



## QMTC

Medium Voltage Air Insulated  
Switchgear for Primary Distribution

# Reliability and Safety

They are the main concerns of QMTC series. Service continuity and long life performances are provided. People safety is a paramount. The QMTC series is fully developed and type tested according to the IEC standards 62271-200. The quality system complies with ISO 9001 standards and it is certified by a third certification body.

The health and safety management system complies with the OHSAS 18001 standards and it is certified by a third certification body. The internal test laboratory complies with UNI CEI EN ISO/IEC 17025 with tests certified by an independent certification body.



FLEXIBILITY



RELIABILITY & SAFETY



SUSTAINABILITY

## FLEXIBILITY

Modular units are available with different functions and combinations in order to satisfy the most common electrical configurations of the typical substations. The QMTC series brings to the market a versatile switchgear ready to cover the most various installation requirements and market segments.

## SUSTAINABILITY AND ENVIRONMENT CARE

The QMTC series development has been driven by the environment sustainability theme. The materials used for its production allow a real low environmental impact during the product life and most important at the end of its life cycle. The QMTC series philosophy fully meets the environment requirements.

The QMTC production site and the environmental management system assumed by G&W Electric is in compliance with the standard for quality rules ISO 14001.

## General Features Arc Proof Air Insulated MV Switchgear

### Reference standards:

- a) IEC 62271-200 A.C. Metal Enclosed Switchgear.
- b) IEC 62271-100 Circuit Breakers.
- c) IEC 60470 Contactors.
- d) IEC 62271-102 Earthing Switch.
- e) DEP 33.67.51.31.

### General features:

- Loss of service continuity category: LSC2B.
- Partition class: PM.
- Internal Arc Classified (IAC): AFLR.
- Circuit-breaker / contactor racking-in/out with closed door.
- Construction with sendzimir pre-galvanized sheets.
- Fully Type Tested in accordance with IEC 62271-200 and ANNEX A.
- Internal partition degree of protection: up to IP4X.



Figure 1



Figure 2

## Switchgear type

Switchgear		QMTC 7,2	QMTC 12	QMTC 17,5	QMTC 24
Rated Voltage	KV	7,2	12	17,5	24
Insulation level Rated Power Frequency	KV 1 min	20	28	38	50
Rated lighting Impulse	KV	60	75	95	125
Frequency	Hz	50/60			
Rated current	A	400÷4000	400÷4000	630÷4000	630÷2500
Short time withstand current	KA	31,5 – 40 – 50	31,5 – 40 – 50	31,5 – 40 – 50	31,5
Short circuit duration	Sec.	3	3	3	3
Peak withstand current	KA	78 – 100 - 125	78 – 100 - 125	78 – 100 - 125	78 – 100
Internal Arc withstand current	KA	31,5 – 40 – 50	31,5 – 40 – 50	31,5 – 40 – 50	31,5
Duration	Sec.	1	1	1	1
Protection degree (external)	Up to IP41				
Internal Separation Partition	Up to IP4X				
Unit with Circuit Breaker					
31,5kA Up to 1250A	mm.	650	650	650	800
31,5kA - 40kA - 50kA - 1600A - 2000A	mm.	800	800	800	800
31,5kA - 40kA - 50kA - 2500A - 3150A - 3600A - 4000A	mm.	1000	1000	1000	1000
Unit with Fuses and Contactor 50kA - Up to 400A	mm.	550	550		



Figure 3

### Dimensions:

Unit height: 2250 mm

Unit height with exhaust duct: 2500 mm

Protection degrees: up to IP 4x

Painting: RAL 7035

Circuit Breakers:

- Vacuum insulated: G&W Electric VCB F/  
ABB VD4
- SF6 insulated: ABB HD4
- Vacuum contactor: ABB V7-V12

## Project Ammonia and Urea Plant in Qatar

### Others:

Earthing switch with making capacity (31,5-40-50KA) Line / Bus-bar Voltage measures by means of withdrawable fused resin insulated Voltage Transformers.



Figure 4

### Example of Design:

Rated Voltage: 12kV  
 Rated Current: 4000A with forced ventilation  
 Short time withstand current: 50kA for 3 sec.  
 Internal Arc fault: 50KA for 1 sec.

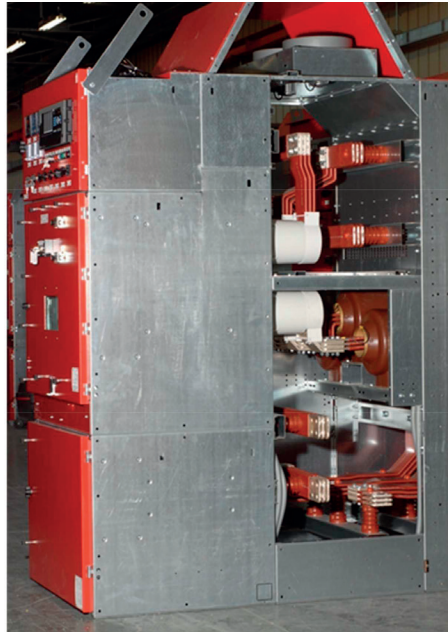


Figure 5

### Design

The switchgear consists of one or more panels, divided into five or six compartments, separated from each other and equipped with doors (see Figure 6):

- Main Bars Compartment
- Cable Compartment (with earthing switch)
- Withdrawable Circuit Breaker / Contractor Enclosure
- Withdrawable Voltage Transformers Enclosure
- Auxiliary / Control / Protection Circuits Compartment
- Exhaust Duct (only in case of internal arc proof switchgears)

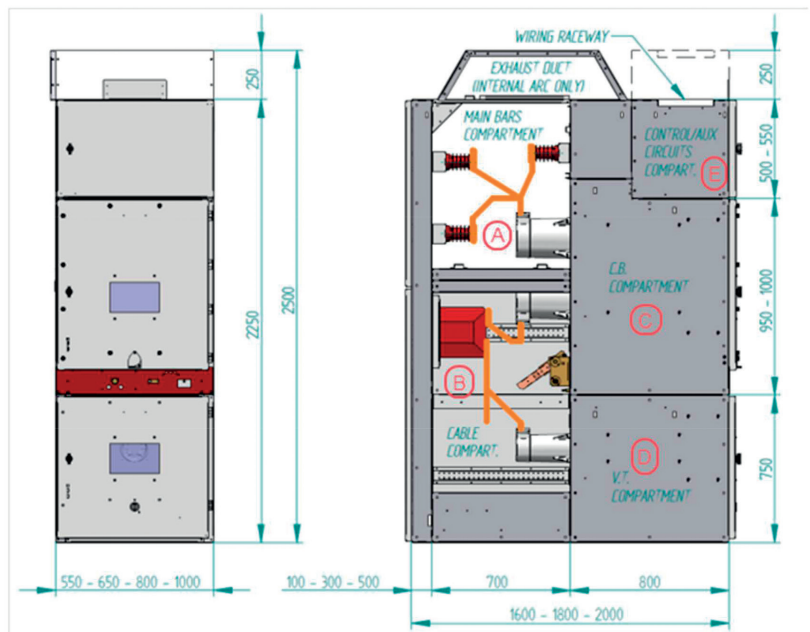


Figure 6: Panel overall dimensions (standard version, with internal arc proof exhaust duct)

### Main bars compartment

It consists of horizontal and vertical fully insulated, hard drawn, high-quality copper bars, supported by insulating holders.



