

Medium Voltage Switchgear 5 through 15 kV Selection and Application Guide

Siemens GM 5kV, 7.2kV and 15kV metal-clad power switchgear assemblies with horizontal drawout type GMI vacuum circuit breakers take advantage of the latest developments in vacuum interrupter technology. Up to two circuit breakers can be stacked in a single vertical section, allowing significant space savings.

The equipment meets or exceeds the latest standards of ANSI, IEEE, and NEMA. UL listing is available where the arrangement allows.

GM switchgear is widely used in industrial plants, commercial buildings, electric utility systems, cogeneration installations, and other electrical systems. It is commonly used for protection and switching of transformers, motors, generators, capacitors, buses, distribution feeder lines, and, in general, for protection of any medium voltage power circuit.

Siemens' experience gained in nearly 70 years of supplying metal-clad switchgear in the U.S.A. has been captured in the GM design. The objective has been to incorporate features designed to provide safety, while simplifying operations, maintenance, and minimizing installation cost.

The switchgear structure and the drawout vacuum circuit breaker are an integrated design, with dielectric, thermal, and interruption integrity built directly into the basic design, not added as an afterthought.

Siemens Vacuum Interrupters

The vacuum interrupters used in the GMI circuit breaker are manufactured by Siemens and have been proven in thousands of installations since 1976. The chrome-copper contact design used in these interrupters assures low chopping levels, eliminating the need for surge protection on most circuits.

Front Mounted Operating Mechanism

The simple GMI operating mechanism makes maintenance and inspection easy. The mechanism is located on the front of the circuit breaker, rather than underneath.



GM Switchgear with GMI Vacuum Circuit Breaker

Five Year Maintenance Interval

If applied under ANSI "usual service" conditions, maintenance is only needed at 5 year intervals.

Floor Rollout

No lift truck or dolly is needed to insert or remove circuit breakers in the lower cell of indoor or Shelter-Clad installations since floor rollout convenience is standard for GMI breakers.

"Universal" Spare Breaker

The physical configuration and interlock logic allow the use of a single circuit breaker to serve as a "universal" spare breaker at an installation site. The interlock logic checks the four principal rating characteristics (continuous current, maximum voltage, interrupting

current, and close and latch current), and allows a circuit breaker to be inserted in a breaker cell, provided that the breaker equals or exceeds the ratings required by the cell.

Single Source Responsibility

Single source responsibility is assured since the complete equipment is designed, manufactured, and tested in a single facility.

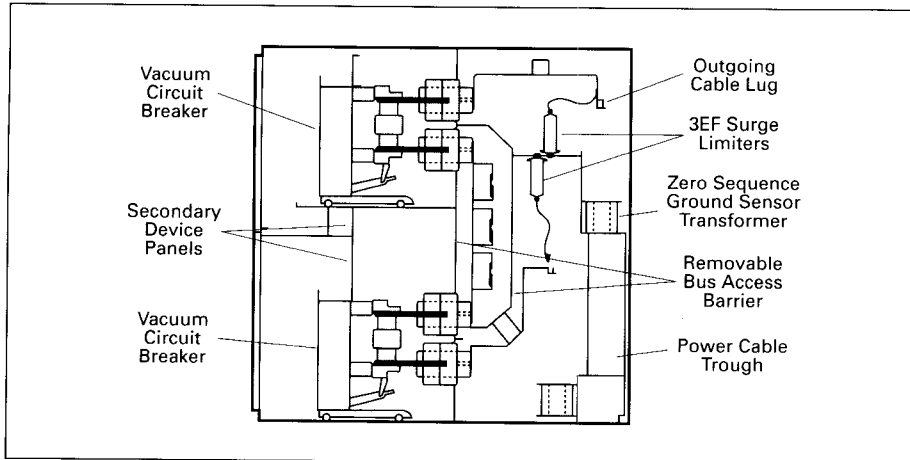
ISGS™ Intelligent SwitchGear System

The ISGS programmable relay can be provided to meet multifunction protection and metering needs. The ISGS unit can be part of an ACCESS™ monitoring system to make all protective and metering data available at a central personal computer.

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General



Tested to ANSI Standards

Siemens GM switchgear is tested to meet the requirements of ANSI standards. A complete design test program, including short circuit interruption, load current switching, continuous current, mechanical endurance, close and latch current, short time and momentary withstand, impulse withstand, and the other tests required by the standards has been successfully completed. These tests encompass the complete equipment design, including both the switchgear structure and the circuit breaker removable element. Production tests to ANSI standards are performed on every group of switchgear and on each circuit breaker. Certified copies of all test data can be furnished to customers upon request.

