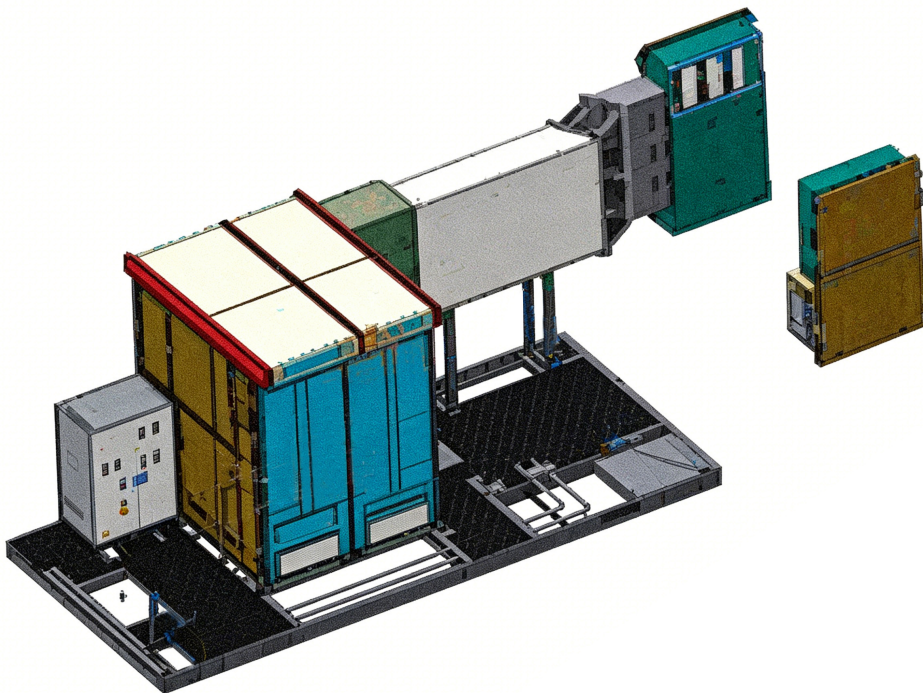




Generator Switchgear Solution (IEC/ANSI)

(An example for TM2000 System)

Engineering & Operation Document



Safety first!

Important recommendations:

- Outdoor aisle-less switchgear equipment is of weatherproof construction. Front and rear sealed outdoor type doors enclose the instrument panel and circuit breaker compartments.
- Installation, operation and maintenance should be carried out by licensed electricians.
- Fully comply with the applicable standards (e.g. IEC), the utility connection requirements and the applicable safety regulations.
- Observe the relevant instructions in the instruction manual for all actions in relation to switchgear and switchboards.
- Pay attention to the hazard notes in the instruction manual marked with this  warning symbol.
- Make sure that the specified data are not exceeded under switchgear or switchboard operating conditions.
- Keep the instruction manual accessible to all personnel involved in installation, operation and maintenance.
- The users must act responsibly in all matters affecting safety at work and correct handling of the switchgear.



WARNING

Always follow the instruction manual and respect the rules for good engineering practice!

Hazardous voltage can cause electrical shocks and burns.

Disconnect power, then earth and short-circuit before proceeding with any work on the equipment.

If you have any further questions about this instruction manual, our field team will be pleased to provide the required information.

We reserve all rights to this publication. We do not accept any responsibility for the information provided, which is subject to alternation.

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1 General

1.1 Summary

This publication contains the information required for installation, commissioning, operation and maintenance of SecoGear-TM25. SecoGear-TM25 is three-phase, metal enclosed, air-insulated factory assembled outdoor switchgear with cable connection box, junction box, Busduct and generator Line side & Neutral side cabinet. It is intended to use on 10,500 to 13,800 volt, three phase, three-wire, grounded, 50 and 60 Hz systems in conjunction with GE PPLP TM2500 gas turbine package. SecoGear-TM25 is type-tested following the IEC62271-200 and referencing NEMA/ANSI37 standards. The panel is designed with withdrawable modules and is fitted with dual busbar system. The withdrawable parts are equipped with circuit breakers, voltage transformers, fuses. Details of the technical design and configuration of individual switchgear, such as the technical data, detailed part lists for the individual panels and comprehensive circuit documentation etc., can be found in the relevant order documents. For correct usage of the switchgear, please read this manual carefully. It is always advisable to use the manual for all operations regarding installation, commissioning, operation and maintenance of SecoGear-TM25 air-insulated switchgear. This instruction is also used as references for personnel to carry out regular maintenance for switchgear.

1.2 Standard and specification

SecoGear-TM25 complies with the standards and specifications for factory-assembled, metal enclosed and type tested high voltage switchgears to IEC publications as given below.

IEC62271-100: 2017	.....	High-voltage alternating current circuit breakers.
IEC62271-200: 2011	.....	AC Metal enclosed switchgear and control gear for rated voltages above 1kV and up to 52kV.
IEC62271-102: 2013	.....	High-voltage alternating current Disconnecter and Earthing Switches.
IEC62271-1: 2017	.....	The common specification for high voltage switchgear and control gear Standards
NEMA 250-2003	.....	Enclosures for Electrical Equipment (1000 Volts Maximum)
IEEE C37.20.3:2013	.....	IEEE Standard for Metal-Enclosed Interrupter Switchgear (1kV-38kV)
ANSI C 37.54 (2002)	.....	Conformance Test Procedures for Indoor Alternating Current Medium Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear
IEEE C37.09(2007)	.....	Test procedure for AC High-Voltage Circuit Breaker Rated on a Symmetrical Current Basis
IEC/IEEE 62271-37-013:2015	.....	Alternating-current generator circuit-breakers.

The following drawings should be used in conjunction with this manual

0PV1250001	.....	General Arrangement Drawings
0PV1507023	.....	Single Line Diagram

CNW2-17NPS02-K00, K01, K02, K03, K04	.....	Secondary Schematic Drawing
CNW2-17NPS02-K00	.....	Cover Page
CNW2-17NPS02-K01	.....	GVCB Panel
CNW2-17NPS02-K02	.....	Auxiliary Panel
CNW2-17NPS02-K04	.....	Transition Junction Box
CNW2-17NPS02-K03	.....	Generator Neutral Side Cubicle

Nameplates

8pv1507830	.....	Nameplate of NEMA 3R Enclosure door
8pv1507831	.....	Nameplate of the Breaker door
8pv1507832	.....	Nameplate of the VT door
8pv1507833	.....	Nameplate of the GNAC
8pv1507834	.....	Nameplate of the GLAC
8PV1507907	.....	Nameplate of the Junction Box LV Cabinet
8PV1507908	.....	Nameplate of the Neutral Side Cabinet LV Cabinet

Drawings and numbers of warning signs refer to Appendix B.

All other corresponding IEC/ANSI/IEEE publications, national or local safety regulations must be followed during the installation and operation of the switchgear. In addition, any project specific advice from GEIS must be considered.

1.3 Operating conditions

1.3.1 Normal operating conditions

The switchgear is fundamentally designed for the normal service conditions for outdoor switchgear to IEC Publication 62271-1:2007. The switchgear shall be suitable for operation at their standard nameplate ratings where the ambient temperature is not above +55 deg C or below -39 deg C. For ambient temperatures above 50 deg C there is a derating of the turbine output performance to 2200 Amps. When installing the switchgear in environments with temperature lower than -15 deg C, the high power 500W heaters in the panels and GNAC must be started up at least 48 hours before normal operation, and turned off after the switchgear has been running for 12 hours.

The following limit values should be applied:

- Ambient temperature
 - - Maximum + 55 deg C
 - - 24h-Average +35 deg C
 - - Minimum -39 deg C
- Humidity
 - Highest average value measured over 24 hours
 - o Relative humidity 95 %
 - Highest average value measured over 1 month
 - o Relative humidity 90 %
- The maximum site altitude is 1000 m above sea level
- Seismic Rating up to Uniform Building Code (IBC-2012)

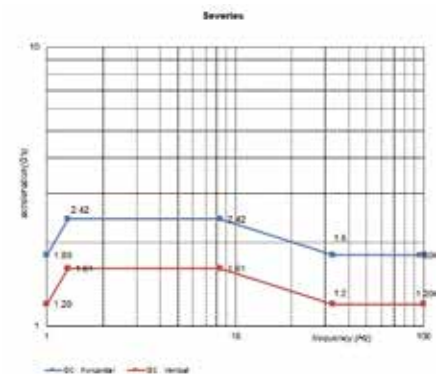


Figure 1.1 Seismic acceleration response spectrum

1.3.2 Special operating conditions

SecoGear is suitable for operation in the climate of outdoor type per IEC IEC62271-1. Special operating conditions must be discussed with the manufacturer in advance, like site altitudes above 1000 m; ambient temperatures over 55 deg C.

1.3.3 Note on any special climatic operating conditions:

When the switchgear is operated in areas with high humidity and/or major rapid temperature fluctuations, there is a risk of dew deposits. Preventive actions (e.g. applying the electric heater) must be consulted with the manufacturer to avoid condensation and any resulting corrosion or other adverse effects. The control of the heaters depends on the relevant project and details can be taken from the order documents.

1.4 Safety and environment protection requirement

1.4.1 Safety Procedure



- Wear the correct Personal Protective Equipment per electric safety regulations before entering the site
- Comply with industry work procedure. Power supply shall be operated by authorized staff.

1.4.2 Environment protection requirements

The manufacturer has a product recycle policy in accordance with related law and ISO14001. Local laws shall be observed when the switchgear is due for recycling.

2 Technical Specification

2.1 Technical specification for SecoGear-TM25 Table 1

Rated Voltage:	kV	12/15/17.5
Rated power frequency withstand voltage	kV/min.	38
Rated lightning impulse withstand voltage	kVp	95
Rated frequency	Hz	50/60
Rated current	A	2500 A @ -39 deg C to 50 deg C 2200 A @ 50 deg C to 55 deg C
Rated short time withstand current (3s)	kA	50
Rated peak withstand current	kAp	130
IP level for weather protection	Enclosure	NEMA 3R

2.2 Technical specification for SecoVac VB2 Plus G (Circuit breaker)

Table 2

Rated Voltage:	kV	12/15/17.5
Rated power frequency withstand voltage	kV/min.	38
Rated lightning impulse withstand voltage	kVp	95
Rated frequency	Hz	50/60
Rated current	A	2500 A @ -39 deg C to 50 deg C 2200 A @ 50 deg C to 55 deg C
Rated short-circuit breaking current	kA	50
Rated short-circuit closing current	kAp	137
Rated short time withstand current	kA	50
Rated peak value withstand current	kAp	137
Rated duration time for short-circuit	s	3
Minimum opening time	ms	24.3
Degree of Asymmetry	%	75
Asymmetry interrupting capability	KAp	73
Close and latch capability	kAp	110
Rate of rise of recovery voltage (RRRV)	kV/us	3.5
Peak recovery voltage	kV	27
Rated auxiliary control voltage	V	125 V DC
Operation sequence:		CO-30 min-CO
Mechanical life operations:	Quantity	10000 (M2)

2.3 Main circuit resistance of SecoVac VB2 plus Table 3

Item	Unit	Value
Rated current	A	2500
Resistance	$\mu\Omega$	≤ 25

2.4 Technical specification for Earthing switch Table 4

S/N	Specification	Unit	Data
1	Rated voltage	kV	12/15/17.5
2	Rated power frequency withstand voltage in open condition of switch	kV/min.	38
3	Rated Lighting impulse withstand voltage (peak value) in open condition of switch	kVp	95
4	Rated short-time withstand current (3s)	kA	50
5	Rated peak value withstand current	kAp	130
6	Rated short circuit making current	kAp	130
7	Centre distance between phases	mm	210
8	Electric endurance	Class	E1
9	Mechanical endurance	Times	2000

2.5 Configuration

There are 2 model types for the Secogear™-25 depending upon the generator plant being used. The 2 models are for GEPC (Power Conversion) and Andritz, the functionality of the switchgear is the same, there are small differences to the dimensions of the equipment to suit the different generation plant.

Shorter Generator (GEPC)	Longer Flex Duct	390A4643P0001
Longer Generator (ANDRITZ)	Shorter Flex Duct	390A4640P0001

For example, if GEPC configuration is ordered, 390A4610P0001 + 390A4643P0001 should be placed, for GEIS part number, the GEPC configuration means the combination of 3PV1507009 and 3PV1507012; If Andritz configuration is ordered, 390A4610P0001 + 390A4640P0001 should be placed. For GEIS part number, the Andritz configuration means the combination of 3PV1507009 and 3PV1507011.

GE AERO P/N	Description	GEIS Part Number
390A4610P0001	SWITCHGEAR, 15KV, 2500A AT 50 DEG C, 50/60HZ, LINE SIDE AND NEUTRAL SIDE, IEC/NEMA-ANSI, METALCLAD VACUUM, GEN 8 GROWTH, NEMA3R	3PV1507009
Configuration		
390A4640P0001	GE-IS FLEXIBLE BUS DUCT SECTION FOR ANDRITZ GENERATOR, 15 KV, 2500A AT 50 DEG C, 50/60 HZ, IEC/NEMA-ANSI, GEN 8 GROWTH, NEMA3R	3PV1507011
390A4643P0001	GE-IS FLEXIBLE BUS DUCT SECTION FOR GE-PC GENERATOR, 15 KV, 2500A AT 50 DEG C, 50/60 HZ, IEC/NEMA-ANSI, GEN 8 GROWTH, NEMA3R	3PV1507012

3 Enclosure design and equipment

3.1 Basic structure

With the withdrawable type SecoVac VB2 plus Vacuum Circuit Breaker installed, SecoGear-TM25 panels are used for the connection of the TM2500 generator to the customers facility and also to connect the generator to the neutral point of the system. Figure 3.1 shows the overall assembly on the trailer.

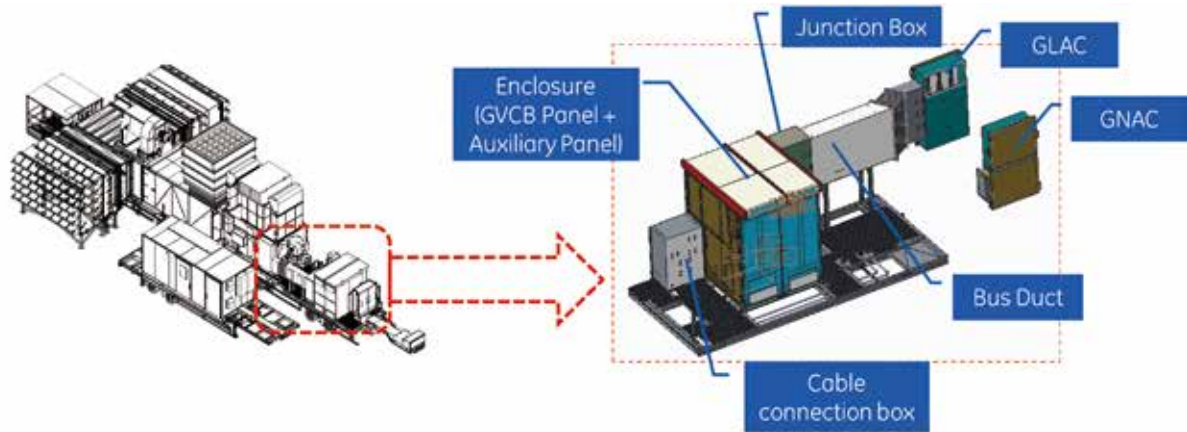


Figure 3.1 Full package structure

The following modules are named as below:

Panel Reference	Description
A01	Circuit breaker panel (GVCB Panel)
A02	Auxiliary Panel
B01	Junction Box
B02	Busduct
B03	Generator Line side Auxiliary Cubicle (GLAC)
C01	Generator Neutral Auxiliary Cubicle (GNAC)

Weight for each module:

Equipment	Weight (kg)	Equipment	Weight (kg)
Main switchgear (GCB panel & auxiliary panel & outdoor enclosure)	2422	Busduct (Busduct & supports & flexible connection)	411
GNAC	342	Cable connection box	180
GLAC	308	MISC & Cables	200
Junction box	276		

Critical individual components weight

Equipment	Weight (kg)
GVCB	280
Generator Side VT	201
Cable Side VT	205

Refer to Appendix B warning label instruction to operate the equipment safely.

3.1.1 Outdoor Enclosure

Doors, walls, and roof panels are bolted together to construct a weatherproof enclosure, rubber washes are used prevent ingress of moisture around bolt holes. Vent openings are provided at the bottom and top as a means of dissipating the internally generated heat. Each bottom vent opening is covered with rain hood; each top vent opening is equipped with drainage system.

The door hinges are designed such that they swing out and away to allow complete access to the door of each switchgear compartment. This feature allows breaker compartment and Voltage transformer compartment doors to open sufficiently for the breaker and VT to be withdrawn without interference, and the earth switch can be operated easily. On each door a stopper is provided, that is easy to disengage with hand or foot. The front hinged doors and rear hinged doors can be opened and held to an angle of 120° . Enclosure door hardware including operating handle is non-corrosive stainless steel. A heavy-duty, five-point latching system is provided for the front door with rollers at all interface points. Stainless bolt locks are provided for the rear door with padlocks. Rubber gaskets are used on all outdoor doors to seal the enclosure.

