OPERATION & MAINTENANCE MANUAL
TYPE GIS 36 kV CUBICLE

L&T Electrical & Automation

A Unit of Schneider Electric India Pvt. Ltd.

CONTENTS - 1 (GV3N), 2 (DS30), 3 (GV3N)

1.0 INTRODUCTION

This manual describes the fundamental handling, operation & maintenance of the GIS GV3N switchgear and its standard handling procedures.

This metalclad SF6 Gas Insulated Switchgear, GV3N with all its devices housed within a compact cubicle and gas sealed is a type tested indoor cubicle for rated voltages up to 36kV.

GV3N

The cubicle is fitted with a vacuum circuit breaker for single busbar system. The insulating medium is SF6 subjected to a minimum pressure.

2.0 SPECIFICATIONS

2.1 - Standards and Operating Conditions:

Applicable standard:
IEC 62271-200, IEC 62271-100, IEC 62271-102, IEC 60376 & IEC 60480.

Operating conditions: The GV3N SF6 Insulating Gas cubicle is sealed with a rated gas pressure of 1.35kg/cm² atmospheric at 20°C for the breaker, disconnecting switch, busbar. It is suitable for indoor application only.

2.2 - Technical Data:

Electrical Characteristics				
Rated Voltage	kV	36		
Rated Current	A	Upto 1250A	2000	2500
Rated Frequency	Hz	50 / 60		
Rated Short Time Current	kA/3sec	26.3/31.5		
Rated short circuit Making Current	kAp	63/80		
Rated short circuit symmetric breaking Current	kA	26.3/31.5		
Rated Lighting Impulse Voltage (1.2/50 Micro Sec.)	kVp	170		
Rated A.C. 1 min pf voltage	kV rms	70		
Width	mm	600	800	900
Depth*	mm	1600	1600	1600
Height*	mm	2500	2500	2500

*Height and Depth may very on different configurations.

Table 2.2: Technical Data

2.3 - Normal Service Conditions for Indoor Switchgear

1) Ambient air temperature
   - -5°C ~ +40°C
   - Minimum ambient air temperature is -5°C
   - Maximum ambient air temperature +40°C

2) The altitude does not exceed 1000m above sea level

   Note: Suitable termination kit to be ordered as per Altitude levels

3) Humidity
   - average value of the relative humidity over 24 hr < 95%
   - average value of vapor pressure over 24hr < 22 mbar
   - average value of the relative humidity over a month < 90%

Note: For any other non-standard requirements/ parameters, please contact L&T E&A.

3.0 STRUCTURAL DETAILS & GENERAL ARRANGEMENT

3.1 - Cubicle Structure

The substation facility comprises 3 compartments sealed with a 1.35 kg/cm2 rated pressure SF6 gas and a control circuit compartment fitted with control devices mechanism and a gas pressure monitoring device.

The main circuit live section is divided into a busbar compartment in which the bus running through all the cubicles. A load-side device compartment Consists of a vacuum circuit breaker. The busbar compartment and the load-side device compartments are gas-sectionalized from each other. CTs are mounted in cable compartment and top/bottom.

3.2 - Typical Arrangement

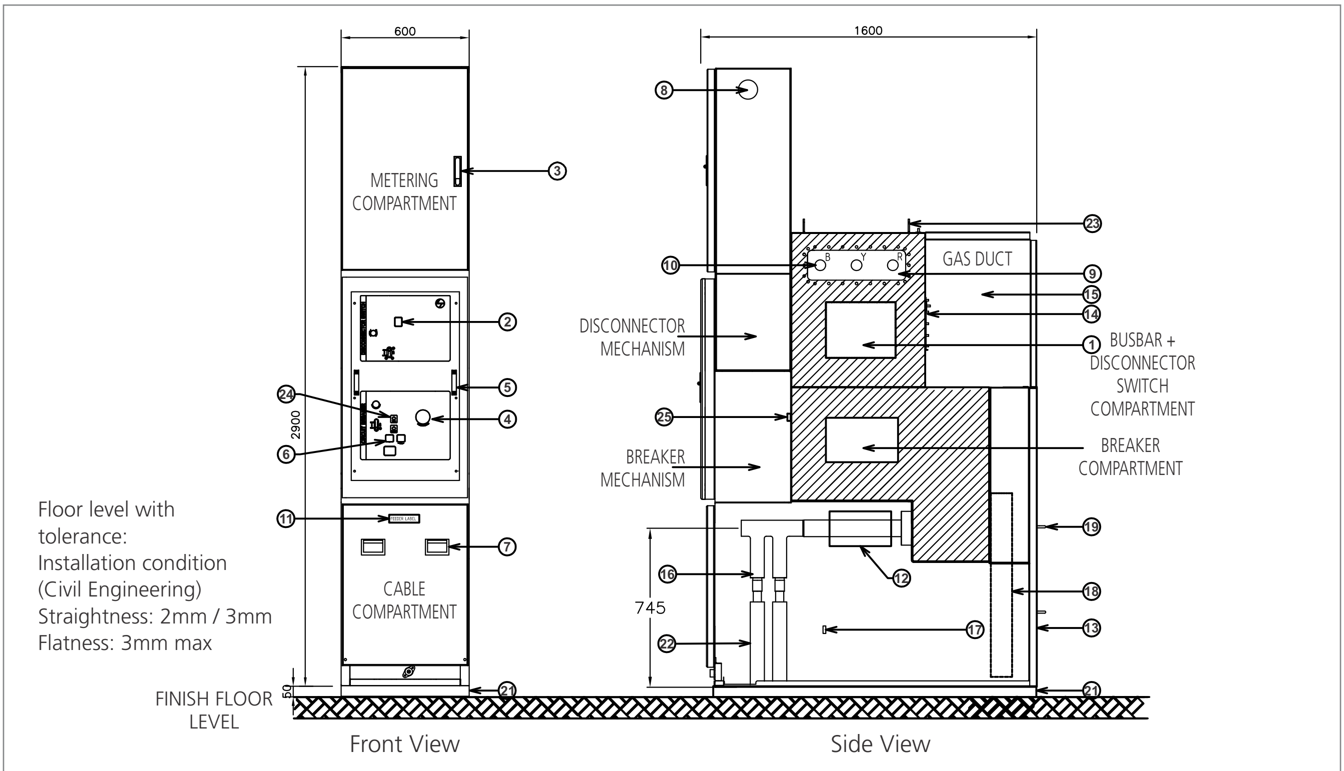


Figure 3.2.1 - Sectional View of Front Cable Entry Panel

LEGEND:

1. BUS BAR + DS CHAMBER SF6 GAS PRESSURE MONITORING DEVICE (WITH 2 CONTACTS, 1 CONTACT FOR ALARM & 1 CONTACT FOR TRIP)
2. VIEWING WINDOW FOR DISCONNECTOR SWITCH
3. HANDLE FOR METERING COMPARTMENT
4. BREAKER COMPARTMENT SF6 GAS PRESSURE MONITORING DEVICE (WITH 2 CONTACTS, 1 CONTACT FOR ALARM & 1 CONTACT FOR TRIP)
5. HANDLE FOR VCB & DS COMPARTMENT
6. VIEWING WINDOW FOR BREAKER STATUS INDICATIONS
7. HANDLE FOR CABLE COMPARTMENT
8. HOLE FOR ROUTING INTERPANEL WIRES
9. BUS BAR + DS GAS COMPARTMENT
10. BUS BAR
11. FEEDER LABEL
12. CURRENT TRANSFORMER
13. REAR COVER
14. BURSTING DISK
15. DUCT FOR HOT GAS
16. POWER CABLE ADAPTER
17. EARTH BAR
18. MULTI CORE CABLE BOX
19. REAR COVER HANDLE
20. PLUG IN TYPE BUS PT
21. BASE FRAME
22. POWER CABLE (NOT IN E&A SCOPE OF SUPPLY)
23. PANEL LIFTING HOOK
24. EMERGENCY TRIP PUSH BUTTON FOR VCB
25. SF6 GAS FILLING POINT FOR VCB COMPARTMENT

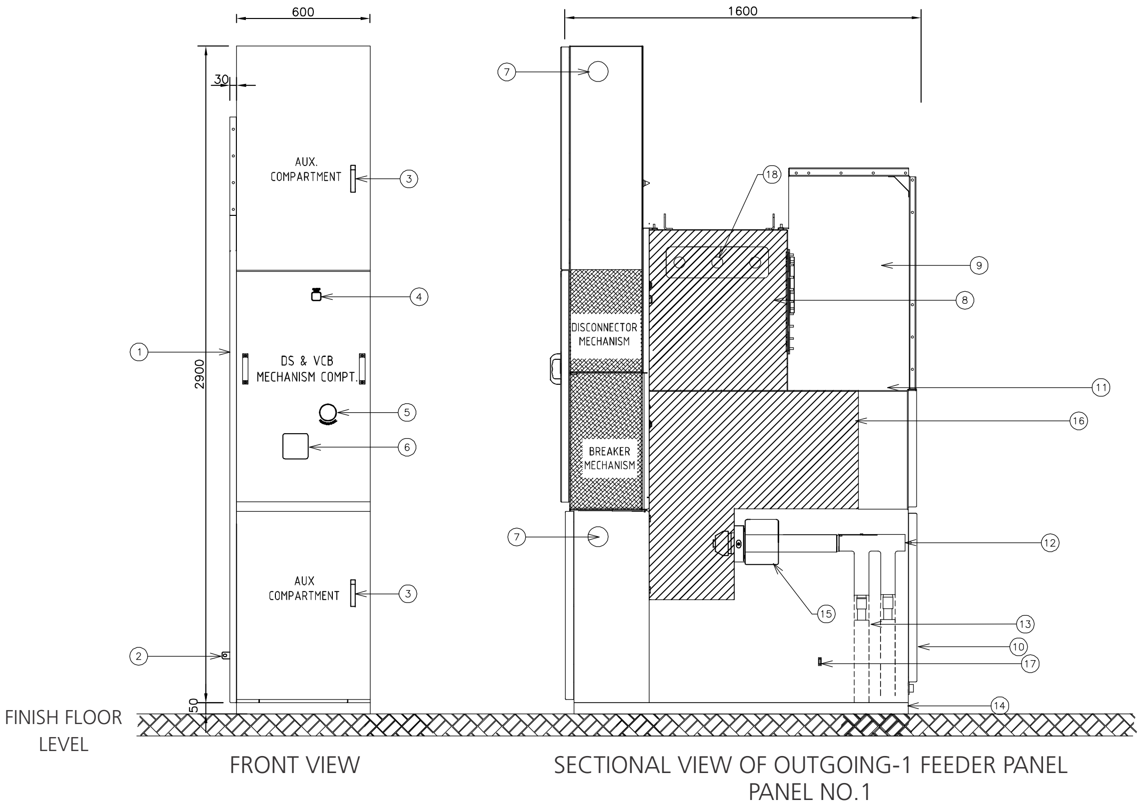


Figure 3.2.2 - Sectional View of Outgoing Feeder Panel

LEGEND:

1. END COVER
2. EARTH BAR TO CONNECT MAIN EARTH GRID AT SITE
3. HANDLE FOR METERING COMPARTMENT
4. VIEWING WINDOW FOR DISCONNECTOR SWITCH STATUS
5. VIEWING WINDOW FOR VCB COMPARTMENT SF6 GAS PRESSURE MONITORING DEVICE
6. VIEWING WINDOW FOR BREAKER STATUS
7. HOLE FOR ROUTING INTER PANEL WIRES
8. BUSBAR + DISCONNECTOR SWITCH COMPARTMENT
9. DUCT FOR HOT GAS
10. REAR COVER
11. PRESSURE RELIEF FLAP
12. POWER CABLE ADAPTER
13. POWER CABLE (NOT IN E&A SCOPE OF SUPPLY)
14. BASE FRAME
15. CURRENT TRANSFORMER
16. BURSTING DISK
17. EARTH BAR
18. COPPER BUSBAR

3.3 - SF6 GAS SYSTEM

The gas-tight compartments and the gas seals ensure long service life.

A gas pressure monitor which is temperature compensated provides accurate readings on the internal gas condition of the switchgear.

3.3.1 - SF6 Gas Pressure Monitoring Device

The Breaker and Busbar compartment is sealed with SF6 gas at 1.35 kg/cm2 @ 20 deg. C, which is continuously monitored by a density monitor.

SF6 Gas density monitor shall be provided for each separate compartment consisting of SF6 gas.

WIKA make Gas density monitor with model number 233.52.063 is as shown in figure 3.3.1 below:

Figure 3.3.1 - Gas pressure monitor (model 233.52.063)

- The safe permissible Gas pressure range is between 1.2 to 1.35 bars @ 20 deg. C
- Some special features of the gas density monitor are as follows:
  - Hermetically leak tight, therefore no negative impact by atmospheric pressure fluctuations and differences in altitude.
  - Local readout with alarm contacts.
  - Temperature compensated.
- The Gas Density Monitor is available with maximum two magnetic snap action switching contacts. These contacts can be normally close (NC) or normally open (NO).
- These 2 contacts can be used for alarm and tripping purpose.
- Let us consider switching contacts are normally closed (NC). The terminal number details are as shown in figure 3.3.2 :

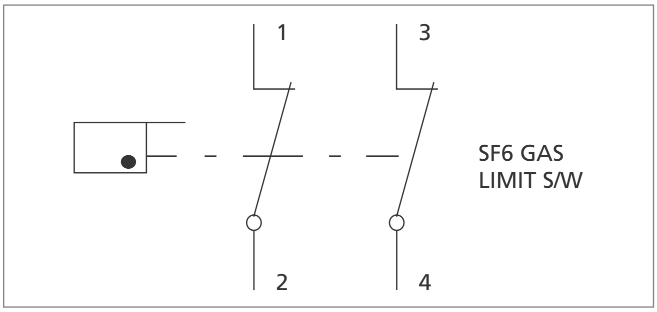


Figure 3.3.2 - Normally closed switching contacts

When gas pressure inside tank is more than 1.25 Kg/cm² then these two contacts shall be open.

1. When gas pressure decreases to less than 1.25 Kg/cm², contact with terminal no. 3-4 becomes Close. This contact can be used to give an alarm, so that gas can be refilled before gas pressure falls to minimum permissible pressure. When the gas is refilled and the internal pressure exceeds 1.25 Kg/cm² then the switch is automatically reset (becomes open).
2. When gas pressure decreases to less than 1.20 Kg/cm², contact with terminal no. 1-2 becomes Close. This contact can be used to trip VCB. When the gas is refilled and the internal pressure exceeds 1.20 Kg/cm² then the switch is automatically reset (becomes open).

Note: The switching point is not adjustable

3.4 - PRESSURE RELIEF DISC

The bursting disc is located on the rear of the breaker chamber of every panel. For the bus compartment, it is located at the top rear with an arcing chute for the main busbar direct arcing produced to the rear. When the gas pressure in the compartment exceeds 3.5kg/cm² during an arc fault, this disc will burst.

MOLECULAR SIEVES

For proper working condition of the SF6 insulated switchgear, the moisture content of the gas must be kept below 150ppm. Condensation within the gas compartment is taken care of by the molecular sieve, which absorbs moisture.

3.4.1 - GAS FILLING

During operation or lifetime of the equipment it may happen that there is leakage in the tank due to some unavoidable circumstances and the pressure on the SF6 manometer on the panel may start dropping and may fall to 1.25 bar. In this case the operator needs to shutdown the panel and has to check it for leakage. Once the leakage is identified and is welded, air is filled in the panel to check, if the weld has removed the leakage and there is no further leakage, after which the SF6 gas is filled in the equipment at a desired pressure of 1.35 bar. The detailed procedure for Vacuuming and Gas filling is provided in Annexure-A. After the gas filling is completed the Power Frequency Withstand Test should be done at site.

Note: For quality and purity of SF6 gas refer the quality certificates of the producers and manufacturers of SF6.

4.0 HANDLING AND STORAGE

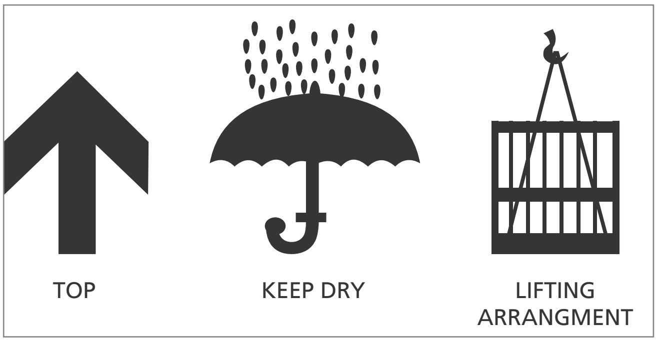
4.1 - Precautions to be taken care

4.1.1 - Safety Aspects

- The Switchgear panels are designed for Indoor Application with all required safety features.
- Before carrying out any installation, operation and maintenance, the service person should be fully acquainted with the relevant safety regulations covering this equipment as well as with the inside of the substation.
- Check that the personnel operating the apparatus have this instruction manual with them.
- We recommend that installation and commissioning should be carried out by qualified and authorized personnel.
- Ensure compliance of local (site) legal and safety norms.

