



General Switchgear & Controls
T&D Switches

380 Markland Street.
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Tel: (905)888-0557 Fax: (905)888-0551
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**Medium Voltage Metal-Clad and
Metal-Enclosed Arc-Resistant Switchgear**



**General
Switchgear &
Controls Ltd**

**The most advanced Arc-Resistant Switchgear,
designed and built to provide maximum safety in
the event of an Internal Arcing Fault.**

***5kV to 38kV,
630 Amp to 4000 Amp
Indoor or Outdoor Application***



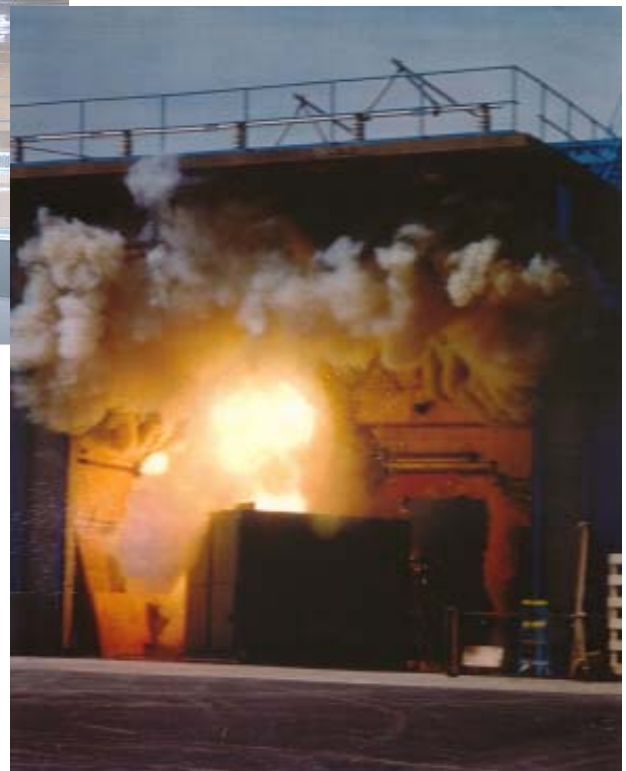
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***Medium Voltage Metal-Clad and
Metal-Enclosed Arc-Resistant Switchgear***

***Arc Resistant Switchgear
The Ultimate in Arc Flash Protection***

Design and Test Stanadards

Designed and Tested to EEMAC G 14-1 Arc Fault Test Standard
Consistent with the latest IEEE/ANSI C37.20.7 Arc Fault Test Standard
Designed to requirements of EEMAC G8-2, ANSI 37.20.2
Maximum in Operator Safety—Minimum Equip't Down Time

Extra Safety Features

Breaker & PT compartment closed Door Racking Interlocks
Racking Only possible if Arc Resistant is Closed and Latched
Arc Resistant Door can only be opened if Bkr/PT is Racked out
In compartment Cameras for Visual confirmation of shutters Closed.

Arc Resistant Classifications

| EEMAC G 14-1 Standard | IEEE C37.20.7 |
|---|----------------------|
| Type A, Arc Resistant Front of enclosure | Type 1 |
| Type B, A-R, Front, Back & Sides of enclosure | Type 2 |
| Type C, A-R Type B enclosure + A-R | Type 2C |
| Compartment to Compartment within a cell | |
| Type C+, Main Bus fault restricted to cell involved | Allowed |



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Recent 15kV Contracts Arc Resistant Switchgear





Medium Voltage Metal-Clad and Metal-Enclosed Arc-Resistant Switchgear

1. INTRODUCTION

Conventional Medium Voltage Metal-Clad and Metal-Enclosed Switchgear built to comply with EEMAC-G8-2 1972 and ANSI C37.202-1987 standards have provided safe and reliable service to the user. The occurrence of a fault on medium voltage switchgear is extremely low and a fault leading to personal injury is very rare indeed. However failure due to defective insulating materials, improper bus joints, poor maintenance, incorrect protective/safety devices, human error, ingress of moisture, abnormal service conditions cannot be ruled out. An internal arcing fault may start as a phase to ground fault but very quickly develops to a 3-phase fault. High arc energy fault causes a rapid rise in the temperature of the surrounding air and rapid rise in pressure inside the enclosure.