Figure 7

### Cable compartment (with earthing switch)

This compartment holds the CB/contactor incoming/outgoing power terminals (supported by insulating holders), the related current transformers, the making capacity earthing switch and an earthing bar. Cable anchoring brackets are also provided.



Figure 8

### Auxiliary / control / protection circuits compartment

It consists of a compartment in which the auxiliary, control, and protection circuits are housed and wired. Equipment and local controls are installed on the door, together with the related actuators and signalling. According to the installation requirements, it is possible to install a compartment of greater height. In the compartment upper part, a panel interconnection wiring raceway is placed. (See Figures 9 and 10)



Figure 9

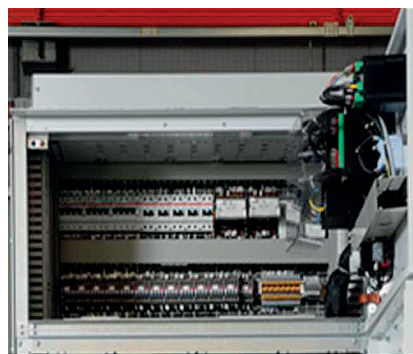


Figure 10

## Withdrawable CB / contactor compartment

This enclosure is designed to house CBs/Contactors with the highest electrical performances. (see Figure 3.5 11 and 12) The enclosure width (which determines the width of the related compartment) varies depending on the characteristics of the CB/contactor, the short-time current and the rated thermal current of the switchgear. G&W Electric's four standard enclosures and associated dimensions:

- L = 550 mm (with contactor) (thermal current up to 400 A, short-time current and internal arc proof up to 50 kA)
- L = 650 mm (with circuit breaker) (thermal current up to 1600 A, short-time current and internal arc proof up to 31.5 kA)
- L = 800 mm (with circuit breaker) (thermal current up to 2000 A, short-time current and internal arc proof up to 50 kA)
- L = 1000 mm (with circuit breaker) (thermal current up to 4000 A, short-time current and internal arc proof up to 50 kA)

## No-load disconnecting truck (NDT)

- Function 1: when installed in a special panel, it allows further extensions of the switchgear (addition of new panels downstream) without having to de-energise the related bus-bar section
- Function 2: when installed in a special panel, it establishes contact – with the switchgear de-energised between the corresponding bus-bar section and the earthing bar, allowing safe maintenance operations

*NOTE: if the switchgear includes voltage Measuring Unit on each bus-bar section, an earthing switch installed on the corresponding V.T.s panel can be provided as an alternative to the disconnecting truck.*

The truck can be compared to a permanently closed withdrawable circuit breaker. The no-load disconnection is obtained by means of the movable power contacts that connect to the upper/lower fixed contacts of the enclosure.



Figure 11:  
From top to bottom:  
Low voltage relay cabinet,  
medium voltage circuit  
breaker cabinet, voltage  
transformer cabinet.



Figure 12:  
Shown with G&W  
VCB F circuit breaker  
withdrawn on cart.

## Earthing truck without making capacity (ET)

The QMTC range is equipped with all the service trucks needed for service maintenance activities.

### Earthing truck without making capacity.

These trucks carry out the same function as the earthing switches without making capacity. They therefore have no capacity to earth live circuits in fault conditions. They are used to ensure an additional fixed earth, as is required by certain installation service and maintenance procedures, as a further safety guarantee for personnel.

The use of these trucks require the removal of the apparatus (circuit-breaker or contactor) from the switchgear and its replacement with the truck. The switchgear panels arranged for the use of the earthing trucks must be provided with a key lock which, when activated, prevents their racking-in.

This truck is available in two versions:

- Earthing of the main busbar system
- Earthing of the power cables

The earthing truck of the main busbars, during the racking-in phase, only lifts the top shutter and earths the contacts connected to the top branch connections (and therefore to the main busbar system) by means of the switchgear structure. The earthing truck of the power cables, during the racking-in phase, only lift the bottom shutter and earths the contacts connected to the bottom branch connections (and therefore to the power cables) by means of the switchgear structure. These trucks can also be used in the bus-tie unit. In this case, they earth one of the two sides of the main busbar system. (See Figure 13)

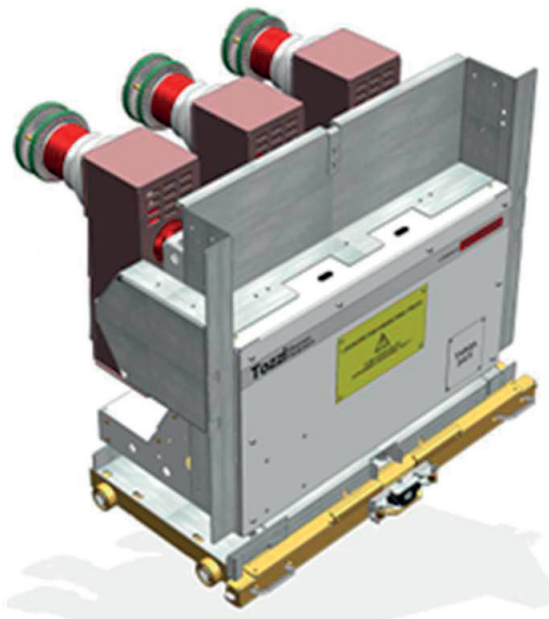
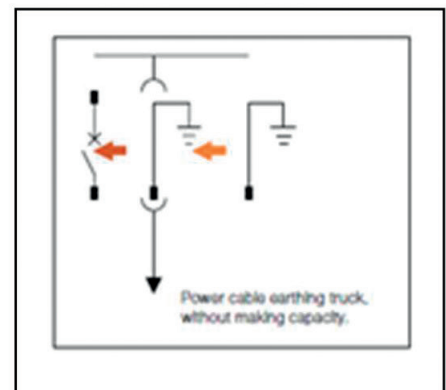
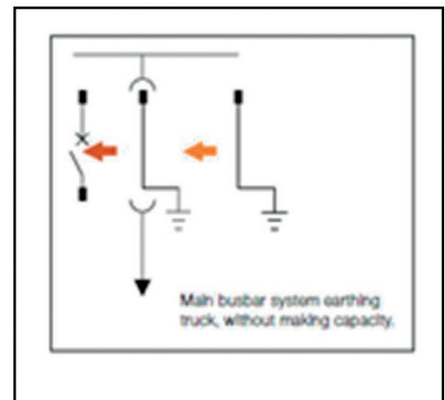


Figure 13





## Circuit breaker mechanical buttons doubling set

It allows manual opening/closing operations when the C.B. is situated inside the enclosure, in the service position, with the door closed and interlocked. The set consists of one or two equalisers, related supports and buttons equipped with flexible wires and pad-lockable guards; it is easy to put onto the C.B. operating mechanism plate. (See Figures 14, 15, and 16)

It is especially useful in case of local/remote electrical controls failure and allows to maintain unchanged the internal arc proof performance, since it is not necessary to unlock and open, in emergency conditions, the enclosure door in order to manually operate the C.B. buttons.