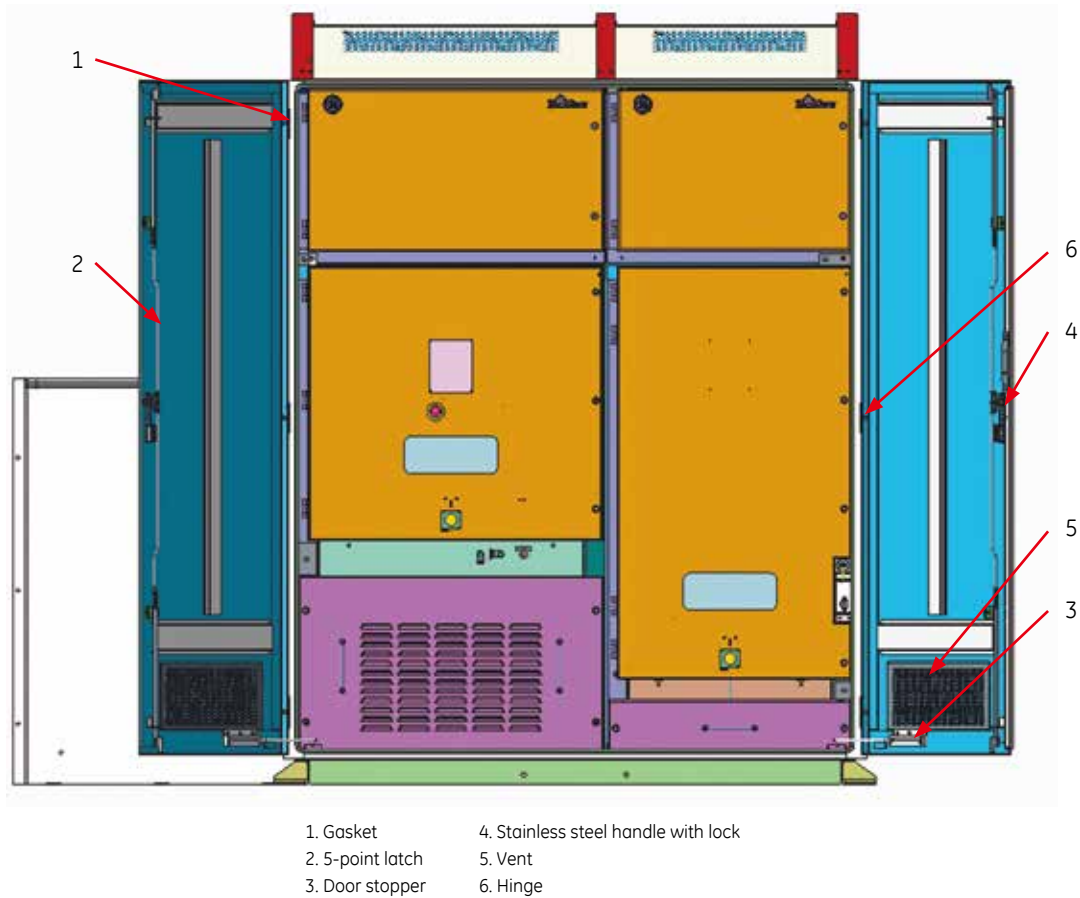
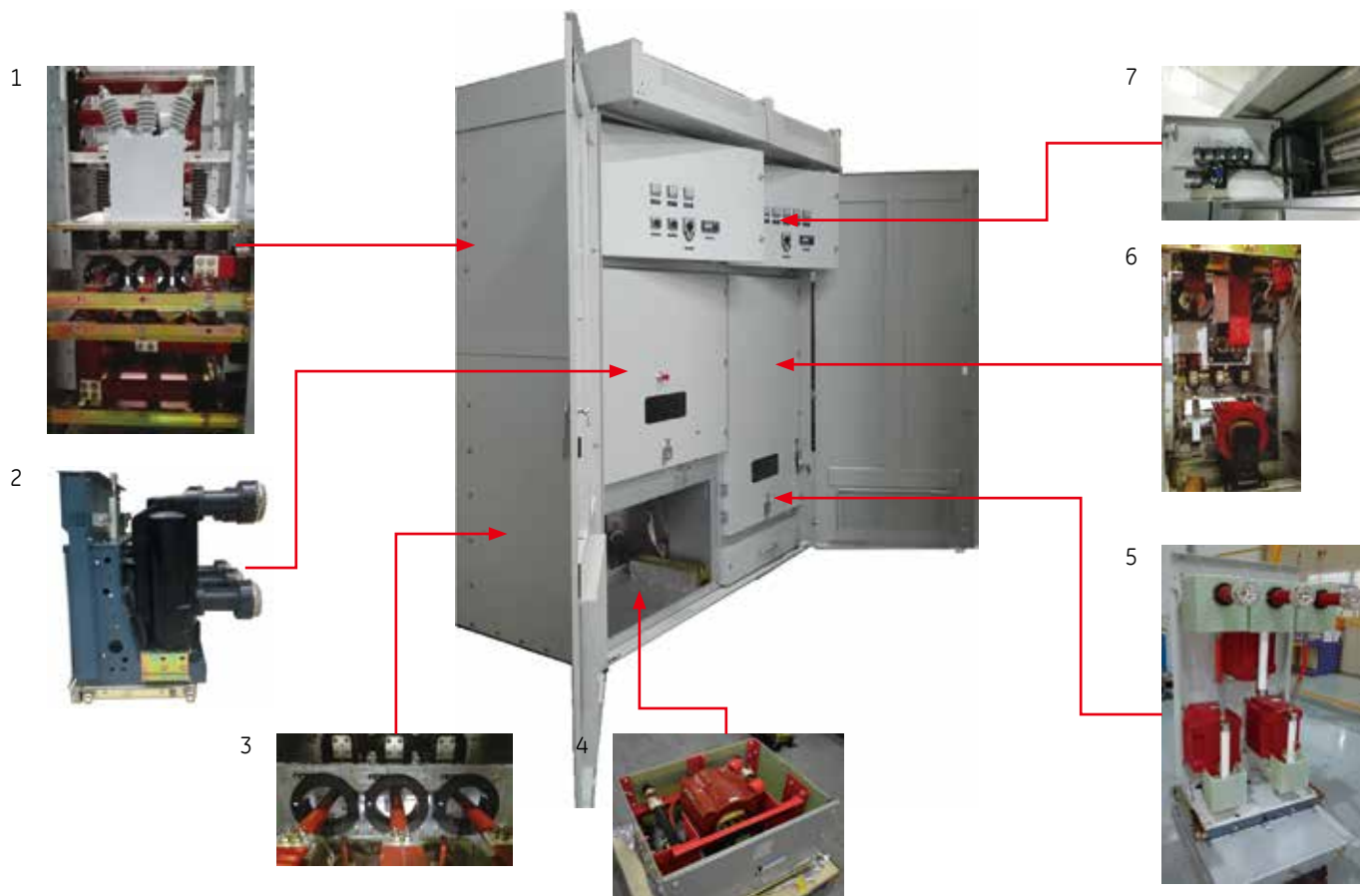


Figure 3.2: NEMA 3R Enclosure

The outdoor enclosure design has successfully passed a NEMA 3R Rain Test in accordance with requirements contained in NEMA 250.

3.1.2 Switchgear structure

The SecoGear outdoor enclosure (Figure 3.3) contains panels A01 and A02, high quality Al-Zinc steel sheets of 2 mm thickness is used for the panels. An inspection window made of security glass is provided on A01 circuit breaker compartment door and A02 voltage transformer compartment door. The panel designed provides an air gap between two adjacent panels after panels are joined together. The earthed internal partitioning ensures safe access to the circuit breaker and VT compartment even when the busbars are energized. The low voltage compartment is fully protected from the high voltage area with the earthed steel sheet. Figure 3.3 shows the key components inside the panels A01 and A02. Figure 3.4 shows the basis dimensions of each panels.



- | | |
|--------------------------------|--------------------------------|
| 1. Surge Capacitor | 5. Voltage Transformer for A02 |
| 2. Vacuum Circuit Breaker | 6. Current Transformer for A02 |
| 3. Current Transformer for A01 | 7. Low Voltage Compartment |
| 4. Voltage Transformer for A01 | |

Figure3.3 Key Components of switchgear

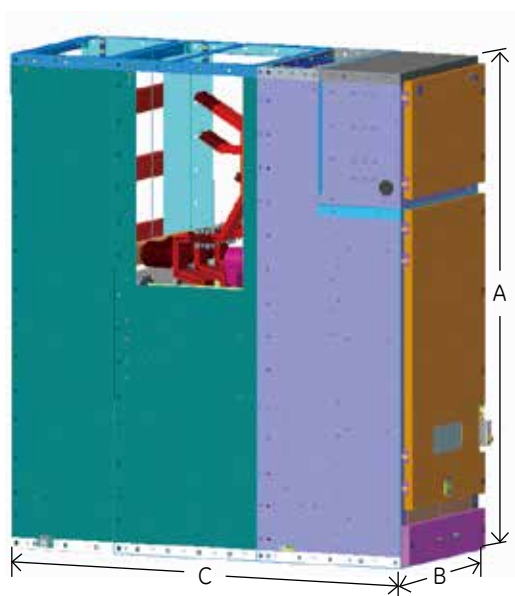
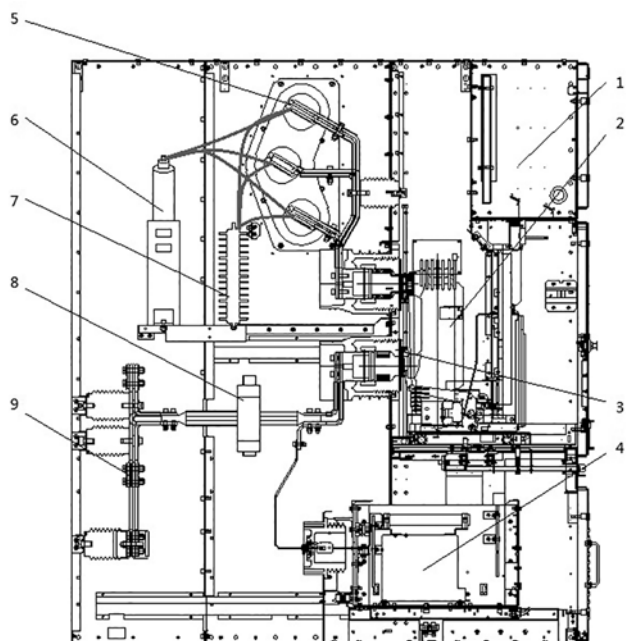


Figure 3.4: Typical dimensions of SecoGear

Description	Item	Dimension(mm)
Height	A	2200
Width	B	A01 : 1000
		A02 : 800
Depth	C	1900

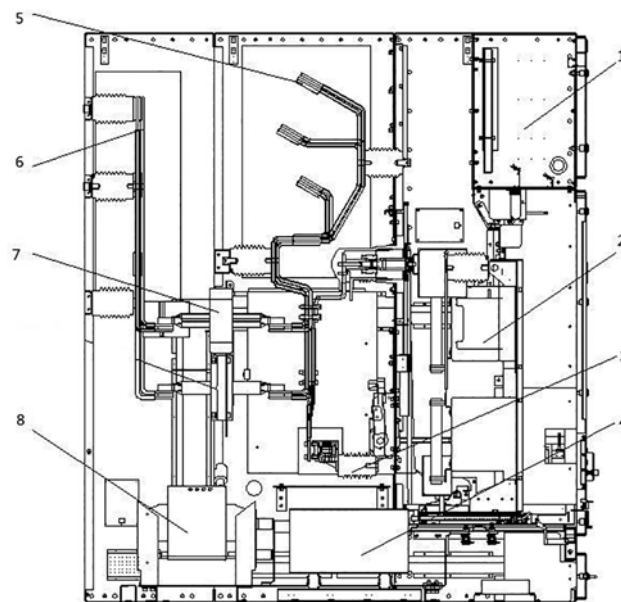
A01 Breaker panel layout



- | | |
|---|---|
| 1. Breaker panel low voltage compartment | 6. Surge capacitor |
| 2. Circuit breaker | 7. Surge arrester |
| 3. Breaker primary spout and shutter | 8. Current transformer |
| 4. Voltage transformer tray (customer side) | 9. Busbar connection to customer connection box |
| 5. Busbar connection to auxiliary panel | |

Figure3.5 : A01 Panel with VCB

A02 Auxiliary panel layout



- | | |
|--|---------------------------------------|
| 1. Auxiliary panel low voltage compartment | 5. Busbar connection to breaker panel |
| 2. Voltage transformer (generator side) | 6. Busbar connection to generator |
| 3. Earth switch | 7. Current transformer |
| 4. Grounding resistor | 8. Grounding transformer |

Figure3.6: A02 Auxiliary Panel with VT Truck

3.1.3 Line Side Equipment

The Line side equipment includes Junction box, Bus Duct and GLAC (Figure3.7), each cubicle is welded to form a rigid box with continuous seal welding. After powder coating, the cubicles are bolted together to form the Line Side Equipment. All doors are removable pan type with suitable gasket material to ensure the NEMA 3R rating. Anti-condensation heating is installed and appropriately sized to ensure condensation will not form at site. A drain is installed to allow any condensate that collects in the bottom to automatically drain out of the cubicle. For personnel safety, each removable panel is provided with warning labels. (See Appendix B)

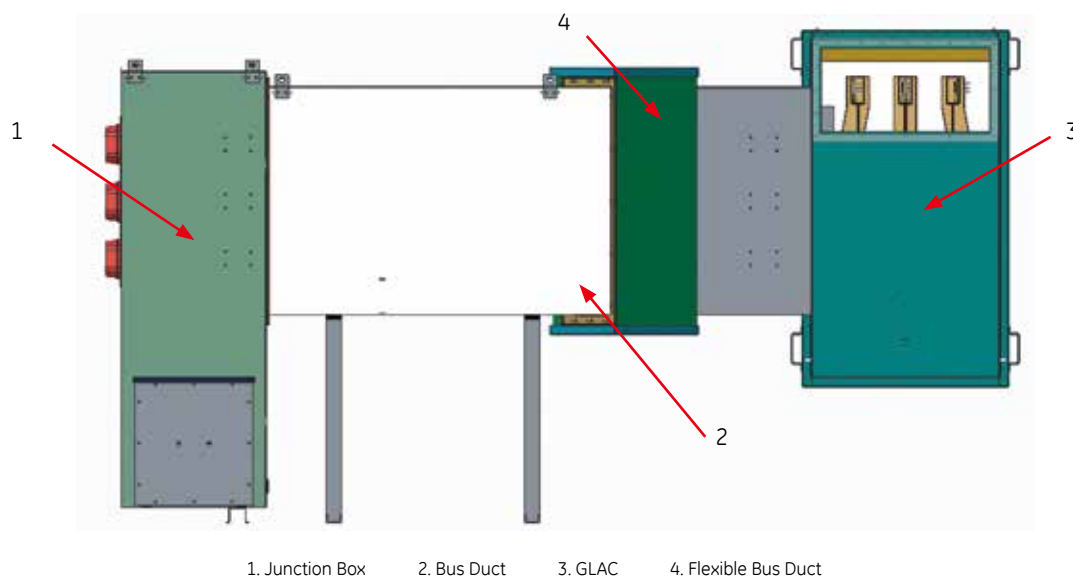


Figure3.7: line side cubicles

Junction Box

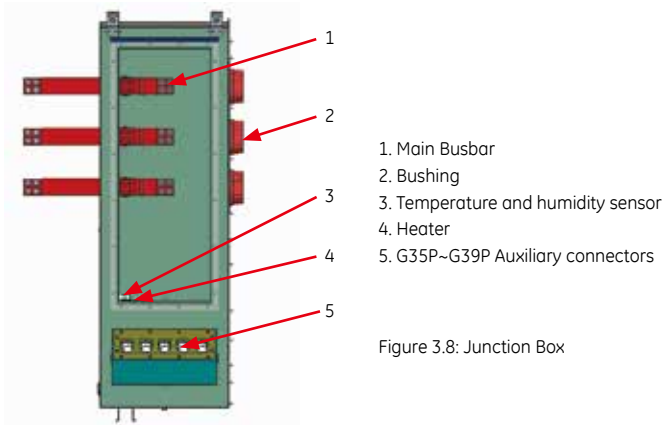


Figure 3.8: Junction Box

Busduct

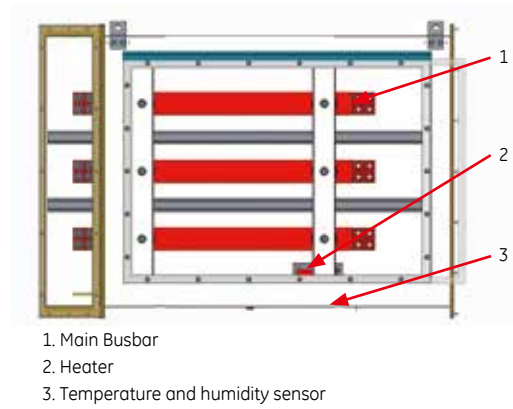


Figure 3.9: Busduct

Generator Neutral Side Auxiliary Cubicle

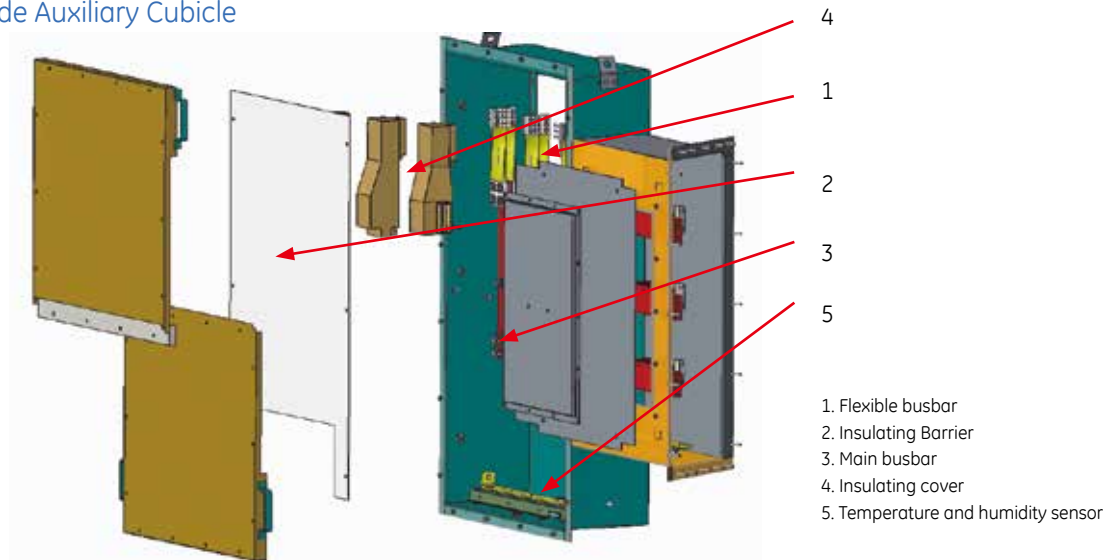


Figure 3.10: Generator Lineside Auxiliary Cubicle

3.1.4 Neutral Side Cubicle

The Generator Neutral Auxiliary Cubicle (GNAC) is arranged for bolting to the generator through flange surfaces with suitable reinforcing. Main branch bus bars are connected to generator terminals through the bus opening in the cubicle back, all bars are centered in the cubicle opening, with adequate phase-to-phase and to earth air clearances. Protective earth bus bar for the GNAC will effectively ground all non-current carrying metallic parts. The top of the cubicle has a 3.0-degree downward slope away from the generator, which will result in a downward slope from the back to the front of the cubicle.