Conventional switchgear is not designed to withstand such a high pressure. This causes the door to blow open, hinges, door latches, relays, etc. start to fly out like missiles, hot gases and burning metals to escape which are potential hazards to persons in the vicinity of the switchgear.

Arc Resistant switchgear designed and tested to EEMAC G14-1 standards provides highest degree of protection to person against internal arcing fault and has been used by utilities and industrial users in recent years.

General Switchgear & Controls Ltd. manufactures Arc-Resistant Metal-Clad and Metal-Enclosed switchgear to meet the CSA, ANSI and industry standards



Medium Voltage Metal-Clad and Metal-Enclosed Arc-Resistant Switchgear

2. APPLICATION

A. Accessibility

The application of arc-resistant switchgear based on EEMAC-G14-1 standard can be summarized as follows:

Type A • is specified if the arc-resistant construction is required at the front only.

Type B • is specified if the arc-resistant construction is required on the front, back and sides of the switchgear enclosure.

Type C • is specified if the arc-resistant construction is required between the compartments of the same cell or adjacent cell, in addition to the front, back and sides of the switchgear enclosure.

Type C+ • is specified when a fault in the bus compartment is not allowed to break into the adjacent bus compartments.

B. Arc-Current

The arc current level is generally specified as the short circuit level of the system or to a current level mutually agreed between the customer and the manufacturer.

C. Duration of Arcing

The arc duration can be specified for 160mSec or 1 Sec. depending on the operating time of the protective relays used in the system. Arc Resistant Switchgear will withstand the pressure wave and will not burn through the steel wall/doors if a 1 Sec. duration is specified but will only withstand pressure wave if a 160mSec. arc duration is specified.

3. STANDARDS

A. Cable Termination

The primary cable should enter the cable compartment from below to avoid damage to the cables from escaped hot gases/vaporized metal from the top of the switchgear.

If top entry cable or bus duct is required a rear extension of the switchgear is generally provided.

It is also important that the cable entries are sealed around the gland plates to avoid escaping hot gases to the outside.

B. Potential Transformer Compartment

PT's are normally located in a separate cell or at the rear of the breaker cell to comply with the arc-resistant requirement.

C. Switchgear Building

The switchgear building should be designed to consider the overpressure generated due to discharged gas and a safe operating aisle is recommended.



**Medium Voltage Metal-Clad and
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4. RATINGS

The basic rating of Metal-Clad Switchgear with Vacuum Circuit breaker and Metal-Enclosed Load Interrupter Switchgear is as follows

A. Metal-Clad Switchgear

| Nominal Voltage Class (kv) | Rated Continous Current at 60 Hz | Rated Short Circuit at rated Maximum Voltage | Arc-Resistant Short Circuit Current Level at 60 Hz | Accessibility Type |
|----------------------------|----------------------------------|--|--|--------------------|
| 4.16 | 1200 2000 3000 | 29 | 36 | B, C & C+ |
| 4.16 | 1200 2000 3000 | 41 | 49 | B, C & C+ |
| 7.2 | 1200 2000 3000 | 33 | 41 | B, C & C+ |
| 13.8 | 1200 2000 3000 | 18 | 23 | B, C & C+ |
| 13.8 | 1200 2000 3000 | 28 | 36 | B, C & C+ |
| 13.8 | 1200 2000 3000 | 37 | 48 | B, C & C+ |
| 27 | 630 1200 2000 | 25 | 25 | B, C & C+ |
| 38 | 630 1200 2000 | 25 | 25 | B, C & C+ |

