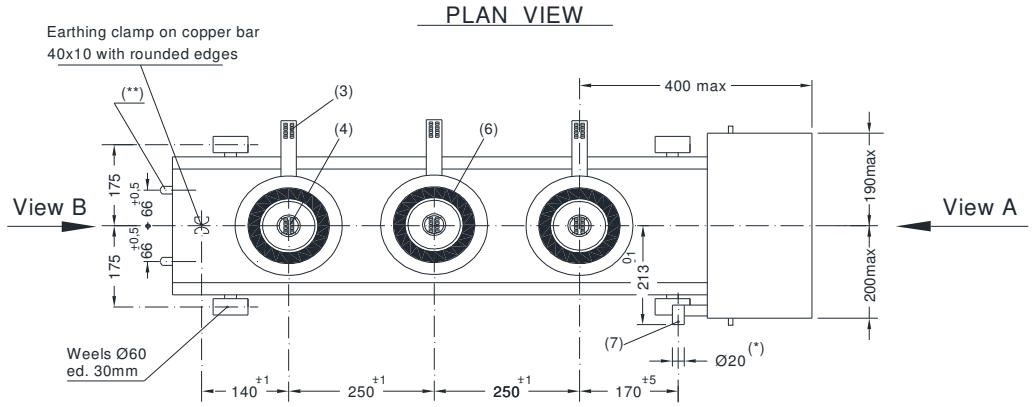
Package shall be assembled for delivering as prescribed in the GUI101.