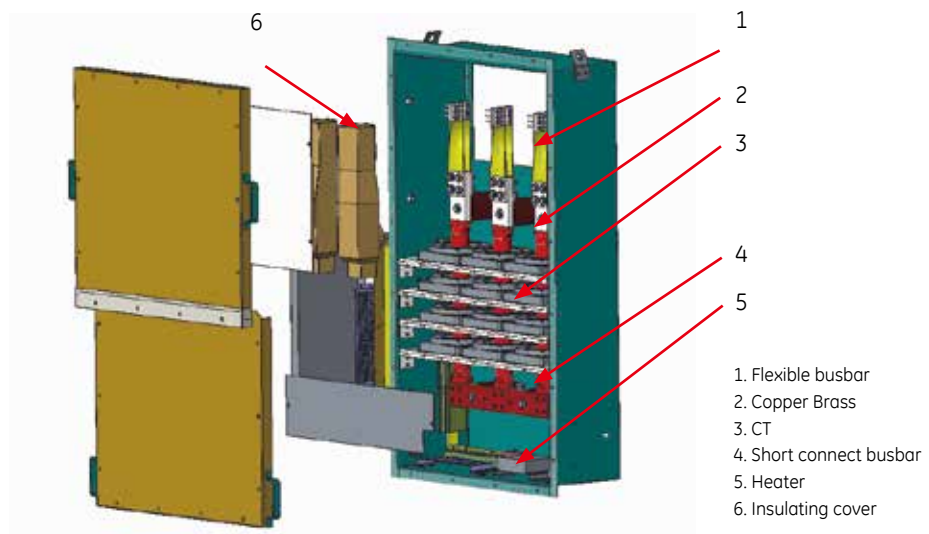


Figure 3.11: Generator Neutral Side Cubicle

3.1.5 Cable Connection Box

The cable connection box assembled beside the switchgear, it is used for connecting the customer cables with panel busbars, the cables would enter from the bottom gland plate (Figure 3.13 the clamps for the cable fixing). The maximum allowable cable diameter to go through the clamps is 67mm.

A maximum of 6 cables x 300sqmm per phase can be accommodated.

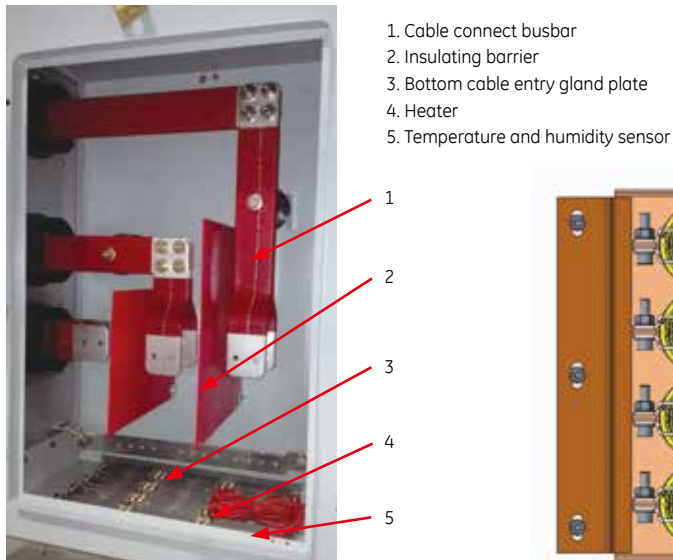


Figure 3.12: Cable connection box

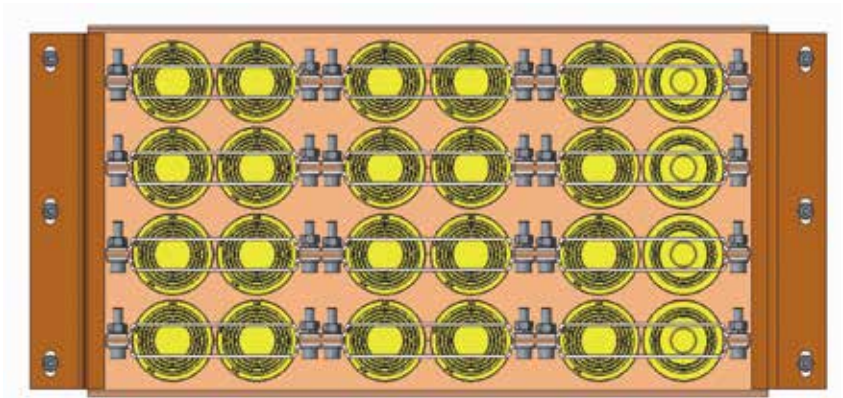


Figure 3.13: Bottom Cable Gland Plate

3.2 Interlock/protection against erroneous operation

3.2.1 Keylock arrangement and operation:

A key interlock system exists between the circuit breaker and the earthing switch. A single key is used to ensure that the correct operating sequence between the circuit breaker and earth switch. The key interlock is used :

- To prevent moving the circuit breaker to working position when the earth switch is in the closed position.
- To prevent closing the earthing switch unless the circuit breaker is in the test position.

The operation sequence should follow the label description in Appendix B.

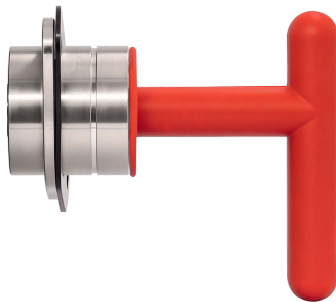
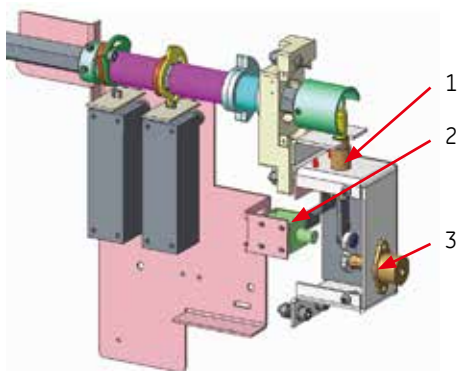


Figure 3.14 Keylock



Figure 3.15: Earthing switch closing key lock



1. Locking pin 2. Electromagnet 3. Closing Castell keylock
Figure 3.16: Earthing Switch keylock interlock



Figure 3.17: VCB trolley Rack-in/out key lock



- Before attempting to close or open the earth switch ensure that the circuit breaker is racked out to the test position
- Before attempting to close or open the earth switch ensure that the auxiliary power supply is turned ON and the electromagnet is energized and not blocking the operation
- Before attempting to rack out or rack in the breaker ensure that the earthing switch is in the opening position.

3.2.2 Padlocking of Circuit Breaker Position

It is possible to lock the circuit breaker in the service or test position using a padlock. To fit the padlock the main enclosure doors must be opened and the padlock is installed below the circuit breaker door on panel A01.

Care should be taken to remove the padlock before attempting to rack in or rack out the circuit breaker.

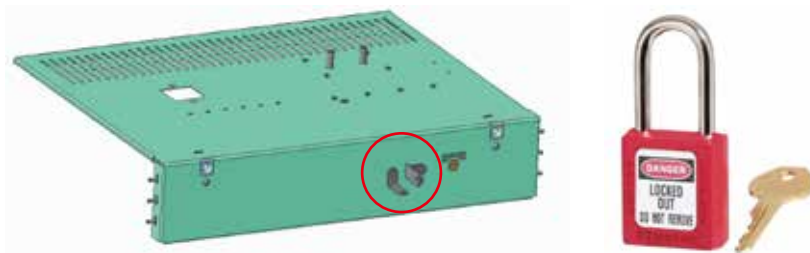


Figure 3.18: VCB trolley position padlock

3.2.3 Padlock for racking handle of VCB and Line Side VT truck Undercarriage

A padlocking facility is supplied to prevent the unauthorised racking in and out of the circuit breaker and the Line Side VT. This padlocking facility restricts the insertion of the racking handle into the racking mechanism. The padlocking facility will accept a padlock with a shackle of up to 8mm diameter.



Figure 3.19: Padlock for Circuit breaker racking-in/out operation

Before rack in the breaker or VT ensure that:



- Make sure the VCB and VT compartment is clear and without any foreign object.
- Make sure the VCB and VT compartment door is closed completely.

The main requirement for this interlock is that the racking handle can't be released unless the VCB or VT is in the fully racked in or racked out position, the main structure is shown in Figure 3.20.

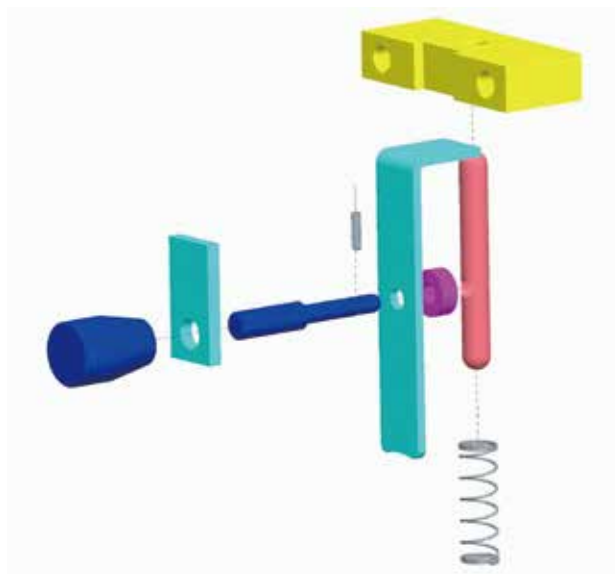


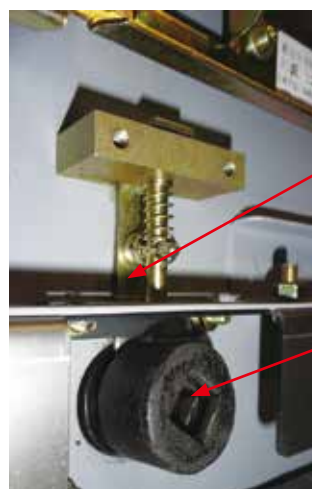
Figure 3.20: Racking handle lock mechanism

Operation sequence:

1. Rotate the cover plate clockwise to open the racking handle hole. (See Figure 3.19).
2. Lift the small cylindrical handle upward, then insert the racking handle into the handle hole (See Figure 3.21).
3. Release the small cylindrical handle, then the block plate which assembled with small cylindrical handle will slide into the groove which on the handle, so the undercarriage handle can't be pulled out during racking in or racking out process. (See Figure 3.22).



Figure 3.21: Insert the undercarriage handle



Block plate

Racking handle

Figure 3.22: Undercarriage handle is blocked

4. Lift the small cylindrical handle upward again for pulling out the racking handle.

Notes: Racking handle Interlock for VCB and VT truck Undercarriage can be released under emergency cases by unscrewing the bolts with wrench on VCB compartment door (See Figure 3.23).



Fixed Bolts

Figure 3.23: Released racking handle Interlock

3.2.4 Interlock for VCB compartment door and VCB

An interlock exists to prevent an operator from racking the circuit breaker when the switchgear panel door is not closed. Also an interlock prevents the door being opened when the circuit breaker is racked in to the service position.

When VCB compartment door is open:

Slide plates block the handle guide bushing from engaging with the racking mechanism, so that the racking handle can't be inserted, VCB Trolley can't be racked in(See Figure 3.24).

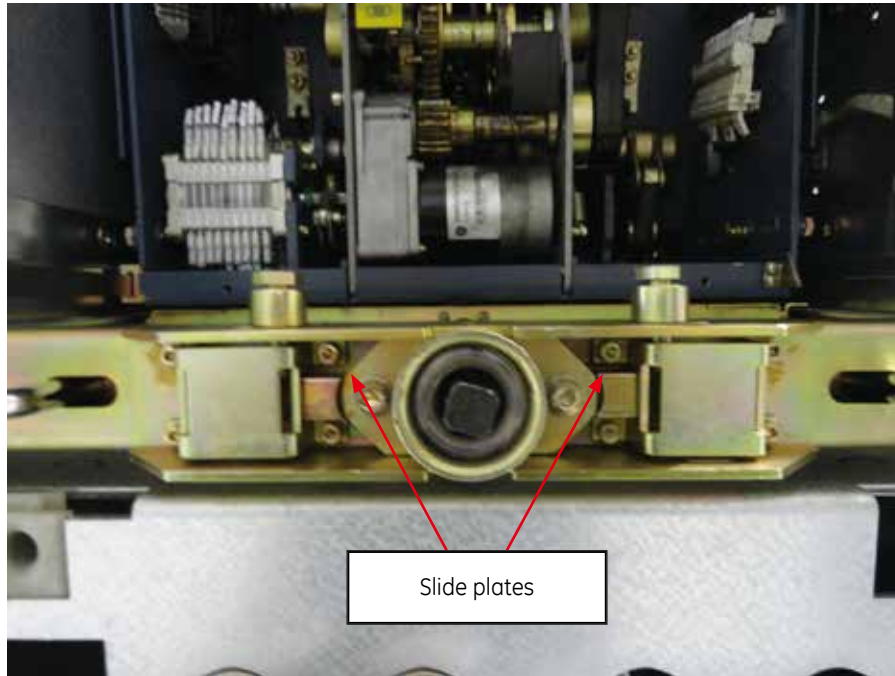


Figure 3.24: Undercarriage for VCB panel

When VCB compartment door is close:

For the VCB panel, the trigger plate on the VCB compartment door will push the slide pins moving two sides outwards, resulting in the slide plates move outwards, so that the handle can be inserted into the handle guide bushing, then it is possible to rack in or rack out the VCB truck(See Figure 3.25).

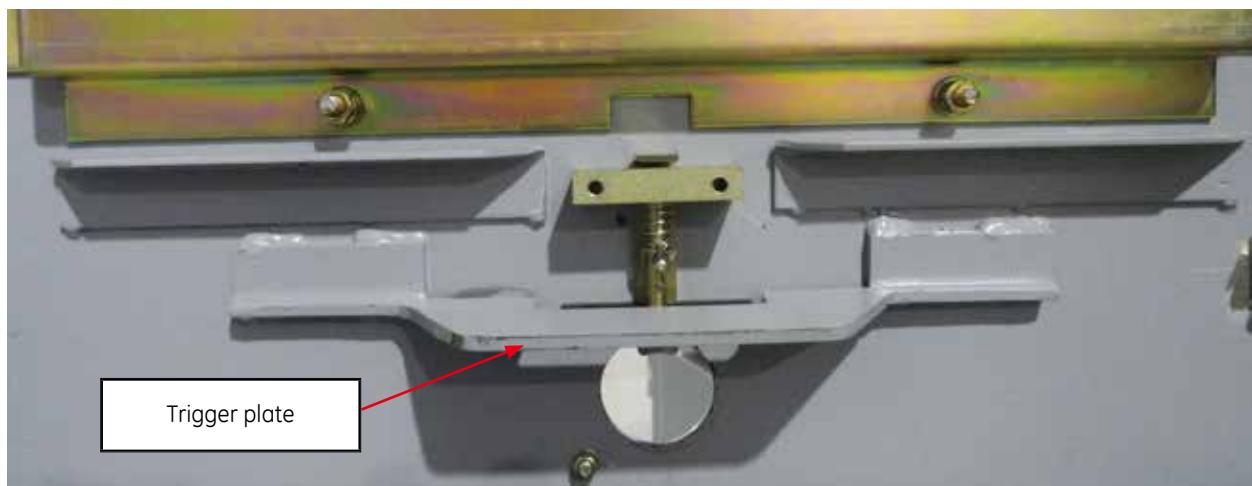


Figure 3.25: Trigger plate on the VCB compartment door

When the VCB truck is in the service position, the hook which assembled on the undercarriage will engage with the lock plate located on the rear of the VCB door, so that the VCB compartment door cannot be opened. After racking out the VCB truck to the test position, the VCB compartment door can be opened (See Figure 3.26 and Figure 3.27).

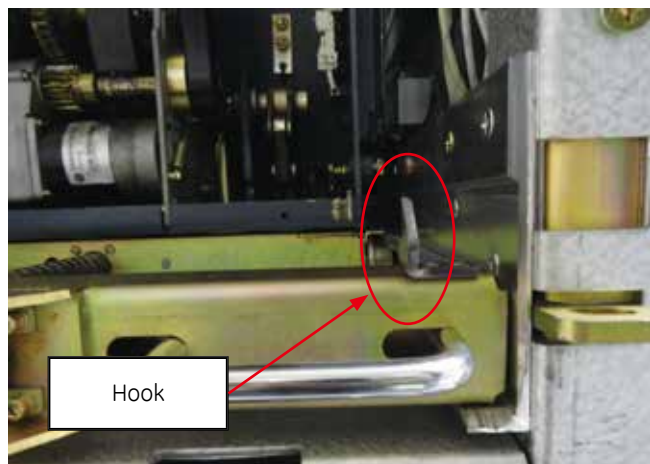


Figure 3.26: Hook for VCB undercarriage

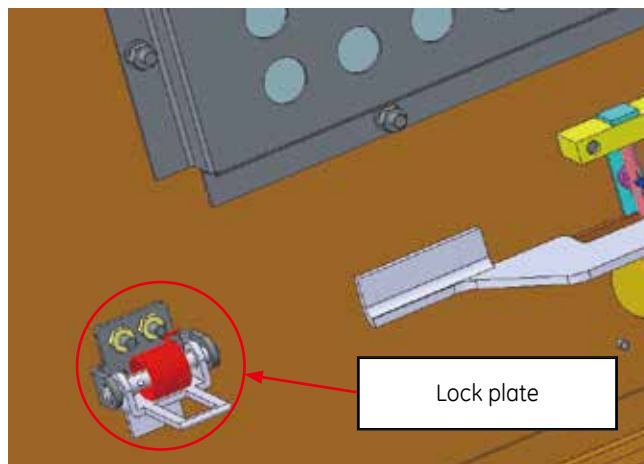


Figure 3.27: Lock plate on VCB compartment door

Notes: Interlock for the VCB compartment door and the VCB Truck can be released under emergency cases by unscrewing the special bolts with special wrench on the VCB compartment door (See Figure 3.28).