4.1.2 - Unloading & Transportation

- The switchgear panels are dispatched in appropriate packaging for the prevailing conditions, e.g. seaworthy packaging.



- Unloading of Panels shall be done as per Instruction stickers given on Panels.
- Panel shall be unloaded with sufficient capacity of crane or Hydra. If unloading is done with wire ropes, fit lifting ropes of appropriate load capacity with shackles and ensure that lifting hooks are locked properly.
- Transport switchgear panels upright only. Carry out loading operations only when it has been ensured that all precautionary measures to protect personnel and materials have been taken and using a

  - crane,

  - fork-lift truck and/or

  - manual trolley jack

- Never tilt the crates over as shown below. Non Compliance with this stipulation may damage the equipment. Always keep it upright.

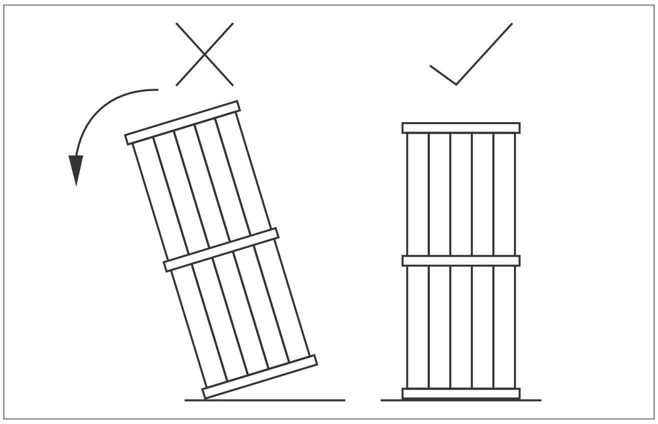


Figure 4.1.2 - Crate Positioning

4.2 - PACKING AND UNPACKING

4.2.1 - Shipping Condition

The GIS panel is packed in the following crates.

1) Cubicle Body - In principle, 1 to 4 cubicles in one packing
2) Foundation framework and fastening bolts.

4.2.2 - Precautions for Unpacking

- Upon arrival at site, the consignment shall be unpacked within one (1) week and checked against the packing list or the delivery note.
- While unpacking wooden cases, top must be removed first.
- It is advisable to locate the switchgear at the sub-station before unpacking. (THE EQUIPMENT SHOULD BE EXAMINED IMMEDIATELY AFTER THE RECEIPT.)
- In case of shortage in supply or damage to the items, report the same within two (2) weeks, accompanied with a full description/ photographs of the missing/damaged parts. Any delay in making the claims will not be entertained.

4.3 - Transport and Handling

The following precautions should be taken in moving the unpacked GIS.

4.3.1 - Precautions for Moving

The equipment may be moved either by suspending it with a lifting apparatus or by hauling with lifting trucks. The following precautions should be observed.

1) When the equipment is hauled on manual lifting truck, be sure that the pallet is of sufficient loading capacity. Furthermore, do not lower the cubicle on its edge as this may result in mechanical damage. The cubicle is provided with a transportation channel base to accommodate the fork of the pallet truck.
2) Rollers may be used for single units of single bus cubicles. Use rollers more than 2.0 meter long with equal diameters. Move the cubicle carefully so that it will not tip over.

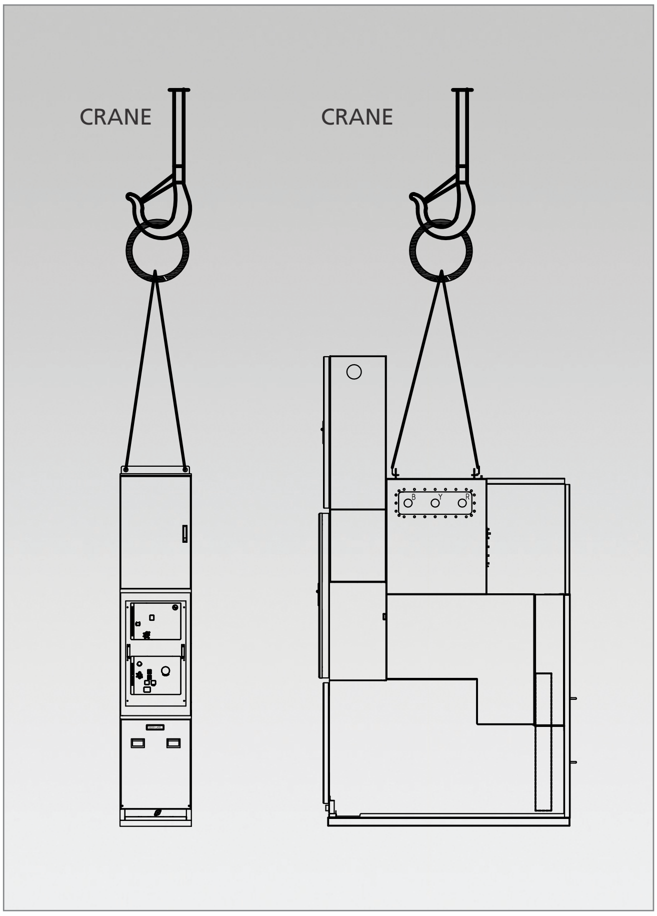


Figure 4.3.1 - Lifting The Cubicle

Figure 4.3.2 - Using Roller To Move Cubicle

Not Recommended

Recommended

4.4 - STORAGE

The type of packing depends on the duration and nature of storage.

The standard cubicle packing is meant for indoor storage where there is no possibility of condensation. If the equipment after being unpacked is to be left as it is or stored for some period of time until the installation commences or the equipment after having been installed is left idle, the cubicle should be covered to avoid contamination of dust on cubicle surface.

- The switchgear is meant for indoor operation and should be stored in a clean, dry and well-ventilated environment.
- The storage area must shelter the equipment from deterioration by agents like

  - Water

  - Water Vapour

  - Salt Laden air

  - Pollution of any type

  - Micro-organisms

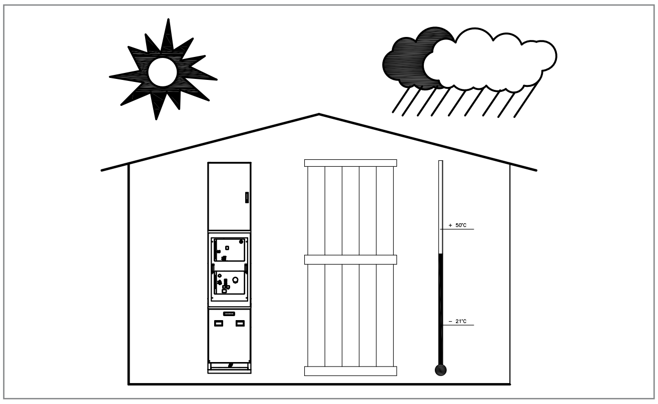


Figure 4.4 - Storage Conditions

- Store switchgear panels standing upright
- Do not stack switchgear panels.
- Switchgear panels are not weather-proof and should not be left outdoor where rain and moisture may cause irreparable damages.
- For temporary indoor storage for less than two (2) weeks, cover the switchgear with plastic sheets to protect it against ingress of dust.
- Do not walk on the roof of the panels.

4.4.1 - Intervention Levels

Definition	Level		
Operations carried out by the client	1		
Operations requiring training and which can be performed by an approved third party		2	
Work which can only be carried out by E&A			3

4.4.2 - Special Instruction for a storage period between 0 and 6 months

Wrapped under plastic Film	1	2	3
Packaging should be periodically inspected	X	X	X
When the equipment is unpacked	-	X	X
10-12 times manoeuvres should be carried out in order to check the mechanical operation of the equipment	-	X	X
The minimum threshold (85% of Un) of the coil electrical operation should be tested	-	X	X

4.4.3 - Special Instruction for a storage between 6 and 12 months period

Wrapped under heat sealing cloth with desiccant bags	1	2	3
Packaging should be periodically inspected (absence of any perforation amongst others)	X	X	X
When the equipment is unpacked : - slightly dilute the dry greases with neutral paraffin oil	-	X	X
10-12 times manoeuvres should be carried out in order to check the mechanical operation of the equipment	-	X	X
The minimum threshold (85% of Un) of the coil electrical operation should be tested	-	X	X

Note : Packing Case age = 1 year.

5.0 INSTALLATION

5.1 - Checks Prior to Installation

Check the order of cubicle arrangement, quantity and external dimensions of the cubicle and base frame according to the drawing provided (Refer figure 5.2 a).

5.2 - Foundation Work

Hack out the floor cement surface out to a level of 50mm below the floor level. The framework is then seated on the sunken floor and is anchored to the floor by angle iron brackets. If the panels are factory coupled with base frames then it can be also fixed on flat floor and channels.

Figure 5.2 a - Base Frame

Adjustment on the M12 anchor bolts is required to level the frame on which the switchgear is to be installed. Leveling must be done with an accurate level gauge. If not level, the GIS switchboard may be distorted, leading to eventual failure of the installed equipment. Please ensure that panel base frame and base frame in finished floor level shall be matched. Both the base frame or base frame and channel shall be bolted or tag welded. Installation should be done in the following order so that the level errors are within an allowable range.

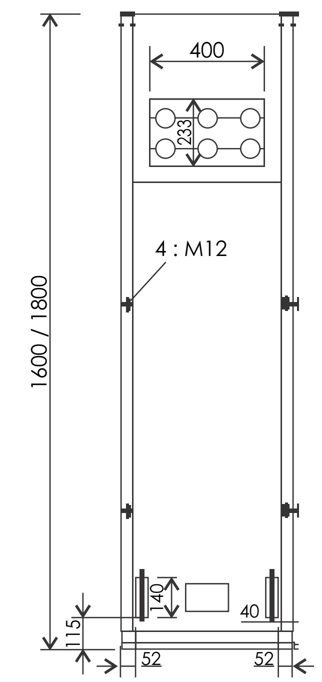


Figure 5.2 b - Base Frame

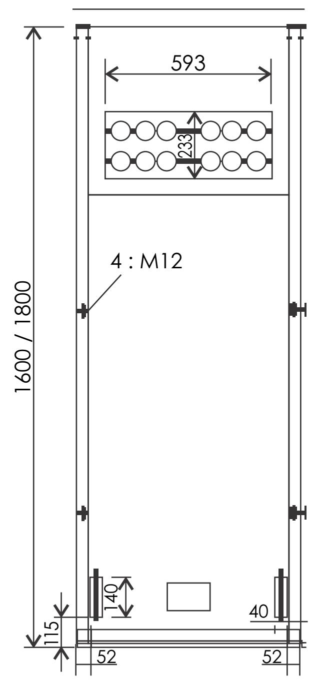


Figure 5.2 c - Base Frame

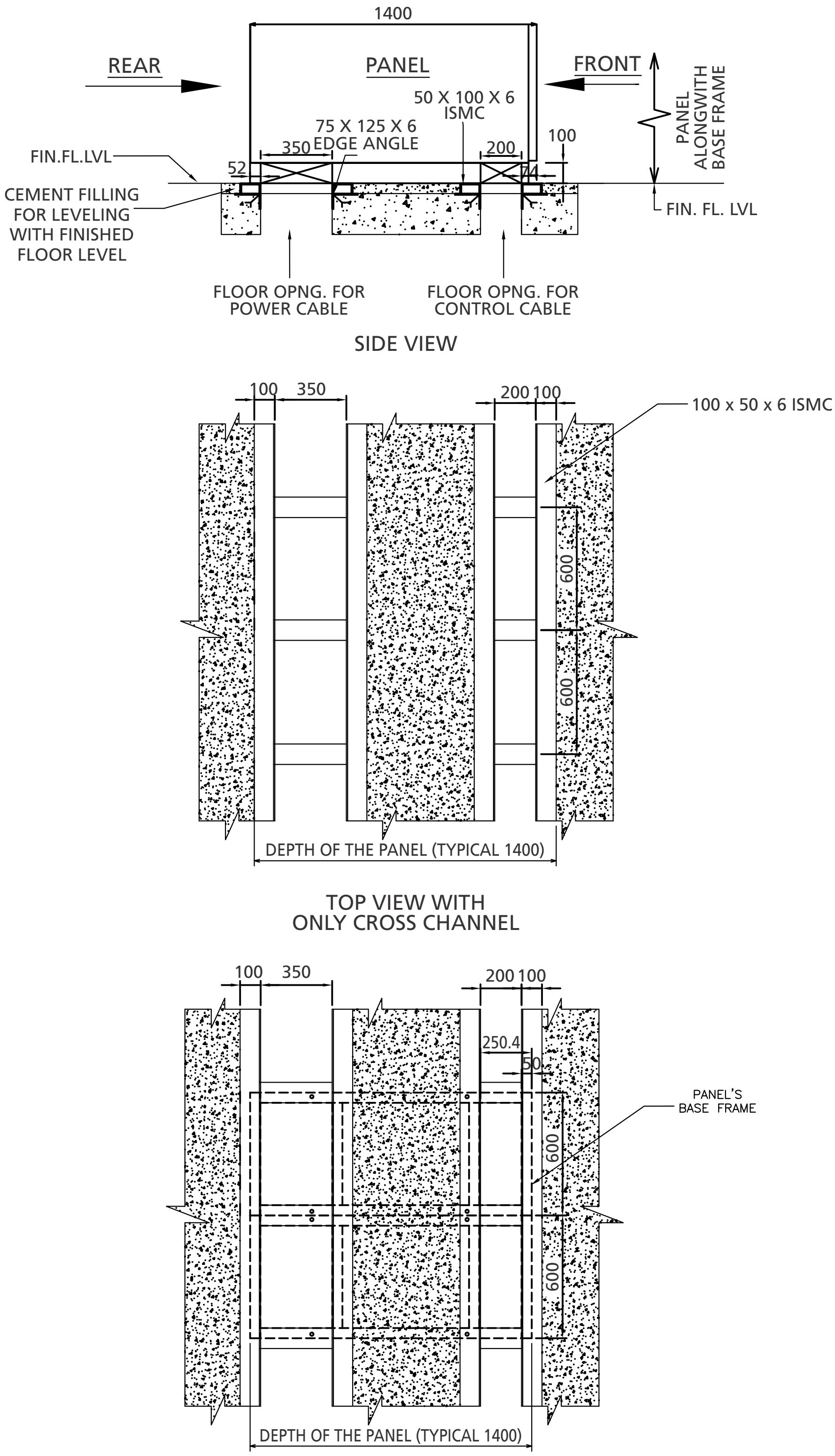


Figure 5.2 c - Top view with panel on Frame & Cross Channel

5.2.1 - Order of Arrangement

1) The unit of the foundation frame is for one to four cubicles. The frame can be combined for a larger housing. Any jointing of the framework must be done only after the leveling of both the frames is satisfactory as detailed in Clause 5.2.2 and the frames are horizontally aligned as in Clause 5.2.3.
2) The installation of foundation frame should begin at the center of the cubicle array, moving progressively toward the left and right side figure 5.2.2 a.
3) Fastening between the cubicle and the foundation frame is done at four prepunched locations for each cubicle. The foundation frame is supplied with M12 foundation bolts.

5.2.2 - Leveling Errors During Installation

The foundation frame should be installed so that the level errors of installed bases fall within the range shown in figure 5.2.2 a & b.

1) Front View of Foundation Frame.

   L: Length of frame in the

   cubicle width direction.

   H: Height from the level reference point to the upper surface of the frame to be installed first

   ……H±1mm

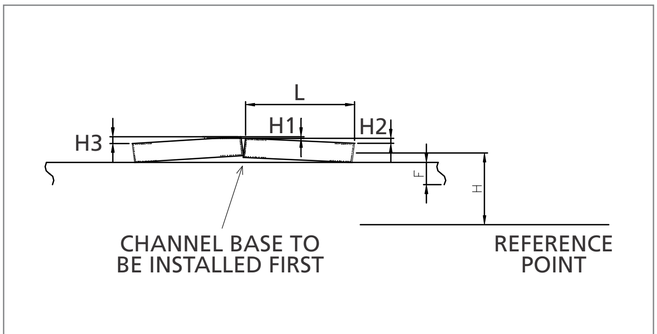


Figure 5.2.2 a - Level errors (front view)

HI: Height difference between the frames arranged in the cubicle width direction ....H1 = ≤0.5 mm

H2: Height difference between the left and right ends of one frame.

H3: Height difference between the left and right ends of another frame.

H2 ≤ 1 mm when L < 3,000 mm

* H2 + H3 ≤ 2 mm when the frames are arranged in the cubicle width direction.