B. Metal Enclosed Switchgear

| Nominal Voltage (kv) RMS | Continous Ampere RMS | CURRENT RATINGS | |
|--------------------------|----------------------|------------------------|--------------------------|
| | | Short-Time Ratings | |
| | | Momentary Asym kA, RMS | Fault-Close Asym kA, RMS |
| 4.16 | 600 | 40 | 40 |
| | 1200 | 61 | 61 |
| 7.2 | 600 | 40 | 40 |
| | 1200 | 61 | 61 |
| 13.8 | 600 | 40 | 40 |
| | 1200 | 61 | 61 |
| 14.4 / 27 | 600 | 40 | 40 |
| | 1200 | 61 | 61 |



Medium Voltage Metal-Clad and Metal-Enclosed Arc-Resistant Switchgear

5. ARC-RESISTANT CONSTRUCTION

The Switchgear cell is specially designed and structurally enhanced to withstand the internal overpressure due to an internal arc. The following enhancements are made to make the switchgear arc-resistant.

Pressure Relief Vents are located on the top of the switchgear cubicle. They are designed to open when subjected to high pressure and relieve the high pressure and dissipate the arc products away from operating personnel. They are therefore designed light enough to keep the inertia low and the same time strong enough to support the weight of maintenance personnel who may walk on top of the cubicle.

A light gauge panel hinged on one side and provided with a unique latch has been developed by General Switchgear & Controls Ltd. for the arc-resistant switchgear. Pressure relief vents are provided above the circuit breaker, busbar and cable compartment to meet the requirements of type C accessibility.

Doors on the cubicle need to be opened often and are provided with various cutouts for viewing windows, operating knobs, louvers and locking handles etc. making them the weakest part of the switchgear line-up. They are therefore reinforced the most, especially at the hinged end. General Switchgear & Controls utilises an 8-point door locking mechanism that locks the door firmly on three sides with a 90° (1/4) turn on a handle. The hinge side is provided with a specially designed high strength hinges. The door and all external cover plates are made to close on a special profile gasket that retains its sealing characteristics even after prolonged compression.

Louvres when required are provided on the front and/or rear bottom doors to ensure circulation of ventilation of the switchgear. However, during an internal arcing fault, the hot gases and arc products will escape through the louver openings in the doors.

General Switchgear & Controls Ltd. uses a novel approach to prevent hot gas to escape through ventilation louver by using a specially designed spring loaded flap over the louvers. When the pressure develops within the enclosure due to an internal arcing fault, the spring on the louvre flap mechanism are released and closes the louver opening in the shortest possible time. After the venting of the first wave of excess pressure, a negative pressure is created inside the enclosure and causes the flaps to open and stay open for the next wave of hot gases and arc products to exit from the louvre openings.

General Switchgear & Controls uses a latch mechanism on the louvre flaps to lock the ventilation flaps in closed position.



**Medium Voltage Metal-Clad and
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6. METAL-CLAD CONFIGURATION

The Switchgear cells are of a welded and bolted construction which forms a rigid self-supporting structure capable of withstanding forces exerted under external short circuit and internal arcing conditions. The switchgear cell is divided into four separate compartments to comply with the requirements of Metal-Clad switchgear construction. The compartments are:



Arc-Resistant Circuit Breaker Compartment

- Circuit breaker compartment or Potential transformer compartment.
- Main busbar compartment.
- Cable connection compartment,
- Low voltage compartment.

The compartments are segregated from each other by reinforced barriers to ensure that any internal fault is contained within its own compartment. Pressure relief vents are installed at the top of each compartment containing high-voltage components.

Circuit Breaker Compartment contains the vacuum breaker mounted on a withdrawable carriage which permits the breaker to be taken out of the enclosure. The front door of the compartment is provided with a 'Lexan' viewing window to observe the mechanical indicators on the front plate of the circuit breaker. The door also has a shutter through which the racking handle can be inserted to rack the circuit breaker in or out. Clearly visible mechanical indication is provided of the circuit breaker's position. ON and OFF pushbuttons can be provided on the door for operating the circuit breaker manually in an emergency. In addition, the circuit breaker compartment door is provided with a 8-point door locking mechanism operated by a single handle.



Arc-Resistant Switchgear PT Compartment

Potential Transformer Compartment can be provided in place of a circuit breaker compartment which can accommodate two or three potential transformers in Open-Delta or grounded wye configuration. The potential transformers are mounted on withdrawable drawers that can be racked in or out and are provided with three primary contacts on the rear that connect the potential transformers to the line or load side and four secondary contacts mounted on the side of the drawer.