Figure 3.28: Release the interlock under emergency cases for VCB panel

3.3 Control compartment

Control compartment is on the top front of each panel, it is low voltage isolated compartment. The secondary instruments such as the metering instruments, operating switch, buttons and relays, etc, can be installed in this compartment. Protection and control circuit components as per customer specification shall be incorporated as required.

LV compartment door arrangement of A01 GVCB Panel



LV compartment door arrangement of A02 AUXILIARY Panel



Change of Frequency 50/60Hz

To change the 50/60Hz of VT output according to the primary system, it's necessary to change the selector switches on the A01 and A02 LV compartment door to corresponding system frequency.

Note: It's mandatory to make sure 50/60Hz selector switches on both A01 and A02 panels indicate the same frequency as the Power System.



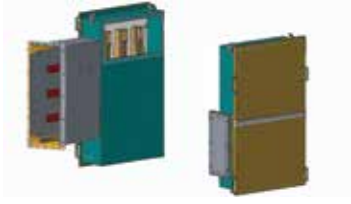
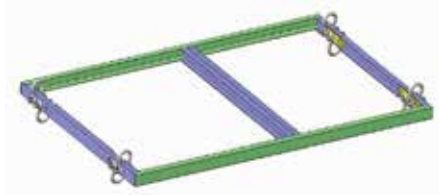
4 Handling and storage

4.1 Condition on delivery

The SecoGear-TM25 panels are verified in the factory for completeness as per the order requirement, this includes passing the routine testing as per IEC 62271-200:2011.

4.2 Packing

Based on the kind of transportation and country of destination, the packing may vary. The standard packing method is: The panels and cubicles will be divided into below main modules for shipment, the connection bus bars are not assembled, and packed separately with fasteners and accessories. All transport units are required to be assembled onsite. Guidance of assembly work will be explained in section 5.

Item	DESC	Package size (mm)			Gross Weight (with package)	Picture
		Length	Width	Height	Kg	
1	VCB Panel& Auxiliary Panel&Base (A01 and A02)	3150	2600	2700	3510	
	Junction Box (B01)					
	Outdoor Enclosure					
2	Bus Duct (B02)	2250	1500	760	397	
3	GLAC (B03)	2100	2000	1150	853	
	GNAC (C01)					
4	Flexible Bus Duct	1300	514	483	340	
5	Cable Connection Box	1250	800	1550	179	
6	GVCB/VT1/VT2	3100	1100	1600	886	
7	Spreader(optional)	2650	1500	250	141	
8	Auxiliary Box 1/ Copper bar box 1	3100	350	600	360	• Operation handle • Fasteners • Flex busbar • Boots • Cable • Gasket • Copper bar

To protect against moisture a drying agent bag is provided. IEC62271-1:2007 guidelines are followed.

- Panels with seaworthy or similar packing (including packing for containerized shipments)
 - ❑ Sealed in polyethylene sheeting
 - ❑ Transport drying agent bags included
 - ❑ Moisture indicator included
- Observe the directions for use of the drying agent bags. Note the following
 - ❑ Drying agent color observed blue indicates the packaged equipment is dry condition
 - ❑ Drying agent color observed pink indicates the packaging contains moisture (relative humidity above 40%). Please contact the manufacturer in this case before installation

4.3 Transport

The transport units normally comprise of individual panels and, in exceptional cases, small groups of panels. Only carry out loading operations when all precautionary measures to protect personnel and materials have been taken, with the following equipment:

- Crane of suitable capacity; the minimum capacity shall be 5 tons
- Fork-lift truck and/or manual trolley
- Lifting ropes/slings of appropriate load capacity with shackles
- Maintain an angle of at least 60° from the front for the ropes leading to the crane hook (Figure 4.1)

For lifting panels in series, the A01 and A02 panels with the outdoor enclosure, the base frame, hooks and spreader are needed. Cables connecting lifting lugs to the spreader bar should be connected so that they are snug against the switchgear enclosure. Make sure the cables clear any outdoor mounted equipment and extended roof sections. Cables should be covered to protect the exterior finish. Cables are connected to the lifting brackets and spreader bar (supplied by GEIS) using adequately sized shackles. The load angle on lifting cables must be at least 60 degrees to prevent damage to the equipment during lifting. (See Figure 4.3) The panels are equipped with four lifting eyebolts.

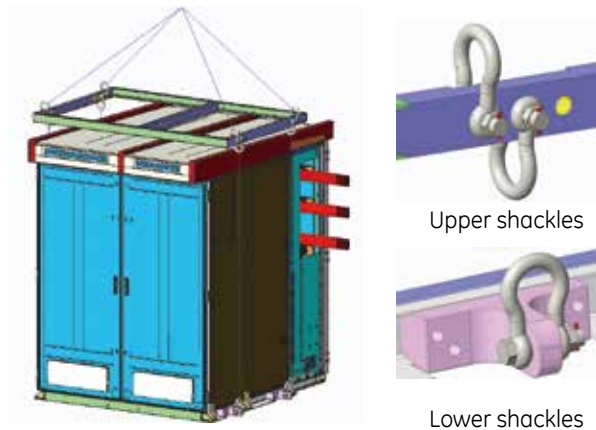


Figure 4.1: Handling by crane

When lift the panels with the junction box, the 4 lifting hooks on junction box should be bounded to the spreader. The lifting method is showed as below. The minimum crane capacity shall be 5 tons.



Figure 4.2: Panels Assembly Lifting

For Junction box and busduct are provide with 4 lifting lugs, GLAC, GNAC and cable connection box are provided with 2 lifting lugs, shown as below:

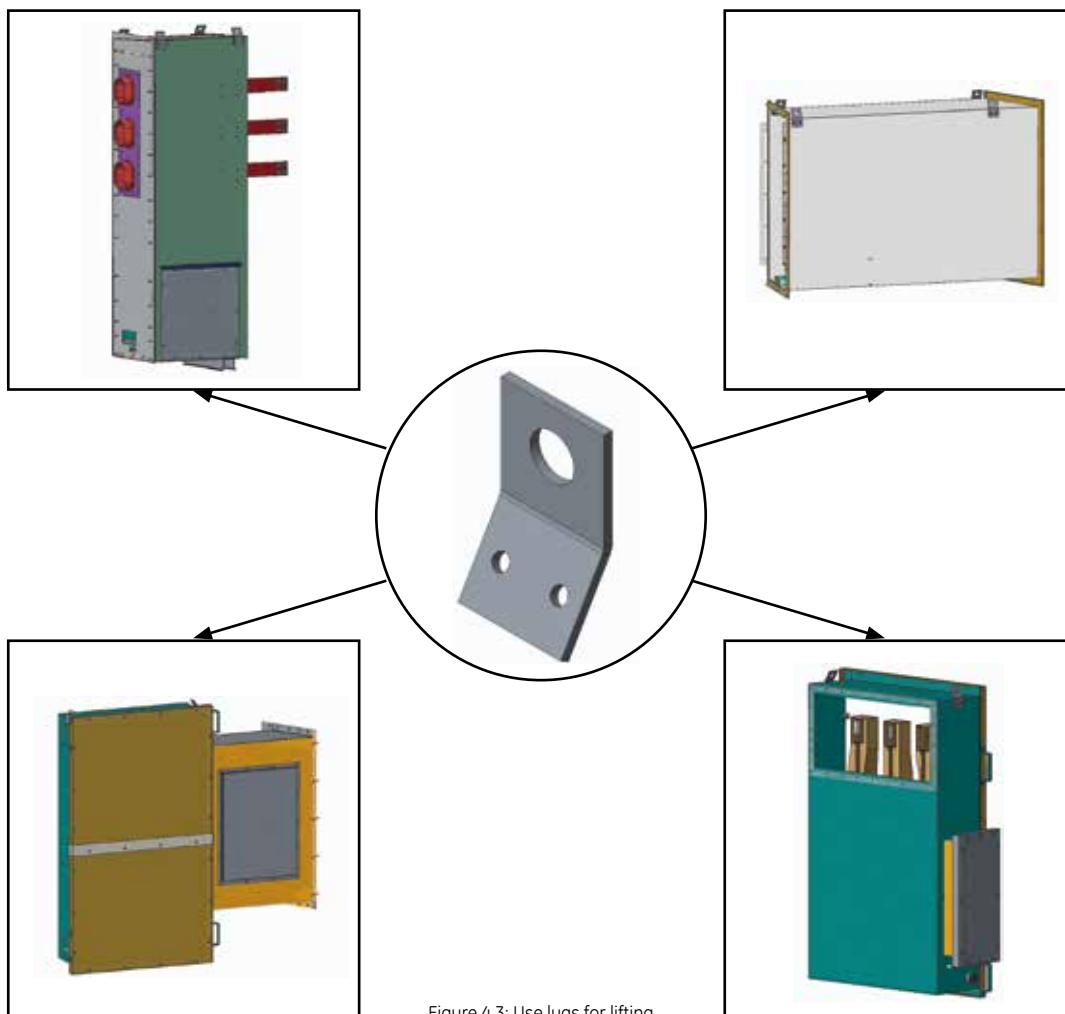


Figure 4.3: Use lugs for lifting

For critical component like VCB and VT, the lifting can be worked as below:

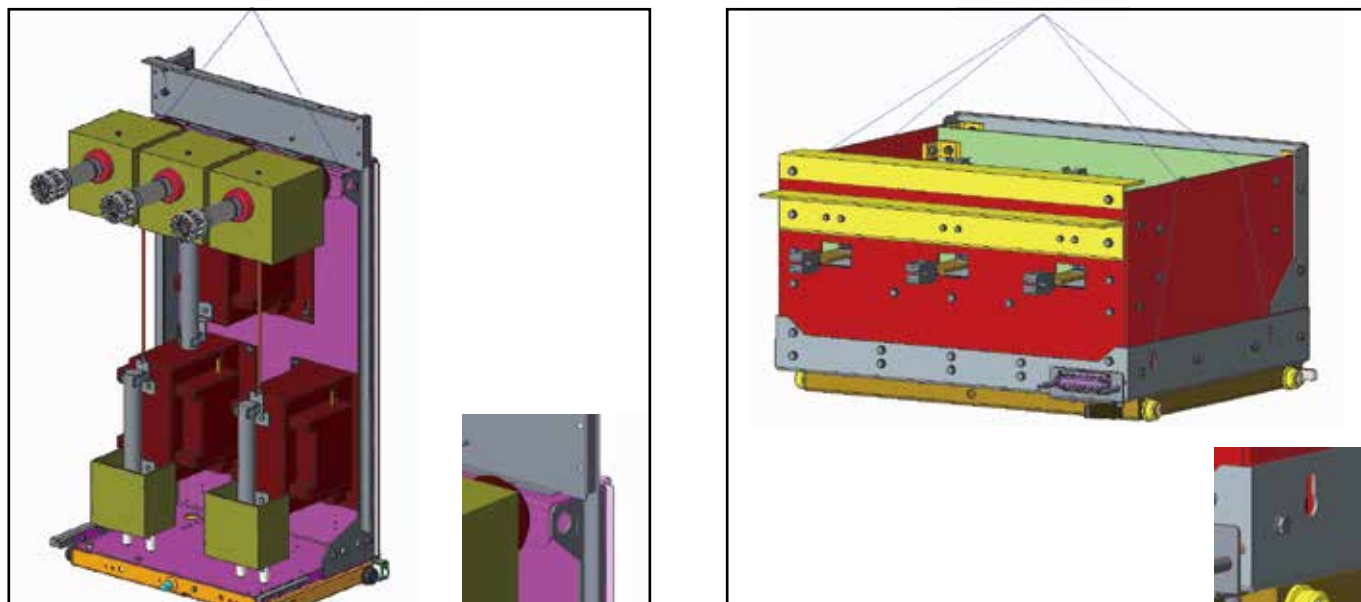


Figure 4.4: Use lifting holes for trucks.

4.4 Upon Receipt

The responsibilities of the consignee when the switchgear arrives at the site include, but are not limited to, the following:
Check the consignment is complete and without damage (e.g. look for any adverse effect caused by moisture). In case of doubt, the packing must be opened and then properly resealed with new drying agent bags (when intermediate storage is necessary).

If any quantities are short, or defects or transport damage are noted, these must be;

- Documented on the respective shipping document
- Notified to the relevant carrier or forwarding agent immediately in accordance with the relative liability regulations

Note: Always take photographs to document any major damage.

4.5 Intermediate storage

Intermediate storage should follow the following practices to avoid any negative consequences:

4.5.1 Panels with basic packing or without packing

- A dry well-ventilated storeroom with a climate in accordance with IEC62271-1:2007
- Store the panels upright
- Do not stack panels
- Panels with basic packing:
- Open the packing, at least partially
- Panels without packing:
- Loosely covered with polythene
- Ensure that there is sufficient air circulation

Check regularly for any condensation during storage.

4.5.2 Panels with seaworthy or similar packing with internal protective covers

- Store the transport units;
 - ✦ Protected from the weather
 - ✦ In a dry place
 - ✦ Safe from any damage
- Check the packing for damage
- Check the drying agent;
 - ✦ On arrival of the consignment
 - ✦ Subsequently at regular intervals

4.5.3 When the maximum storage period (starting from the date of packing) has been exceeded

- The protective function of the packing can no longer be guaranteed
- Take suitable action if intermediate storage needs to be continued



Do not walk on the top of the Panel to prevent damage to the roof

5 Installation of switchgear

To obtain an optimum installation sequence and ensure high quality standards, site installation of the switchgear should only be carried out by specially trained, or at least by supervised personnel and monitored by responsible persons.

5.1 Panel layout for switchgear arrangement

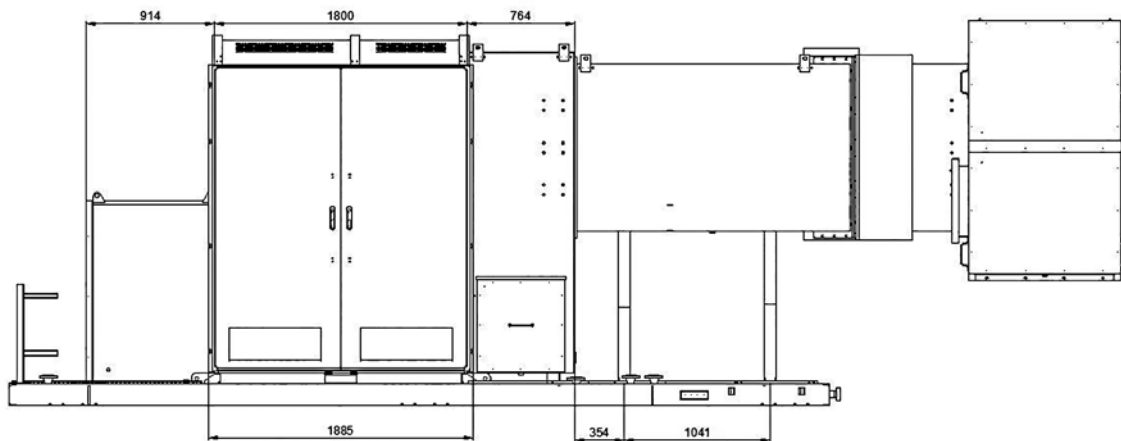


Figure 5.1: whole set layout (all the dimension units is mm)

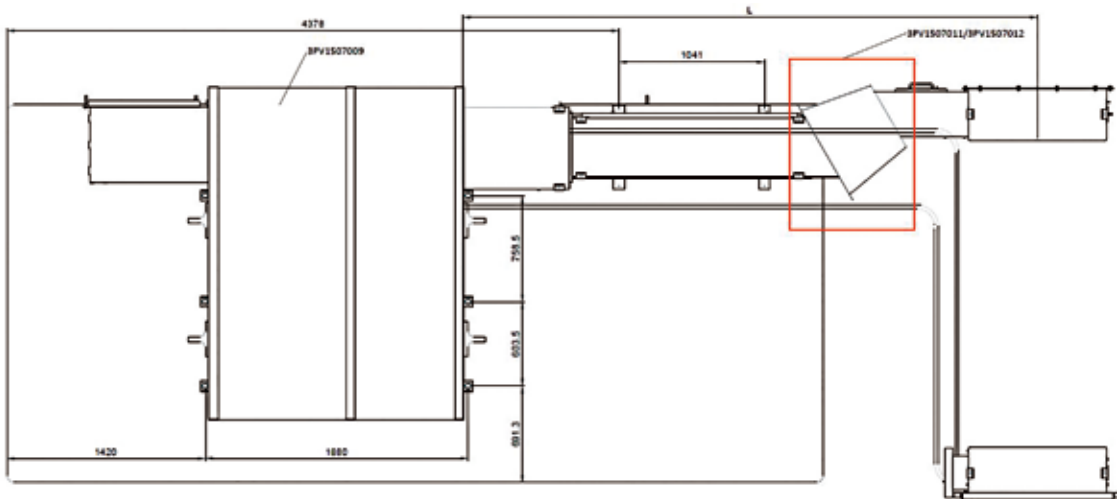


Figure 5.2: Whole set layout top view

GE AERO P/N	Description	GEIS Part Number	
390A4610P0001	SWITCHGEAR, 15KV, 2500A AT 50 DEG C, 50/60HZ, LINE SIDE AND NEUTRAL SIDE, IEC/NEMA-ANSI, METALCLAD VACUUM, GEN 8 GROWTH, NEMA3R	3PV1507009	
Configuration of flexible duct			L
390A4640P0001	GE-IS FLEXIBLE BUS DUCT SECTION FOR ANDRITZ GENERATOR, 15 KV, 2500A AT 50 DEG C, 50/60 HZ, IEC/NEMA-ANSI, GEN 8 GROWTH, NEMA3R	3PV1507011	3978.8
390A4643P0001	GE-IS FLEXIBLE BUS DUCT SECTION FOR GE-PC GENERATOR, 15 KV, 2500A AT 50 DEG C, 50/60 HZ, IEC/NEMA-ANSI, GEN 8 GROWTH, NEMA3R	3PV1507012	4111.5

5.2 Component list

5.2.1 Primary Components

Item	Component Description	Type	Description
1	Vacuum Circuit Breaker	VB2 Plus G-17.5 3150A-50kA	VB2 Plus G-17.5 kV 3150A-50kA
2	Current Transformer	780I-SD-15247MA	Model 780I 2500:1A 30VA CL 10P20 RF 1.0 @ 65C 50/60Hz 0.72kV IEC, CE/UL Ith > 50kA for 2 Seconds
3	Voltage Transformer	PTG5 -1-110-SD03726F	Ratio 11.5kV/ $\sqrt{3}$: 0.115kV/ $\sqrt{3}$: 0.115kV/ $\sqrt{3}$ 14.4kV/ $\sqrt{3}$: 0.12kV/ $\sqrt{3}$: 0.12kV/ $\sqrt{3}$
	H.V. Fuse	1E 80kA	1A, 15.5kV, 80kA
4	Earthing Switch	JNH1-17.5(S)/T50kA-210	JNH1-17.5(S)/T50kA-210
5	Lightning Arrestor	9L11XPM015S	Continuous operating voltage 12.7kV Rated voltage 15kV Nominal discharge current 5kA Maximum 8/20 μ s discharge voltage(5kA) 37kV
6	Grounding transformer	CPT5-95-15-SD07471	95 kV BIL Rated voltage 15 kVA Single Phase 13.8kV/ $\sqrt{3}$: 120/240V 50/60 HZ B Taps
7	Grounding resistor	WF-BNR-0.37/313	Load resistor resistance +/- 5% @ 25 C 0.37 Ohms Min time required to withstand fault current 40 sec Max allowed Resistor Temperature 385 deg C Short time Current (40 sec) 313 A Voltage: 120V IEEE Std C57.32™-2015 Max allowed Resistor Temperature for Steady state 385 deg C
8	Surge Capacitor	18L0012WH 13.8KV 0.25uF	Maximum Voltage L-L 15.18 kV Voltage Rating L-L 13.8kV Poles per unit: 3 Microfarads per pole: 0.25

5.2.2 Secondary Components

Item	Component description	Type
1	Heater	Heater 500W DJR-500F
2	Heater	Heater 100W BJ_2
3	Temperature and humidity controller	Temperature and humidity controller KS_1BK

5.3 Mounting on site

Fix the panels on the trailer

After the panels are lifted onto the specified trailer, remove the spreader on the panels tops, the slings, the shackles and lifting hooks, bolt the panels to the trailer, 6 bolt locations are used. Damper springs should be used on the three bolt down points on the right-hand side of the enclosure. On the left side, directly bolt the base with trailer.