UL Listing Available

When specified, if the component configuration allows, the switchgear can be provided with the UL listed label, indicating conformance to the requirements of ANSI C37.54 and C37.55.

Structural Flexibility

Siemens GM metal-clad switchgear provides enhanced flexibility in locating circuit breaker, auxiliary, and metering cells within the structure layout. Circuit breakers rated 1200 amperes and 2000 amperes may be located in upper or lower cell positions, to a maximum main bus self cooled limit of 4000 amperes per vertical section.

Bus sectionalizing (tie) circuit breaker cells may be located on the upper or lower levels and are ordinarily located next to an auxiliary cell on the same level to accommodate transition bus work.

3000 ampere circuit breakers can be located either in the bottom cell or the top cell of a vertical section. If the 3000 ampere circuit breaker is located in the lower cell, the upper cell can be used for metering devices only. If the 3000 ampere circuit breaker is in the upper cell, the lower cell may be used to house a set of drawout voltage transformers.

The 3000 ampere circuit breaker can be used for 4000 amperes continuous, with the addition of fan cooling equipment in the auxiliary cell above the circuit breaker. This application is well suited if loads above 3000 amperes are infrequent, as for example, in the case of a fan cooled rating on a power transformer.

Each vertical section contains a main bus bar compartment and two cells for auxiliary devices and/or circuit breakers, including primary and secondary disconnects, instrument transformers, instruments and relays, secondary wiring, and other components as necessary. The switchgear is normally designed so that additional vertical sections may be added in the future.

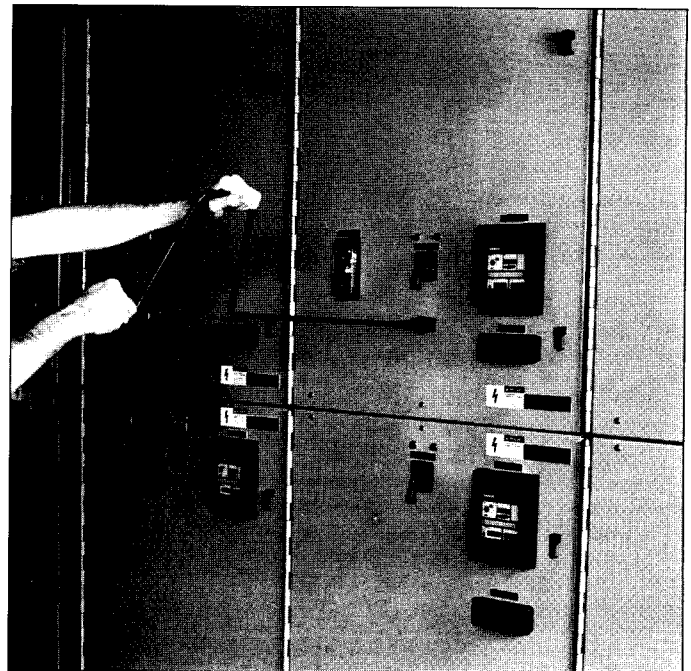
Enclosure Design

The GM design includes full ANSI C37.20.2 Metal-Clad construction. This means complete enclosure of all live parts and separation of major portions of the circuit to retard the spread of faults to other compartments. Removable plates permit easy access to all compartments. The rear panels are individually removable for access to either downfeed or upfeed cables.

Sheet steel inter-unit barriers extend the full height and depth of each vertical section for isolating adjacent sections. The ground bus extends the entire length, and to all circuit breaker cells in the complete switchgear lineup.

Breaker Interchangeability

The GM switchgear cubicle and the removable GMI circuit breaker element are both built to master fixtures so circuit breakers of the same ratings are interchangeable with each other even if the breaker is required for use with a cell with "provisions only" supplied years earlier.



Upper Cell Breaker being Racked Out with Door Closed

Construction

Switchgear Compartments

Vacuum Circuit Breaker Cell

The circuit breaker cell is a bolted, reinforced, sheet steel enclosure, with provisions for a type GMI vacuum circuit breaker. It includes a hinged front door, inter-compartment and inter-unit barriers, primary and secondary disconnects, racking mechanism, interlocks, instruments and relays, control wiring and devices, and current transformers.

Vacuum Circuit Breaker Element —

The GMI vacuum circuit breaker includes a stored energy operating mechanism, primary and secondary disconnects, auxiliary switches, ground contact, control wiring, and interlocks.