For line connected potential transformers, tilt-out or withdrawable drawers can be provided on the upper rear part of the enclosure. These drawers also have primary and secondary contacts and normally project 14" from the rear of the standard enclosure.

Main Busbars are completely enclosed by metal barriers and are high strength, 98% conductivity, rectangular copper with rounded edges. The busbars are coated with a flame retardant and tract resistant epoxy insulation. Busbar joints are silver plated and covered with insulated boots. The



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*Arc-Resistant Switchgear
Cable Compartment*

busbars are braced on epoxy or porcelain supports to withstand stresses developed under short circuit conditions. The busbars between the adjacent cubicles run through specially designed bushings. Main busbars are available for ratings of 1200A, 2000A and 3000A.

Cable compartments are located at the rear of the cubicle. Connections are generally provided for bottom entry cables. If top entry cables or top entry bus duct connections are required, a 14" deep box are mounted at the upper rear part of the enclosure due to the location of the pressure relief vents.

Low Voltage Compartment is located above the breaker compartment and completely segregated from the high voltage compartment. Protection devices, meters, instruments, control switches, pilot lamps etc. are mounted on the hinged door. Fuses, auxiliary relays, terminal blocks etc. are mounted inside this compartment.

7. METAL-ENCLOSED CONFIGURATION

The Switchgear cell are of a welded and bolted construction which forms a rigid self-supporting structure capable of withstanding forces exerted under external short circuit and internal arcing conditions. The switchgear cell has three compartments to prevent accidental contact of live parts by the operator. These compartments are:

- Load Break Switch Compartment & Main Bus Compartment
- Power Fuse and Cable Compartment
- Low Voltage Compartment if required.

The compartments are segregated for each other by either insulated or metal barriers. A pressure relief vent is provided on the top of each compartment containing high voltage components.

Load Break Switch Compartment contains the load break switch and main bus connection. A 'Lexan' window is provided to view the position of the switch blades. The door is provided with an 8-point door locking mechanism. The door is also interlocked with the power fuse compartment door.

Power Fuse and Cable Compartment is normally combined. The power fuse compartment door is provided with an 8-point door locking mechanism and interlocked with the switch handle and the load break switch compartment door so that this door cannot be opened if the switch is closed and will not permit the load break switch compartment door to open if the load break switch is closed.

Low Voltage Compartment is provided if required. The compartment would contain mainly terminal blocks, control fuses, thermostats and occasionally current transformer test blocks and ammeters.



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8. ARC RESISTANT SWITCHGEAR SAFETY BENEFITS

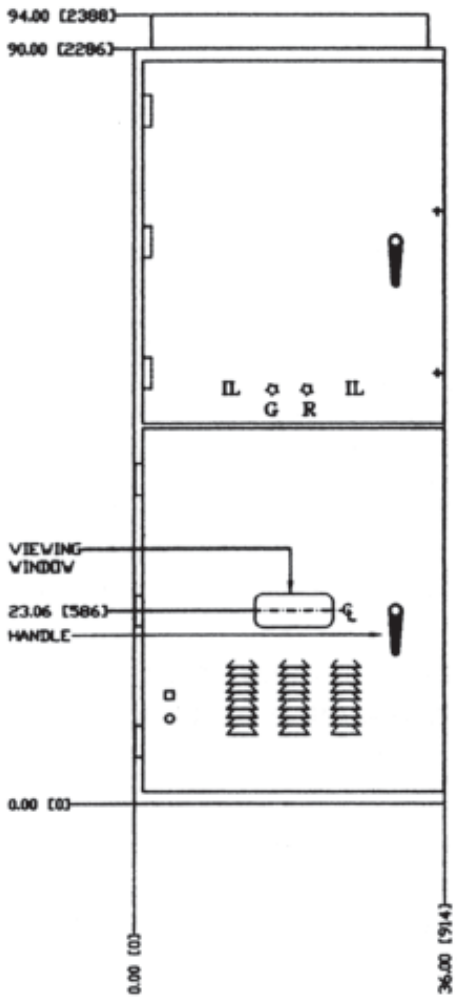
- Each compartment doors and barrier plates are designed to withstand pressure surge due to internal arcing.
- Hot gases and molten particles escape through a specially designed pressure relief vent located on the roof of the enclosure away from the operating personnel.
- Closed door racking of circuit breaker provided for added safety.
- Viewing window allows to observe the status of the circuit breaker without opening the door.
- The low voltage compartment is completely segregated to avoid any pressure build up.
- The arc-resistant switchgear design will contain the damage within the faulty compartment and hence down time is greatly reduced.