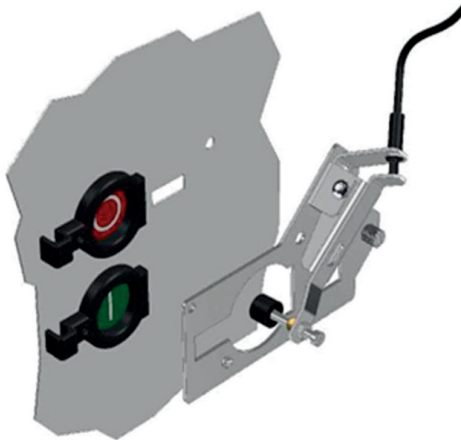


Figure 14

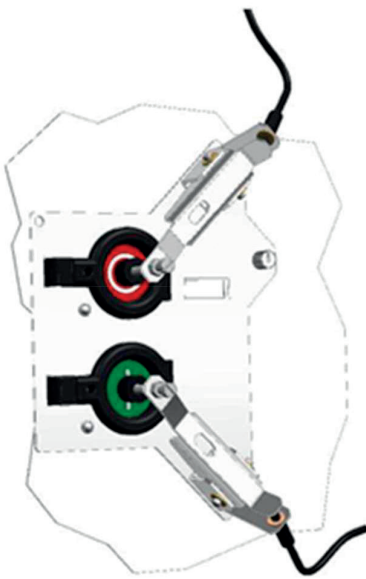


Figure 15 Double button set  
(C.B. opening/closing)

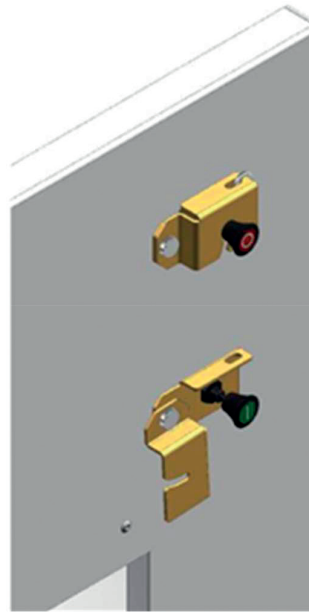


Figure 17: External buttons on the door

## Voltage Transformers Enclosures

The withdrawable VTs enclosure is designed to house transformers with integrated fuse holder. The blown fuse signalling for each VT is available on request; in this case the VT must be of special construction, according to DIN Standard.

Each enclosure is equipped with lockable metallic shutters that protect the fixed live contacts connected to the bus-bar/cable compartments. The purpose of the shutters is to safeguard the personnel's safety and to maintain the internal degree of protection when the related unit is removed (VT is, therefore, outside the panel) and In this condition it is possible to access the enclosure. The enclosure is also equipped with mechanical interlocks which ensure the safety of both the personnel and the installation. Additional electro-mechanical interlocks are available on request.

(See Figures, 18, 19, and 20)



Figure 18



Figure 19



Figure 20: V.T. with integrated fuse-holder (exploded view)

If the switchgear has to be installed against a wall, this fully withdrawable, double-nested structure is provided; it allows to access to the cable compartment (located at the back of the V.T.s compartment) from the switchgear front. (See Figure 21)

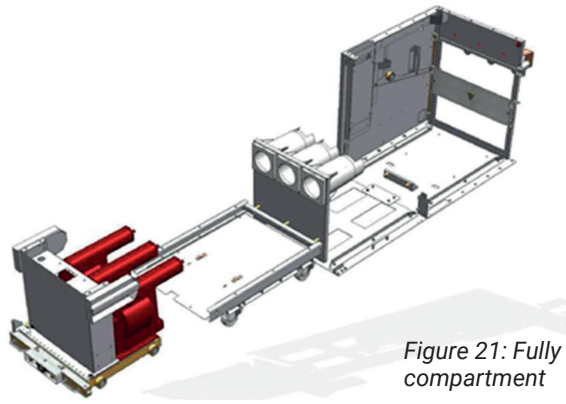


Figure 21: Fully withdrawable V.T.s compartment

### Withdrawable unit truck key lock

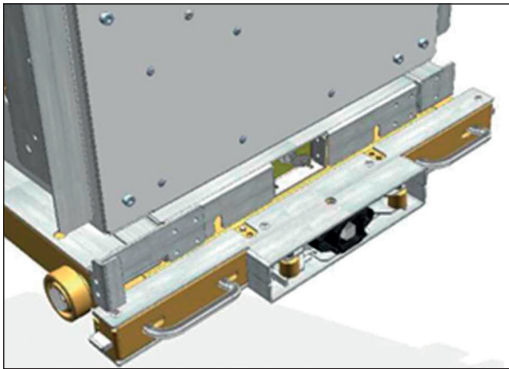


Figure 22

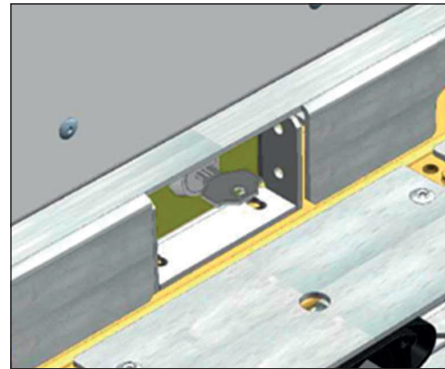


Figure 23

It allows to lock the truck in the DISCONNECTED position, thus preventing undesired operations by unauthorized personnel. (See Figures 22 and 23)

### Partitions

Each compartment is separated from the adjacent one by means of metallic partitions designed to avoid any direct contact with live parts, to limit the spreading of fires, and, in case of internal arc proof switchgear, to withstand the pressure wave and convey plasma cloud and debris towards the exhaust duct.