Annex A - OVERALL DIMENSIONS

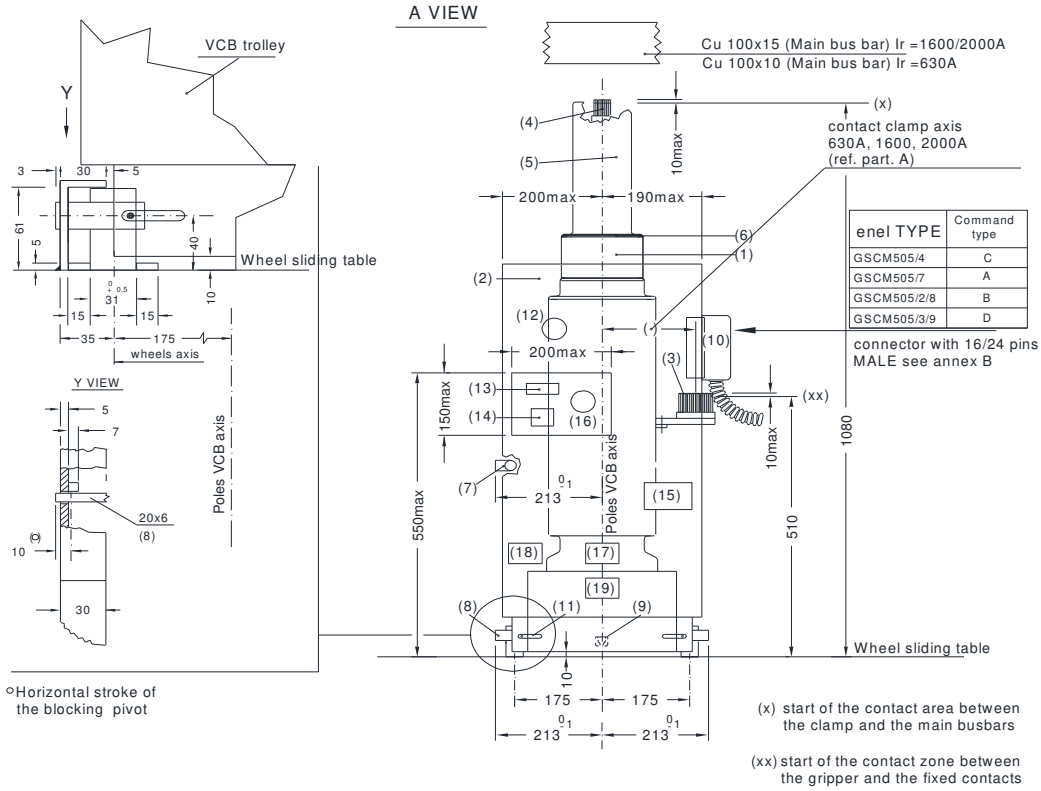


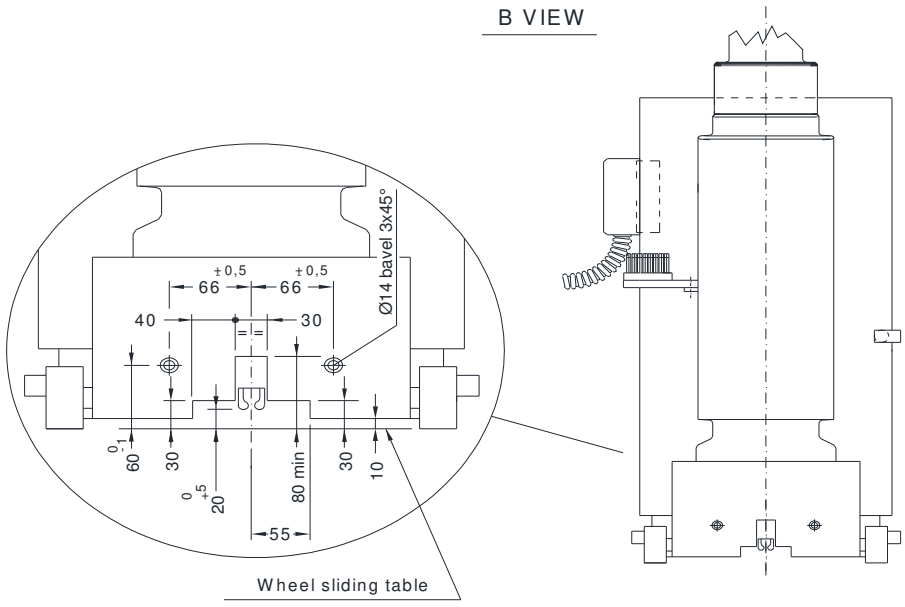
(xxx) n°4 handles (2 for side)