Auxiliary Cell — An auxiliary cell is similar to a circuit breaker cell, except without provisions for a circuit breaker. Space may be used for VT's, CPT's and fuses, batteries, chargers, and other auxiliary devices.

Bus Compartment — The bus compartment is a separately enclosed space for three-phase insulated main power bus bars, supports, and connections to circuit breaker cells.

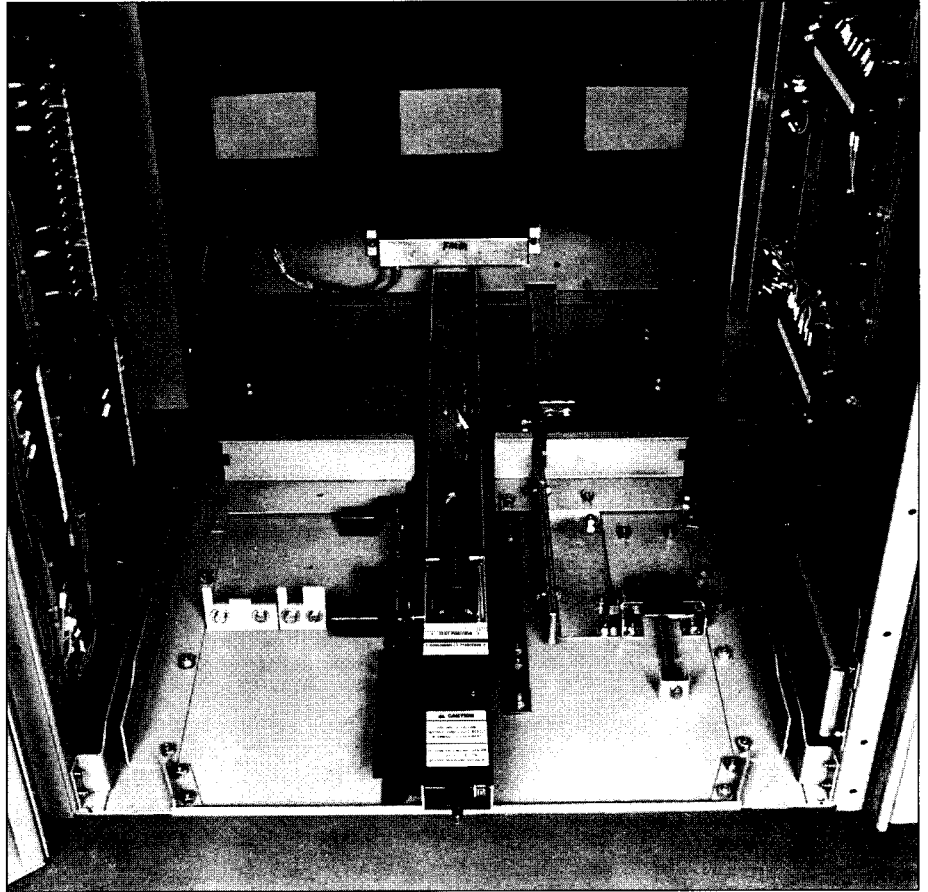
Cable Entrance Compartment — The rear area of the unit includes space for connecting incoming or outgoing power cables, busway connections, transformer connections, or surge protection devices.

Circuit Breaker Cell Features

Floor Rollout — Breakers in the lower cell can be rolled out directly on the floor in front of the unit, without a handling device, lift truck, or hoist for indoor and shelter-clad installations. A lift truck accessory is optionally available for handling circuit breakers in the upper cell, or in non-walk-in outdoor enclosures.

Closed Door Racking — The circuit breaker can be racked in or out with the cell door open or closed. For racking, a manual drive crank or an optional electric motor drive may be used.

Interlocks — Interlocks prevent moving a closed circuit breaker in the cell, by preventing engagement of the racking crank if the breaker is closed. A second interlock lever holds the circuit breaker mechanically and electrically trip-free between positions. The racking mechanism can be padlocked to restrict unauthorized racking of the circuit breaker. Separate padlock provisions may be used to hold the circuit breaker in the trip-free condition.



Circuit Breaker Cell Interior

Automatic Shutters — Automatically operated grounded steel shutters allow or block access to the stationary primary disconnects. The shutters are opened by the circuit breaker as it moves toward the connected position. The shutters close as the circuit breaker is racked away from the connected position to the test position. The shutters remain closed until they are forced open by insertion of the circuit breaker. This design maximizes protection for personnel, as compared to shutters which are linked to the racking mechanism.

Current Transformers — Front-access current transformers may be mounted around both the upper and lower stationary primary disconnect bushings. Up to a total of four per phase may be located in each circuit breaker cell.