The internal partitions have a standard degree of protection IP2X. Internal protection degrees IP3X and IP4X are available on request.

The external protection degree is ensured by strong doors on the front/rear, while screwed covers are fixed on the switchgear top and sides. The standard degree of protection of external doors and covers is IP4X. IP41 external protection degree is available on request.

## Anti-condensation

On request, in order to prevent condensate formation, the switchgear can be provided with space heaters located in the panel base.

## Internal arc proof switchgear

QMTC12-24 switchgear is supplied, on request, with internal arc proof features: in this case, all outside covers and doors are equipped with stiffening crosspieces and bullet-proof glass inspection windows, while the internal partitions are adequately reinforced.

An exhaust duct is placed on the top of switchgear; it holds the horizontal covers – provided with a series of flaps – of all CB, bus-bar and cable compartments of each panel. These flaps act as check valves, which open to release pressure wave, plasma cloud and possible debris caused by the internal arc. At the same time, the flaps related to the compartments not involved in the fault react against the pressure wave and remain closed, thus preventing the spreading of the arc.

At both ends, the exhaust duct has two openings which are provided with removable plates: the latter protect the duct inside from dust and foreign bodies during freight and installation stages. The plates must be removed (see Figure 24), extending the duct in order to release the pressure wave and discharge the plasma cloud outside the equipment room, towards a clearance area forbidden to personnel (see Figure 25).

Each duct extension end is equipped with a flap, intended to open in case of fault only (see Figure 26). G&W Electric design, produce and supply, on request, tailor made exhaust duct extensions (see Figure 27).

However, in some plants such as, for instance, Oil & Gas offshore installations, this is not possible, due to limited space and/or particular environmental conditions. In this case, we provide a couple of kits – for each switchgear – consisting of a grille, a relief flap and a baffle to be fixed on the exhaust duct openings, using the existing holes.

The flap allows to release the pressure wave, while the grille stops possible fragments, and the baffle conveys plasma cloud and debris upwards.

For safety reasons, this implies the personnel preclusion from the areas adjacent to the switchgear sides when the latter is in operation.

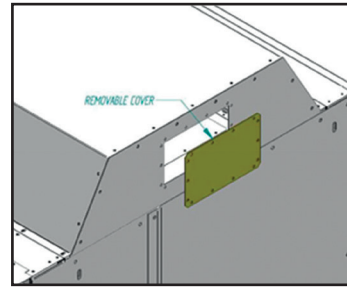


Figure 24: Exhaust duct end cover removal

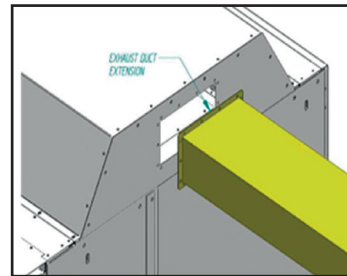


Figure 25: Exhaust duct extension installation

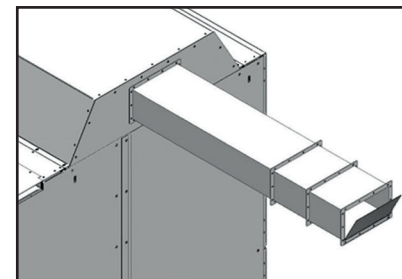


Figure 26 Exhaust duct extension end flap (open)

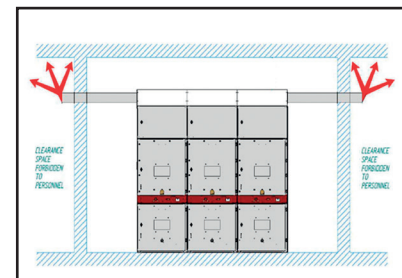


Figure 27: Exhaust duct extensions installation example

To improve safety it is possible to install a pressure wave detector that allows a much faster opening of the related C.B. Various configurations can be provided depending on how many compartment are equipped with the detectors. (See Figures 28 and 29)



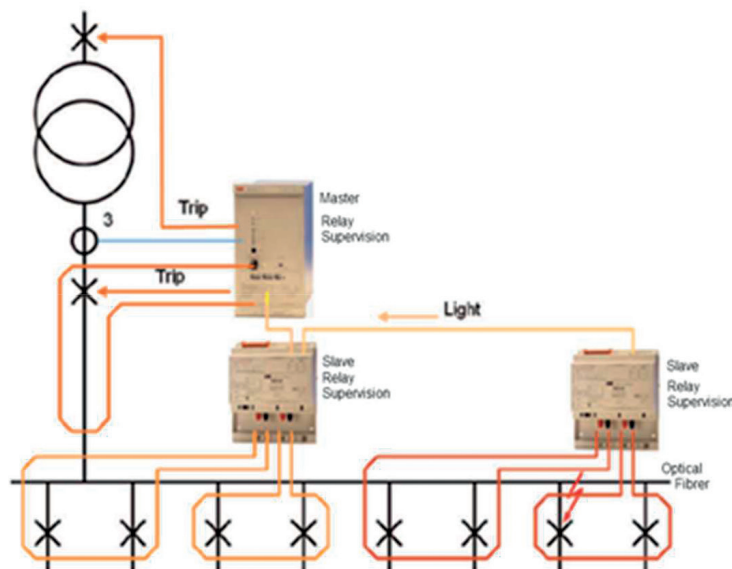
Figure 28



Figure 29

### Pressure Wave Detector

In order to obtain the best safety performance it is possible to install a smart system of arc detection and fast C.B. opening. The Arc Protection System is based on the arc detection of the light generated by arc through optical fibres also. In this case, too, there are several configurations, for example:



### NOTE:

A switchgear damaged by a destructive event such as an internal arc must absolutely undergo a radical maintenance. All parts damaged beyond repair must be replaced; all electrical contacts (of both power and control circuits) and all the internal surfaces must be carefully cleaned, thus re-establishing perfect electrical and mechanical operations. In particular, all insulating supports and components must be checked: although they might appear intact, it is advisable to replace them in case of doubt, in order to avoid risks related to possible cracking and surface discharges. At the end of service and before commissioning, voltage test (according to the related applicable standards) must be applied to the switchgear main and control circuits, making sure that the correct level of insulation has been re-established.

## Withdrawable Unit, Related Enclosure and Earthing Switch

Each withdrawable functional unit is housed in a suitable enclosure, equipped with an earthing switch and with all mechanical and electrical interlocks that ensure its own proper working and personnel and plant safety. Each unit is entirely independent from each other installed on the switchgear but, at the same time, it is interchangeable with the ones having the same function, dimensions and electrical configuration. A mechanical code system is available on request: it does not allow that units of identical dimensions, but different function, are inadvertently exchanged.