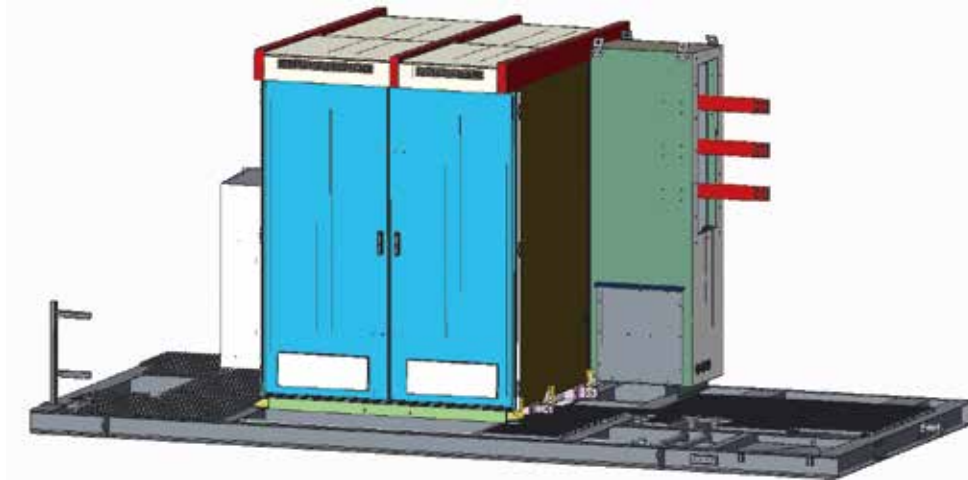


Figure 5.3: Connect Panels and Trailer

Application	Illustration	Set of Hardware	Set Number	Tightening Torque N.m (Deviation $\pm 5\%$)
steel on steel		2 Plain Washer: GB97.1 M20 1 Spring Washer GB93 M20 1 Bolt: GB5783 M20x55 1 Nut: GB6170 M20 (Hot Galvanizing, Grade 8.8)	3	300 (without lubricant)
steel on steel with spring		2 Plain Washer: GB97.1 M20 1 Plain Washer: GB93 M20 1 Bolt: GB5783 M20x200 2 Nut: GB6170 M20 (Hot Galvanizing, Grade 8.8)	3	Pre-compact spring length to be 150mm, the limit compacting length is 100mm

Notes: In case of the nuts vibrating off, two nuts are working for self-locking.

Assembly left side customer connection cable box

Notes: The customer connection box side cover plates are assembled for shipment, these should be taken off before the customer connection assembly. The gasket (seal strip, EMKA 30x5) should be used between the connection surface.

Customer connection box assembly steps:

1. Remove the enclosure 2 cover plates on the customer connection box side;

2. Install three phase busbars. Torque setting for the bolts refer to below table;

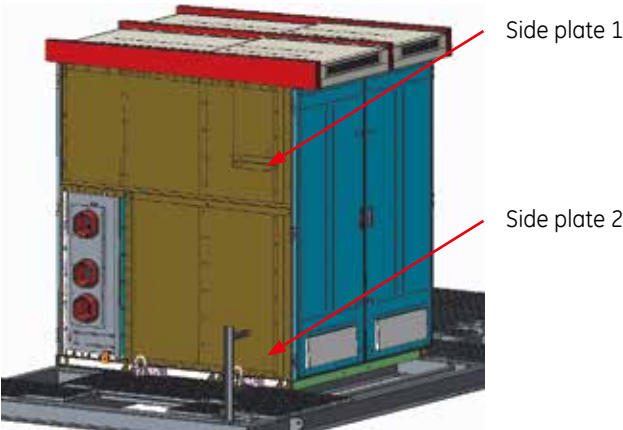


Figure 5.4: Enclosure Side Plate Re-assembly

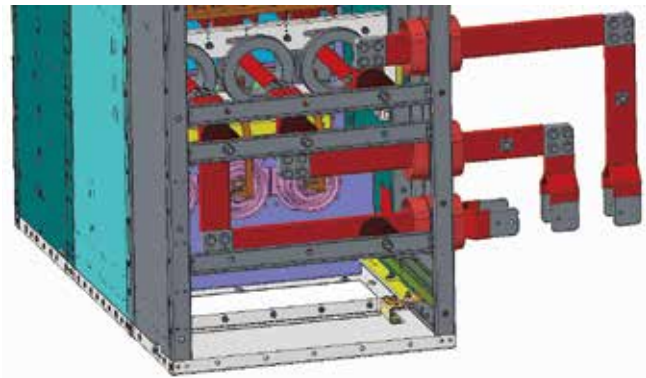
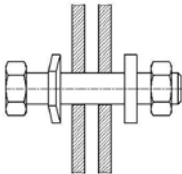
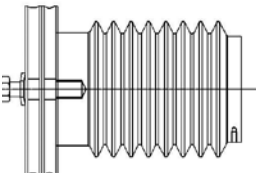


Figure 5.4: Main bus bars connection of customer connection box

Application	Illustration	Set of Hardware	Set Number	Tightening Torque N.m (Allowed deviation ± 5%)
copper bar with copper bar		1 Pressure Washer KX915 M16 1 Plain Washer: GB97.1 M16 1 Bolt GB5783 M16x70 1 Nut: GB6170 M16 (color-plated zinc , Grade 8.8)	5	85 (with lubricant)
copper bar with insulator		1 Pressure Washer KX915 M16 1 Bolt GB5783 M16x55 (color-plated zinc , Grade 8.8)	3	85 (with lubricant)

3. Install the customer connection box module, and re-assemble the side 2 covers

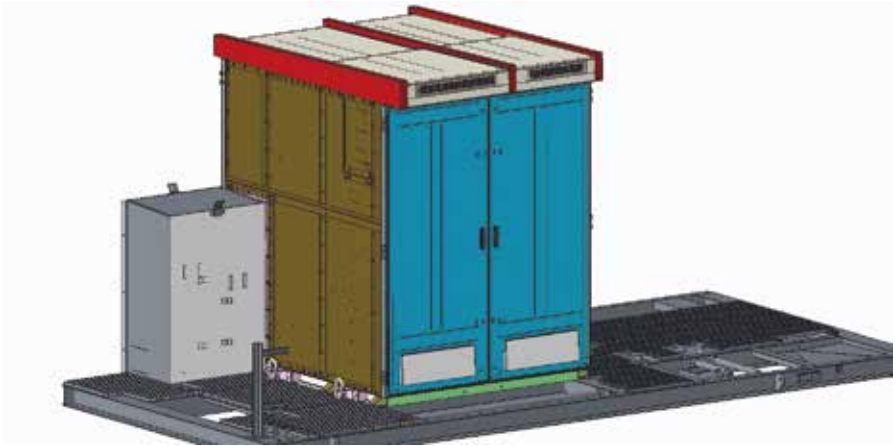


Figure 5.5: Customer Connection Box Connection

Hardware for Customer Connection Box with Panel

Set of Hardware	Set Number	Tightening Torque N.m (Allowed deviation $\pm 5\%$)
1 Plain Washer GB97.1 D10 1 Spring Wsher GB93 D10 1 Bolt GB5783 M10x25 (316 stainless steel)	10	45 (without lubricant)

Hardware for Customer Connection Box with Panel

Set of Hardware	Set Number	Tightening Torque N.m (Allowed deviation $\pm 5\%$)
1 Plain Washer GB97.1 D8 1 Spring Wsher GB93 D8 1 Nut GB6170 M8 (316 stainless steel)	10	25 (without lubricant)
1 Plain Washer GB97.1 D10 1 Spring Wsher GB93 D10 1 Bolt GB5783 M10x25 (316 stainless steel)	23	45 (without lubricant)
1 Plain Washer GB97.1 D6 1 Spring Wsher GB93 D6 1 Nut GB6170 M6 (316 stainless steel)	12	13 (without lubricant)

4. Install customer connection cables

The hardware for cable connection type depends on customer connection cable type, customer shall select the required cables.

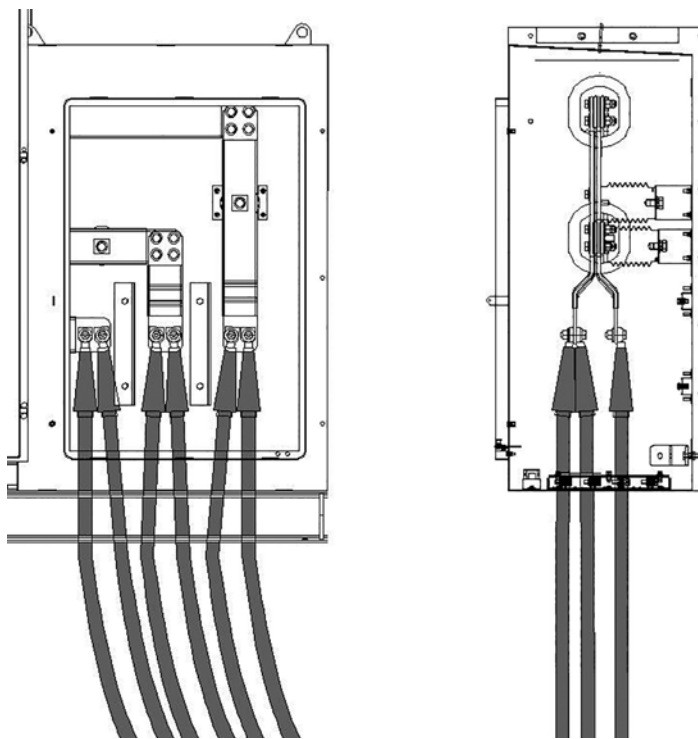


Figure 5.6: Cable compartment layout

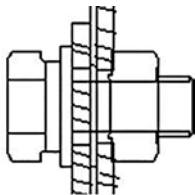
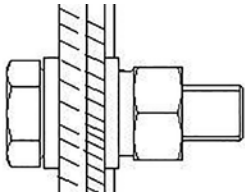
Assembly solid busduct

The solid busduct connects to junction box, which is supported by the bottom two legs on the trailer. gasket (EMAK1016-24,30x5) should be applied for the connection surface between solid bus duct and junction box. Assemble the busbar connection from junction box to solid bus duct.



Figure 5.7: Solid Bus Duct Connection

Hardware for bus duct connection

Application	Illustration	Set of Hardware	Set Number	Tightening Torque N.m (Allowed deviation $\pm 5\%$)
Bus duct with Junction Box		1 Plain Washer GB97.1 D10 1 Spring Washer GB93 D10 1 Bolt GB5783 M10x25 (316 stainless steel)	18	45 (without lubricant)
Bus duct leg with trailer		2 Plain Washer GB97.1 D16 1 Spring Washer GB93 D16 1 Bolt GB5783 M16x45 1 Nut: GB6170 M16 (316 stainless steel)	4	170 (without lubricant)

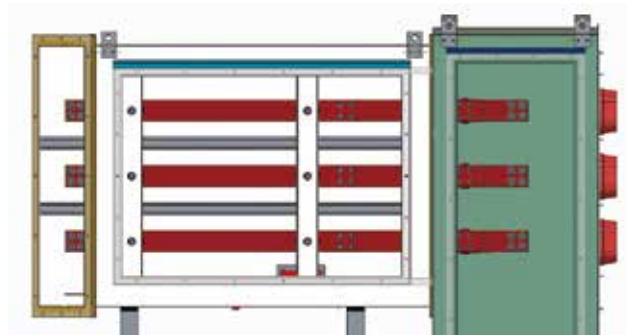
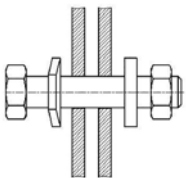
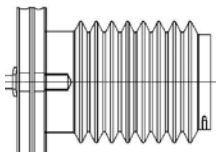


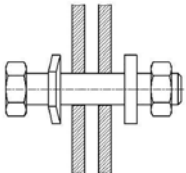
Figure 5.8 Busbar Connection between JB and Bus Duct

Application	Illustration	Set of Hardware	Set Number	Tightening Torque N.m (Allowed deviation $\pm 5\%$)
copper bar with copper bar		1 Pressure Washer KX915 D16 1 Plain Washer: GB97.1 D16 1 Bolt GB5783 M16x70 1 Nut: GB6170 M16 (color-plated zinc , Grade 8.8)	6	85 (with lubricant)
copper bar with insulator		1 Pressure Washer KX915 M10 1 Bolt GB5783 M10x50 (color-plated zinc , Grade 8.8)	12	25 (with lubricant)

Assembly GLAC and GNAC

The GLAC and GNAC are connected the generator, gasket (EMAK1016-24, 30x5) should be applied between the connection surface. Customer shall choose the hardware for GLAC and GNAC to generator.

Hardware for flex bus bar connects between generator and GLAC/GNAC is :

Application	Illustration	Set of Hardware	Set Number	Tightening Torque N.m (Allowed deviation $\pm 5\%$)
copper bar with copper bar		1 Pressure Washer KX915 D8 1 Plain Washer: GB97.1 D8 1 Bolt GB5783 M8x80 1 Nut: GB6170 M8 (color-plated zinc , Grade 8.8)	48	10 (with lubricant)

Assembly flexible connection

With the fixed solid bus duct and GLAC assembled, flexible bus duct and braid bus bars will be assembled. The flex bus duct cover is used to protect against contact with the busbar system, assemble the U cover upon the flex bus duct, then connect the lower cover.

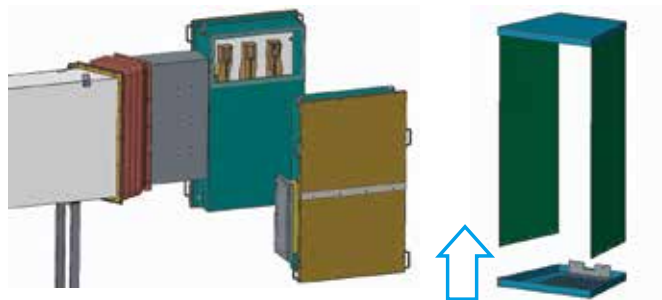


Figure 5.9: Flexible bus duct and braid bus bar connection

Hardware Connection of busbar

Application	Illustration	Set of Hardware	Set Number	Tightening Torque N.m (Allowed deviation $\pm 5\%$)
Main Flex busbar with copper busbar connection		1 Pressure Washer KX915 D16 1 Plain Washer: GB97.1 D16 1 Bolt GB5783 M16x70 1 Nut: GB6170 M16 (color-plated zinc , Grade 8.8)	24	85 (with lubricant)
Flex earthing busbar connection		1 Pressure Washer KX915 D10 1 Plain Washer: GB97.1 D10 1 Bolt GB5783 M10x30 1 Nut: GB6170 M10 (color-plated zinc , Grade 8.8)	4	25 (with lubricant)
Flex duct connection		1 Plain Washer GB97.1 D8 1 Spring Wsher GB93 D8 1 Bolt GB5783 M8x25 1 Nut GB6170 M8 (316 stainless steel)	16	25 (without lubricant)
		1 Plain Washer GB97.1 D8 1 Spring Wsher GB93 D8 1 Bolt GB5783 M8x25 (316 stainless steel)	16	25 (without lubricant)
Flex duct cover bottom plate connection		1 Plain Washer GB97.1 D10 1 Spring Wsher GB93 D10 1 Bolt GB5783 M10x25 (316 stainless steel)	12	45 (without lubricant)

5.4 Cable connections

All wiring connection should follow the secondary wiring drawings.

5.4.1 Generator neutral side cable connection

Here is the cables from GNAC, the cables are fixed on the trailer, customer arranges the cable routing.