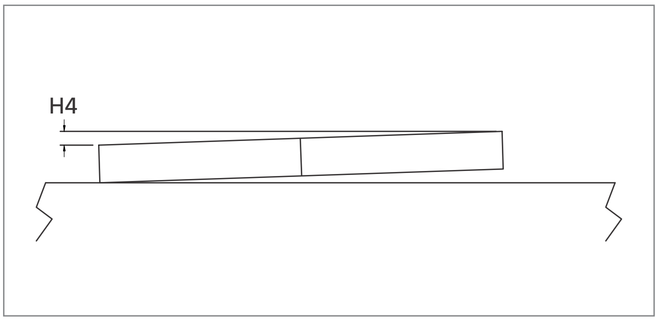


Figure 5.2.2 b - Level errors (side view)

F: Exposed height from the floor surface to the upper surface of the frame …..F ≤ 2

2) Side View of Foundation Frame.

H4: Height difference between front and rear frames ….H4 ≤ 2mm.

5.2.3 - Horizontal Deviations

Horizontal deviations of frames in the lateral and longitudinal directions should be within the range shown in figure 5.2.3.

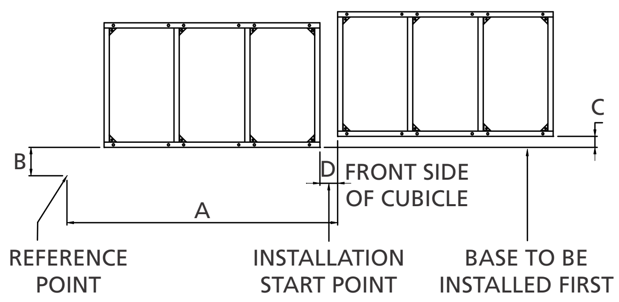


Figure 5.2.3 - Longitudinal deviations (top view)

A: Distance from the reference point to the cubicle installation start point

......................A < 1 mm

B: Distance from the reference point to the front side of the frame

......................B < 1 mm

C: Longitudinal deviation (in the front and back direction) between the frames arranged in the cubicle lateral direction

......................C < 1 mm

D: Gap between the laterally arranged, adjacent frames

......................D < 1 mm

5.2.4 - Foundation Frame

After the foundation frame installation is completed, fill the hollowed floor around the perimeter of the frame with cement as in figure 5.2.4.

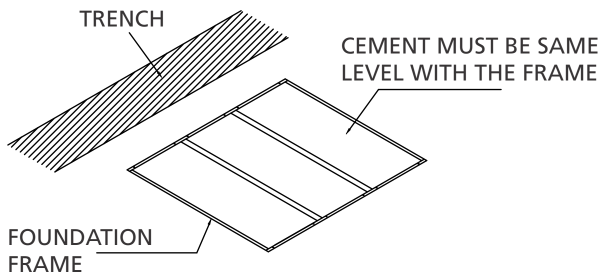


Figure 5.2.4 - Cement Filling

5.3 - Cubicle Installation

5.3.1 - Location of Fastenings

GIS is divided into unit cubicles. Parts (bolts, nuts, etc) used for installation are packed in a vinyl bag with a tag and attached to the cubicle body.

5.3.2 - Order of Installation

1. Draw cubicle reference line on the foundation frame. These reference lines will serve a guide for more accurate alignment of the cubicle.
2. Remove the transportation bolt on the top of the cubicle.
3. Remove the top gas duct from all panels.
4. Locate the first panel onto the center position with the aid of a preferable hydraulic jack, making sure that its front base channel is aligned to the reference line. If the alignment is good, the four foundation bolts can be quite easily inserted into the framework holes.

Do's:

1. Floor levels are clean and ensure there should not be any hardware / small equipment's below the panels.
2. Check all the components received are in proper condition.
3. Please refer O&M Manual for floor leveling.
4. Clean the panels using lint free cloths provided.
5. Use preferred Contact grease HBK83-102 as mentioned.
6. Use MOLYKOT 111 Compound/FOMBLIN GRM60 for sealing purpose.
7. Use proper setting of torque wrench for tightening hardware.
8. During panel movement ensure that copper rod, guiding pin and lead screw are engaging properly.
9. Ensure all the hardware's are tightened properly.
10. Ensure all three B/B Plug-in conductor main are fixed in the panel during coupling only.
11. Ensure for equivalent movement of the panel from top and bottom levels during coupling.
12. Ensure Earthing spring cord of all B/B Plug-in are properly fixed with the plate using M5 screw size.
13. Ensure the Arc Release Ducts chamber are not fixed with the panel during panel movement and coupling.
14. Keep proper vision and attention on the B/B Plug-in conductor main alignment during coupling.
15. Check the alignment of earth bar during coupling of panels.

Don'ts:

1. Handling of components without hand gloves.
2. Misalignment of bushings & busbar.
3. Using additional force during coupling (use only lead screw or hydraulic jack as mentioned in O&M manual).

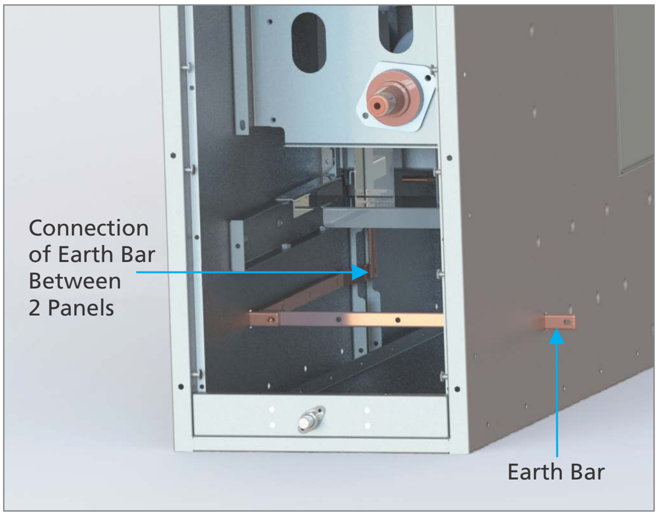


Figure 5.3.5 - Assembly of The Earthing Bus

4. After applying MOLYKOT 111 Compound/FOMBLIN GRM60 to silicon plug, Don't Keep open to atmosphere more than half an hour.
5. Fix B/B Plug-in conductor main with the panel during panel movement.
6. Leave the B/B Plug-in conductor main with the panel after fixing it.
7. Leave the Earthing Spring Cord in hanging condition.

5.3.5 - Connecting the Earthing Bus

The earthing bus is provided at the lower back of each cubicle. After the cubicle and busbar coupling is completed, connect the earthing buses. The GIS is divided into unit cubicles as shown in figure 5.3.5 and the earthing bus is likewise divided at the same positions.

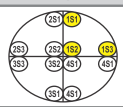
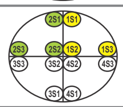
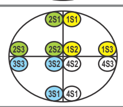
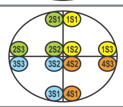
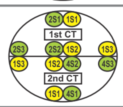
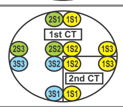
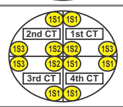
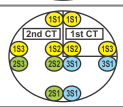
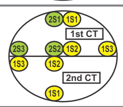
1) The earth terminal is provided at the left-end unit of the cubicle array. Draw out the earthing wire from here.
2) Determine the earthing wire drawout position according to the separate GIS floor plan.
3) The earthing wire should have a minimum of $180mm^2$ stranded bare hard copper wire.
4) Cable earthing shall be done on holes provided on earth bar.

5.4 - Connecting Control Wiring

1) The multicore cable termination for the control cable is provided at the front on the right side. Connection should be

made according to the connection diagram given.

2) For CT's in buscoupler panel inside tank CT secondary bushing connections are given in respective LV panel as shown in Figure 5.3.6.

Sr No	No of CT/Ph	No of Core	For Shop Floor
1	1	1	
2	1	2	
3	1	3	
4	1	4	
5	2	2+2	
6	2	3+1	
7	4	1+1+1+1	
8	4	1+3	
9	2	2+1	

Core No bus coupler CT	1	2	3	4

Figure 5.3.6 - Bus coupler CT secondary bushing terminals

Precautions:

The terminals must be tightly, fastened.

Check the tightness of all terminals before energizing.

5.5 - Connecting Power Cable

Termination and connection of the power cable should follow the instructions of cable termination manufacturer.

If CTs are mounted on bushing no need to remove CTs during cable termination.

Terminate power cable into bushing. Ensure correct phase co-ordination. Insert termination cables into sockets located at the rear compartment and secure with screws. Align cable and support cables properly to avoid tension.

The procedure for fixing the gland plate is as below:

a) The gland plate can be cut into two for easy installation.

b) Measure the diameter of the cable.

c) Cut a semicircle on each half of the gland plates to match the cable diameter.

d) Adjust the position of the power cable and mount the cable gland plates onto the welded studs at the cubicle base plate. Tighten the nuts securely.

e) If there is any gap between the power cables to fill the gap with sealing compound.

f) The Cable screen should be properly connected to the panel earthing.

Note:

1. Connect only one end of the cable earth and not both. For single core cables, there should be a gap between the split plates and the same to be sealed with compound. This is to prevent eddy current circulation.

2. Refer ANNEXURE-B for further details of Cable Connections.

5.6 - Inspection after Installation

5.6.1 - General Inspection

1) Check that the door can be smoothly opened and closed.

2) Make sure that the bolts and nuts that were tightened during installation are not loose.

3) Factory-tightened bolts and nuts are torque-marked with a red paint. Check that the marks on these fastenings are not shifted.

4) Check that the earthing bars are correctly connected and that the earth is connected at one point to the substation earthing.

5) Inspect all protection relays and meters. Remove shipping stops, if any.

6) Check the connection for control wiring.

7) Clean complete panel from inside and outside.

6.0 COMMISSIONING

This section is a guide to the minimum checks and tests that should be performed on site prior to energising the equipment.

6.1 - PRELIMINARY CHECKS

Preliminary inspections should be carried out prior to the connection of the high voltage supply:

1) Check the mechanical and electrical interlocks for correct operation.
2) Check that the switchboard is earthed to the station earthing.
3) Check the gas monitors for correct operating pressure within the green zone.
4) Check that the control power is on.
5) Conduct a primary current injection on the protection relay to ensure functional operation with proper test set.
6) Perform a dielectric test on the power cables to appropriate standards.
7) Conduct an operational test on the panel's control and protection system.
8) Check the general condition of the switchboard for any abnormalities that will affect operations.
9) Check external equipment such as remote controls, auxiliary power source and substation condition.

6.2 - TESTING

On site test for the gas-filled compartments should include the following:

a) Hipot test of the main circuits. (PT should be isolated from the main circuit before test)
b) Moisture content of gas one day after gas filling.
c) Contact resistance & Insulation resistance
d) Current Injection on Primary & Secondary Circuit

6.3 - START-UP

1) During start-up, safety regulations should be observed.
2) Ensure that all the switch-disconnectors and circuit breakers are in off position.
3) Remove any connecting or shorting links used during the preliminary tests.
4) Energise the switchboard step-by-step, observing all signals and indicators.
5) Watch for any abnormalities.

6.4 - SWITCHING OPERATIONS

6.4.1 - POSITION ISOLATION

The 3-position disconnecting switch selects one of three positions-ON, OFF and Earth by a pair of blades.

The cable side may be earthed through the circuit breaker. It can be electrically and mechanically interlocked with an associated circuit breaker. For details, refer to the relevant instruction manual.

Manual operation: Please refer to the attached manual (and the caution plate on the operating device). for the operation of the Disconnecting Switch.

Electrical operation: As a precaution for electrical operation, the manual operation handle must be OUT. After the interlock is cancelled, turn the handle of the Disconnect or control switch on the front door panel. Only one disconnecting switch can be operated at any one time.

This section is a guide to the minimum checks and tests that should be performed on site prior to energising the equipment.

6.4.2 - Interlocks between VCB and 3-Position Disconnecting Switch.

The disconnecting switch cannot interrupt load current. Hence, the switch can only be operated when the breaker is OFF.

When the breaker is ON, the mechanical and electrical interlocks prevent the disconnecting switch from being operated.

In addition, closure of breaker is not possible when the disconnecting switch operation is in progress. Operation of the switches or breaker is not possible with the shutter of the switch opened.

PRECAUTION: The interlock system may differ from case to case. Refer to the operating system in the schematic drawings.

6.4.3 - Circuit Breaker Operation

Manual operation: Refer to the Breaker Installation Manual and the caution plate of the operating device for the operation of the breaker.

Electrical operation: Turn the local breaker control switch (TNC) handle on the front door panel to OFF or ON or remotely switch the breaker. The status of the device can be checked with the indicators located at the front door.

6.4.4 - Earthing of Bus and Switches

An interlock allows the bus to be earthed when all the feeder switches are disconnected from the bus (Dead Bus Check).

This is to ensure the respective bus is dead before earthing.

Motorised version of the earth switch is provided as standard package.

Before earthing operation switch the local remote switch to local mode.

Do not trip the breaker electrically when disconnector switch is in earth position.

Any special interlocks for earthing operations will be shown in the technical project drawings.

6.5 - Safety interlocks in GIS Switchgears

Following Interlocks are provided in GIS switchgear for safety purpose during operation & maintenance :-

1. Mechanical & Electrical interlocks prevent the operation of disconnector switch, when the breaker is ON.
2. Disconnector switch can be operated only when VCB is off.
3. Closure of VCB is not possible when the disconnector switch is in operation.

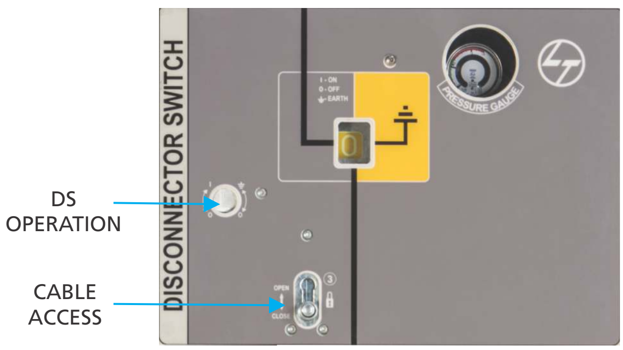


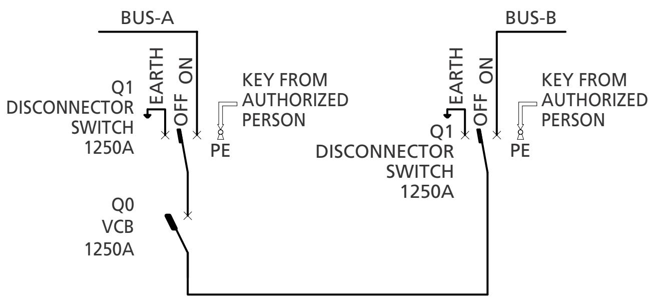
Figure 6.4.4 - DS Facia

4. At a time, Disconnector switch can be operated either electrically or mechanically but not simultaneously.
5. Closure of VCB is not possible unless the spring is fully charged.

1. VCB / Disconnector Switch

- Isolator can be operated only when VCB is in "OFF" condition. The selector position is padlockable.
- VCB can't be operated, either mechanically or electrically, when Isolator is accessed.

2. Permissive Earth



Lock & Key Qty Details
PE: 1 Lock & 1 Key

Figure 6.4.5 - Bus Coupler & Riser

Feeder: Bus Coupler & Riser

Premissive Earth (PE)

1. In normal condition key will not be available in PE lock.
2. To operate DS from OFF to Earth position key has to be trapped in PE lock.
3. Key will be trapped in lock till DS is in Earth position.

Sequence of operation for BUS-A Earthing

1. To Earth power cable, key has to be trapped in PE lock.
2. Key suitable for PE lock shall be made available only with authorized person. Authorized person will issue the key only after ensuring that BUS-A is dead.
3. Trap the key in PE lock provided at riser panel and move DS of riser to Earth postion.
4. Earth BUS-A by making DS and breaker of BUS coupler ON.

Sequence of operation for BUS-B Earthing

1. To Earth power cable, key has to be trapped in PE lock.
2. Key suitable for PE lock shall be made available only with authorized person. Authorized person will issue the key only after ensuring that BUS-B is dead.

3. Trap the key in PE lock provided at BUS Copler panel and move DS of BUS Coupler to Earth postion.
4. Earth BUS-B by making DS Riser and breaker of BUS coupler ON.

3. PROOF OF EARTH

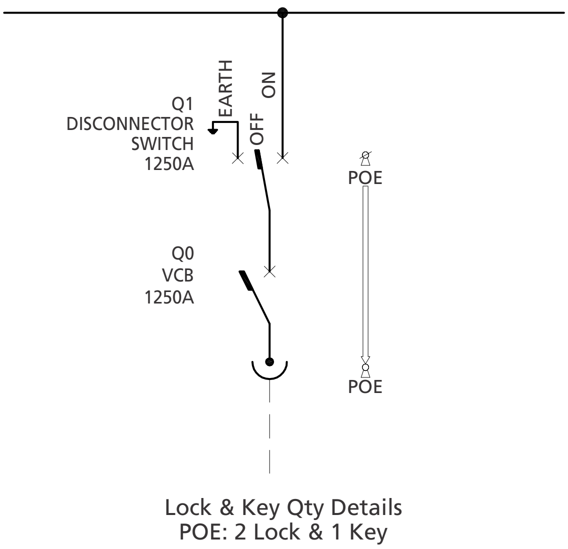


Figure 6.4.6 - Incomer & Outgoing Panels

Feeder: Incomer & Outgoing Panels

Proof of Earth (POE)

1. In normal condition key will be trapped in POE lock located at DS mechanism.
2. Key shall be available free only when DS in Earthed.
3. DS can not be operated from Earth position, till Key is inserted in lock.