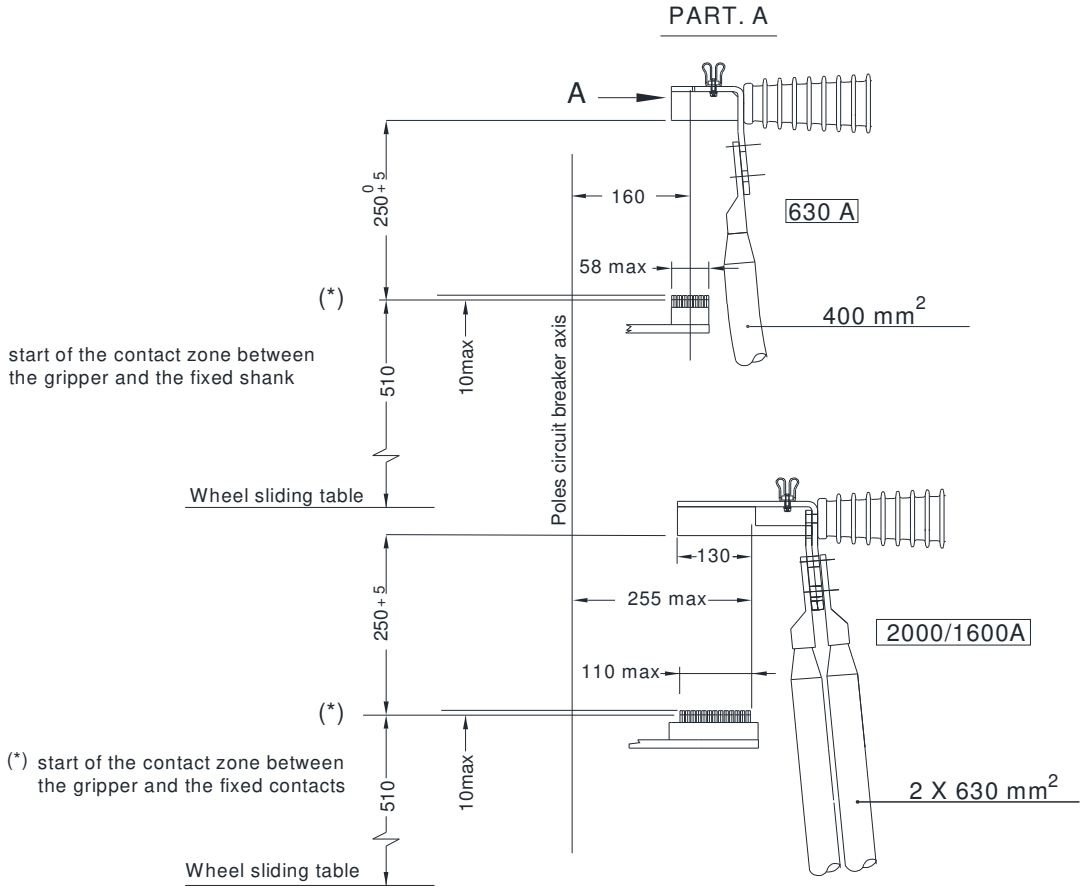
(***) 160 mm for CB with Ir=2000A/1600A
(****) 215 mm for CB with Ir=2000A/1600A