Item	Circuit	Connection	Entry Location	Voltage Level	Parameters
1	GNAC CT Circuit	From GNAC LV JB to Switchgear JB	JB Right Side	Low voltage AC	16 cores, 6mm ² , cable diameter 26mm, length 10m
2	Star Point Grounding Cable	From GNAC star point bus bar to Grounding Transformer in Auxiliary panel	Auxiliary Panel Right side	Medium Voltage	Single core, 35mm ² , cable diameter 28mm, length 10m
3	Earthing circuit	From GNAC earthing straps to Switchgear JB	JB Right Side	/	Core section 25mm ² , cable diameter 10mm, cable length 10m
4	GNAC Heater 100w & 500w power feed	From GNAC LV JB to Switchgear JB	JB Right Side	230VAC	4 cores, 4 mm ² , cable diameter 15mm, cable length 10m

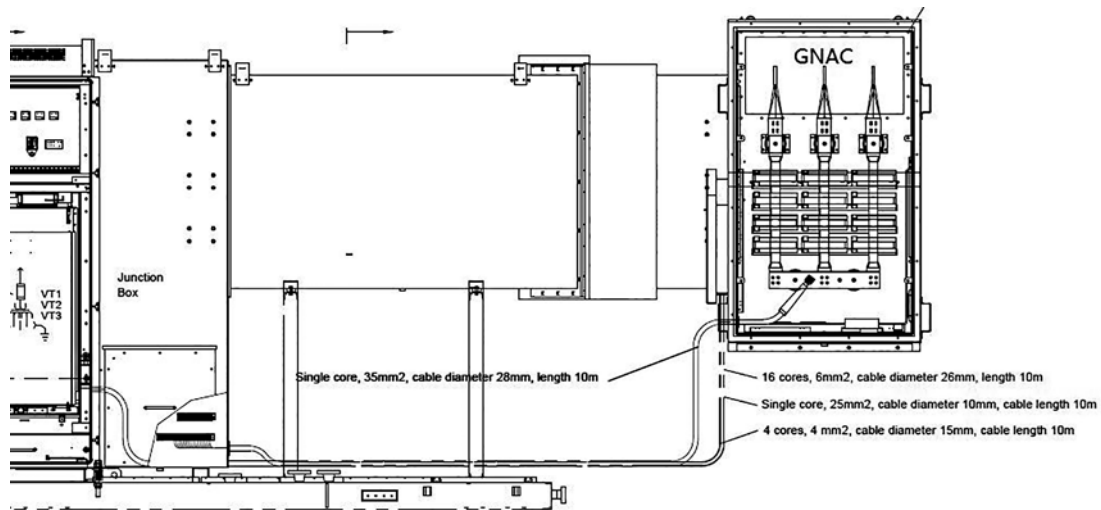


Figure 5.10: GNAC cable connection

5.4.2 Customer high voltage cable connection

Customer connection box contains the terminals for terminating the customers cables. It is bottom entry and can accommodate 6 x 500 kcmil / phase (6 x 300mm²) / phase.



Figure 5.11: cable connection box

5.4.3 Rextac for cable sealing and fixing

The Rextec RS is a round entry seal, consisting of two halves and an adaptable center with removable layers. Compression is integrated in the seal. Allows installation around an existing cable or pipe.

- Attachment by expansion in holes
- For one cable or pipe

The allowable cable diameter is 8-30mm.



Figure 5.12 Rextac

5.4.4 Customer control wiring connection

Customer control and signal wiring connection is made by quick connection sockets.



QUICK CONNECTOR	AMPHENOL PART NUMBER	PIN NUMBER	WIRE SIZE
GS35	EX-17-1-20-310PNKG	37	12 AWG
GS36	EX-17-1-20-332PNKG	20	12 AWG
GS37	EX-17-1-20-332PNKG	20	12 AWG
GS38	EX-17-1-20-332PNKG	20	12 AWG
GS39	EX-17-1-20-310PNKG	37	12 AWG

6 Operations and trouble shooting

6.1 Preparations

Before start up, the following work should be completed:

- a. Check the overall condition of the switchgear and clear any potential risk factor.
- b. Check the switch, truck, isolated contactor and insulating parts etc. by visual inspection.
- c. Check the connection between earthing bus bar and earthing conductor of the transformer substation outside the compartment is secure.
- d. Remove all of the remaining materials, unnecessary objects and tools inside of the compartment.
- e. Wipe the compartment body and the insulation parts with a soft cloth that should be clean and dry. Then wipe off any remaining dust and grease.
- f. Clean the surface of earthing busbar.
- g. Re-install the cover removed during the period of installation, wiring and commissioning.
- h. Remove the shipping cap on the pole of the circuit breaker.
- i. When testing the power frequency withstand voltage of main circuit, pay attention to sensors, cables and other equipment during the test process.

Attention: Read the product manual carefully when testing the VT withstand voltage; use a test voltage of appropriate frequency to avoid core saturation.

- j. Place the circuit breaker on auxiliary control power.
- k. Perform the operation test of the circuit breaker by manual or electric control; observe the corresponding position indicator.
- l. Check the interlocking validity, both mechanical and electrical.
- m. Conductive paste can be applied on the circuit breaker primary contacts.



- a. Comply with all relevant safety regulations.
- b. Maintain circuit breakers in disconnection position.
- c. Remove earth wires and short wires of the hazardous areas.
- d. Pay attention to any abnormal situations.

6.2 Use of hand tools

1) Gear door lock key
drawing no: 5GD.253.008



2) Rack handle for truck
drawing no: Y-002



3) Earthing switch operation handle
drawing no: 5PV1507477



4) Door interlock defeat handle
drawing number: 8PV1060408



6.3 Rack Circuit Breaker out from service position to test / disconnected position

6.3.1 Move circuit breaker truck from transfer truck into the switchgear

- Check the fixed primary contact and apply an adequate amount of conductive paste (BURNDY PENETROX). Check the interlocking mechanism and apply lubricant (Exxonmobile EP2) on the moving parts to ensure smooth operation.
- Place the Circuit Breaker on transfer truck and put in lock position. (See figure 6.1).
- Move the transfer truck to the front of the switchgear, turn the adjusting nut to adjust the height of the transfer truck platform, (See figure 6.2). Aim the guiding pin at the guiding jack in front of the switchgear, push and make the transfer truck engage with the switchgear by using the lock key. At the same time, insert the front guide rail of the transfer truck into the bottom guide rail groove of the switchgear truck. (See figure 6.3).

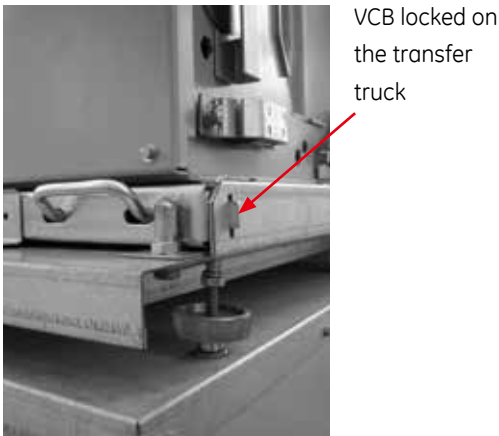


Figure 6.1: VCB truck on the transfer truck



Figure 6.2: Transfer truck lock with switchgear

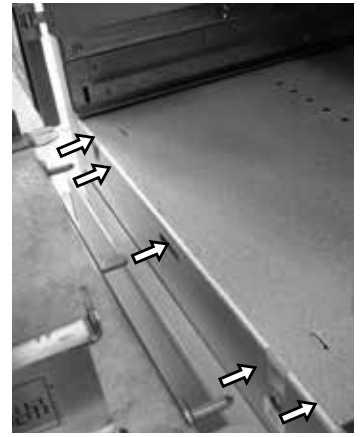


Figure 6.3: Lock VCB in switchgear



The trolley has four nuts for adjusting the platform, to the same level of the breaker compartment.

- Push the two sliding cranks inward under the truck to remove the locked position with the transfer truck, and then push the truck forward to make it enter the switchgear compartment and lock it in the disconnect / test position.
- Operate the lock key releasing lever of the transfer truck to remove the locked relation between the transfer truck and the switchgear, and then remove the transfer truck.



Figure 6.4: Lock VCB in switchgear

6.3.2 Move the truck from disconnect / test position to service position

- a. Make sure the front and back door of the switchgear are closed. Make sure the earthing switch is in the open position, the circuit breaker compartment is clear and without any unexpected object.
- b. Insert the secondary plug of the truck into the socket on the topside of the switchgear truck compartment and put into the lock position. (See figure 6.5 & 6.6)



Figure 6.5: Take off secondary plug from truck



Figure 6.6: Put the secondary plug into switchgear socket

- c. Make sure the circuit breaker is in the OPEN position.
Make sure NO PADLOCK for breaker rack in prohibit
Make sure KEY engage and KEYLOCK turn to breaker rack in allow position
- d. Insert the racking handle of the truck into the rectangular handle hole of the screw mechanism of the truck through the operation hole under the door of the circuit breaker compartment. (See figure 6.7).

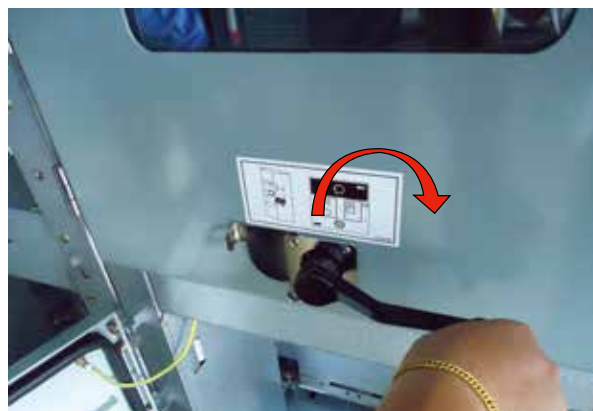


Figure 6.7: Rack in the breaker to service position

- e. Turn the crank clockwise (approximately 20 turns) until it can't be moved any more, listen for a strong cranking sound when the breaker changes into the operating position.
- f. The position indicator on the door of the low voltage compartment shows the breaker is in service position.
- g. Take off the racking crank. The racking operation is now complete.



The truck is not allowed to be placed in any intermediate position between disconnect/test position and operating position.

6.3.3 Move the Circuit Breaker from service position to test position

- a. Make sure the circuit breaker is in open position.
- b. Perform the operating steps for moving the Circuit Breaker into operation position in reverse order.



The truck is not allowed to be placed in any intermediate position between disconnect / testing location and operation position.

6.3.4 Move the Circuit Breaker from switchgear compartment to transfer truck.

According to the operation steps of moving the truck from transfer truck to switchgear, operate it in reverse. Make sure the transfer truck is completely locked with the switch and the transfer truck block plate have been pulled downward by the lock plate on the truck before pulling out the breaker.

6.4 Circuit breaker

For operating instructions refer to the circuit breaker instruction manual.

6.5 VT truck operation

6.5.1 Auxiliary panel VT truck (VT1, VT2, VT3)

Rack VT truck out from service position to test / disconnected position

6.5.1.1 Move VT truck from transfer truck into the switchgear

- a. Check the fixed primary contact and apply an adequate amount of conductive paste. Check the interlocking mechanism and apply lubricant on the moving parts to ensure smooth operation.
- b. Place the VT truck on transfer truck and put in lock position.

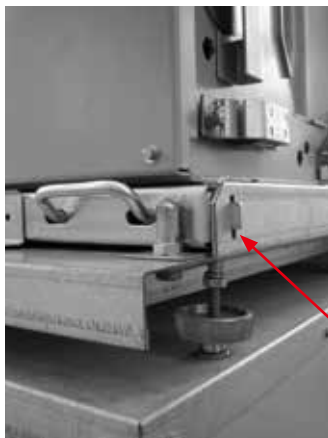


Figure 6.8: VT truck on the transfer truck

VT Truck
locked on the
transfer trolley

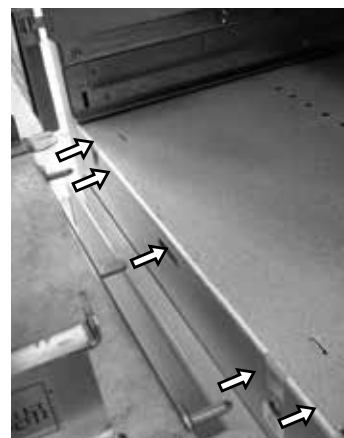


Figure 6.9 : Lock transfer trolley in switchgear

- c. Move the transfer truck to the front of the switchgear, turn the adjusting nut to adjust the height of the transfer truck platform. Aim the guiding pin at the guiding jack in front of the switchgear, push and make the transfer truck engage with the switchgear by using the lock key. At the same time, insert the front guide rail of the transfer truck into the bottom guide rail groove of the switchgear truck.
- d. Push the two sliding cranks inward under the truck to remove the locked position with the transfer truck, and then push the truck forward to make it enter the switchgear compartment and lock it in the disconnect / test position. The operation as same as VCB truck.
- e. Operate the lock key releasing lever of the transfer truck to remove the locked relation between the transfer truck and the switchgear, and then remove the transfer truck.

6.5.1.2 Move the truck from disconnect / test position to service position

- a. Make sure the front and back door of the switchgear are closed, the VT Truck compartment is clear and without any unexpected object.
- b. Insert the secondary plug into the socket on the topside of the switchgear truck compartment and put into the lock position. (See figure 6.10& 6.11)



Figure 6.10: Take off secondary plug from truck

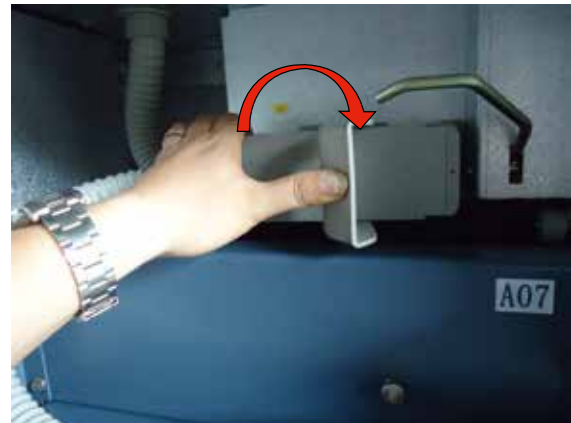


Figure 6.11: Put the secondary plug into switchgear socket

- c. Insert the racking crank of the truck into the rectangular cranking hole of the screw mechanism of the truck through the operation hole under the door of the circuit breaker compartment. (See figure 6.12).



Figure 6.12: Rack in the breaker to work position

- d. Turn the handle clockwise (approximately 20 turns) until it can't be moved any more, listen for a strong cranking sound when the truck changes into the operating position.
- e. Take off the racking crank. The racking operation is now complete.



The truck is not allowed to be placed in any intermediate position between disconnect/test position and operating position.

6.5.1.3 Move the VT truck from service position to test position

Perform the operating steps for moving the VT truck into operation position in reverse order.



The truck is not allowed to be placed in any intermediate position between disconnect / testing location and operation position.

6.5.1.4 Move the VT Truck from switchgear compartment to transfer truck.

Per the operation steps of moving the truck from transfer truck to switchgear, operate it in reverse. Make sure the transfer truck is completely locked with the switchgear and the transfer truck block plate have been pulled downward by the lock plate on the truck before pulling out the VT truck.

6.5.2 Transformer side VT truck (VT4, VT5, VT6)

6.5.2.1 Move VT truck into the switchgear

- Check the fixed primary contact and apply an adequate amount of conductive paste.
- Raise up VT truck to an appropriate height by a crane or forklift, ensure the bottom plane of VT truck and guide rail almost in the same plane.
- Take the front two wheels into the guide rail. (See figure 6.13).
- Push the two sliding cranks inward under the truck and push VT truck into switchgear. (See figure 6.14).
- Release the two sliding cranks and make sure the lock plate inserting into the holes at both sides of guide rail. (See figure 6.15).

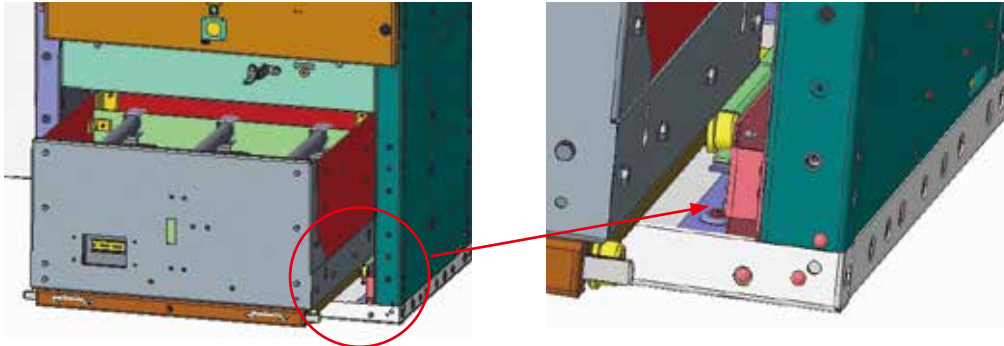


Figure 6.13: Take the front two wheels into the guide rail

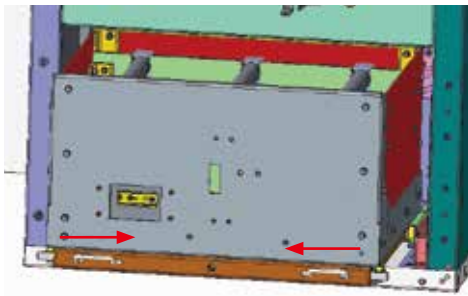


Figure 6.14: Push the two sliding cranks inward

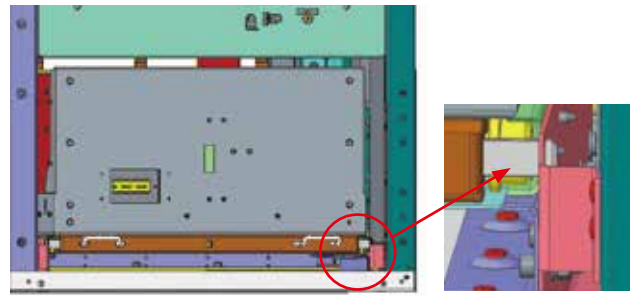


Figure 6.15: Lock the truck into the panel

6.5.2.2 Move the truck from disconnect / test position to service position

- Make sure the front and back door of the switchgear are closed., the VT Truck compartment is clear and without any foreign object.
- Push the two sliding cranks inward under the truck and push VT truck into switchgear. (See figure 6.16).
- Release the two sliding cranks and make sure the lock plate inserting in the holes at both sides of guide rail. (See figure 6.17).