Sequence of operation to open cable compartment cover person

1. After Earthing cable, take out key from POE lock located at DS mechanism.
2. This POE key can be used to open power cable compartment.
3. Key will be trapped in lock provided for opening power cable compartment cover till it is open.
4. Key will be available free only after closing cable compartment with its cover.

4. CABLE ACCESS

- The opening of cable access cover is not possible unless the cable have been connected to "EARTH".
- Isolator operation is not possible if the cable access cover is "OPEN".

Padlocking Facility :-

1. Metering & DS mechanism compartment door handle.
2. VCB compartment door handle.
3. Aux./ front cable entry compartment door handle.
4. DS operating hole pad loack.

Visual Indications :-

1. ON & OFF status of VCB.
2. ON , OFF & EARTH status of Disconnector Switch.
3. Operation counter (5digit) on VCB front facia.
4. Spring Charged/Discharged indication flag on VCB front facia.
5. SF6 Gas pressure monitoring device on VCB compartment door facia for VCB & DS compartment tank.
6. SF6 Gas pressure monitoring device on Metering & DS mechanism compartment door facia for busbar chamber tank. This device is provided in any one panel of the board as bus bar chamber tank is common.

Optional Interlock and Visual Indication :-

Following Optional interlocks can be provided :-

1. M.I.L. solenoid interlock is provided to prevent opening of rear cable cover.
2. VCB is tripped electrically if SF6 Gas pressure falls below the minimum permissible value i.e., 1.2 bars.
3. Semaphore indication is provided.
4. **For any special key interlock please refer key interlock arrangement provided by Design.**

ELECTRICAL SWITCHING SEQUENCE FOR GIS INCOMING/ OUTGOING FEEDER PANEL

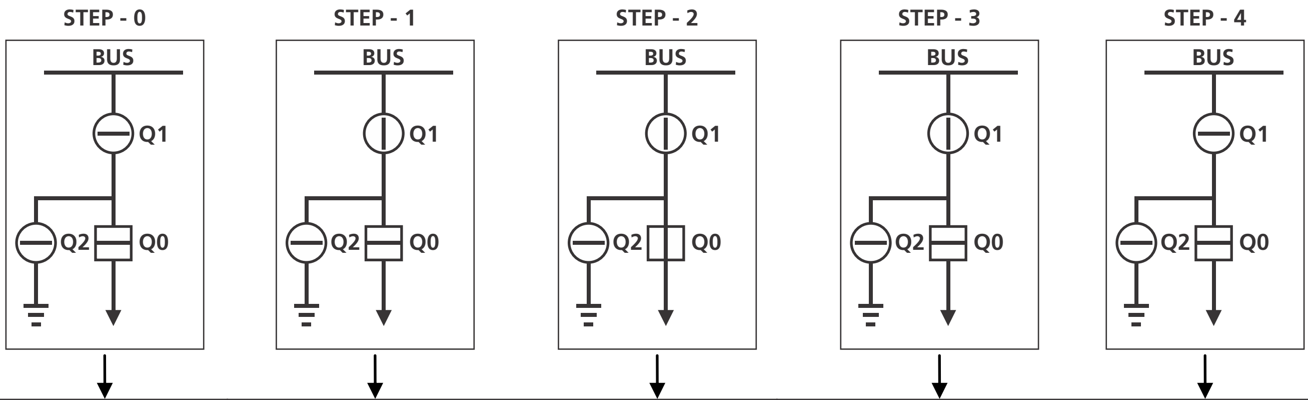
Q0 – Circuit Breaker   Q1 – Busbar disconnecting switch   Q2 – Earthing Switch
(Q1 & Q2 incorporated in one 3 position switch)

Note: The below operating sequence is standard operating sequence. If any key interlocks / key exchange are provided please refer key interlock arrangement provided by Design.

DURING ELECTRICAL OPERATION DO NOT INSERT OPERATING HANDLE

1) SWITCHING VCB

SWITCHING SEQUENCE

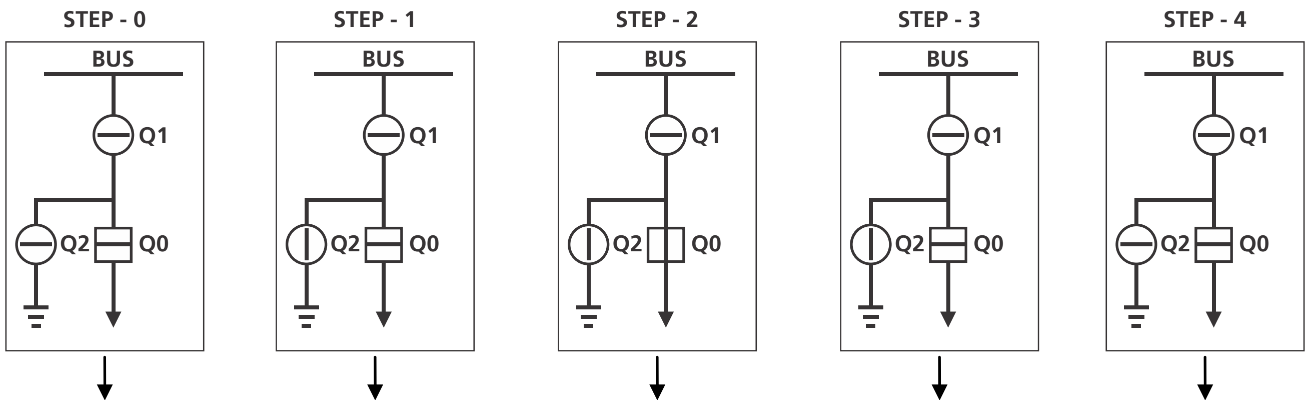


INITIAL STATUS	CONNECTING FEEDER TO MAIN BUSBAR		DISCONNECTING FEEDER FROM MAIN BUSBAR	
Q1 - OFF	Q1 - OFF to ON	Q1 - ON	Q1 - ON	Q1 - ON to OFF
Q0 - OFF	Q0 - OFF	Q0 - OFF to ON	Q0 - ON to OFF	Q0 - OFF
Q2 - OFF	Q2 - OFF	Q2 - OFF	Q2 - OFF	Q2 - OFF

2) CABLE EARTHING:

*BEFORE OPERATION, ENSURE FEEDER IS DEAD.

SWITCHING SEQUENCE



INITIAL STATUS	CONNECTING CABLE TO EARTH BUS		DISCONNECTING CABLE FROM EARTH BUS	
Q1 - OFF	Q1 - OFF	Q1 - OFF	Q1 - OFF	Q1 - OFF
Q0 - OFF	Q0 - OFF	Q0 - OFF to ON	Q0 - ON to OFF	Q0 - OFF
Q2 - OFF	Q2 - OFF to ON	Q2 - ON	Q2 - ON	Q2 - ON to OFF

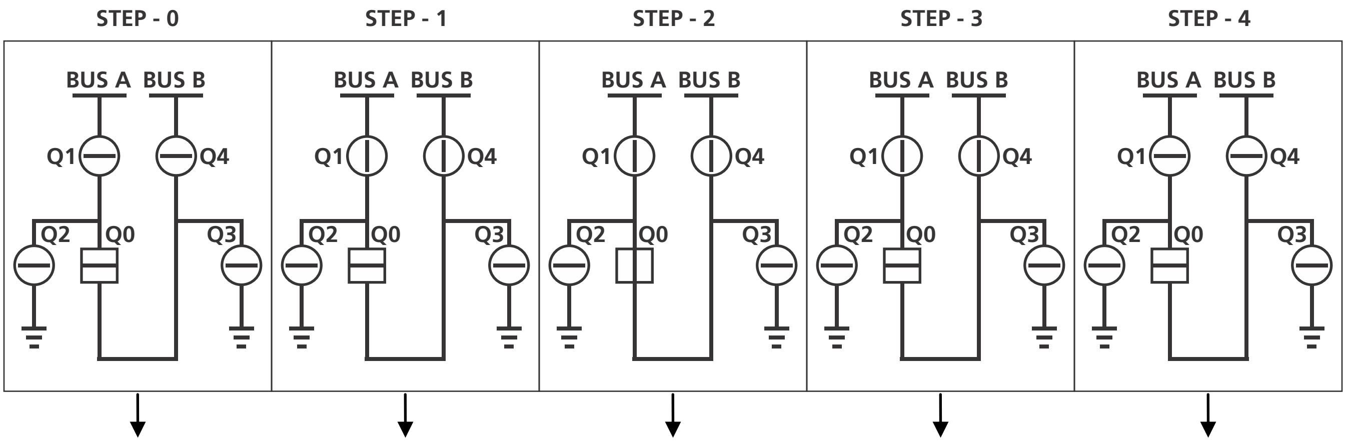
ELECTRICAL SWITCHING SEQUENCE FOR GIS INCOMING/ OUTGOING FEEDER PANEL

Q0 – Circuit Breaker Q1 / Q4 – Busbar disconnecting switch Q2 / Q3 – Earthing Switch
(Q1 & Q2, Q3 & Q4 incorporated in one 3 position switch)

Note: The below operating sequence is standard operating sequence. If any key interlocks / key exchange are provided please refer key interlock arrangement provided by Design.

DURING ELECTRICAL OPERATION DO NOT INSERT OPERATING HANDLE

3) SWITCHING SEQUENCE TO CONNECTING BUS A AND BUS B. AND TO DISCONNECT BUS A AND BUS B



INITIAL STATUS	CONNECTING BUSBAR TO EARTHING		DISCONNECTING BUSBAR FROM EARTHING	
Q1 - OFF	Q1 - OFF to ON	Q1 - ON	Q1 - ON	Q1 - ON to OFF
Q0 - OFF	Q4 - OFF to ON	Q4 - ON	Q4 - ON	Q4 - ON to OFF
Q2 - OFF	Q0 - OFF	Q0 - OFF to ON	Q0 - ON toOFF	Q0 - OFF
Q4 - OFF	Q2 - OFF	Q2 - OFF	Q2 - OFF	Q2 - OFF
Q3 - OFF	Q3 - OFF	Q3 - OFF	Q3 - OFF	Q3 - OFF

ELECTRICAL SWITCHING SEQUENCE FOR GIS INCOMING/ OUTGOING FEEDER PANEL

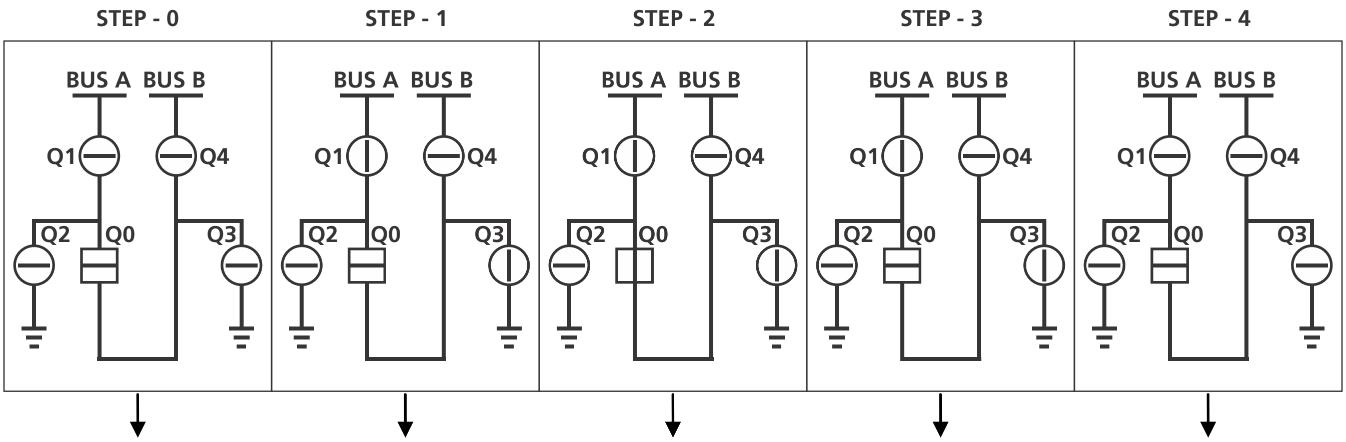
Q0 – Circuit Breaker Q1 / Q4 – Busbar disconnecting switch Q2 / Q3 – Earthing Switch
(Q1 & Q2, Q3 & Q4 incorporated in one 3 position switch)

Note: The below operating sequence is standard operating sequence. If any key interlocks / key exchange are provided please refer key interlock arrangement provided by Design.

DURING ELECTRICAL OPERATION DO NOT INSERT OPERATING HANDLE

4) SWITCHING SEQUENCE TO CONNECTING BUS A TO EARTHING. AND TO DISCONNECTING BUS A FROM EARTHING.

SWITCHING SEQUENCE



INITIAL STATUS	CONNECTING BUSBAR TO EARTHING		DISCONNECTING BUSBAR FROM EARTHING	
Q1 - OFF	Q1 - OFF to ON	Q1 - ON	Q1 - ON	Q1 - ON to OFF
Q0 - OFF	Q3 - OFF to ON	Q3 - ON	Q3 - ON	Q3 - ON to OFF
Q2 - OFF	Q0 - OFF	Q0 - OFF to ON	Q0 - ON toOFF	Q0 - OFF
Q4 - OFF	Q4 - OFF	Q4 - OFF	Q4 - OFF	Q4 - OFF
Q3 - OFF	Q2 - OFF	Q2 - OFF	Q2 - OFF	Q2 - OFF

ELECTRICAL SWITCHING SEQUENCE FOR GIS INCOMING/ OUTGOING FEEDER PANEL

Q0 – Circuit Breaker   Q1 / Q4 – Busbar disconnecting switch   Q2 / Q3 – Earthing Switch
(Q1 & Q2, Q3 & Q4 incorporated in one 3 position switch)

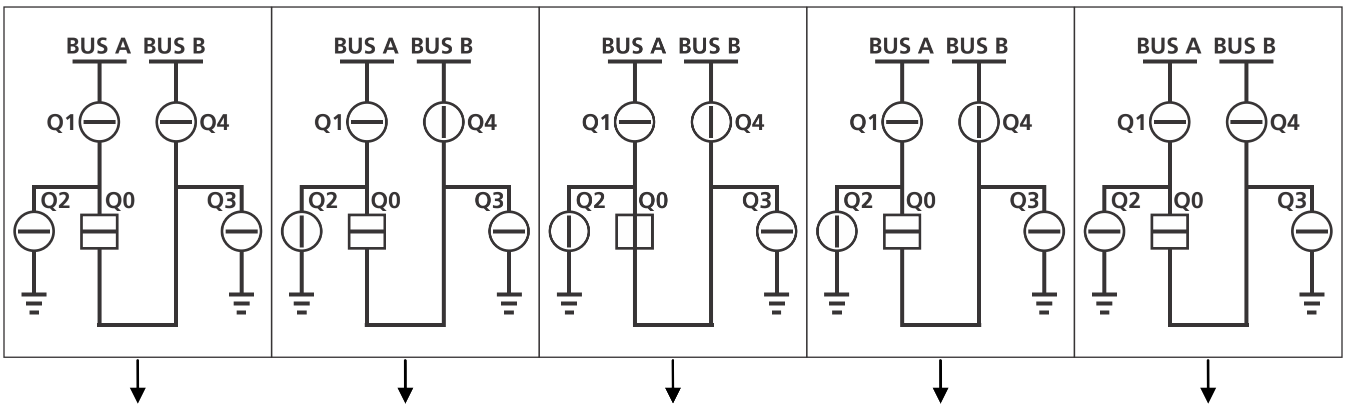
Note: The below operating sequence is standard operating sequence. If any key interlocks / key exchange are provided please refer key interlock arrangement provided by Design.

DURING ELECTRICAL OPERATION DO NOT INSERT OPERATING HANDLE

5) SWITCHING SEQUENCE TO CONNECTING BUS B TO EARTHING. AND TO DISCONNECTING BUS B FROM EARTHING.