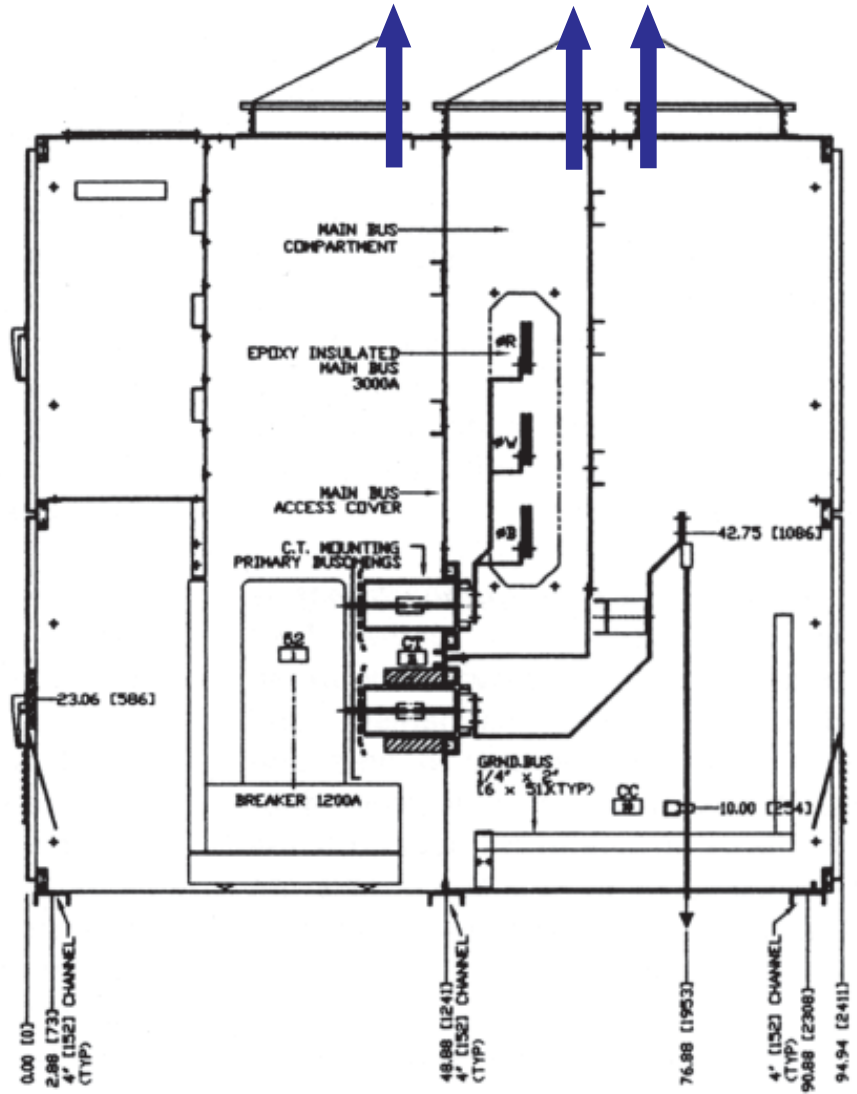


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Main & Feeder Breaker Cell



Front View

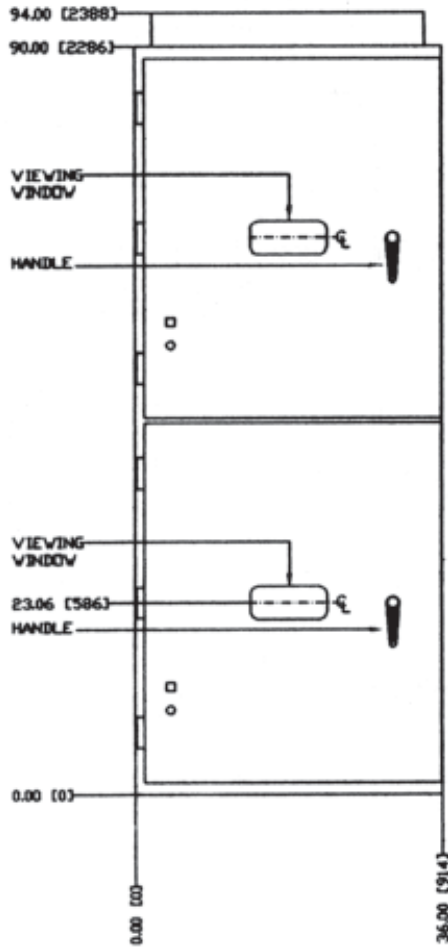