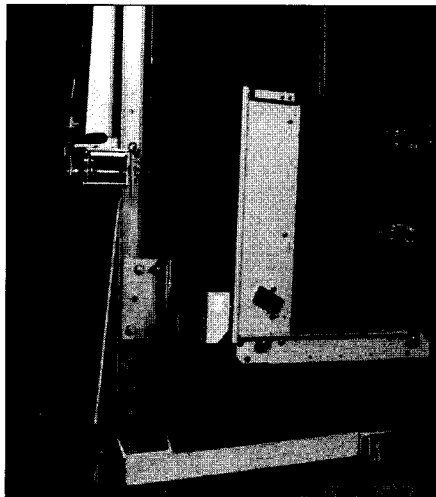
Primary Disconnects — The cubicle stationary primary disconnect contacts are recessed inside the insulator assemblies, and are located behind grounded steel shutters to prevent accidental contact when the breaker is withdrawn. The primary disconnect finger clusters are mounted on the circuit breaker.

Secondary Disconnects — The cubicle mounted stationary contacts mate with spring loaded secondary contacts on the side of the circuit breaker. The secondary disconnects automatically engage in both the test and connected positions.

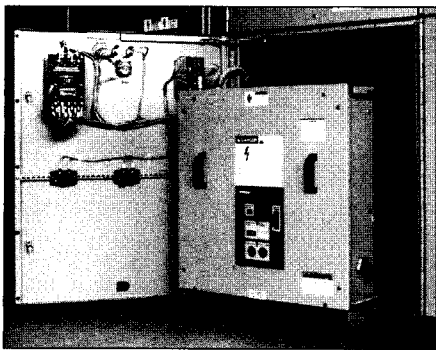
Mechanism Operated Cell (MOC) Switch — When required, up to 24 stages of the MOC auxiliary switch can be mounted in the circuit breaker cell.

Truck Operated Cell (TOC) Switch — When required, up to 12 stages of truck operated cell switch can be mounted in the circuit breaker cell.

Construction



GMI Circuit Breaker on Lift Truck



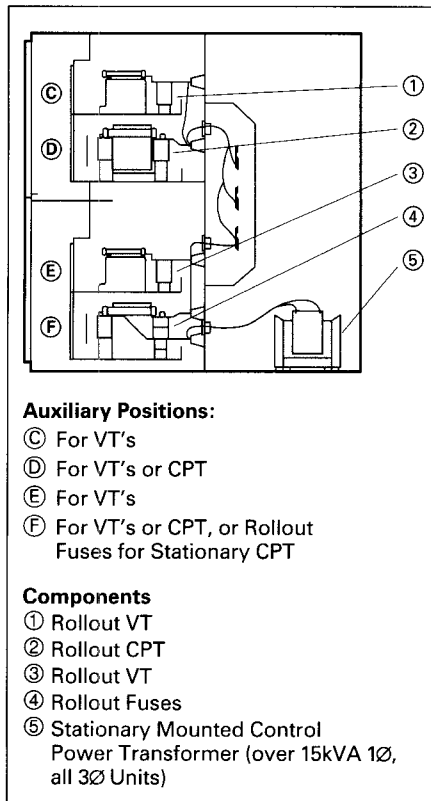
Floor Rollout / Roll-In

Circuit Breaker Cell Features, cont'd Unobstructed Terminal Block

Space — Terminal block areas are located on each side of circuit breaker or auxiliary cells. Since racking system components are not mounted on the cubicle sides, these terminal blocks are not obstructed as in other designs. Installation of field wiring is simplified, as wiring can be easily laid directly against the side sheet. It is not necessary to "fish" the wiring under, around, and through obstructions.

Secondary Control Device Panel —

Each circuit breaker or upper auxiliary cell incorporates its own secondary control device panel. The panel can accommodate pullout fuse holders or molded case breakers to suit the protective practices of the purchaser, and can also accommodate auxiliary relays, transducers, or similar devices. Since each circuit breaker cell has its own secondary control device panel, controls from two or more circuits are not intermingled, reducing the chances of confusion, maintenance errors, and the like.



Auxiliary Cell

Auxiliary Cells

Auxiliary cells are constructed in the same general manner as the circuit breaker cells, except without provisions for a circuit breaker element. Auxiliary cells may be located in the top or bottom of a vertical section. The front door panels may be used to mount meters, relays, or other instrumentation. The cubicle portion of the cell may be used for mounting devices such as voltage transformers, control power transformers, automatic transfer switches, battery chargers, or batteries. Rollout trays may be included for mounting VT's or CPT's.