SWITCHING SEQUENCE

STEP - 0   STEP - 1   STEP - 2   STEP - 3   STEP - 4



INITIAL STATUS	CONNECTING BUSBAR TO EARTHING		DISCONNECTING BUSBAR FROM EARTHING	
Q1 - OFF	Q2 - OFF to ON	Q2 - ON	Q2 - ON	Q2 - ON to OFF
Q0 - OFF	Q4 - OFF to ON	Q4 - ON	Q4 - ON	Q4 - ON to OFF
Q2 - OFF	Q0 - OFF	Q0 - OFF to ON	Q0 - ON toOFF	Q0 - OFF
Q4 - OFF	Q1 - OFF	Q1 - OFF	Q1 - OFF	Q1 - OFF
Q3 - OFF	Q3 - OFF	Q3 - OFF	Q3 - OFF	Q3 - OFF

Table 5: List of Inspection Items

Inspection item		Routine patrol inspection	Ordinary inspection	Detailed inspection	Servicing	Interval	Target equipment
Category	Description						
Externals	Open - close indication: lamp indication	✓				During patrol	Facility as a whole
	Abnormal noise and smell	✓				During patrol	
	Rust and damage of Cubicle	✓				During patrol	
	Tightness of fastenings		✓			Once every 3 years	
	Number of operations	✓				During patrol	
Structural	Cracks or breaks of bushing			✓		Once every 6 years	Facility as a whole
	Broken wire		✓	✓			
	Tightness of terminals of low - voltage circuit wiring		✓	✓			
	Overheat and discoloration of low voltage circuit wiring terminals		✓	✓			
	Rust and damage of air-insulated section inside cubicle		✓	✓		Once every 3 years	
	Rust and damage of gas piping		✓	✓			
	Gas pressure		✓	✓			
	Monitor indication (if Monitor is provided)		✓	✓			
Operating devices	Cleaning oiling and greasing		✓	✓		Once every 3 years	Circuit breaker
	Tightness of terminals of low-voltage circuit wiring					Once every 3 years	
	Conduction of auxiliary switches			✓		Once every 6 years	
	Tightness of bolts and nuts		✓	✓		Once every 3 years	Isolator With earthing switch
	Internal check of operation mechanisms			✓		Once every 6 years	

7.0 MAINTENANCE AND INSPECTION

GIS is designed to be maintenance-free, requiring only very simple maintenance and inspection, lowering the running cost.

To keep the desired level of performance of the installed devices, enable early detection of faulty parts and thereby forestall possible troubles, it is recommended that the following check is performed according to IEC 1208:

Inspection ~ to predict actual condition

Servicing ~ to preserve specified conditions

Repairs ~ to reestablish specified conditions

Maintenance servicing may only be performed by trained specialists familiar with the peculiar characteristics of the switchboard. It is recommended that E&A engineers be called in to carry out some critical maintenance or repair works.

7.1 - Fundamental Philosophy of Maintenance and Inspection

- The gas-sealed sections are continually monitored by the gas monitoring device so it does not require a periodical overhaul and inspection.

- It is recommended that an ordinary inspection centering on operations. Check be performed one year after installation and there after once every 2-4 years depending on operating and local conditions.

- It is recommended that operation mechanisms for circuits breakers and other devices be subjected to a detailed inspection once every 6 years.

- When any abnormal conditions is detected or when a specified number of operations is reached, an inspection should be performed.

7.2 - Classification of Maintenance and Inspection

1) Routine Patrol Inspection

This inspection is performed externally while the panel is in operation such as voltage and current readings and any deviation from normal conditions. This inspection is part of the routine patrol on the facility as a whole.

2) Periodically Inspection (Ordinary and Detailed)

This inspection is performed periodically at specified intervals to keep the GIS and installed devices in good condition and at the required level of performance.

- Ordinary inspection:

GIS operation is not interrupted and check is made mainly external such as the effects of pollution or any other environmental influences.

- Detailed inspection:

GIS operation is interrupted and checked for protection and control functions and operations of signaling devices and interlock Mechanisms. Parts replacement is done according to criteria.

3) Servicing.

Servicing is performed in the following cases:

- when an abnormal condition is found as a result of inspection and

- when a specified number of operation is reached. Refer to breaker and switch manuals for further detailed instructions.

Basic work on the panels should include but not limited to the following:

- general cleaning of the panels. Clean off all contamination and condensation when panels are installed in the tropics. Remove any dust or dirt deposits, which can be lightly swept off with a lint free cloth. Remove any sticky and greasy deposits on insulators with a lint-free cloth dipped in an approved cleaning agent.

- Procedure as in detailed inspection.

OPERATION AND MAINTENANCE MANUAL
TYPE GIS DISCONNECTING SWITCH

Introduction, Specifications, Disconnecting Switch,
Operating Mechanism, Interlock Features
Maintenance & Inspection Criteria and Standard
Accessories

CONTENTS - 1 (GV3N), 2 (DS30), 3 (GV3N)

1.0 INTRODUCTION

This manual describes the handling and operation methods for the disconnecting switch installed in the gas-insulated switchgear panel.

The disconnecting switch is dedicated for installation in the gas-insulated switchgear type GV3N and its performance is guaranteed under the condition that a specified pressure of SF6 gas is sealed in the GIS.

The conditions of use shall conform with those stipulated in IEC-62271-102. Other conditions are as specified in this manual.

DS30

For safe, long service, this manual should be read for thorough understanding and be kept for quick reference.

Disconnecting Switches

2.0 SPECIFICATIONS

2.1 - Standards and Operating Conditions:

Applicable standard: IEC 129.
Operating conditions: Switch is mounted in type GV cubicle with minimum gas pressure of 1.2 bars absolute above atmosphere at 20°C.

2.2 - Technical Data:

Electrical Characteristics		630A	1250A	2000A	2500A
Rated Voltage	kV	36			
Rated Current	A	630	1250	2000	2500
Rated Frequency	Hz	50			
Rated Short Time Current	kA/3sec	26.3/31.5			
Rated short circuit Making Current	kAp	63/80			
Rated short circuit symmetric breaking Current	kA	26.3/31.5			
Rated Lighting Impulse Voltage (1.2/50 Micro Sec.)	kVp	170			
Rated a.c. 1 min pf voltage	kV rms	70			
SF6 Gas Sealing Pressure	kg/cm^2 abS@20°C	1.35			
Operating method	Motor-spring/ Manual-spring operation				
Operation Voltage	48 / 110 / 220 V DC				
Operation Current	1-3.5A at 48 / 110 / 220 V DC				
Mechanical operation life	2000 operations				

Table 2.2 - Technical Data

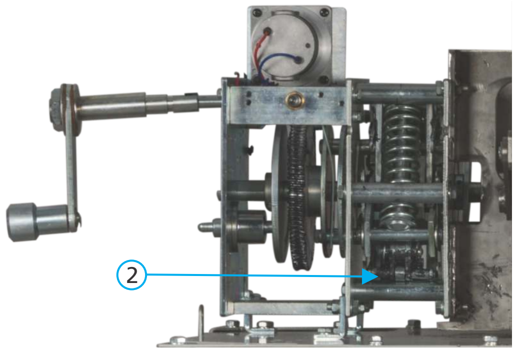
3.0 DISCONNECTING SWITCH

3.1 - External View

The disconnecting switch (DS) provided in the panel is of a 3-position type. The whole driving mechanism is accessible from the front panel, which is air insulated. The moving contacts, fixed contacts and the drive link are located inside a gas compartment.

The operation can be performed by both the motor spring drive (CLOSE/OPEN) or manual-spring drive (CLOSE/OPEN/ EARTH).

Front View



Side View

1) Disconnecting Switch Position Indication

2) DS operating mechanism

3) DS Operating handle Socket

Figure 3.1 - DS Fascia

3.1.1 - Fascia of Disconnecting Switch

The driving force from the operation device is transferred through the connecting shaft to the rod and blade.

As the shaft rotates, the insulating rod drives the blade to select one of three positions - CLOSED, OPEN, OR EARTHED.

The gas sealing of the drive rod is well taken care by a double 'O' ring and gas seal.

3.1.2 - Position of the Switch Blades

The moving contact consists of two coupled blades which can swing over to either sides to mate with the LOSE/EARTH contacts. The CLOSE contacts are mounted on independent resin cast insulators. The contacts are made of drawn copper conductors. Earth contacts are connected to the cubicle framework.

In the CLOSE operation, the blades connect the breaker to the busbar.

Whilst in OPEN operation, the blades are isolated from the breaker and earth.

For EARTH operation, the moving contacts connect breaker to the earth contacts mounted on the disconnect switch frame.

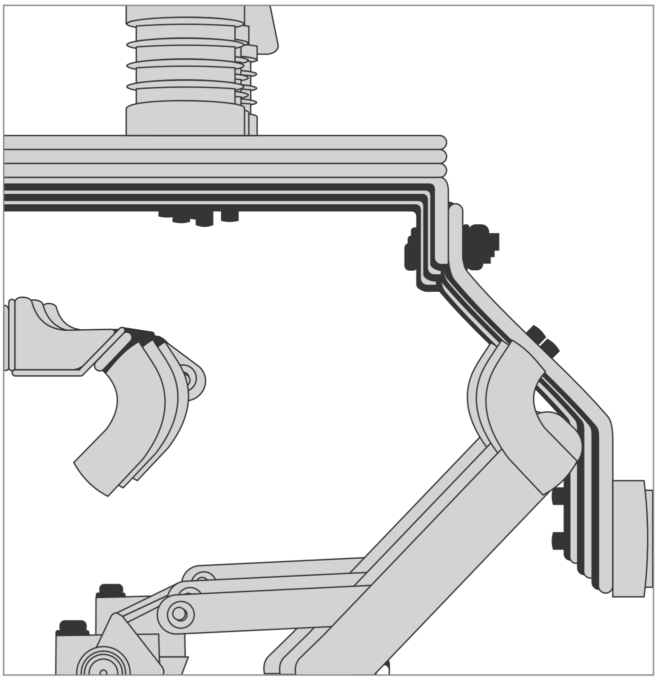


Figure 3.1.2 b - DS in CLOSE Position

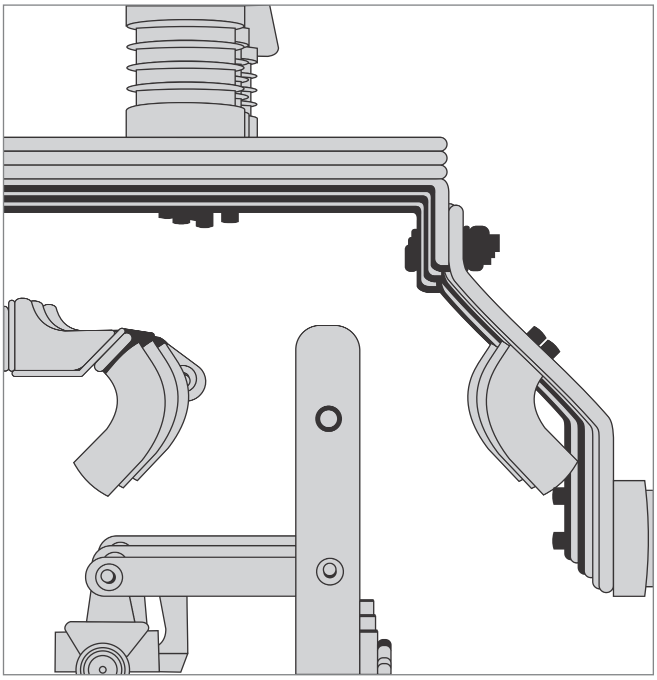


Figure 3.1.2 a - DS Assembly in OPEN Position

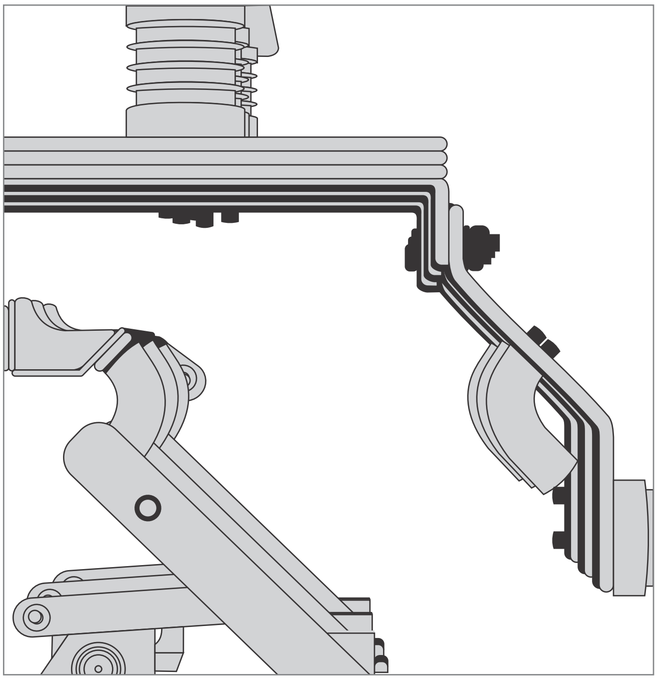


Figure 3.1.2 c - DS in EARTH Position

3.2 - Operating Mechanism

The opening and closing of the disconnecting switch can be electrically or manually operated.

However, the earthing operation is manual with an option for motorised operation.

3.2.1 - Electrical Operation

The driving force of the motor is conveyed to a set of gears and finally to worm wheel Worm wheel rotates the mechanism main shaft, charging the closing spring. Towards the end of the operation, the closing spring will be released and this released energy drives the mechanism to rotate at high speed. This mechanism is connected to DS main shaft through a gas tight coupling. The driving force from the mechanism rotates the main DS shaft which in turn moves the contact blades. At the end of the operation, the mechanism switching is completed with an operation sound. The switch positions (open/ close / earth) are displayed by a mechanical flag at the front of mechanism housing and indicating lamps are mounted on the front door.

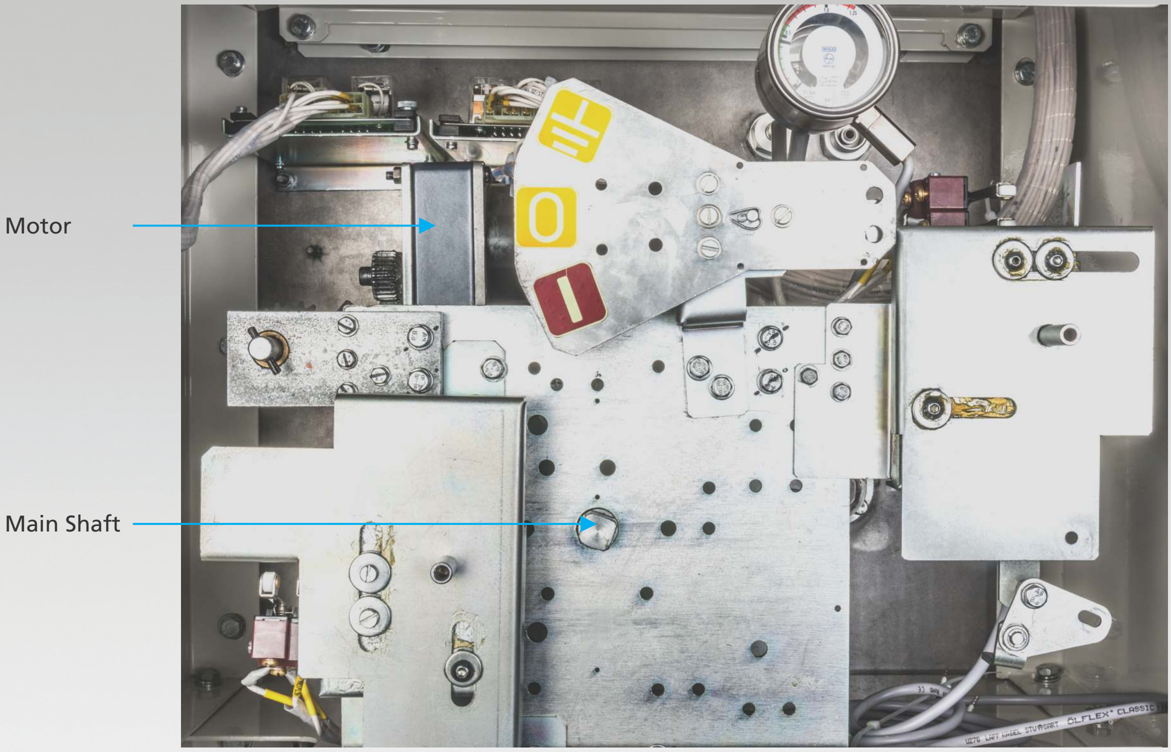


Figure 3.2.1 - Structure Of Operating Mechanism

3.2.2 - Manual Operation

A caution plate, as detailed below, is attached to the cover. Check the interlock before proceeding to operate. The number of rotation for the manual handle is about 17.

Caution Before Manual Operation

1. Do not attempt to operate the Disconnecting switch if the circuit breaker is in closed position.
2. When the circuit breaker is in CLOSED position, interlocks prevents the shutter from being opened.
3. Do not operate DS manually in open door condition.

To Operate Disconnecting switch manually

1. Remove the Padlock of Latch and rotate the latch.
2. Open the shutter in the direction of the arrow .
3. Insert the manual handle so that it engages with the pin of the shaft.