A withdrawable unit consists of the following main components:

- CB/contactor/VT
- Movable power terminals and related insulating parts
- Auxiliary/control circuits plug
- Electro-mechanically interlocked truck
- Metal sheet frame

The unit operating mechanism prevents any undesired operation by the personnel. A set of mechanical/ electrical locks ensures proper use of the unit and personnel safety.

The units has the following positions:

- Drawn-out: the unit is outside the panel
- Disconnected: both the power and control circuits are disconnected
- Test: the power circuits are disconnected – the control circuits are connected
- Connected: both the power and control circuits are connected

The unit can be operated by a special crank only. Operation is allowed only from the outside, with the door closed. A mechanical interlock prevents the door from being opened before the CB/contactor/VT truck is safely in the “disconnected” position.

Electrical interlocks and signalling are performed by one or more micro-switches and related actuators. (See Figures 30, 31, 32 and 33)

**IMPORTANT:** In case of emergency, it is possible to open the door – if the unit is in “connected” position, through a manual emergency procedure.

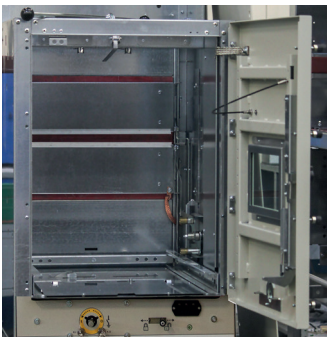


Figure 30: Withdrawable unit enclosure overall views, with unit removed



Figure 31: Withdrawable unit enclosure overall views, with unit installed

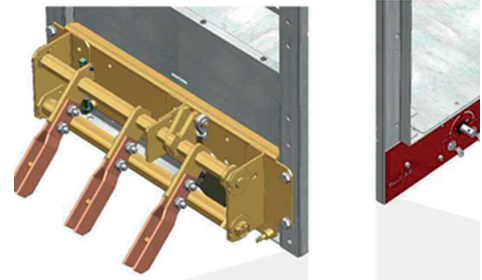


Figure 32

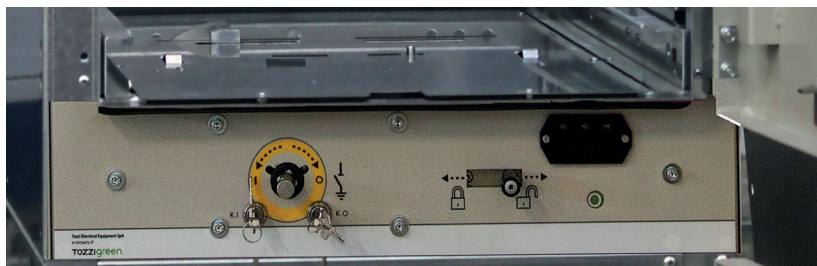


Figure 33: Earthing switch (located on the enclosure rear), related lever and operating mechanism front view

## Special Construction & Additional Features

According to specific project requirements, the panels can be manufactured in special constructions and/or equipped with additional features (See Figures 34, 35, and 36):