Voltage Transformers — Up to three VT's with their integrally mounted current limiting fuses may be mounted on each rollout tray. The upper and lower cells can each accommodate up to two rollout trays. When moved to the disconnect position, the primary fuses are automatically disconnected and grounded to remove any static charge from the windings.

When the rollout tray is withdrawn, insulated shutters cover the cubicle primary disconnects, protecting personnel from exposure to energized components.

Control Power Transformers — One single phase control power transformer of up to 15kVA capacity, with its primary current limiting fuses and secondary breaker, may be mounted on the rollout tray of an auxiliary cell. The secondary molded case breaker is interlocked with the rollout tray such that the secondary breaker must be open before the control power transformer primary can be disconnected or connected. This prevents load current interruption on the main primary contacts. With the secondary breaker open and the latch released, the tray can be rolled easily to the disconnect position. As the tray rolls out, the primary fuses are automatically grounded to remove any static charge and insulated shutters close to shield energized conductors.

Large single-phase and all three-phase control power transformers are stationary mounted on the floor in the rear of the vertical section. The primary fuses for these large transformers are mounted on the rollout tray in the lower portion of the bottom auxiliary cell, and interlocked with the secondary breaker. Withdrawing the rollout tray closes the insulated shutters.

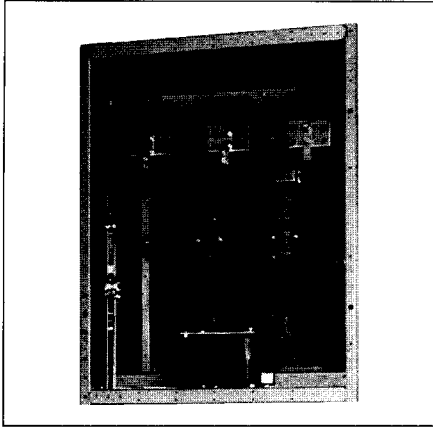
Current Transformers — Siemens toroidal current transformers comply with ANSI standards, and are mounted at the rear of the circuit breaker cell. Up to four standard accuracy MD current transformers may be mounted on each phase — two on the bus side and two on the load side, around the primary disconnect bushings. Current transformers may be added or changed with the cell de-energized without removing bus bar or cable connections.

For higher accuracy, type MDD current transformers are available. Due to their larger physical size, only one MDD CT can be installed on each side of the circuit breaker.

Primary Termination Compartment

The primary termination compartment is located at the rear of the switchgear and is separated from all other compartments by metal barriers. When two circuit breakers are located in the same vertical section, their primary cables are separated by steel horizontal barriers and by an enclosed vertical cable trough (or chimney) where both sets of cables exit in the same direction. Upper and lower bolted rear plates are standard and provide separate access to the cable area for each breaker.

Construction

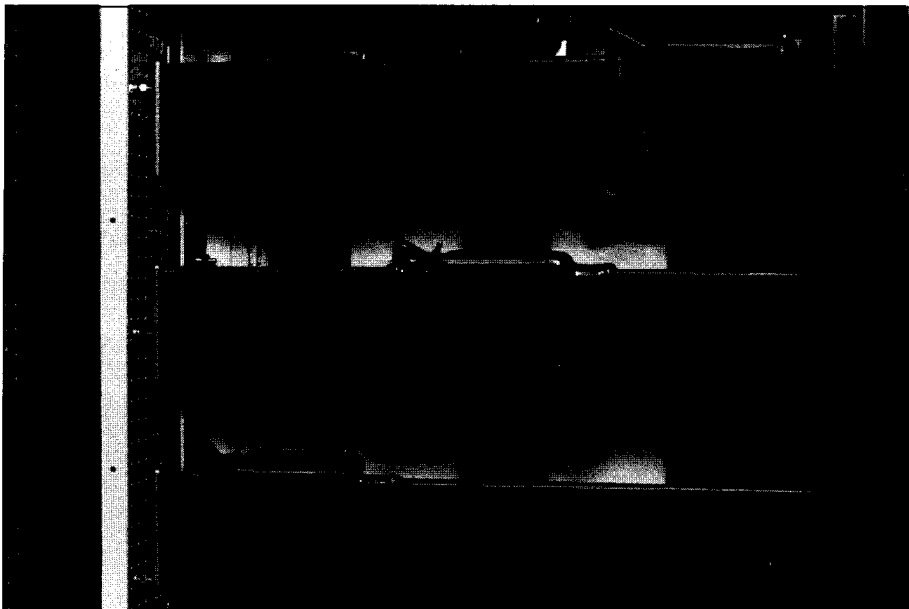


Cable Termination Area

Bus Bar System

The main bus bar system is enclosed by grounded metal barriers and feeds both the upper and lower cells in a vertical section. Full rounded-edge copper bus bar with silver plated joints is standard. Tin-plated aluminum bus, or tin-plated copper bus are available as options. High strength Grade 5 steel hardware assures constant pressure low resistance connections. Split lock washers are provided with copper bus, while spring washers are used in all joints involving aluminum bus. A copper ground bus is standard in all cubicles.