(*) rounded edges (minimum radius 1.5 mm)
(**) n°2 centering pivot Ø14 with bavel 3x45° for VCB trolley



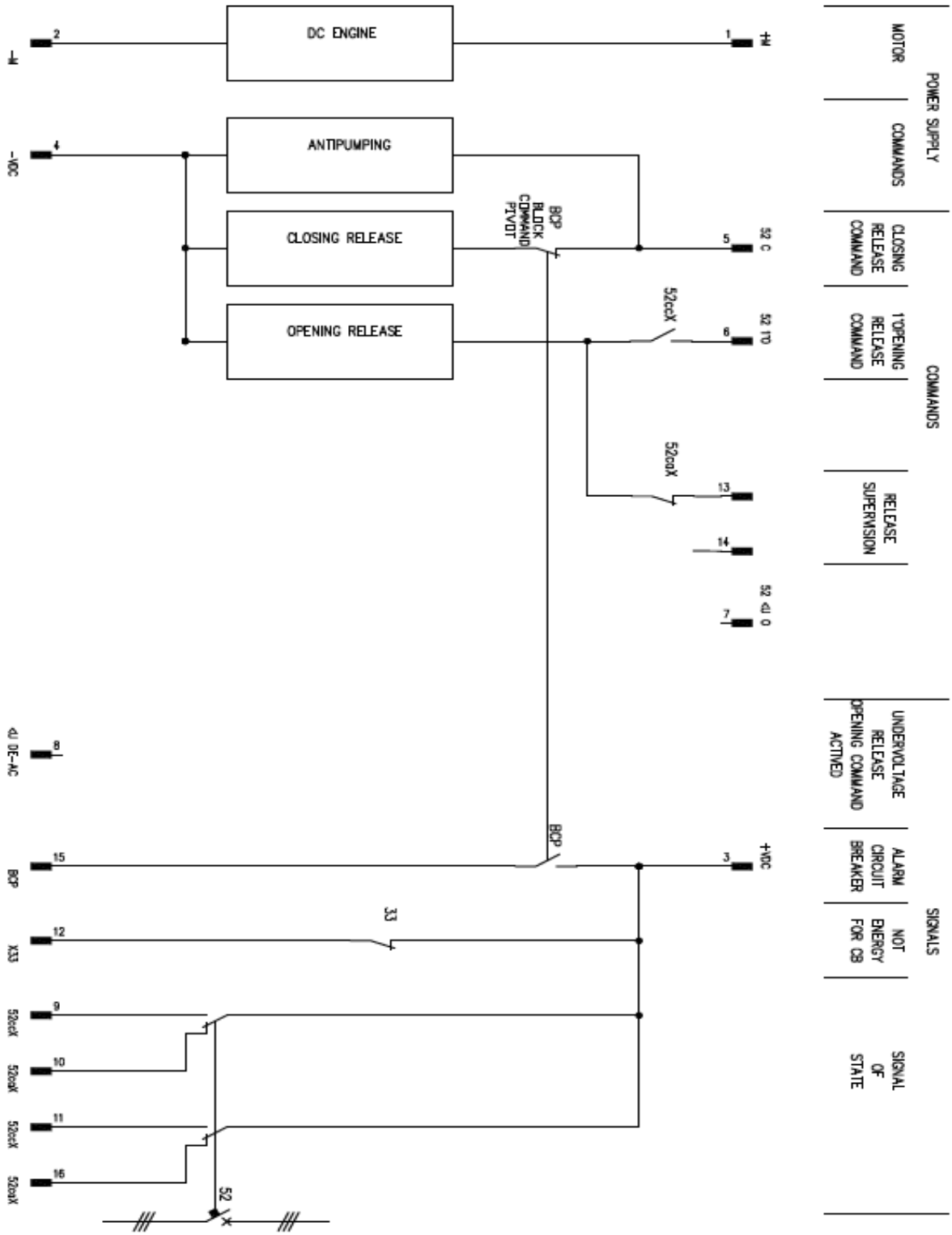




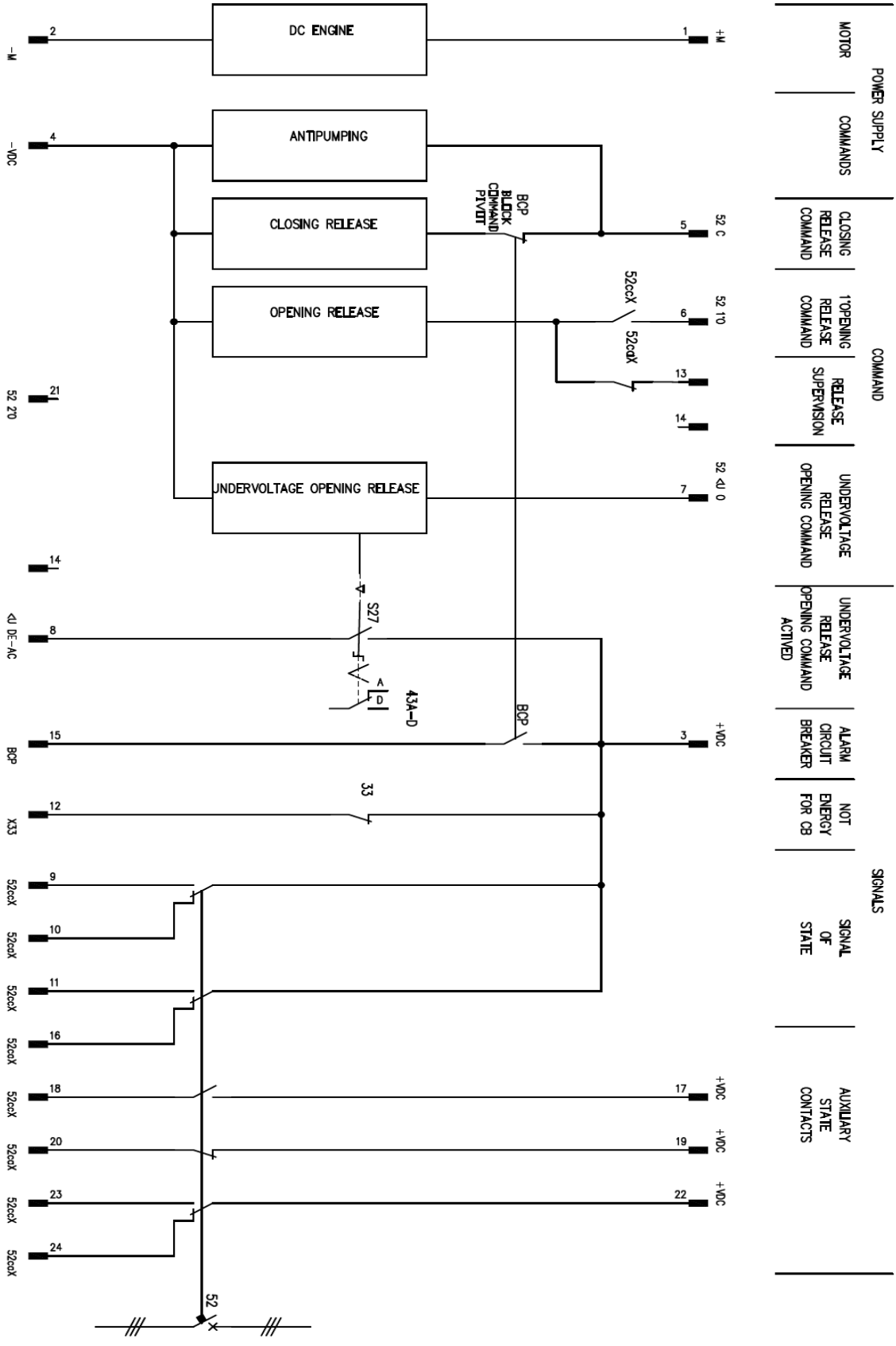
LEGEND

(1) Insulating container vacuum bottle
(2) VCB command
(3) Clamp contacts for inferior copper bar with thickness 15mm for Ir= 1600/2000 A and 10 mm for Ir=630A (see part A)
(4) Clamp contacts for main copper bus bar 100x15 mm for Ir=1600/2000A and 100x10 mm for Ir=630A;
(5) Contact-holder shaft insulating cover
(6) Silicone rubber or EPDM ring (maximum thickness 14 mm); the ring shall have a hardness such as to guarantee the expected disconnection stroke of 280 mm.
(7) Blocking pivot Ø20 of command during translation
(8) Rectengular blocking pivots with VCB inserted in the switchgear
(9) Earthing clamp for copper bar 40x10 mm (20 mm from the wheel slide table)
(10) LV connector
(11) Operation handles for rectangular blocking pivots (8)
(12) Opening button
(13) Manouvrers counter
(14) Springs loaded/unloaded signalling
(15) Plate
(16) VCB status indicator (Op/Cl)
(17) Manual device for restoring operating energy
(18) Indicator of maneuvering energy storage status
(19) State of the predisposer for activating/deactivating the opening under-voltage release (only for command type B/C)