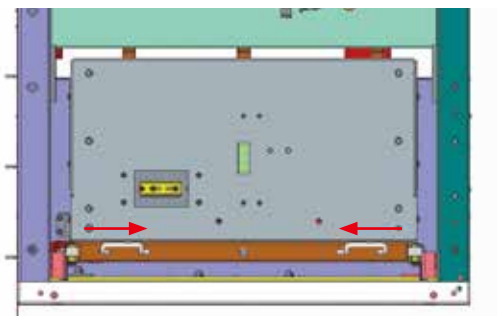


Figure 6.16: Push the two sliding cranks inward

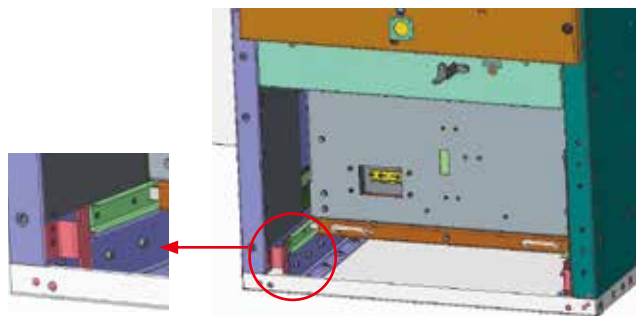


Figure 6.17: Lock the truck in the panel

6.5.2.3 Move the VT truck from service position to test position

Perform the operating steps for moving the VT truck into operation position in reverse order.

6.6 Earthing switch operation

The earthing switch has a rapid close-open mechanism, which is independent to the rotation speed of the earth switch drive shaft.

The closing brake function can be quickly applied through the rapid close-brake mechanism.

The earthing switch can be operated only when the truck is in disconnect / test position and the rear cover of the switchgear is in the closed position.

The operating hole of the earthing switch located in the lower position of the right side in front of the panel.

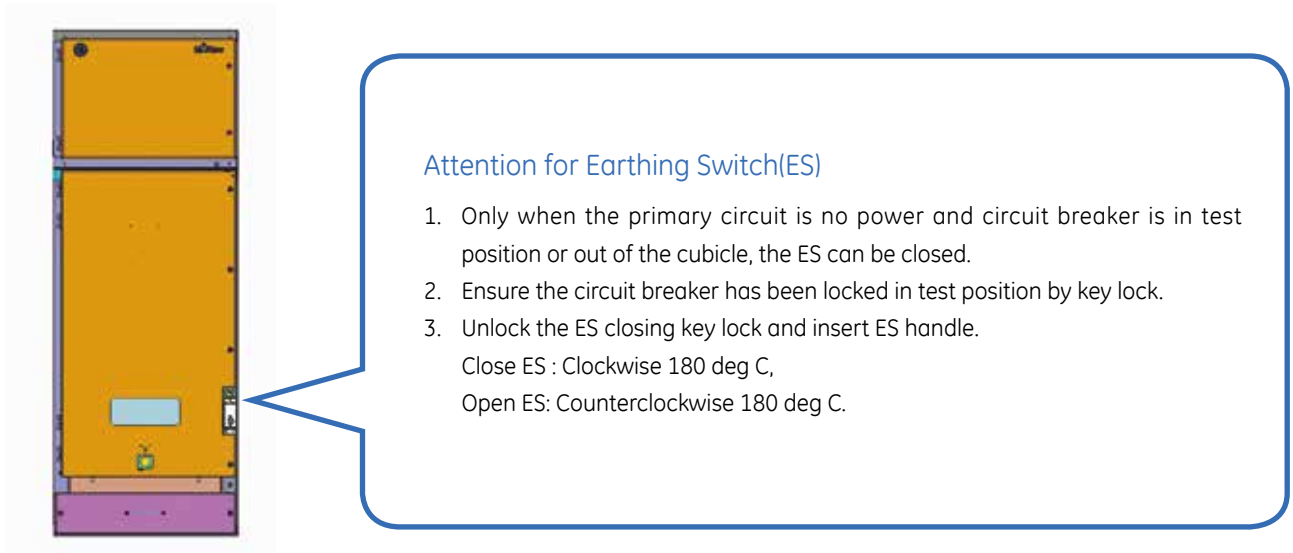


Figure 6.13: Earthing switch operation warning

6.6.1 Close the earthing switch

- a. Check that the voltage presence indication on the low voltage compartment is off.
- b. Check other electrical interlock, if applicable, to allow the operation.
- c. Check VCB is in disconnect position and be locked by key lock.
- d. Make sure keylock can be operated, counterclockwise rotate key to allow earthing switch operate handle can be engaged.



Figure 6.15: Earthing switch closing key lock

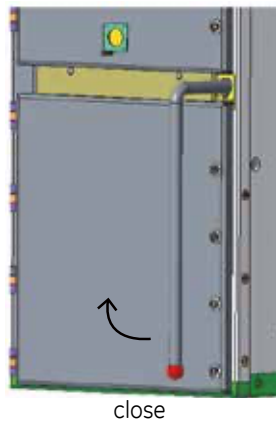


Figure 6.16: Open earthing switch



Figure 6.17: Close earthing switch

- e. (See figure 6.16) Insert the operating handle, and turn the handle 180 deg C, clockwise to close the earthing switch.
- f. Ensure the earthing switch is fully closed.



Check the position indicator on low voltage compartment door
Check the flag adjacent to the earthing switch operating hole

6.6.2 Open the earthing switch



Make sure the cable compartment is clear and without any foreign objects.

Make sure the cable compartment door is closed completely.

- a. Insert the earthing switch operating handle, and turn the handle 180 deg Counterclockwise to open the switch (See figure 6.17).
- b. Check the mechanical interlock label and indication light to ensure the earthing switch is fully open.

6.7 Interlocking of the switchgear

- The circuit breaker can be closed only when fully engaged in the test or service position.
- The control plug can be released when the circuit breaker is in test or disconnected position. The secondary plug is latched when the circuit is in service position (see figure 6.18).
- The circuit breaker can be racked in/out only when it is in the open position and the keylock is in the allowed operation position.
- The Earthing switch can be closed only when the main power is off and the VCB is locked in disconnect position.



Figure 6.18: Secondary plug latch

7 Inspection and maintenance

7.1 Summary

After the process of installation and testing, the switchgear is available to use. Timely and proper maintenance can keep the switchgear trouble-free and can prolong the life of the switchgear as long as possible.

The maintenance work must be carried out by certified persons who are familiar with the related operations of the switchgear and understand relevant IEC and other local safety rules and important guides established by other technical departments as well. Allow a GE representative to assist when the switchgear and its components need to be repaired. Users should think about the operating environment and the operation frequency when developing maintenance rules. Usually the inspection of some equipment /components (such as wearable parts) and the maintenance intervals (maintenance period) depend on the running time, operating frequency and the number of short circuit cycles. The maintenance period of other parts depends on the working situation, the degree of the load and environmental impact (including pollution and corrosive gasses).

7.2 Inspection and maintenance interval

The maintenance interval determined by operating conditions of the switchgear depends on the operating mode, the operating number of rated current and short circuit current, environment temperature and pollution.

The recommending maintenance interval is showed in the following table:

maintenance content	interval(years)	according to the operation cycle of circuit breaker
inspection	2~3 ¹	5000 ³
care and maintenance	2~3 ²	

1. Recommended shorter interval years when operated in very severe running conditions.

2. According to inspection results.

3. Refer to the VCB manual.

7.3 Diagnosis and trouble shooting for malfunction during operations

Malfunction	Reason	Resolution
The circuit breaker can not be racked into service position from test position	1. The handles on the withdrawable frame is not in position. 2. The circuit breaker is closed 3. The earthing switch is closed 4. The circuit breaker is electrically interlocked (electromagnetic Y0 locked) 5. Shutter is not completely open 6. The rack in key lock is locked.	1. Adjust the frame and handles 2. Open the circuit breaker 3. Open the earthing switch 4. Unlock /Check electromagnetic Y0 5. Check shutter drive mechanism 6. Unlock the rack in keylock.
The circuit breaker can not be racked out to test position from service position	1. The circuit breaker is closed 2. The circuit breaker is electrically interlocked (electromagnetic Y0 locked)	1. Open the circuit breaker 2. Unlock /Check electromagnetic Y0
The Earthing switch can not be closed	1. VCB is in service position 2. The main circuit is power on, the electromagnetic is not in allow operation position.	1. Ensure the VCB is in test position before close Earthing switch 2. Ensure the main power is shutdown before close Earthing switch.
The circuit breaker can not be closed	1. No auxiliary power supply 2. The control plug is not inserted 3. The circuit breaker is not engaged in test / service position 4. The closing spring has not been charged 5. The electrical interlocking in position 6. Closing release not working	1. Turn on auxiliary power supply 2. Insert and lock control plug 3. Fully engage the circuit breaker to test /service position 4. Charge the closing spring 5. Check power supply for interlocking 6. Check power supply for closing release
The circuit breaker can not be opened	1. No auxiliary power supply 2. Opening release not working	1. Turn on auxiliary power supply 2. Check power supply for opening release

7.4 Maintenance item and cycle



Maintenance of the switchgear should be carried out by trained personnel, who are familiar with the switchgear characteristics, in accordance to the manufacturer's instructions and IEC standards.

It is recommended any major repairs (if required) shall be assisted by the manufacturer or a qualified representative.

7.5 Routine Inspection



Safety measure: Routine inspection is to ensure smooth operation of the switchgear. It does not require power shutdown, but requires care to prevent incorrect operations.

The purpose for routine inspection is to find issues in advance so they can be resolved immediately.

Routine inspection includes:

- Check compartment doors are closed properly
- Verify the control voltage, auxiliary voltage and battery voltage are in normal condition
- The status indication and position indication for the circuit breaker and earthing switch etc are normal
- Check ammeter and voltmeter on the display
- Check relay indications. (The power indication should be on and fault indication should be off.)
- Check alarm and pre alarm indications
- Partial discharge should not occur on the surfaces of equipment at operating voltage. This can, for example, be detected by characteristic noises, a clearly perceptible smell of ozone, or visible glowing in the dark;
- Check the heater condition, if installed. The relay monitoring the heater current is in the low voltage compartment. Check the heater circuit if the red current indication turn off due to the heater losing power supply. (see figure 5/1)

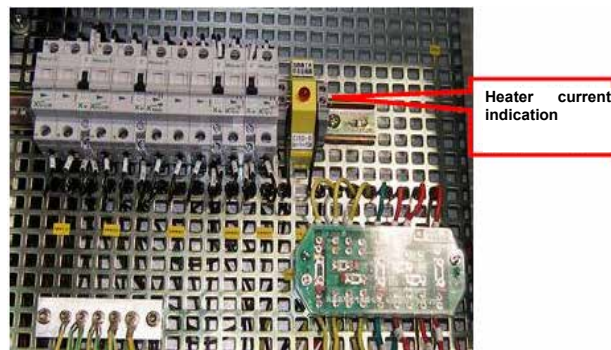


Figure 7.1: Heater current monitoring relay

If any abnormal condition is found, then the cause must be identified in order to restore normal condition.

7.6 Service



Safety measure: The power must be shutdown before scheduled switchgear service, and the work area must be isolated. Measures must be taken to disallow the power being switched on. Ensure proper earthing and padlocks in place. Specially trained personnel are required to supervise.

The purpose for the service is to guarantee the operation quality of the switchgear and avoid any possible malfunctions. This increases the life of the switchgear. The scope of work is as follows:

- Inspection: Determination of the actual condition
- Servicing: Measures to preserve the specified condition
- Repair: Measures to restore the specified condition

The service interval for the switchgear depends on external factors including the operating environment, the operation frequency and service age etc.

It is recommended to have switchgear serviced every 2-3 years, if installed in good environment and not frequently operated.

It is recommended to have switchgear serviced every year, if operated more than 10 times a month.

It is recommended to have switchgear serviced every half year, if installed in adverse environment and frequently operated.

It is recommended to have the circuit breaker replaced, if reached its mechanical operating cycles or rated short circuit breaking times.



It is recommended to inspect the circuit breaker every 6 months if in stand-by for a significant period of time

7.7 Repairs Immediate repairs are required in case of following situation emerges:

- Deteriorated insulation, discharges, flashover and breakdown
- Damaged component in the switchgear
- Any other abnormal observation which may affect safety

7.8 Inspection Items

- Check all the compartments and internal components for dampness, rust and dirt.
- Check the tightening torques of the busbar bolted connections on selected samples.
- Remove the pressure flaps on the busbar compartment and remove the insulation shield. Check the torque is 86 N-m using a torque wrench.
- Check the fixed contact including its profile for any sign of sparking or wear-and-tear.
- Check the shutter mechanism in the circuit breaker compartment.
- Check the interlocking between the circuit breaker and the earthing switch.
- Check the bolted connection between the power cable connectors and lugs.
- Check earthing switch operation.
- Check the interlocking between the circuit breaker and the breaker compartment door.
- Check live voltage indications.
- Check the heater.

7.9 Performance test

Performance test is to validate the electrical performance of the switchgear. It is recommended to be carried out together with the scheduled service.

Performance test includes:

- Close and open the Circuit Breaker for five times, and check the circuit
- Check all the interlocking mechanism
- Electrical test including power frequency withstand test, CT/VT ratio and the contact resistance for the Circuit Breaker
- Verify mechanical characteristics of the Circuit Breaker

7.10 Major Repairs and examples



Be sure to comply with the applicable safety regulations when carrying out repairs.

- Open the main busbar compartment and check the tightening torques for the busbar bolted connections
- Check the main busbar and branch busbar for any dampness or rust.
- Check all the sidewalls for any dampness or rust.
- Check the main busbar compartment for any unexpected object.
- Restore the insulation shield and the pressure flap on the top of the panel.
- Check the fitness of the fixed contact and the surface condition.
- Open the cable compartment and check the cable connection as well as the connectors for color distortion.
- Check the sealing condition of through holes for the primary and secondary cables.
- Check the heater condition.
- Check the breaker and cable compartment for unexpected objects.
- Check the secondary connections of the CTs.
- Check the current terminals in the low voltage compartment for the close loop of the secondary current circuit. Check the protection relay, ammeter, energy meter, etc. on the CT secondary are in service.

7.11 Inspection and replacement of the fixed contact and spout bushing

It is normal to find the fixed contact surface oxidized due to current flow and environmental factors during period of service. However if the surface becomes rusty due to wet or corrosive conditions, the fixed contact must be replaced. The spout bushing may be replaced depending of its condition.

Clean the contact with a cotton-free paper, and apply some pure alcohol if necessary. Brush small amount of contact lubrication grease (DE-G51 for example) on the surface after wiping. It is important to check any abnormal condition such as the burning marks on the spout bushing, which may be caused by the epoxy.

7.11.1 Check and replace the fixed contact



Verify the switchgear is de-energized and the safety measures are in place.

- Withdraw the circuit breaker. Open the shutter mechanism, and insert two M8 bolts into the overlapping holes on the shafts (See figure 7.2). Then the fixed contact along with the spout bushing are visible.



Figure 7.2 : Insert bolts into the overlap holes to disable the shutter mechanism

Recommend torque (N-m)		
Bolt size	Without lubrication (oil)	With lubrication (oil)
M8	25	10
M10	45	25
M12	85	45
M16	170	85
M20	300	120

- Tighten the bolt on the upper branch and main busbar. Ensure that applied torque is 85 N-m
- Tighten the bolt of the lower branch busbar and the current transformer. Ensure applied torque is 85 N-m
- Remove the inserted bolts on the driving mechanism of the shutter, and then put down the shutters

7.11.2 Inspection and replacement of the shutter mechanism

In case of distortion or deformation, the driving mechanism of the shutter shall be replaced.

The steps as follows:

- Remove the split pins of the driving mechanism of the shutters and connection bar (see figure 7.3)
- Screw off the bolt which is used to fix driving mechanism
- Remove the driving mechanism out
- Replace the driving mechanism of the corresponding shutter, and ensure the correct fitment according to difference from left and right driving mechanism
- Reassemble the split pin and the mounting screw

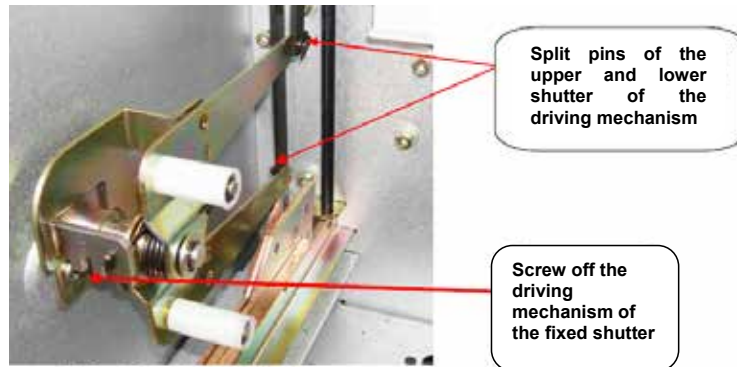


Figure 7.3: Driving mechanism of the shutter

7.11.3 Replacing the earthing switch

The replacing of the earthing switch includes changing the earthing switch along with labels for ON and OFF position, the driving mechanism including driving gear assembly and drive rod.

The steps for replacement are as follows.



Ensure switchgear is in Power OFF position and consider the safety measures

- Rack out the voltage transformer
- Remove the compartment separating plate
- Remove the cover plate on the right side in the cable compartment



Figure 7.4: Screw of the fixed ring on drive rod

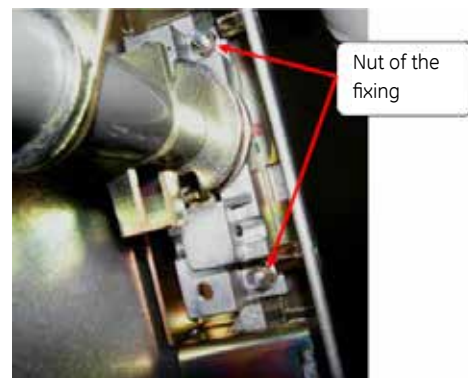


Figure 7.5: Fixed bracket for the drive mechanism

- Loosen the fastening screws of the fixed ring (see figure 7.4), but do not remove completely. The parts of the drive rod in the switchgear can be inserted backwards now



Attention: Both screws can be accessed only when the earthing switch is in OPEN position

- Unlock the ES closing key lock
- Draw out the drive rod forward



Attention: Don't fully remove the drive rod, otherwise all the parts will fall out.