Section View

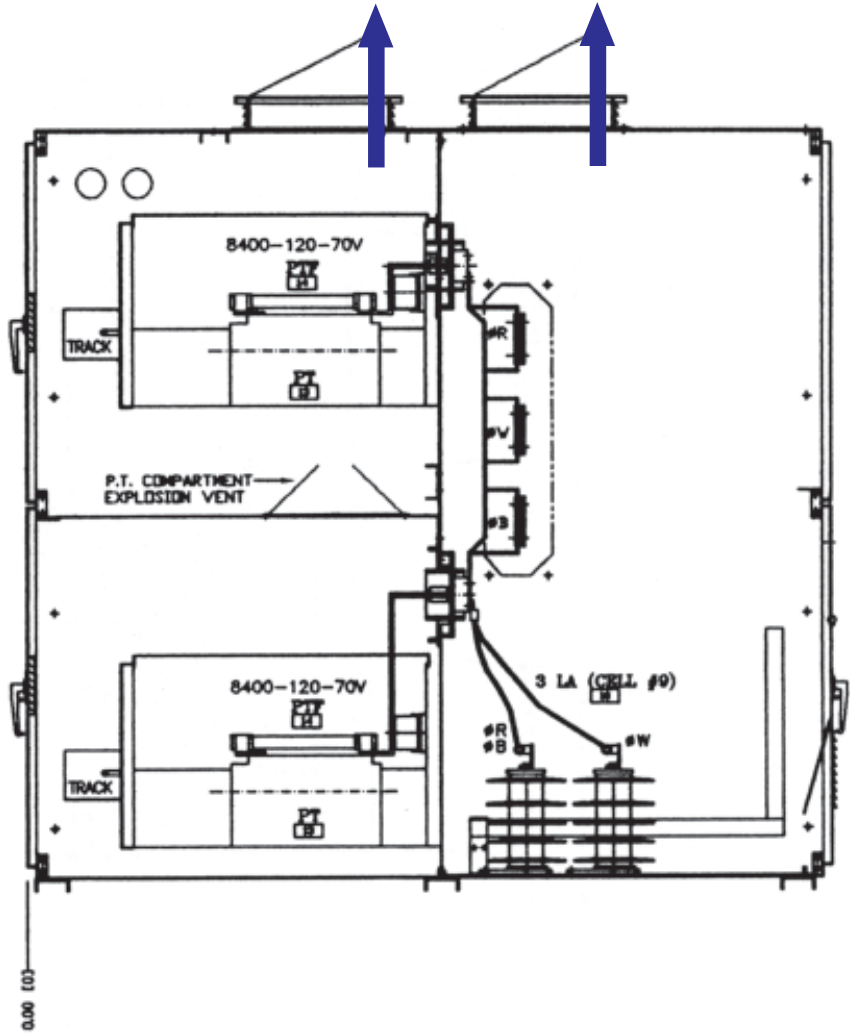


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Power transformer Cell



Front View