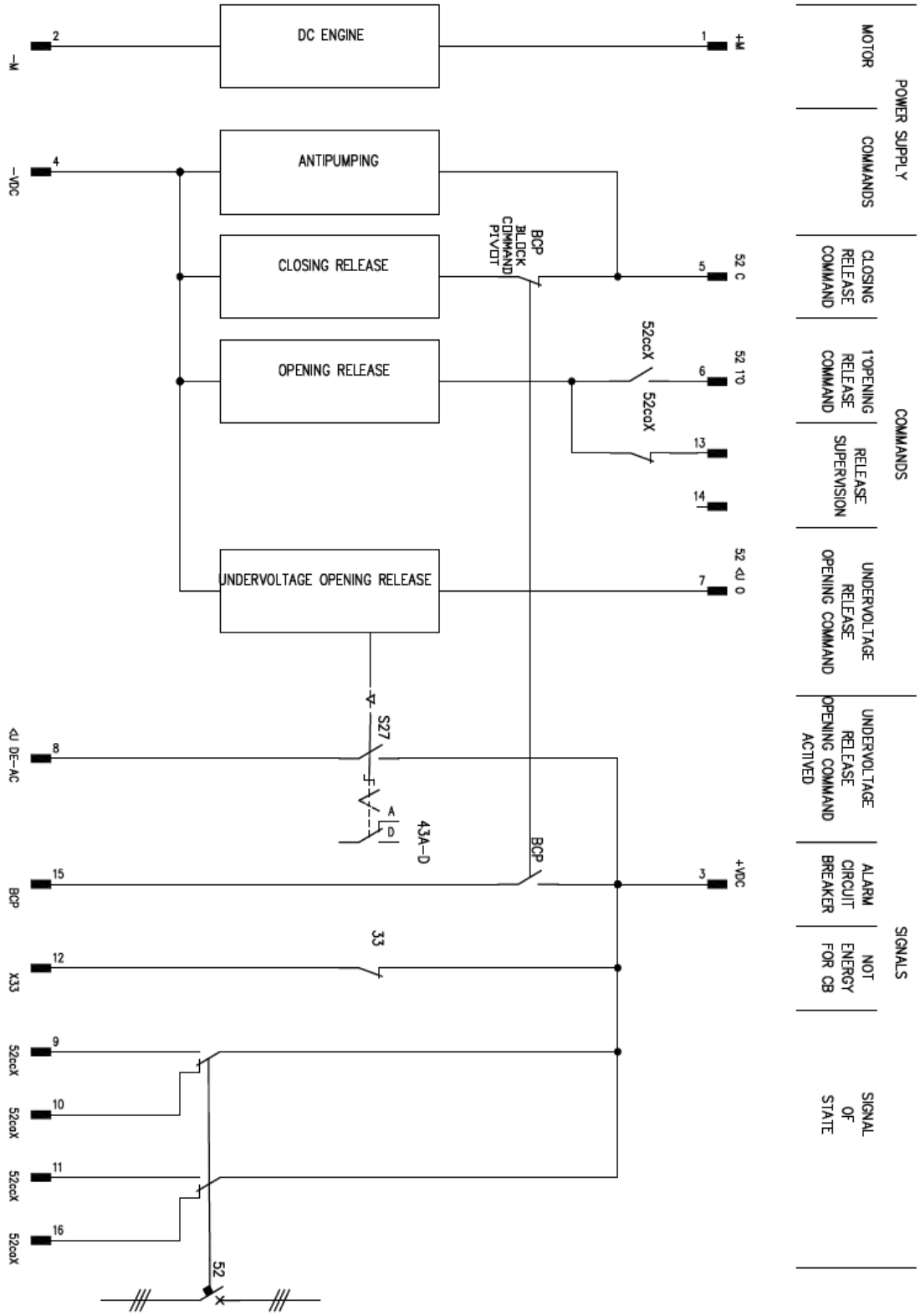
Annex B - COMMAND CIRCUITS



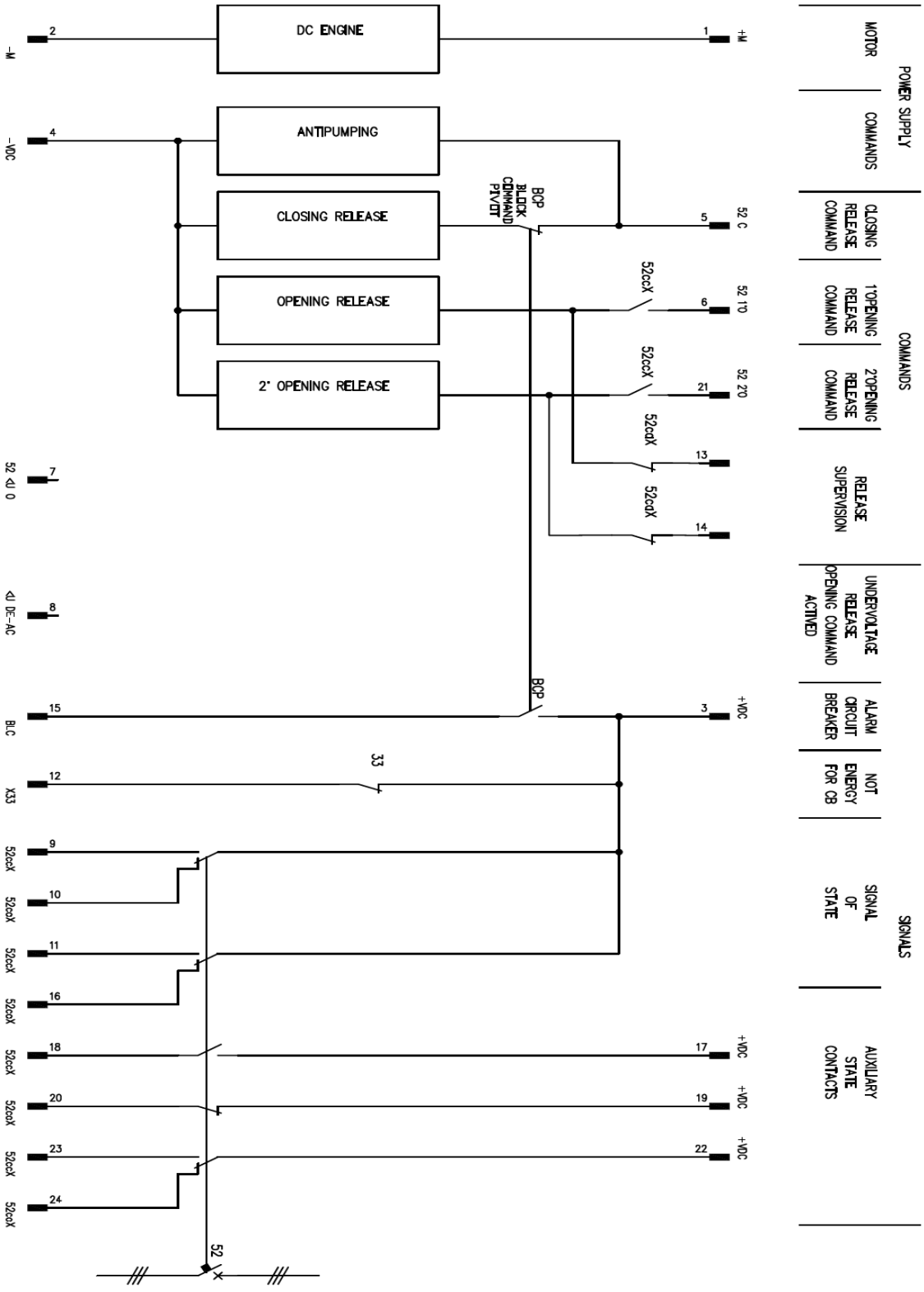
TYPE A



TYPE B



TYPE C



Annex C - Documentations to be provided in technical offer

Documentations:

- Check list, to fill in for each ***enel*** type code;
- Drawings with overall dimensions;
- Supplier declaration of compliance of offered products with present TS and main standards and laws;
- Deviations letter (if any).

Technical specification:		**Offer number:**	
Constructor:		**Site of production:**	
***enel* type code:**		**Constructor type code or designation:**	
***enel* material code:**			
Technical ratings		**Request**	**Constructor offer**
1	**Service conditions**	Capt. 5	
2	**Maximum altitude only for Colombia(m)**	2700	
3	**Minimum ambient air temperature (°C)**	-5	
4	**Severity degree of pollution (IEC 62271-304)**	design class 2	
5	**Seismic level; acceptance class**	2 ;1	
6	**Rated normal current Ir (A)**	Table 1	
7	**Rated frequency fr (Hz)**	50 and 60	
8	**Rated voltage Ur (kV)**	24	
9	**Rated Voltage Ur (kV) to 2700 m**	Constructor information	
10	**Rated power-frequency withstand voltage Ud (kV)**	50	
11	**Rated lightning impulse withstand voltage Up (kV)**	125	