Bus Bar Insulation — Bus bars have fluidized bed, flame retardant, track resistant epoxy insulation. The epoxy is bonded to the bus bars, virtually eliminating corrosion due to intrusion of gas or moisture between insulation and bus bar.



Main Bus Construction

Bus Joint Insulation — For normal joint configurations, bolted bus joints are insulated by pre-formed molded polyvinyl boots which are held in place by nylon hardware. Preformed insulating materials eliminate the need for molding and taping joints when connecting shipping groups in the field, reducing installation time and costs. For uncommon joint configurations, taped joint insulation is used.

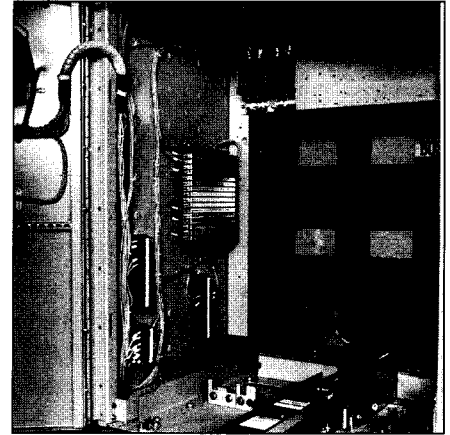
Bus Support Insulation — Track-resistant, flame retardant glass polyester or epoxy insulation components insure a uniformly high level of insulation quality throughout the switchgear. Bus bar supports and primary disconnect bushings are made of high impact strength insulation with high dielectric strength and low moisture absorption characteristics.

Optional Porcelain Supports — Electrical grade porcelain is available on GM switchgear for inserts on main bus bar inter-unit supports and stationary primary disconnect bushings in circuit breaker cells. For this option the stationary primary disconnect incorporates true porcelain line-to-ground integrity, unlike some other designs which add a porcelain component to a glass polyester support, but rely on glass polyester for the line-to-ground insulation integrity.

Finish

All uncoated steel parts are conveyed through a spray tunnel where they are degreased and exposed to a hot phosphate chemical treating mixture followed by a sealing solution. The phosphate bath effects a chemical

conversion of the metallic surface to a non-metallic phosphate coating. Insoluble in water, this coating is effective in retarding corrosion and is excellent undercoating for paint. After cleaning and stabilization, a coat of polyester urethane ANSI 61 paint is applied in an airless, electrostatic process. The parts are conveyed through the baking oven to insure adequate curing.



Circuit Breaker Cell Wiring

Wiring

The secondary and control wiring is connected to terminal blocks which have numbered points for identification. One side of the terminal blocks for all connections leaving the switchgear is reserved for external connections. Secondary and control wire is No. 14 AWG, extra-flexible, stranded type SIS wire, insulated for 600 volts. Insulated barrel, crimp-type locking fork terminals are used for most applications, except where the devices require a different type of terminal. Where they pass through primary compartments, secondary control wires are armored or enclosed in grounded metal wire troughs.

Instrumentation and Relays

Instruments, meters, and relays can be traditional switchboard type, or modern electronic type, depending on the requirements of the specification. If traditional electromechanical devices are used, they have semi-flush cases with dull black covers. Protective relays, if available as standard, are of the drawout type with built-in test facilities. Indicating and recording instruments, meters and relays are of the rectangular type, semi-flush mounted. All scales have a suitable range and are designed with black letters on a white background.

Construction / Accessories

Control and Instrument Switches

Switches furnished are rotary, switch-board type and have black handles. Circuit breaker control switches have pistol-grip handles, while instrument transfer switches have round notched handles, and auxiliary or transfer switches have oval handles.

Circuit breaker control switches have a mechanical flag indicator showing a red or green marker to indicate the last manual operation of the switch.

Outdoor Housings

Two types of outdoor housing — Non-Walk-In and Shelter-Clad — are available to meet almost any application. For both types the underside of the base is coated with a coal tar emulsion. The switchgear is shipped in convenient groups for erection in the field.