1) OPEN to CLOSE or EARTH to OPEN positions. Rotating the manual charging handle clockwise will cause the disconnecting switch to be operated.

2) CLOSED to OPEN or OPEN to EARTHED positions.

- Turn the manual handle counter-clockwise in the same manner asabove.
- After completion of the operation, rotate the shutter anticlockwise to release the lock. Then, remove the charging handle. The shutter will return automatically to its original position.
- The manual handle has a torque limiting feature which will cause the handle to slip when a torque in excess of the specified value is applied.
- When the handle slips, do not rotate the handle forcibly.
- Check for the correct direction of rotation. After completion of manual operation i.e. when the switching sound is heard, continue to rotate the operating handle for approx. one and a half turns in the same direction of rotation.

This is to enable the electrical interlocks to reset for the next motor operation.

Rotate the shutter knob anticlockwise to remove the operating handle. The shutter is spring loaded and will automatically close.

The interlock plunger resets as soon as the handle is removed.

Figure 3.2.2 a - DS FACIA

3.2.3 - Emergency Operation

In case of emergency situations such as secondary power failure the following procedure applies.

In the event of secondary power failure, the interlocks will prevent the disconnecting switch from being operated manually. To disable the interlocks of the disconnecting switch for manual operation of open/close/earth, remove the cover by first loosening those screws marked. The shutter interlock cam &plunger which prevents cam rotation are accessible once the cover is removed. Lift the plunger upwards with a screwdriver to free the cam and shutter. The shutter can then be opened and it is possible to insert the manual-charging handle for the required operation.

3.3 - Interlock Features

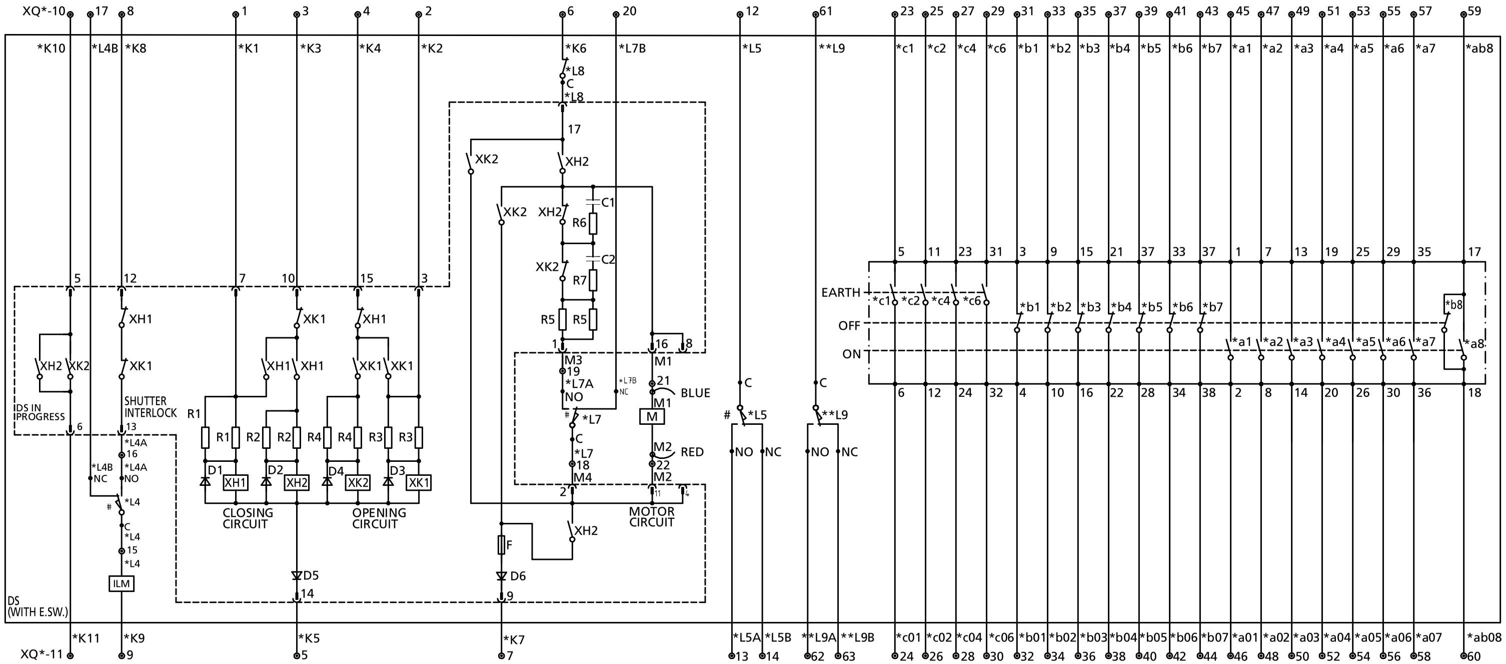
The basic electrical and mechanical interlocks are provided between the disconnecting switch (DS) and the circuit breaker are as follows:

1) DS can be operated only when the circuit breaker is in open condition.

2) While the DS is in operation, the circuit breaker cannot be closed.

3) On line transfer can be achieved by electrical operation.

3.4 - Standard Wiring Diagram



- CONTROL CARD

LEGEND	DESCRIPTION
L4, L5 & L7	INTERLOCK SWITCH CONTACT OPERATES WHEN DS SHUTTER IS MANUALLY OPERATED (INSERT HANDLE)
a1-a8	DS AUX. CONTACT -ON
b1-b8	DS AUX. CONTACT -OFF
c1-c2, c4, c6	DS AUX. CONTACT -EARTH
ILM	INTERLOCK MAGNET
XH1, XK1	AUX. RELAY
XH2, XK2	CONTROL RELAY
D	DIODES
F	FUSE
R	RESISTORS
C	CAPACITOR
M	MOTOR
L8	POE LIMIT SWITCH
L9	PE LIMIT SWITCH

MOTOR SUPPLY :220VDC, BLOCKING MAGNETIC :220VDC
OPENING & CLOSING CIRCUIT :220VDC

NOTE : #
1) L4 & L5 CONTACT CLOSED WHEN
HANDLE IS INSERTED.
2) L7 CONTACT CLOSED WHEN
HANDLE IS INSERTED.

NOTE *:
USE (1) FOR ALL FEEDER & BUS SECTION & (2) FOR TRANSITION PANEL

NOTE **
APPLICABLE ONLY WHERE PE IS USED

Figure 3.4 - DS Wiring Diagram

4.0 MAINTENANCE & INSPECTION CRITERIA

The Disconnecting Switches require little maintenance during their normal working life. The criteria shown below should be observed to keep the disconnecting switch serviceable for a long period of time.

4.1 - Inspection and Servicing Criteria

The inspection intervals should be shortened for equipment used in adverse conditions.

1) Visual inspection	: Arbitrary time
2) Ordinary inspection	: Performed every 3 years
3) Detailed inspection and major service	: Performed every 6 years or 2000 operations or whenever abnormal condition is found

Table 4.1 - Inspection Intervals

4.2 - Contents of Inspection

Check points in visual, ordinary and detailed inspection are listed in table 4.1.

4.3 - Check Points for Maintenance & Inspection

<table>
<tr><th rowspan="2">Category</th><th rowspan="2" colspan="2">Check point</th><th colspan="3">Inspection</th></tr>
<tr><th>Visual</th><th>Ordinary</th><th>Detailed</th></tr>
<tr><td rowspan="2">Externals</td><td rowspan="7">Visual check</td><td>Appearance (rust, dewpoint)</td><td>✓</td><td rowspan="7">✓</td><td rowspan="7">✓</td></tr>
<tr><td>Gas pressure</td><td>✓</td></tr>
<tr><td rowspan="11">Operating Mechanism</td><td>Open - close indicator</td><td>✓</td></tr>
<tr><td>Abnormal noise and smell</td><td>✓</td></tr>
<tr><td>Loose bolts and nuts</td><td rowspan="3"></td></tr>
<tr><td>Filings and chips, dislocated parts, foreign matters</td></tr>
<tr><td>Deformation, damage, wear</td></tr>
<tr><td rowspan="4">Lubrication and operation</td><td>Movement of operating spring</td><td rowspan="4"></td><td rowspan="4">✓</td><td rowspan="4">✓</td></tr>
<tr><td>Movement of link</td></tr>
<tr><td>Warping or galling of parts</td></tr>
<tr><td>Greasing state in sliding and rotating parts</td></tr>
<tr><td rowspan="2">Oiling and greasing</td><td>Oiling (machine oil) state in sliding and rotating parts</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>Remove old grease and apply new grease</td><td></td><td></td><td>✓</td></tr>
<tr><td rowspan="6">Control Circuit</td><td rowspan="2">Visual check</td><td>Check for dislocated connectors and pins and for deformation and breaks</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>Check for loose fastenings of the switch terminals and for rust</td><td></td><td>✓</td><td></td></tr>
<tr><td>Check on Mechanical parts</td><td>Contact state of auxiliary switches</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td rowspan="3">Test</td><td>Contact state of limit switches</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>Device operation test (measurement taken during motor operation)</td><td></td><td></td><td>✓</td></tr>
<tr><td>Sequence test (interlock operation)</td><td></td><td>✓</td><td>✓</td></tr>
</table>

Table 4.3 - Check Points

5.0 STANDARD ACCESSORIES

5.1 - Manual Operating Handle

Figure 5.1 - Manual Operation Handle

OPERATION AND MAINTENANCE MANUAL
TYPE GIS BREAKER GV3N

Introduction, Specifications, VCB, Maintenance
and Standard Accessories

CONTENTS - 1 (GV3N), 2 (DS30), 3 (GV3N-CB)

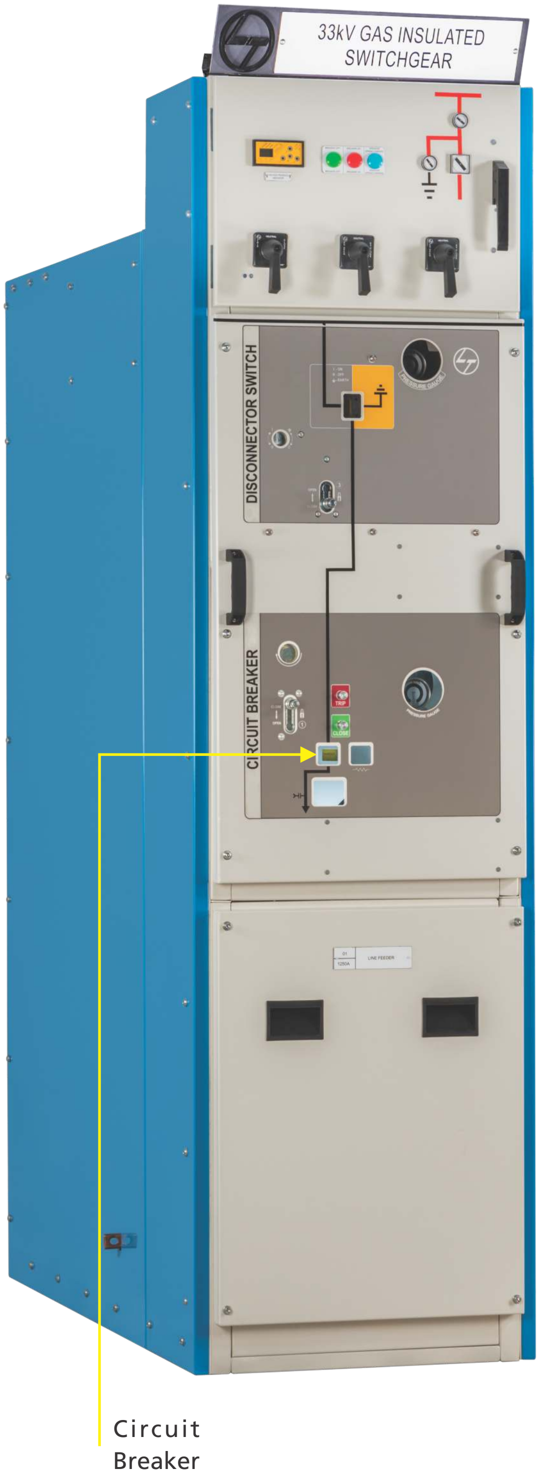
1.0 INTRODUCTION

This manual describes the handling and operation methods for the vacuum circuit breaker types: GV3N-CB

The vacuum circuit breaker is dedicated for installation in the GV3N cubicle type Gas insulated switchgear and its performance is guaranteed under the condition that a specified pressure of SF_6 gas is maintained in the GIS. The circuit breakers conform to IEC 62271-100 within the parameters of their technical data.

GV3N-CB

The type GV3N-CB are not only suitable for frequent switching under normal load conditions but are also capable of a large number of short circuit breaking operations within the restrictions of the technical data. They are also suitable for auto-reclosing.



2.0 SPECIFICATIONS

2.1 - Standards and Operating Conditions:

Applicable standard: IEC 62271-200, IEC 62271-100, IEC 62271-102, IEC 60376 & IEC 60480.
Mounted in type GV cubicles with a rated gas pressure of 1.35 bars absolute above atmospheric at 20 °C.

2.2 - Technical Data:

Electrical Characteristics		630A	1250A	2000A	2500A
Rated Voltage	kV	36			
Rated Current	A	630	1250	2000	2500
Rated Frequency	Hz	50			
Rated Short Time Current	kA/3sec	26.3 / 31.5			
Rated short circuit Making Current	kAp	63 / 80			
Rated short circuit symmetric breaking Current	kA	26.3 / 31.5			
Rated Lighting Impulse Voltage (1.2/50 Micro Sec.)	kVp	170			
Rated a.c. 1 min pf voltage	kV rms	70			
SF6 Gas Sealing Pressure	kg/cm² abS@20°C	1.35			
Operating method	operations	Motor-spring / Manual-spring operation			
Operation Voltage	-	48 / 110 / 220 V DC			
Operation Current	-	1-3.5A at 48 / 110 / 220 V DC			
Mechanical operation life	operations	10,000 operations			
Operating duty	-	O-0.3s-CO-3 min-CO			
Typical make time	ms	< 60ms			
Typical opening time at minimum volts	ms	< 60ms			
Spring motor charging time	sec	< 10 sec			
INTERRUPTER DATA:					
Mechanical life	operations	10000 ops			
Normal rated current interruptions	operations	10000 ops			
Full symmetrical fault interruptions	operations	100 ops			

Table 2.2 - Technical Data

3.0 VACUUM CIRCUIT BREAKER

The type GV3N-CB are tested as per IEC. They have been designed for reliability with minimal maintenance so that there is no need for access into the SF6 insulated chambers during the life of the vacuum interrupter. The motor wound stored energy spring mechanism has been designed with a minimum number of high quality components in line with this concept.

The mechanism and drive is bolted out side of the circuit breaker tank and the three pole assemblies are bolted inside SF6 tank. They are connected via contact wipe springs and coupling rods through gas tight sealing bushes to the insulators fixed to the vacuum interrupter moving terminals. The sealing ring is mounted in the brass hub on the tank.

3.1 - Pole Assembly

The vacuum interrupter is fixed to its cast resin insulation supports by a connection plate attached to the fixed terminal.

The "mechanism" end of the assembly is tied together by the molding mounting plate which located around the seal bush. The phase assembly is fixture built to ensure the correct lineup of interrupter, current transfer contact from interrupter moving terminal and the drive through the sealing bush. Thus when an interrupter reaches the end of its life, the complete pole assembly is replaced.

3.1.1 - Closing of Interrupter Contacts

The discharging of the mechanism closing spring rotates the secondary shaft anti-clockwise to push the interrupter contacts to the contact touch point via the pre-stressed contact spring and the coupling rods. The coupling rods stop moving at this point but the mechanism continues to further compress the contact spring opening up the wipe or snatch gap until the mechanism latches and the circuit breaker pole is then considered closed. This closing movement also charges the pre-loaded opening springs.

3.1.2 - Opening of the Interrupter Contacts

The displacement of the mechanism trip latch allows the opening springs and the contact springs to rotate the secondary shaft clockwise until the wipe or snatch gaps are zero. This is the point of contact separation and from this point the momentum and the continuing action of the opening springs alone pull the coupling rods and thus the interrupter contacts to the fully open position.

3.2 - Vacuum Circuit Breaker Operating Mechanism

The mechanism is of the stored energy, motor wound or manually charged spring operated type. It is suitable for auto-reclosing duties. Basically it comprises a closing spring charging system and a spring charged latch, a closing cam, the close / trip latch which is displaced to trip the closed circuit breaker, and the drive to the poles in the form of the secondary shaft. In addition there are the spring release solenoid, the trip solenoid, the auxiliary switches and manual operation On-Off push buttons.

3.2.1 - Motor Charging Mechanism

The closing springs are charged electrically by the motor and gearbox rotating the mechanism main drive shaft via the pawl drive arm and ratchet plate. The rollers mounted each side of the ratchet plate engage with the closing spring latch after passing through "top dead centre". Reverse movement of the mechanism shaft is prevented by a clutch mounted in the mechanism side sheet. The design of the ratchet plate prevents overcharging by means of a non-toothed area. An additional cam on the main shaft operates a limit switch which opens the motor circuit and completes the spring release solenoid circuit. When the closing spring is discharged, the limit switch condition is reversed and the motor recharges the closing spring automatically.