12	**Rated short-circuit breaking current (kA)**	16	
13	**Rated duration of short circuit tk (s)**	1	
14	**Rated short-circuit making current & Rated peak withstand current Ip (kA)**	41,6	
15	**Rated supply voltage of closing and opening devices and of auxiliary and control circuits Uop (Vdc) and rated supply voltage of auxiliary circuits Ua (Vdc)**	110 and125 Vdc	

16	**Rated operating sequence**	O – 0,3" – CO – 15"- CO	
17	**Break-time (ms)**	60 ÷100	
18	**Rated first-pole-to-clear factor *kpp***	1,3 and 1,5	
19	**Auxiliary devices**	Par 7.5	
20	**Circuit breaker class**	S1	
21	**Electrical endurance class**	E2	
22	**Mechanical endurance class**	M2	
23	**Probability of restrike during capacitive current breaking class**	C2	
24	**Rated line charging breaking current I_l (A)**	10	
25	**Rated cable-charging breaking current Ic (A)**	31,5	
26	**Rated single capacitor bank-breaking current Isb (A) for 6MVAR of maximum reactive power**	400	
27	**Rated back-to-back capacitor bank breaking current Ibb (A)**	table 4	
28	**Rated back-to-back capacitor bank inrush making current Ibi (kA) fbi 4250 Hz**	table 4	
29	**IP degree**	2X	
20	**Overall dimension**	Annex A	

Table 7 - Check list