Non-Walk-In Design

The non-walk-in switchgear consists of indoor type breaker and auxiliary cubicles located in a steel housing of weatherproof construction. Each vertical section has a full height exterior front door with provision for padlocking. Each cell is also equipped with an inner hinged front door for mounting relays, instrumentation, and control switches. Two removable rear panels are included for cable access to the primary termination area. Each cubicle includes a switched lamp receptacle for proper illumination of the cubicle during maintenance and inspection, a duplex receptacle for use with electric tools, and necessary space heaters. A switch for all space heaters is located in one cubicle.

Shelter-Clad Design — Single Aisle

The shelter-clad switchgear consists of indoor type circuit breaker and auxiliary cubicles located in a weatherproof steel housing having an operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test or maintenance. An access door is located at each end of the aisle, arranged so that the door can be opened from the inside regardless of whether or not it has been padlocked on the outside. The aisle space is provided with incandescent lighting which is controlled by means of a three-way switch at each access door. Each cubicle includes necessary space heaters. Each lineup includes two utility duplex receptacles, one at each aisle access door, for use with electric tools, extension cords, etc.

The weatherproof enclosure for the aisleway is shipped disassembled for erection in the field.

Shelter-Clad Design — Common Aisle

The Shelter-Clad-Common Aisle switchgear consists of two lineups of indoor type circuit breaker and auxiliary units located in a weatherproof steel housing having a common operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test or maintenance. Otherwise, the construction is as described for single aisle design.

Accessories

Standard accessories include

- Manual Racking Crank
- Spring Charging Handle
- Drawout Extension Rails (facilitate handling of circuit breakers in upper cell)
- Lifting Sling (for breakers above floor level)
- Contact Lubricant
- Touch-Up Paint

Optional accessories available include:

- Circuit Breaker Lift Device
- Split Plug Jumper
- Test Cabinet
- Test Plugs (for drawout relays, meters)
- Electric Racking Motor Assembly
- Fifth Wheel Handling Device

Test provisions, either a split plug jumper or a test cabinet, are available for testing the circuit breaker outside its cubicle.

The split plug jumper is used to bridge the secondary disconnects with a flexible cable, so the circuit breaker may be electrically closed and tripped with the control switch on the instrument panel. The test cabinet is used for closing and tripping the circuit breaker at a location remote from the switchgear.

Manual Ground and Test Device

This is a drawout element that can be inserted into a circuit breaker cell. It opens the shutters, connects to the cell primary disconnecting contacts, and so provides a means to make the primary disconnect stabs available for testing. It is suitable for high potential testing of outgoing circuits or of the switchgear main bus, or for phase sequence checking. It also provides a means to connect temporary grounds to de-energized circuits for maintenance purposes.

Electrical Ground and Test Device

An electrical ground and test device includes a power operated switch arranged to allow grounding one set of disconnect stabs. Two devices, one each for the upper and lower stabs, are required if grounding is desired to either side of the unit. The device also provides a means of access to the primary circuits for high potential tests or for phase sequence checking. These devices are able to close and latch against short circuit currents corresponding to the ratings of the equipment. Due to the unique requirements frequently involved in such devices, all applications of electrically operated ground and test devices should be referred to Siemens for review.

Note: Due to the special nature of ground and test devices, it is recommended that each user develop definitive operating procedures incorporating safe operating practices. Only qualified personnel should be allowed to use ground and test devices.

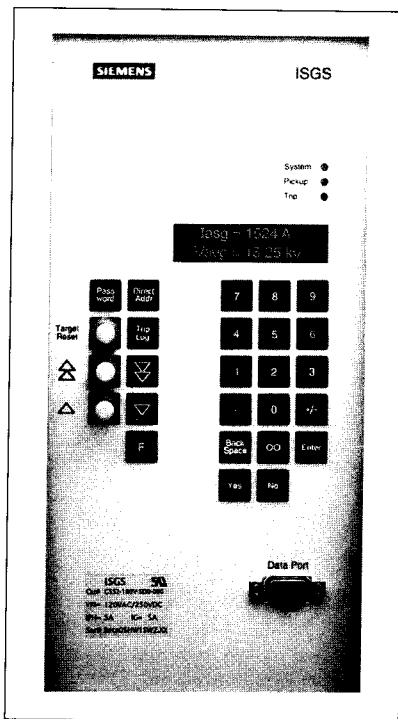
ISGS™ Relay, ACCESS™ System

Application

The ISGS protective relay is used to provide all common protective relay functions, metering, indication and control associated with switchgear circuit breaker installations. The ISGS relay replaces separately mounted and wired components simplifying specification and installation while providing increased reliability and functionality.