- Completely draw out the drive rod from another side at a slight angle.
- Loosen both of the bolts on the fixing bracket (see figure 7.5), and then remove the fixing bracket and plastic indication plate



Attention: Replace the bevel gear assembly and earthing switch in the same way. Use care to avoid damage as the main body is much heavier.

- Remove the lower branch connections screw fitted with fixed contacts on CT
- Unscrew both of the bolts on the bevel gear (See figure 7.6).

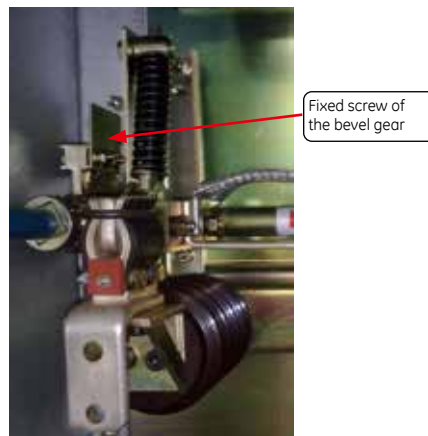


Figure 7.6: Fixing screw of bevel gear

- Unscrew the flexible connections between the earthing switch and common earthing busbar
- Unscrew the connections between the lower branch busbars and earthing switch.
- Remove the fixing screw of the earthing switch, and then push the bevel gear and the main body of the earthing switch (See figure 7.7)
- Now replacement can be done with the above instructions following the previous instructions in reverse order.

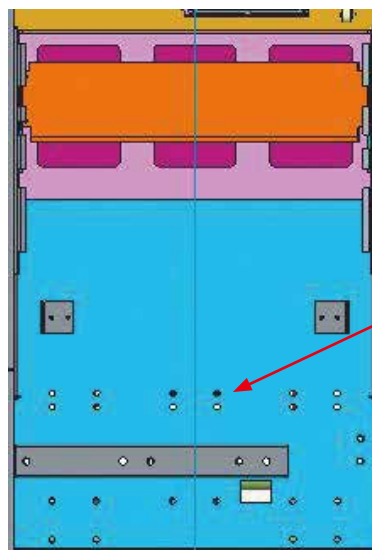


Figure 7.7: Fixing screw of the earthing switch

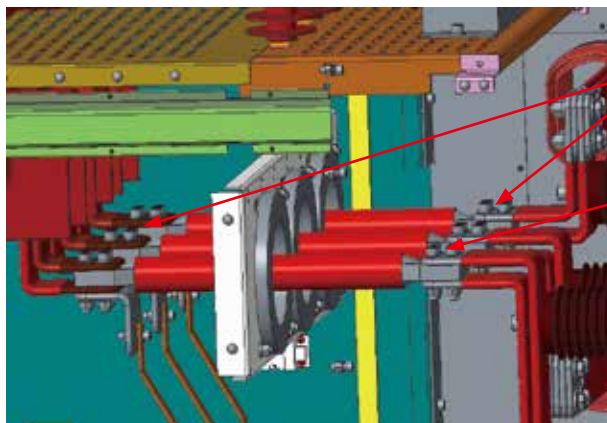
7.11.4 Replacing the current transformer

Replace the current transformer if the assembled current transformer cannot meet the function due to a change in the load conditions. The steps are as follows:



- Confirm the equipment is powered off and make sure to follow proper safety measures.
- Confirm the earthing switch is in OPEN position.

- Open the rear door.
- Remove the connection bolt between the copper brass and the vertical copper connections and remove the copper brass.



Bolts used for connect busbar and copper brass

Copper brass

Figure 7.8: CT assembly

- Remove the three bolts which are used to fix the current transformer, and remove the current transformer
- Replace the current transformer with new one and screw with the three bolts



Be care of the CTs mounting direction, when replace a new CT, it should keep the same direction as the original one.

- Screw the bolts on the copper brass and branch busbars with a torque of 85 N-m
- Connect the secondary connection of the CT and cover it per the requirements
- Close the rear door;

7.11.5 Inspection and replacement of the surge arrester

It is necessary to replace the surge arrester based on big difference between reference voltage and the test data recorded on site during the maintenance and recording. The steps are as follows:

7.11.5.1 Remove the surge capacitor from mounting plate

- Remove the cable between the surge capacitor and copper connection
- Remove the fixed bolts on both sides of the mounting bracket of the surge capacitor (See figure 7.9)
- Remove the surge capacitor (See figure 7.10)

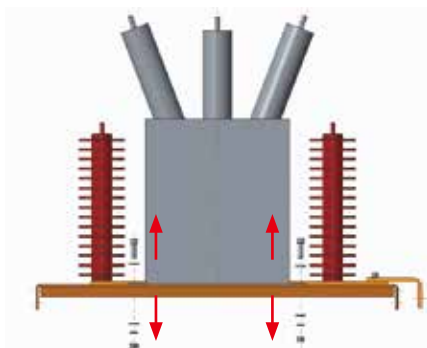


Figure 7.9: Remove the fixed bolts

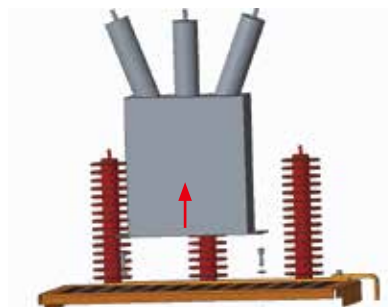


Figure 7.10: Remove surge capacitor

7.11.5.2 Remove the arrestors from mounting plate

- Remove the cable between the arrester and copper connection
- Remove the fixed bolts of the mounting bracket of the arrester (See figure 7.11)
- Remove the three arresters from the bracket (See figure 7.11)

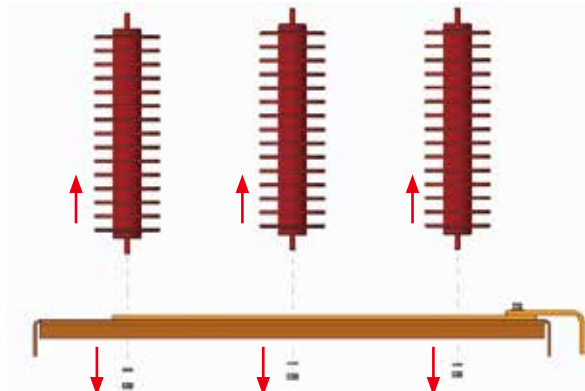


Figure 7.11: Remove the fixed bolts and arrestors

7.11.5.2 Install the new arrester and surge capacitor on the mounting bracket

- Install three arrestors on the bracket and fasten the bolts with 45Nm torque
- Fix the surge capacitor on the bracket and fasten the bolts with 85Nm torque
- Fix the connection between the arrester and copper connection

7.11.6 Inspection and replacement of potential indicator

If the display "Lock" on the potential indicator is flashing, and an abnormal sound from the relay is continuously heard, there may be two reasons that can cause this problem. First, there may be a problem with the potential indicator contact. Second, the display itself may have a fault despite three-phase power condition.

Both of these situations demand to replace the display. The steps are as follows:

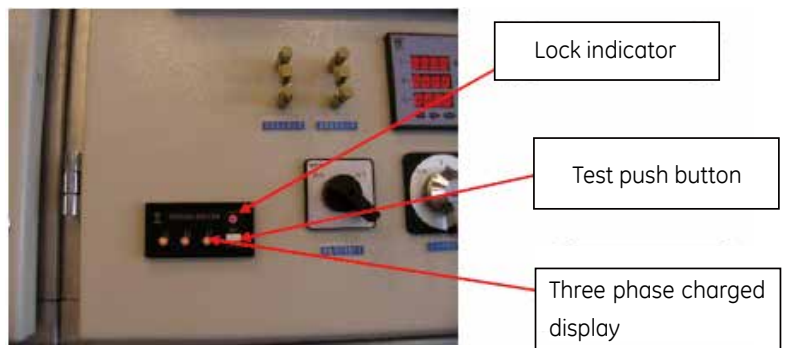


Figure 7.9 Potential indicator

There are two types potential indicators. One is with latching contact, and another is without the latching contact. The replacement for the two types is the same.

- Cut off the auxiliary power of potential indicator (if any)
- Disconnect all the connection from the back of the indicator
- Remove the lock of the potential indicator, and then push it out (See figure 6/15)
- Replace with the new one, and fix the lock
- Reconnect the wires at back
- Recover the auxiliary power

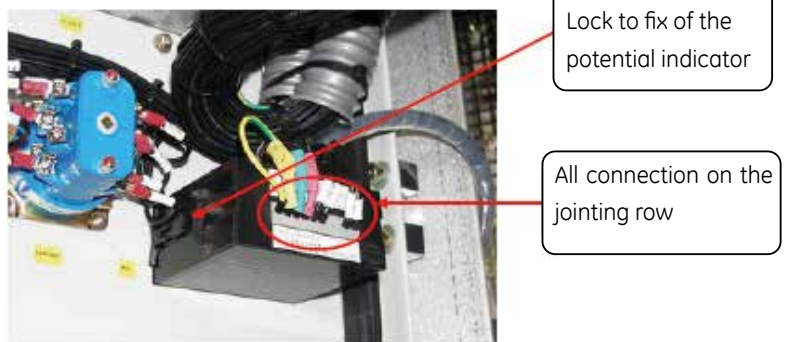


Figure 7.10 : Removing and installing for the potential indicator

7.12 Rule and Note:

Below is a table indicating Busbar sizing;

Description	Rated current	Cross section (copper)
Main Busbar & Branch Busbar (Rectangle)	2500A	100×10×2
Main Flex bus bar for flex bus duct	2500A	Braided Wire section: 600mm2×2
Main Flex bus bar for GLAC & GNAC to generator	2500A	Braided Wire section: 720mm2×2

Torque on bus joints:

Recommend torque (N-m)		
Bolt size	Without lubrication (oil)	With lubrication (oil)
M8	25	10
M10	45	25
M12	85	45
M16	170	85
M20	300	120

8 Spare parts

Please refer to recommended spare parts list below. Other spare parts are also available based on customer's requirement.

S/N	Name	Unit	Comments
1	Heater	Piece	
2	Key for door lock	Piece	
3	Earthing switch operating handle	Piece	
4	Breaker operating handle	Piece	
5	Service Truck T800	Set	
6	Service Truck T1000	Set	
7	Key for emergency unlock	Piece	
8	Undercarriage handle	Piece	

Appendix A - Onsite service safety instruction

Before operating the equipment, please check and make sure to follow all safety requirement.

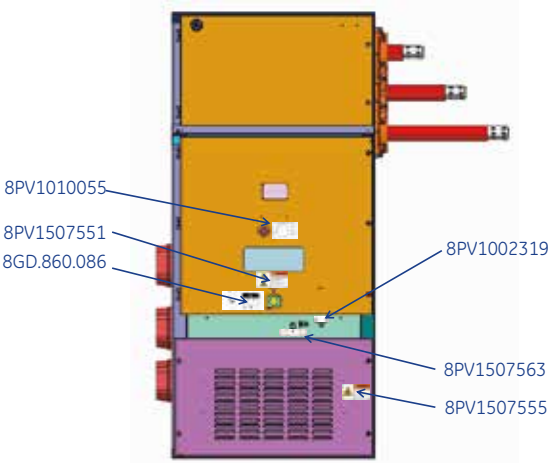
If for any reason the work is interrupted, please make sure site safety procedure is followed when restarting the work.

1. Before operating, please check site layout, both inside and outside of the electrical operating area, earthing line layout, ON or OFF condition of the control power, state of the temporary power, and if any personnel is present and all safety/emergency exits are clear.
2. Ensure if safety procedures on working sheet are well implemented, recheck if the safety procedures comply with requirements, if isolation procedure between live equipment and test equipment is established, and there are clear instructions on the product labels.
3. Once equipment is in power off phase, it is strictly forbidden to operate the circuit breaker or switch. Please switch OFF circuit breaker and move VCB to test or withdrawn position. Instrument and power transformer to power of the equipment shall be switched off in order to avoid any unintended charging of the equipment.
4. Please confirm the switchgear reference data and series number to avoid working on the wrong equipment.
5. All current transformer and voltage transformer secondary winding shall only have one permanent and reliable protective earthing.
6. If it is necessary that personnel must service the switchgear, please make sure to contact GE or that site personnel is properly trained and are capable of following proper safety measures.

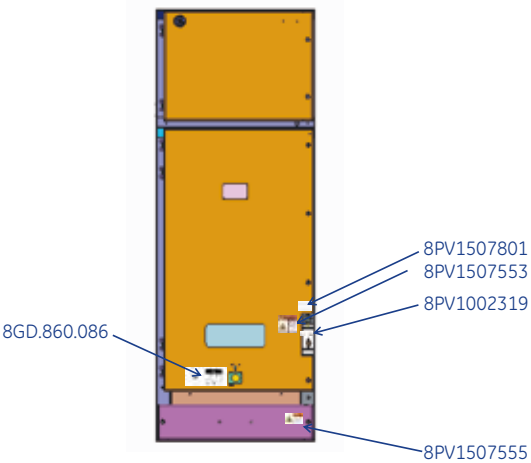
Appendix B - Warning labels

Caution: Read this entire manual before attempting to install the switchgear, and follow all the warning labels instruction to operation.

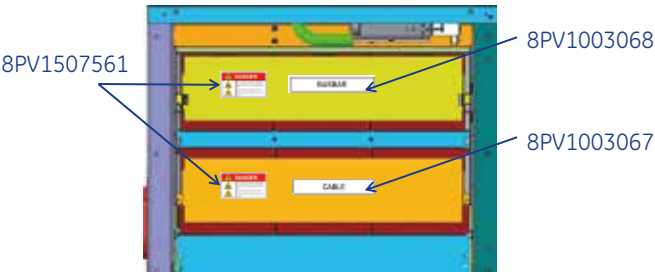
VCB Panel



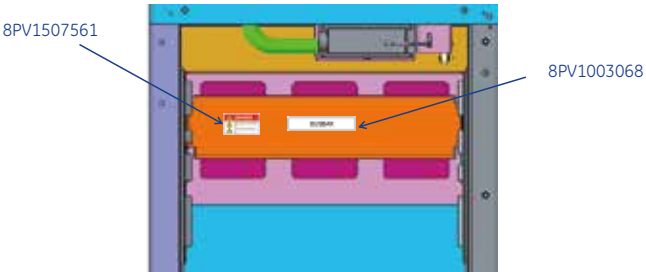
AUX Panel



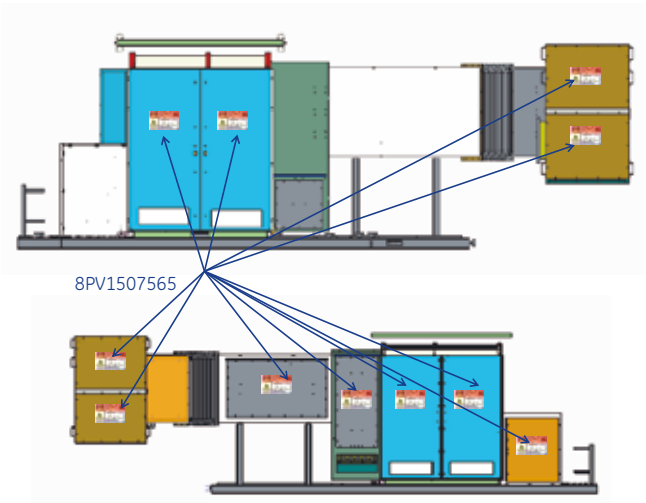
VCB Panel



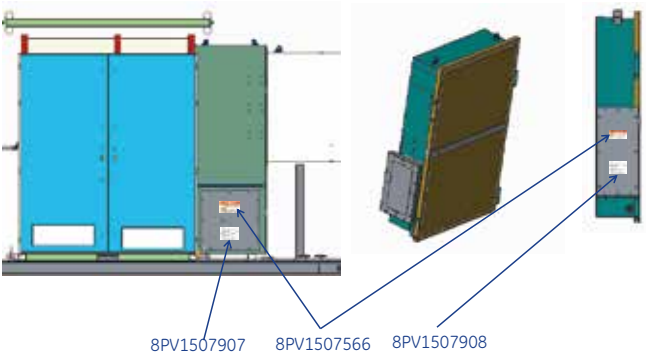
AUX Panel

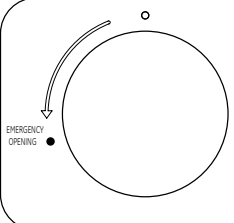
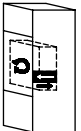
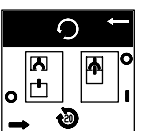


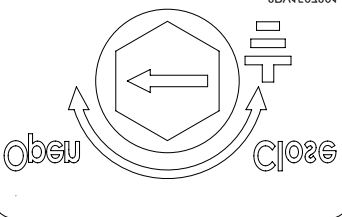
Enclosure



Enclosure



ITEM	DRAWING No.	Detail
1	8PV1010055	 EMERGENCY OPENING DEVICE OPERATING INSTRUCTION Turning the knob counter clockwise to emergency opening (Red Panel). Emergency opening can be released by pressing the center button. Automatic restoration after losing hand.
2	8PV1507551	  WARNING Potential arc flash and shock hazard Rack in VCB according to Circuit Breaker Operation Sequence instruction.
3	T/8GD.860.086	 
4	8PV1002319	
5	8PV1507563	 8PV1507563
6	8PV1507555	 WARNING Potential electrical hazard. Ensure the primary circuit is de-energized and earthed before opening the front cover plate and accessing the cable compartment.
7	8PV1507561	 DANGER  ARC FLASH & SHOCK HAZARD Operation & Service by qualified personnel only. Follow all safety procedures and wear proper PPE in accordance with NFPA 70E. Failure to comply can result in serious injury or death.

ITEM	DRAWING No.	Detail
8	8PV1003068	BUSBAR
9	8PV1003067	CABLE
10	8PV1507801	 8bA1201801
11	8PV1507553	 WARNING Potential arc flash hazards. Ensure the circuit breaker has been locked in test or withdrawn position by rack-in key lock before closing the earthing switch.
12	8PV1507565	 DANGER HAZARDOUS VOLTAGE Death or Serious injury Lockout power before working inside Proper PPE must be worn Follow all safety procedures
13	8PV1507566	 DANGER  ELECTRICAL SHOCK Lockout power before working inside Proper PPE must be worn Follow all safety procedures

GEIS

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The manual is for reference only, we reserve the right to include modifications.