### Single level switchgear with double bus-bar systems (normal/emergency)

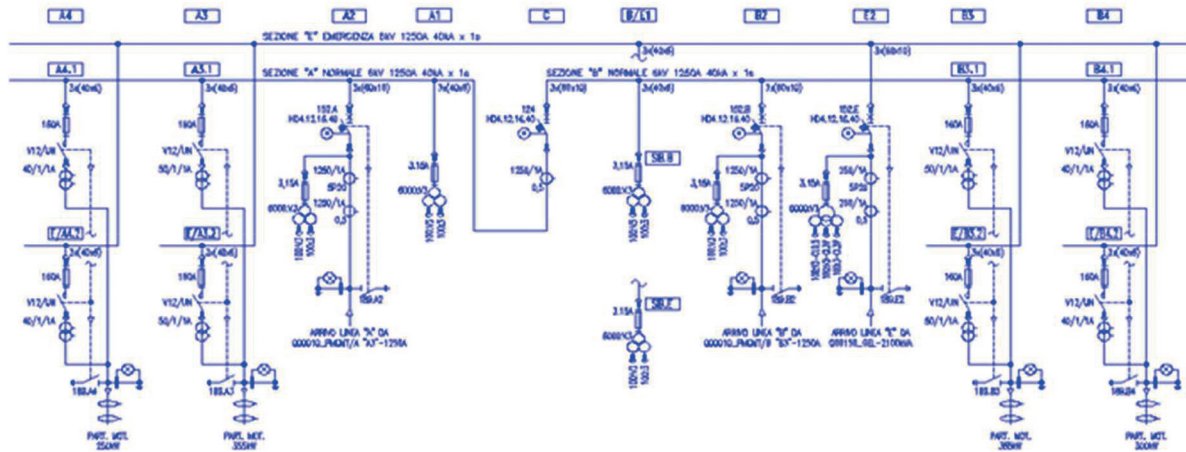


Figure 34

C.B. fed through normal line

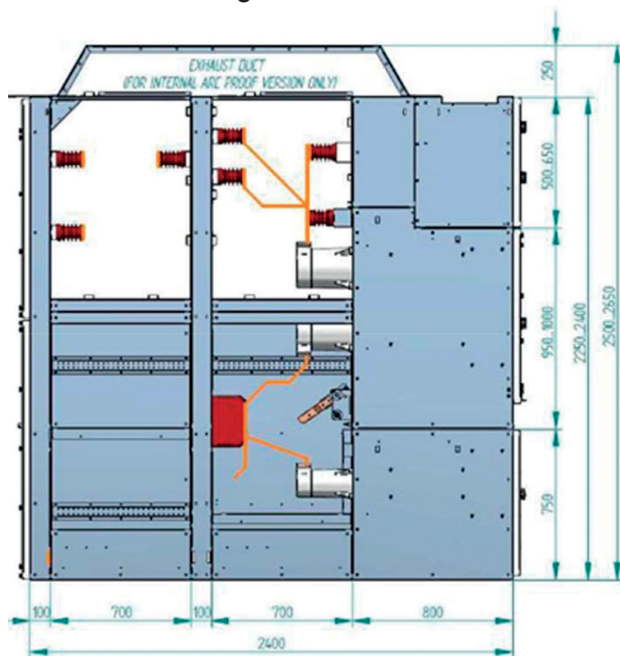


Figure 35

C.B. fed through emergency line

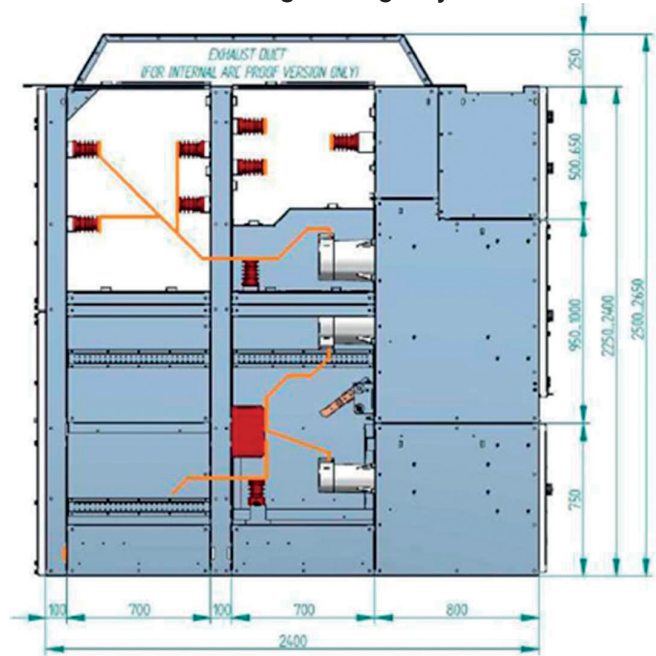


Figure 36

## Double-level switchgear with split bus-bar system

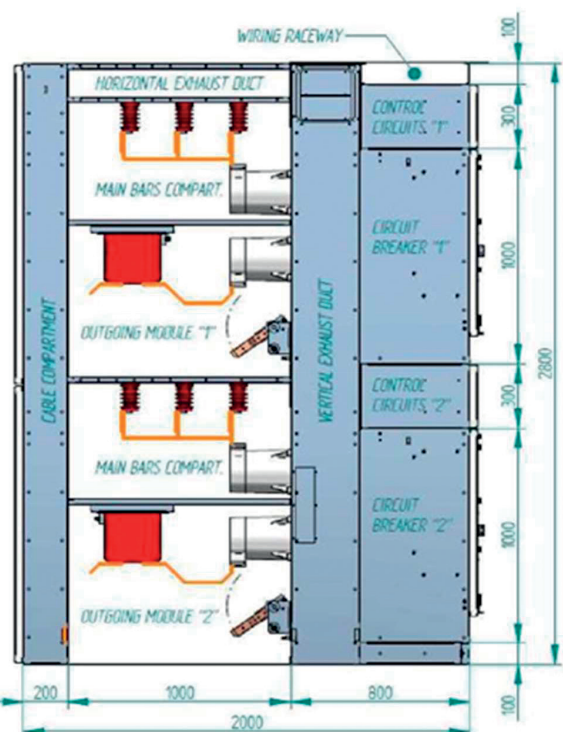


Figure 37

Switchgear		QMTC 7,2	QMTC 12
Rated Voltage	KV	7,2	12
Insulation level Rated Power Frequency	KV 1 min	20	28
Rated lightning Impulse	KV	60	75
Frequency	Hz	50/60	
Main bus bar Rated current	A	up to 4000	up to 4000
Feeder Rated current	A	up to 2000	up to 2000
Short time withstand current	KA	31,5 – 40 – 50	31,5 – 40 – 50
Short circuit duration	Sec.	3	3
Peak withstand current	KA	78 – 100 - 125	78 – 100 - 125
Internal Arc withstand current	KA	31,5 – 40 – 50	31,5 – 40 – 50
Duration	Sec.	1	1
Degree of Protection (external)		Up to IP41	
Internal Separation Partition		Up to IP4X	
Unit with Circuit Breaker	mm.	650	650
31,5kA Up to 1250A	mm.	800	800
31,5kA - 40kA - 50kA - 1600A - 2000A	mm.	800	800
Unit width Fuses and Contactor 50kA - Up to 400A	mm.	550	550



## Intelligent switchboards

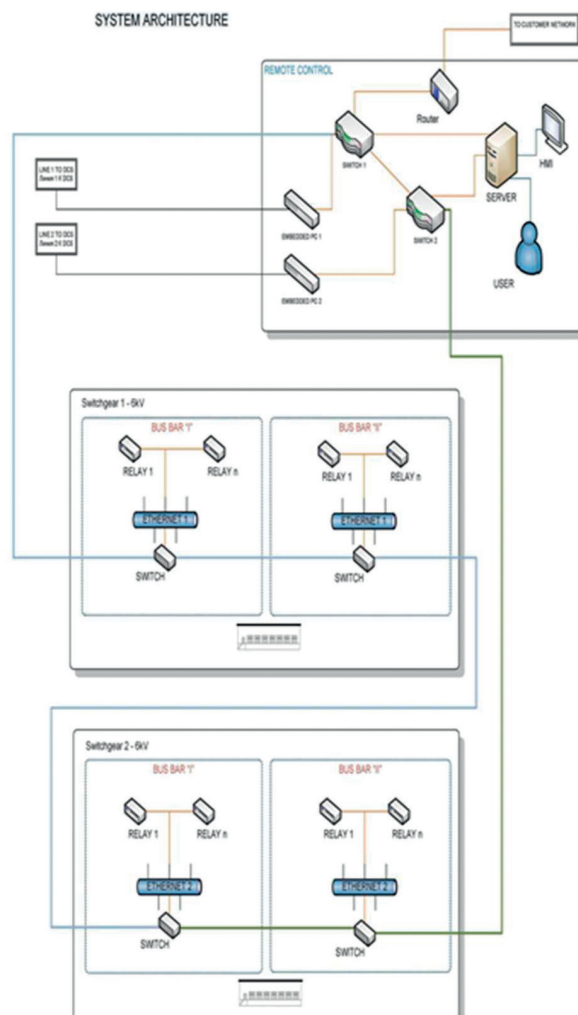
G&W Electric is able to supply its electrical switchboards together with supervision and control systems.

Such systems, whose software is entirely realized at G&W Electric, allow:

- The monitoring and the control of the switchboards and of the entire plant
- An easier ordinary and extraordinary maintenance the improvement of the data filing with connections to management software systems

The configuration of the systems is designed according to our customers' specifications and special requests; for such aim the following devices may be used:

- Electronic devices in operation zones
- Interface devices which allows concentration of data and possible exchanges with several communication protocols Profibus, Modbus, IEC61850 and Moreover
- Supervision devices designed on PC (SCADA)



For civil, military and industrial plants, with the state of the art software available in the market or with operator panels. Together with the supervision and control systems, G&W Electric provides to the customer all the necessary assistance for the commissioning of the system as well as the staff training, in addition to the after-sales assistance.