3.2.2 - Manual (emergency) Charging

The closing spring is tensioned manually by fitting the hand crank lever onto the intermediate shaft on the motor gearbox. This handle is fitted with a clutch to prevent reverse movement.

3.2.3 - Closing

When the closing spring is "CHARGED" and the circuit breaker indicates "Open", the circuit breaker can be closed by either the electrical release of the closing spring or by the manual close pushbutton. This causes the main shaft and thus the drive cam to rotate driving the secondary shaft anti-clockwise via the roller. When the circuit breaker is fully closed, the close/trip latch locates behind the roller holding the circuit breaker closed and indicating "Close".

3.2.4 - Opening

The circuit breaker can be opened by electrical trip or by the manual open pushbutton. The close / trip latch located behind the roller is displaced and the contact springs and opening springs rotate the secondary shaft clockwise to fully open the circuit breaker and indicating 'Open'.

3.3 - Operation of Control Circuit

3.3.1 - Closing Spring Charging Operation

Figure 3.4a shows the control circuit of the circuit breaker when the closing spring is in the charged state and the circuit breaker is open. When the closing spring is discharged it rotates the mechanism main shaft with its switch operating cam and **LS** is switched on. In this state when M1 & M2 is connected to an auxiliary supply the motor automatically recharges the closing spring and **LS** is switched off (spring charging time <10secs). During this closing operation, the b contact of the auxiliary switch is turned off, and also the energised relay Y opens it contact Yb to complete the pumping prevention circuit. Thus, if the same close signal stays on, Yb remains open and prevents reclosing of the circuit breaker. The closing circuit is also provided with contact Xb from the control relay which prevents the spring release coil CC being energised while the closing spring is being charged.

3.3.2 - Opening Operation

The tripping circuit is formed by **a1-TC**. When the circuit breaker is closed and the external operating switch is turned to TRIP the trip coil **TC** is energised and the circuit breaker opens in<60ms. During the open operation the contact of the auxiliary switch is turned off de-energising the trip coil **TC**.

Note: the TC terminals are used to monitor the trip circuit.

3.4 - Figures

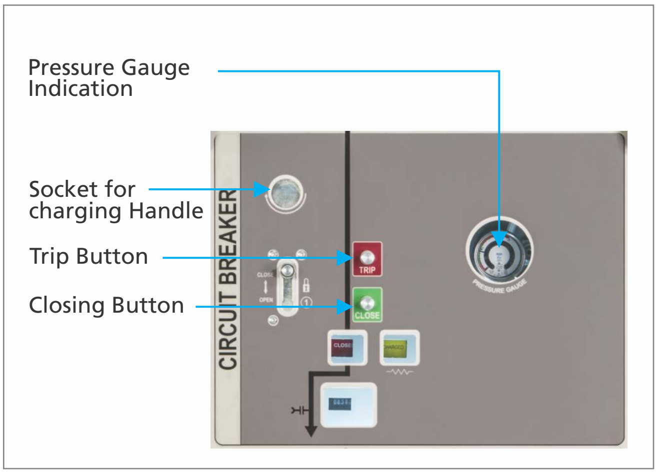


Figure 3.4 a - Front View of The Vacuum Circuit Breaker

Figure 3.4 b - Side View of Gas Tank and Mechanism

Figure 3.3.4 shows the front view of the operation mechanism with the front fascia of the Circuit breaker mechanism removed.

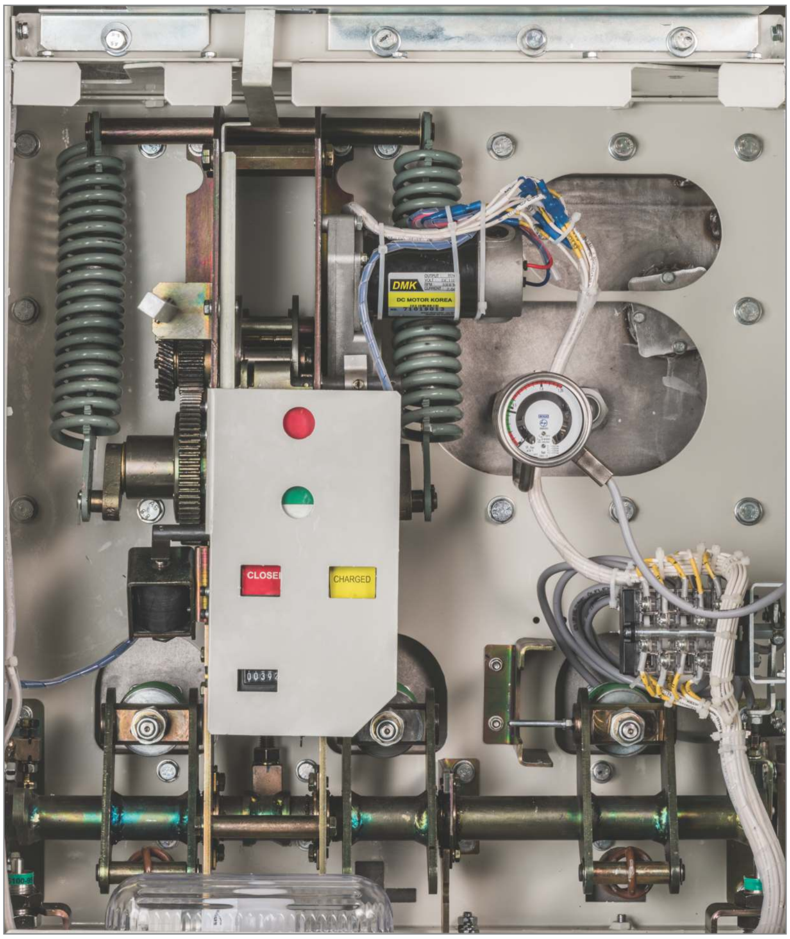
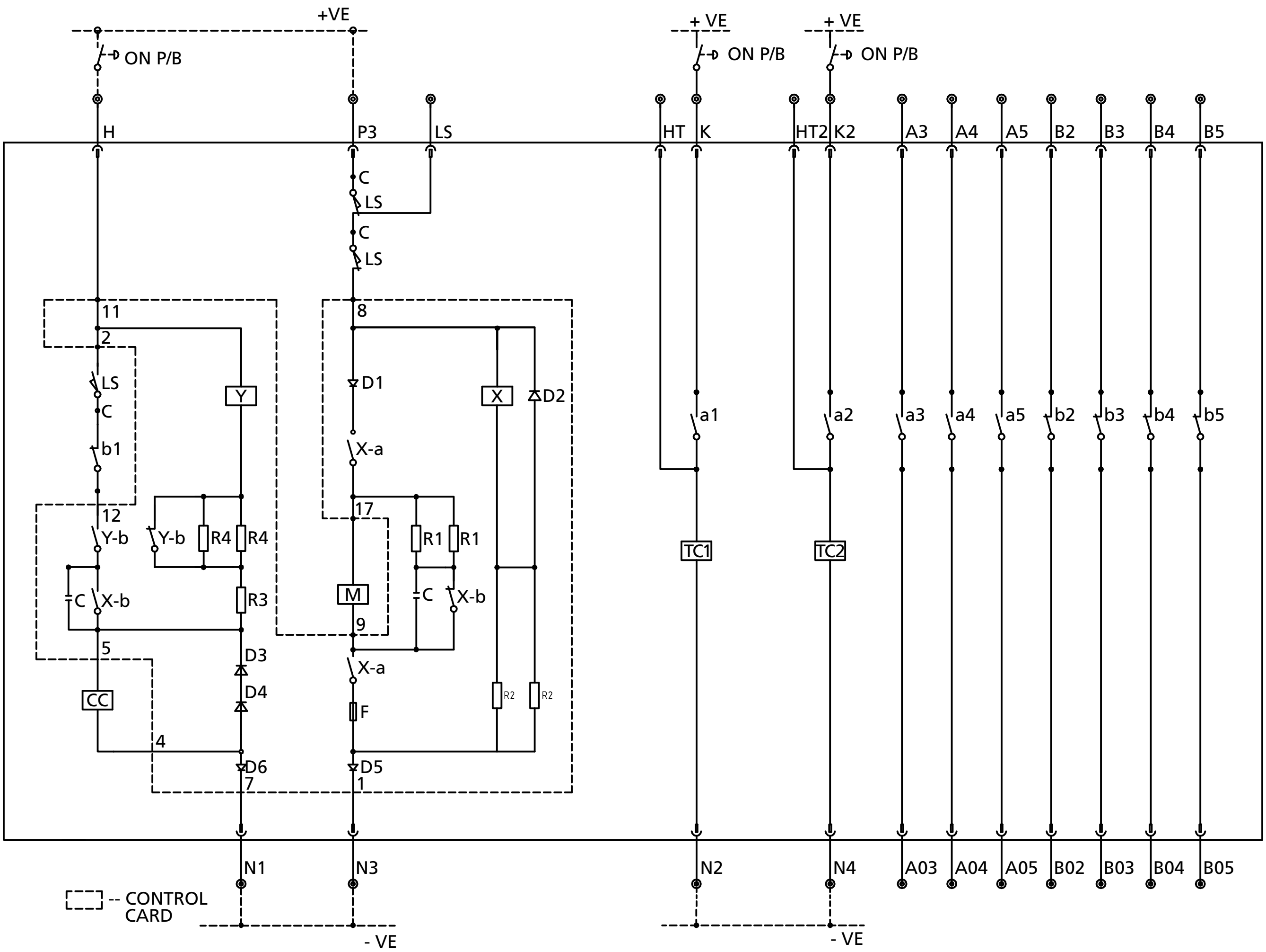


Figure 3.3.4 a - Front View of The Operation Mechanism

3.5 - Standard Wiring Diagram



LEGEND	DESCRIPTION
Y	AUX. RELAY
Y-b	Y RELAY N/C CONTACT
X	CONTROL RELAY
X-a	X RELAY N/O CONTACT
X-b	X RELAY N/C CONTACT
CC	CLOSING COIL
TC1	TRIPPING COIL 1
TC2	TRIPPING COIL 2
M	SPRING CHARGING MOTOR

LEGEND	DESCRIPTION
a	BKR. AUX. CONTACT - N/O
b	BKR. AUX. CONTACT - N/C
C	CAPACITOR
D1 - D6	DIODES
R1 - R4	RESISTORS
F	FUSE
LS	LIMIT SWITCH CONTACT CHANGES OVER WHEN SPRING IS FULLY CHARGED.

Figure 3.5 - VCB Wiring Diagram

4.0 MAINTENANCE

Type GV vacuum circuit breakers require little maintenance during their normal working life. The pole assembly including the interrupter is considered maintenance free for the working life of the interrupter, the mechanism require regular inspection and little maintenance.

4.1 - Inspection and Servicing Criteria.

The inspection intervals should be reduced for equipment used in an adverse environment.

Table 4.1: Inspection Intervals

4.1.1. Visual inspection:	Arbitrary time
4.1.2. Ordinary inspection:	Performed every 3 years or 2000 operations
4.1.3. Detailed inspection and major service:	Performed every 10,000 operations or 100 Operations at rated short circuit breaking Current and rated voltage or when the wipe / snatch gap has reduced to 1mm.

4.2 - Contents of Inspection

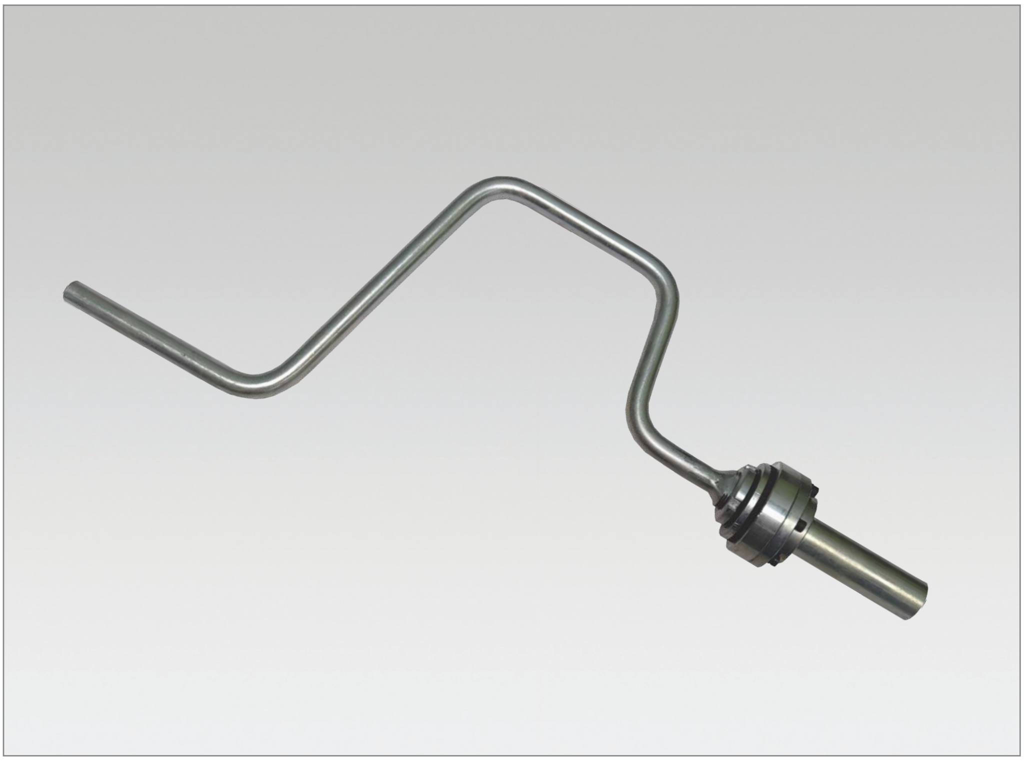
Check points for visual, ordinary and detailed inspections are listed in table 4.2.

<table>
<tr><th rowspan="2">Category</th><th rowspan="2" colspan="2">Check point</th><th colspan="3">Inspection</th></tr>
<tr><th>Visual</th><th>Ordinary</th><th>Detailed</th></tr>
<tr><td rowspan="11">Operation Mechanism</td><td rowspan="6">Visual check</td><td>Loose bolts and nuts</td><td rowspan="3"></td><td rowspan="6">✓</td><td rowspan="6">✓</td></tr>
<tr><td>Dust and foreign matters</td></tr>
<tr><td>Dislocated parts</td></tr>
<tr><td>Filling and chips</td><td rowspan="2">✓</td></tr>
<tr><td>Indication of indicator and Counter</td></tr>
<tr><td>Deformation, damage, wear</td><td></td></tr>
<tr><td rowspan="4">Operation</td><td>Resetting operation of trip prop and closing prop</td><td rowspan="4"></td><td rowspan="4">✓</td><td rowspan="4">✓</td></tr>
<tr><td>Movement of rollers and pins</td></tr>
<tr><td>Warping or galling of parts</td></tr>
<tr><td>Check on reset condition</td></tr>
<tr><td>Greasing</td><td>Remove old grease and apply new grease</td><td></td><td></td><td>✓</td></tr>
<tr><td rowspan="5">Control Circuit</td><td rowspan="2">Visual check</td><td>Check for dislocated connectors and pins and for deformation and break</td><td rowspan="2"></td><td rowspan="2">✓</td><td rowspan="2">✓</td></tr>
<tr><td>Check for loose fastenings of The switch terminals and for rust</td></tr>
<tr><td rowspan="3">Check on mechanical parts</td><td>Operation of auxiliary switches</td><td rowspan="3"></td><td rowspan="3">✓</td><td rowspan="3">✓</td></tr>
<tr><td>Contact state of limit switches</td></tr>
<tr><td>Electrical open-close operation</td></tr>
<tr><td rowspan="2">Others</td><td rowspan="2">Whole circuit breaker</td><td>Abnormal noise</td><td rowspan="2"></td><td rowspan="2">✓</td><td rowspan="2">✓</td></tr>
<tr><td>Abnormal smell</td></tr>
</table>

Table 4.2: Check points for maintenance and inspection

5.0 STANDARD ACCESSORIES

5.1 - Manual charging handle



6.0 MANDATORY SPARES

Spares for 33KV GIS			Mandatory Spares
Sl. No.	Description		Quantity
1	TRIP-NEUTRAL-CLOSE SELECTOR SWITCH FOR BREAKER	Nos	2
2	OPEN-NEUTRAL-CLOSE SELECTOR SWITCH FOR INDOOR DS	Nos	4
3	DOUBLE POLE MCB 16A	Nos	2
4	PUSH BUTTON	Nos	2
5	CONTROL FUSE RATED CURRENT : 10 AMP	Nos	2
6	SEMAPHORE INDICATOR SHAPE : ROUND TYPE	Nos	2
7	SEMAPHORE INDICATOR SHAPE : SQUARE TYPE	Nos	2
8	CLOSING COIL	Nos.	1
9	TRIPPING COIL	Nos.	1
10	INDICATING LAMP	Set	1
11	MANUAL DS OPERATING HANDLE	Nos	1
12	MANUAL SPRING CHARGING HANDLE	Nos	1
13	ELECTRIC CONTACT GREASE	Set	1
14	MECHANICAL CONTACT GREASE	Set	1
15	TOUCHUP PAINT	Set	1
16	VCB SPRING CHARGING MOTOR	Nos	1
17	DOOR HANDLES	Nos	2

Note - While Ordering Spares please mention "Board Drawing Number" as given in Switchboard Name Plate.