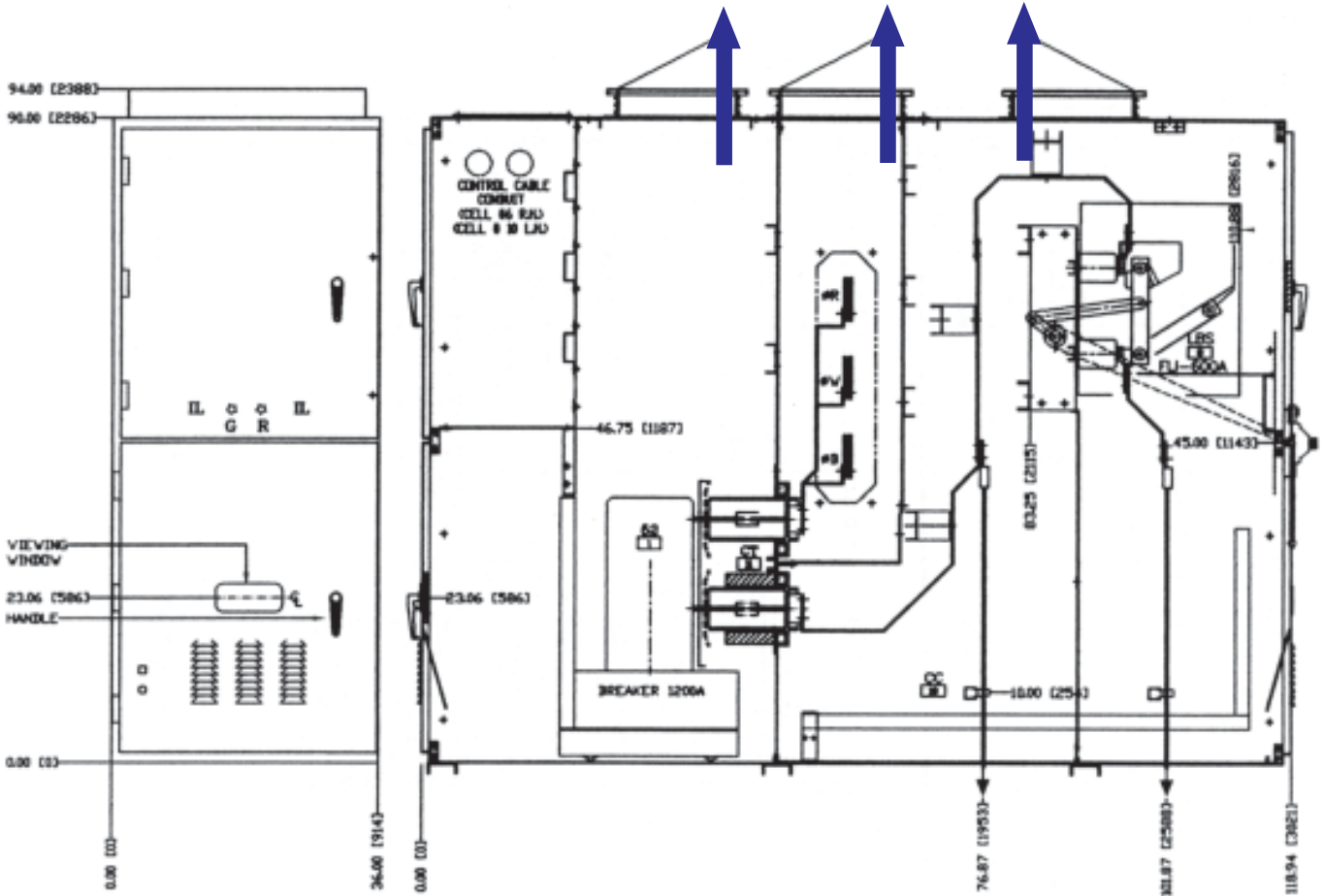


Section View



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Feeder Breaker Tie Switch Cell



Front View

Section View