## Bus-ducts

In case of particular equipment room arrangements, it is possible to install bus-ducts in order to link two or more switchgear bus-bar sections. (See Figures 38 and 39)



Figure 38

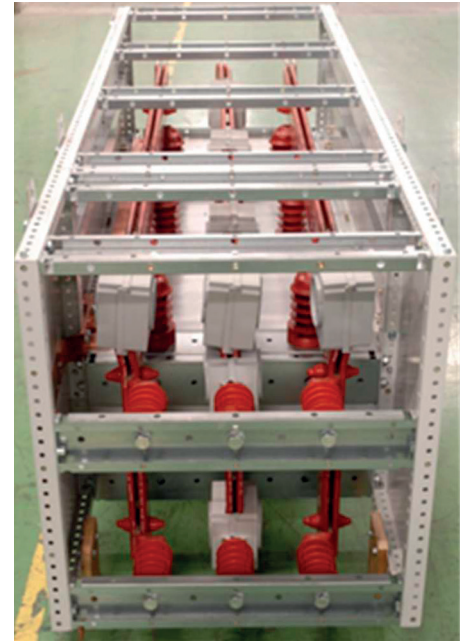


Figure 39

## Installation

### General considerations

Installing the switchgear correctly is of vital importance. A copy of the project documentation is sent in advance to allow a proper preparation of the installation site. The documentation comprises: general arrangement drawings, base plans, cross sections, fixing details, single line/schematic diagrams and the list of the equipment installed in the switchgear together with the related instructions and manuals.

### Installation room

When installing the switchgear on site, minimum distances with respect to any possible obstacles should be carefully taken in account. They should allow easy opening of the doors, insertion/drawing out of the units, ordinary maintenance and personnel safety.

### Foundation & fixing surfaces

Concrete floor and/or iron channels must support – without deforming – the weight of the switchgear, fitted with all the equipment. The foundations must be prepared beforehand, carefully following indications and drawings provided with the project documentation.

### Foundation & fixing surfaces con't

In case of panels provided with bottom cable entry, the openings shown in fig. 1 should be completely free from obstacles. The panels can be fixed either directly to the concrete floor with screw anchors or on iron channels embedded in concrete, by means of M12 screws.

The standard operations to be carried out are the following ones:

#### Direct floor fixing

1. Clean the installation area
2. Carefully level the floor in every direction with a levelness tolerance of one per thousand for each meter in all direction but maxim  $\pm 3$  mm for the whole length of Switchgear
3. Trace out the plan of each panel of the switchgear on the floor, observing the minimum distances;
4. Create the openings for cable entry, referring to the foundation drawings
5. Bore the floor with a drill at the switchgear section fixing points
6. Insert the anchors (provided with M12 screws or stud-bolts) in the holes and expand them

**Fixing on channels embedded in concrete** (See Figures 40, 41, and 43)

1. Clean the installation area
2. Trace out the plan of each panel of the switchgear on the floor, observing the minimum distances
3. Create the openings for cable entry, referring to the foundation drawings
4. Arrange the channels on the floor, observing the dimensions shown in the drawings
5. Carefully level the channels in every direction with a levelness tolerance of one per thousand for each meter in all direction but maxim +/-3 mm for the whole length of Switchgear
6. Once the channels are firmly placed, block them with quick-setting cement
7. Finally, pour the cement into the provided holes of the channels, making sure that they stick out, at least, 1 or 2 millimetres from the floor surface

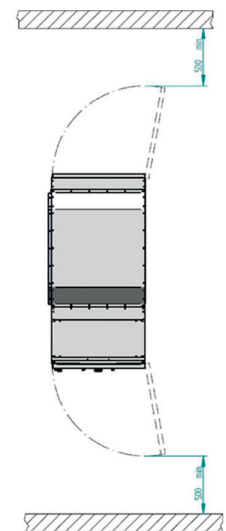


Figure 40

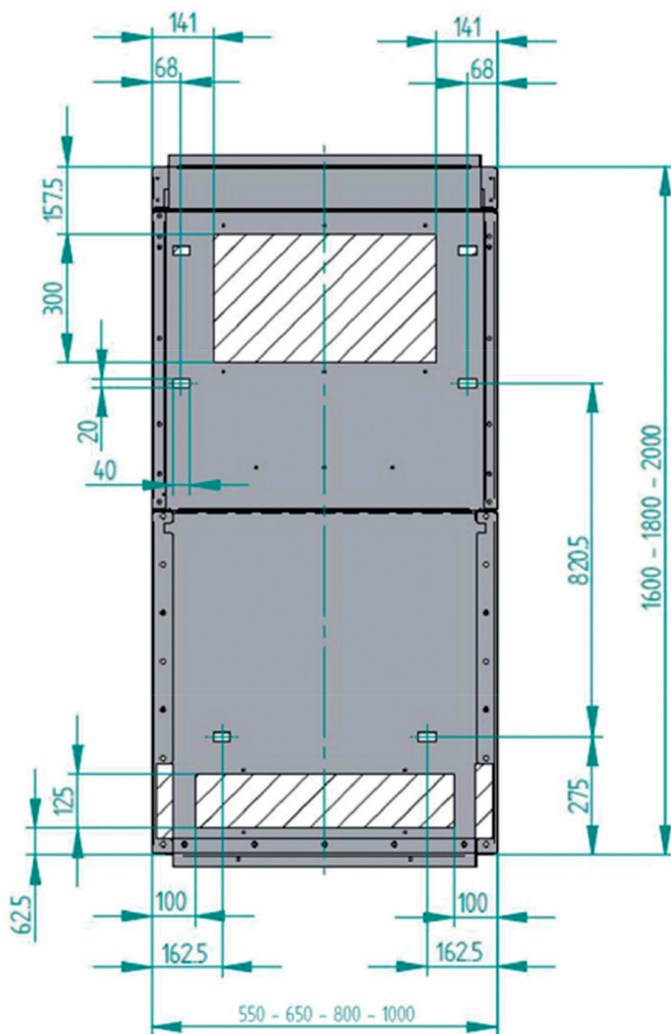


Figure 41: Switchgear panel – Base plan (standard construction)

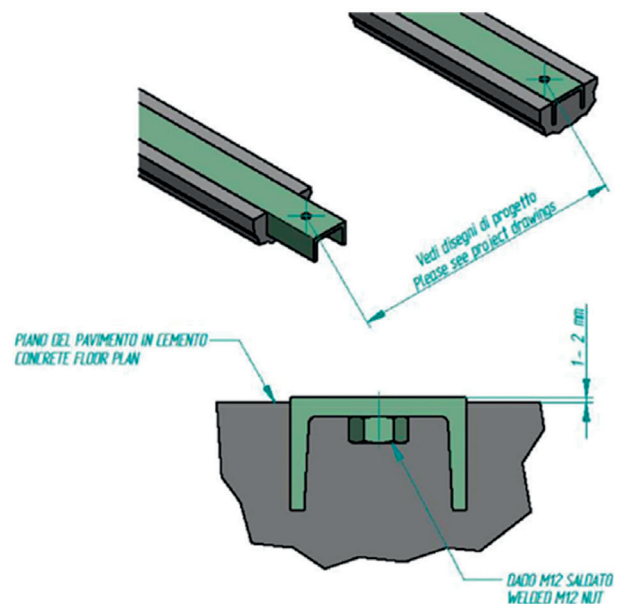


Figure 42: Floor fixing channels

## Spare parts

On request, the switchgear can be provided with spare parts\* according to the project needs. It is however recommended to get a minimum set of spare parts, consisting of the following components:

Functional unit drawing out crank



Earthing switch operating lever



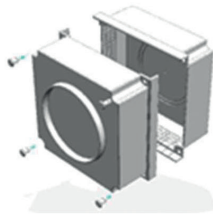
Insulating bushing rear cover



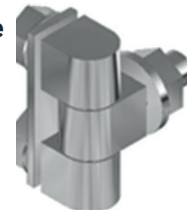
Bus bar & droppers



Bar junctions insulating shell



Compartment doors hinge



Compartment door key lock



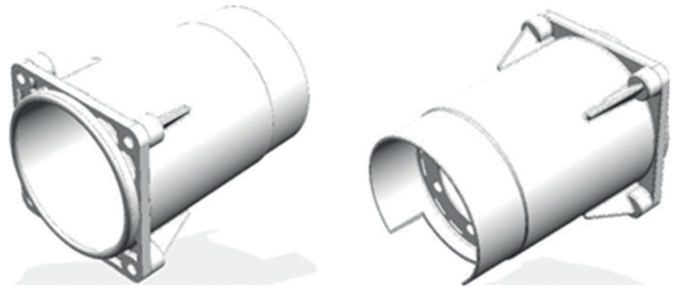
Compartment doors knob set (for internal arc proof switchgear only)



*\*Parts replaceable also by the user*

**Parts replaceable by G&W Electric personnel ONLY:**

**Withdrawable unit enclosure insulating bushing**



**Used with:**

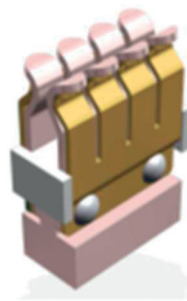
- Withdrawable unit enclosure fixed power contact insulating support
- Withdrawable unit enclosure fixed power contact
- Insulating bushing front frame
- Withdrawable unit movable power contact
- Withdrawable unit movable power contact arm



**Withdrawable unit switch movable power fixed contact; contact arm insulating bushing**



**Earthing fixed contact**



**Earthing switch movable contact**



## Special Equipment (available on request)

### Withdrawable units lifting & handling service truck

It allows the easy draw-out and handling of the units. It is equipped with hookings and guides for the unit trucks and supplied in three versions, one for each standard panel width (650, 800 & 1000 mm). The standard maximum lift up height is 1600 mm. On request, the truck can be supplied with a loading platform having a maximum lift up height of 1800 mm. (See Figures 43 and 44)



Figure 43

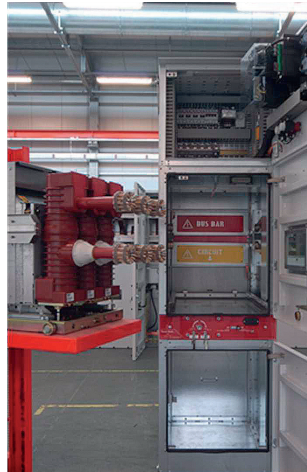


Figure 44

### Live fixed power contacts check & inspection truck

It can be operated with OPEN door; it allows to operate the withdrawable unit enclosure shutters in order to inspect & check the fixed contacts voltage values & phases correct sequence, by introducing a suitable probe. It must be operated by well-trained and authorized personnel ONLY. (See Figures 45 and 46)



Figure 45



Figure 46

Functional units drawing-out crank & earthing switch operating lever rest (wall fixed).

## Switchgear Packaging Handling and Storage

The below instruction must be respected to avoid switchgear damages during handling transport and storage.

### Packing

The standard packing of the QMTC switchgear is a waterproof plastic film wrapped around the panel with polystyrene foam panels protection placed on the operating mechanism to protect them. Mechanicals impacts, dust and water infiltrations are thus avoided during the loading, unloading and storage phases. Other packaging methods are available (wooden box, wooden box with barrier bag for sea shipment etc.) and can be selected in accordance with the shipment and storing customer needs. During storage the switchgear must be left with its original packing. If the panel or parts of it are unpacked for checking, the original packing must be restored.

### Handling

The switchgear must be handled and transported vertically. To lift the QMTC switchgear a lift machine having a proper lifting power with respect to the panel weight must be used. Attention has to be paid to keep the unit balanced during the lifting operations. The QMTC switchgear is equipped with eyebolts placed on its top that allow its handling using either a bridge crane, forklift or a crane. (See Figure 47)

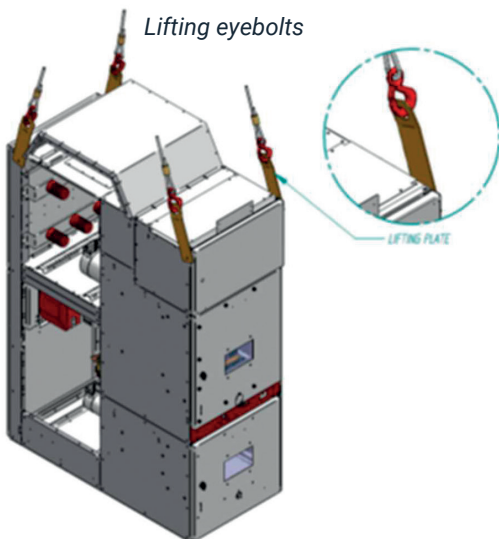


Figure 47: Panel lifting/handling example

### Storage

In case the switchgear installation is not carried out immediately after delivery its storage must be done respecting appropriate conditions as follow (See figure 48):

- The unit must be kept in its original packing
- The storage place must be dry and not affected by degradation factors such as:
  - Water
  - Vapor (coming from water, chemicals products, corrosives substances etc.)
  - Pollution
  - Saline atmosphere
  - Chemical agents

And all the dangerous conditions that may affect the switchgear integrity.



Figure 48: Storage Temperature:  
- 40°C - +70°C

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Since 1905, G&W Electric has been a leading provider of innovative power grid solutions, including the latest in load and fault interrupting switches, reclosers, system protection equipment, power grid automation and transmission and distribution cable terminations, joints and other cable accessories. G&W is headquartered in Bolingbrook, Illinois, U.S.A., with manufacturing facilities and sales support in more than 100 countries, including Canada, Italy, China, Mexico, Brazil, India, UAE and Singapore. We help our customers meet their challenges and gain a competitive edge through a suite of advanced products and technical services.

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