ANNEXURE-A

Vacuuming Procedure:

- Plug the unit into a suitable power supply, (see nameplate for more information).
- Make sure the equipment you will be evacuating does not contain pressure.
- Connect a mechanical Torr gauge or electronic vacuum gauge to your equipment.
- Turn valve V-6 (located on the exhaust port of the vacuum compressor) into the EXHAUST position to allow the vacuum compressor to exhaust to atmosphere.
- Connect one end of the equipment hose to Valve -VB (as shown in figure-1) of the Switchgear equipment to vacum the breaker comportment. (use of a shutoff valve is recommended).
- Connect the other end of the equipment hose to the EQUIPMENT CONNECTION on the operator panel.
- Turn on the main circuit breaker and the vacuum compressor power switch. The vacuum compressor will start.
- Continue to evacuate until the equipment reaches the desired vacuum that is the pressure is zero bar (approximately 10-6 bar) as shown in figure (Figure 2B).
- After it reaches that level continue to vacuum for a minimum of 15 minutes.

  Note: the total time for vacuuming will depend on the number panel compartments to be vacuumed.
- Close shutoff valve on equipment.
- Disconnect the hose from EQUIPMENT CONNECTION on the operator panel.
- Turn valve V-6 into the RECOVER position and immediately turn off the main circuit breaker.

Note: Same procedure shall be followed to vacuum the busbar and disconnector switch comportment by connecting the equipment to the valve VBD of the switchgear (As shown in figure 1).

VBD# : For Plugin bushing arrangement the Valve VBD shall be present in each feeder of the switchboard. The Vaccuming for Busbar and Disconnector compartment shall be done through separate VBD valves present in each panel.

Gas Filling:

- Plug the unit into a suitable power supply.
- Close all valves.
- Make sure the vacuum compressor power switch is OFF.
- Connect one end of equipment hose to the equipment being charged. (Connect to valve VB for filling gas in VCB compartment and connect to valve VBD for filling gas in Busbar and DS compartment).
- Turn valve V-1 to the “Charge” position, (up).
- Turn valve V-2 to the “Charge” position, (down).
- Open tank valve V-3. The “Suction” gauge should read approximately 30-psig/2.0 bar.
- If you are charging from an external tank, connect the tank to V-5 on the operator panel.
- Open the valve on the external tank, open V-5 and open V-4.
- Set the regulator to the desired pressure (1.35 bar), viewable on the EQUIPMENT gauge.
- Connect the equipment hose to the EQUIPMENT CONNECTION on the operator panel and open the valve to the equipment. Note that as gas flows from the GFU10-XDS into the equipment, the reading on the “Regulated” gauge will drop.
- Press the START button to turn on the compressor.
- Monitor pressure at the equipment on locally mounted gauge. Note that while charging is taking place, there may be a difference between the readings of the local gauge and the EQUIPMENT gauge.
- Once the desired pressure 1.35 bar (As shown in Figure-2C) has been reached, turn off the valve on the equipment.
- Turn V-2 into the “Recover” position, (up).
- Close tank valve V-3. Allow the “Suction” gauge reading to drop to zero or into slight vacuum.
- Turn panel valve V-1 into the “Recover” position. Allow the “Suction” gauge reading to drop to zero or into slight vacuum.
- Turn off the compressor.
- Close all valves.
- Remove equipment hose from GFU10-XDS and equipment.
- Zero the regulator for the next use.

Note: As the equipment pressure increases, the discharge pressure also rises. This happens because the compressor begins to pump faster than gas is being transferred to the equipment. If the GFU10 shuts down on high pressure, wait a few minutes for the excess pressure to pass through the regulator into the equipment. Then restart the GFU10.

HINT: To speed charging, keep the vessel you are drawing gas from warm. This applies to the onboard tank or external vessel.

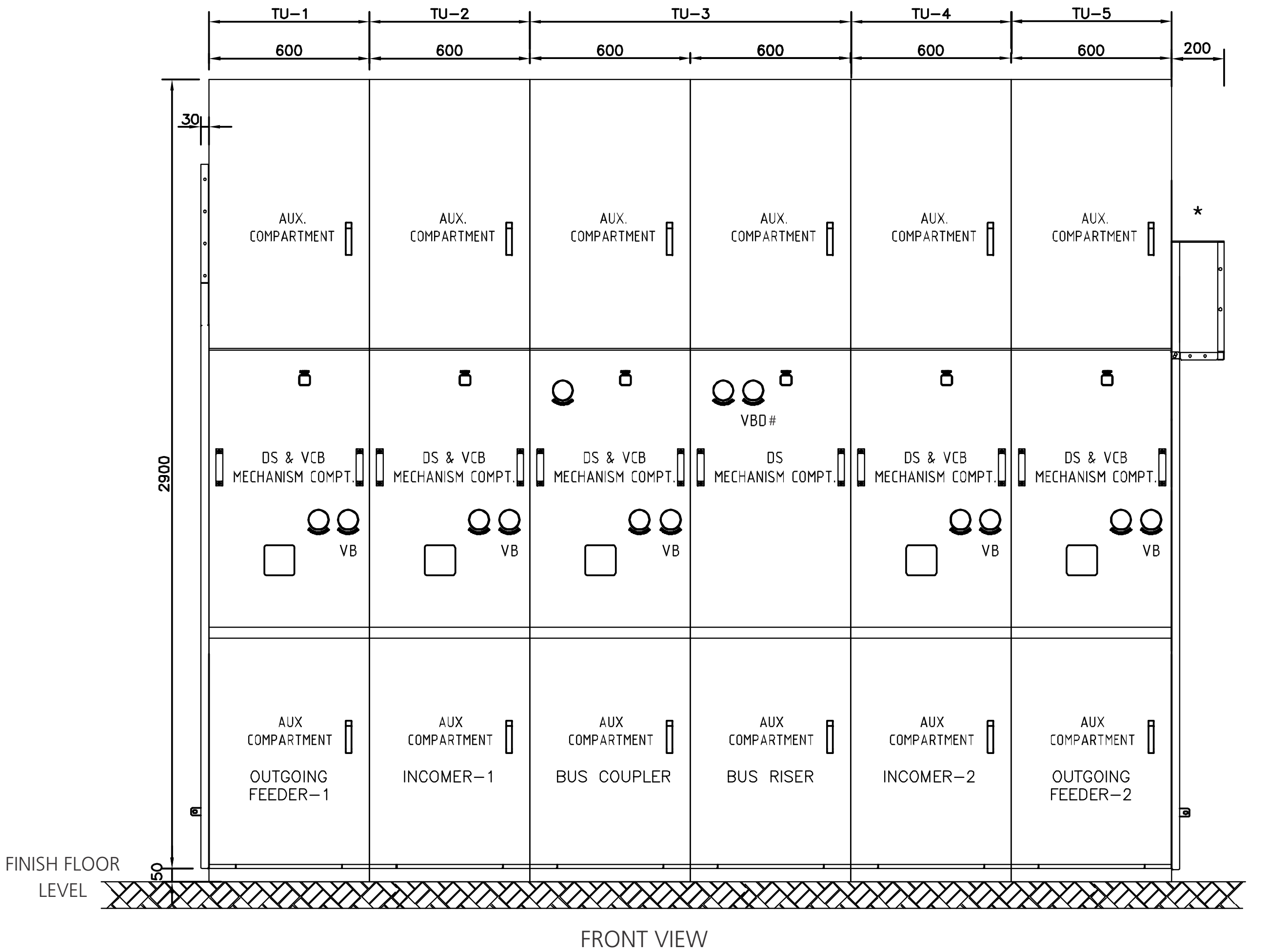


Figure -1 : Showing Arrangement of panels with SF6 gas inlet valve

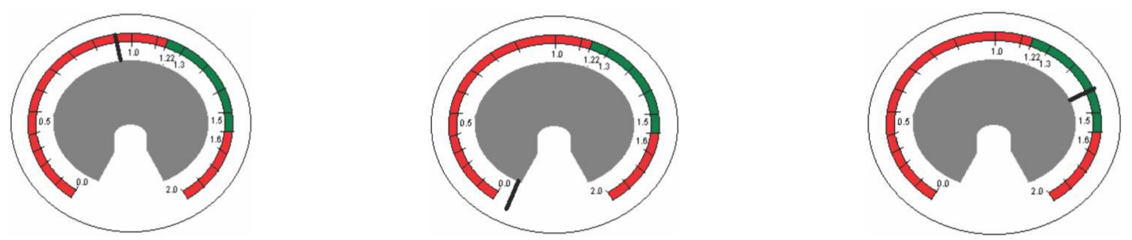


Figure - 2A *Figure - 2B* *Figure - 2C*

Figure -2 : Showing different positions on Manometer

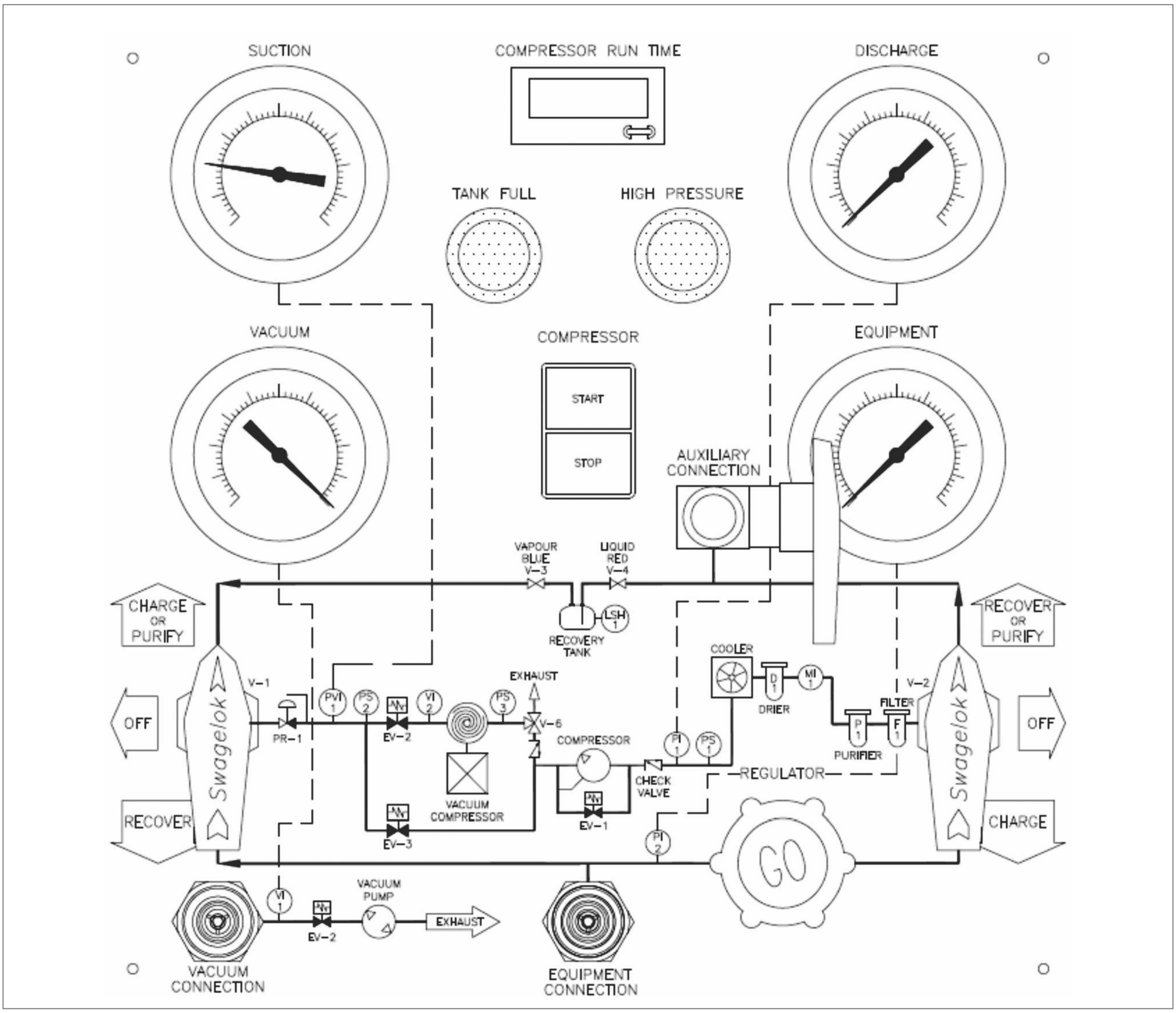


Figure 3.4.1 - GFU10-XDS Operator panel

Spares for GAS filling			Mandatory Spares
Sl. No.	Description		Quantity
1	SF6 GAS pressure manometer	Nos.	1
2	SF6 GAS REFILLING&EVACUATING-MODEL GFU10	Nos.	1
3	SF6 IR LEAK DETECTOR-MODEL - GIR-10	Nos.	1
4	SF6 Gas Cylinder	Nos.	1
5	Filling adapter(Pipe)	Nos.	1

ANNEXURE-B

Cable Connections (GV3N)

1. Do's & Don'ts (pre-caution) during cable connection to Switchgear:-

I. Ensure the Bushings, cable termination kit and terminated cables are clean before connecting to cable bushings of panel. (Note: Always refer cable termination kit manufacturer's assembly instructions for cable end termination & Connection procedure to switchgear panel).

ii. Cable lug should be concentric with bushing termination hole.

iii. Clamp the cables at desired position, ensure the cable is not creating cantilever load on termination bushings.

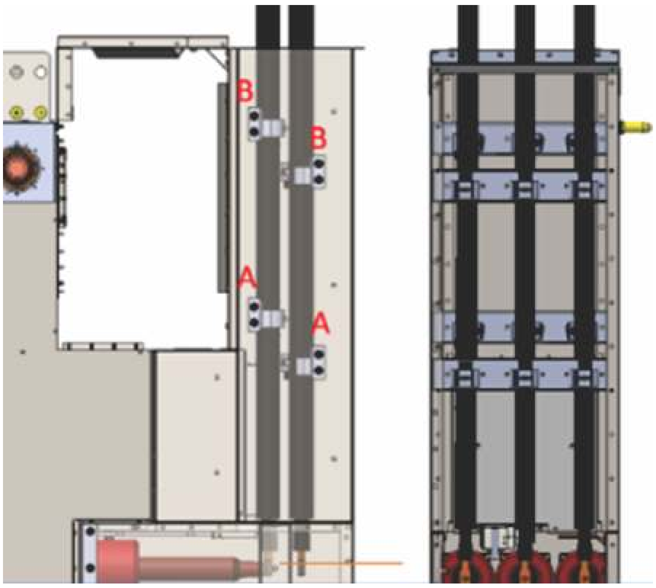
iv. Connection of termination bushings and cable adaptors are fitted in such way that air is not trapped to form ionisation.

v. Cable trifurcation shall be done outside panel in case of 3 core cable.

vi. Cable should be hold in cable trench such that no stress/Cable Weight exerts on bushing.

vii. Customer / cable terminator needs to ensure proper height of cable trench so that power cable can enter into GIS panel in vertically straight way.

2. Brief SOP with diagrams of proper cable Connections within Switchgear: -



Action – A

Adjustment of cable length to match the cable lug concentricity with cable bushing.

Step-1

1. Open the Rear cover/ cable compartment.

2. Route the power cable in the panel through cable gland plate.

3. Clamp the cable at position "A"

Action – B

Adjustment of cable length to match the cable lug concentricity with cable bushing.

Step-2

4. Clamp the cable at position "B"

5. Recommended makes for cable terminations kits: -

• NKT Or Euro-mould.

Note:- When cable termination is in user scope, then jointer should be Authorised Vendor of cable termination kit manufacturer with valid certificate.

Cable termination

(I) Cables shall be kept minimum of 1.2m straight from Bushing conductor point.

(ii) They shall be clamped internally in the cable compartment of GIS, as well as externally to the GIS.

(iii) Also check concentricity of cable lug with the Bushing conductor.

(I), (ii) & (iii) are mandatory in order to ensure there is no mechanical stress on bushing.

In case of three core cables, trifurcation shall be done at a point external to the GIS so that the above conditions are met.

While clamping the cable, care to be taken not to damage the cable insulation.

Boots shall be tightly plugged so that there is no air gap

Please contact OEM at the End of Service Life.

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