Features

- Three phase plus ground time and / or instantaneous overcurrent protection, replacing four separate relays.
- 9 selectable time overcurrent curves and 1 custom curve.
- Large 16 character 2-line, back-lit LCD front panel display for easy review of metered data and settings.
- Standard metering functions:
RMS and average RMS currents
Ampere demand (per phase & average)
- Optional metering functions
RMS and average RMS voltages
Active power (kWatts)
kW demand
kW hours
Apparent power (kVA)
Volt-amperes reactive (kVAR)
kVAR hours
Power factor
Frequency
- Optional protective functions
Over and / or under voltage protection (59/27)
Phase and ground directional overcurrent (67/67N)



Over and / or under frequency protection (81 O/U)
Negative sequence overcurrent (46)
Negative sequence voltage (47N)
Voltage phase sequence (47)
Four-shot reclosing (79)

- Waveform capture (2 buffers at 1 full second duration each), allowing a review of the fault waveforms and line harmonic conditions on your PC.

- Trip log, recording information on the last eight trip events, including time, date, interrupted amps, time in pickup and other pertinent data to add in quick disturbance analysis.
- Event Log, monitoring relay functions for status changes and recording data available when one occurs.
- Min / Max logs, storing data from metering functions, including current, voltage, power and frequency, all with time stamping.
- Front-mounted RS232 port for local access to all data and settings.
- Direct connection to the Siemens ACCESS electrical data system via an optional RS485 port for enhanced communications and control.

Construction

The ISGS relay system does away with the costly wiring, drilling and debugging time required to install multiple electromechanical relays. The ISGS unit is housed in a standard M-1 draw-out case and is compatible with commonly used XLA test plugs.

Mode of Operation

The ISGS relay system allows the addition of options or configuration changes at any time without discarding the basic hardware. New configuration settings are keyed in directly using the ISGS keypad. The ISGS unit also features a local communications port that allows device configuration and communications with a local PC.

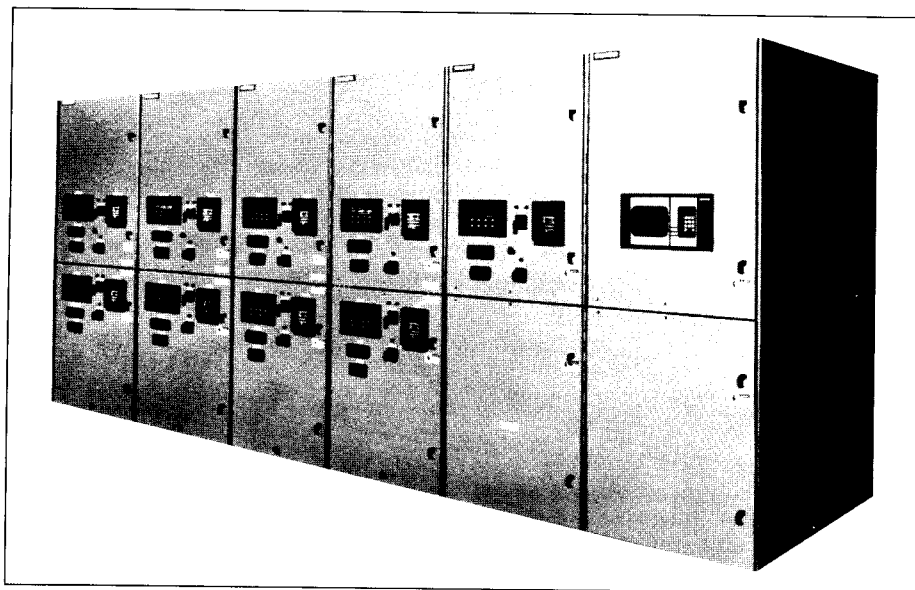
Siemens ACCESS System

Siemens brings the power of communications to medium voltage switchgear. GM switchgear can be provided with a variety of ACCESS-compatible devices for protection, instrumentation, or other needs. ACCESS provides real-time critical operating information for electrical distribution systems.

Metering, protection, and event recording are integrated into an easy-to-use package offering:

- Full Metering Capability
- RMS Sensing
- Graphics Display
- Event Recording
- Remote Monitoring

Contact your local Siemens representative for more information on the ACCESS system and ISGS relay.



Type GM Switchgear
Outfitted with Siemens ACCESS-Compatible Devices



Vacuum Circuit Breakers

Type GMI Vacuum Circuit Breakers — 5kV, 7.2kV, and 15kV

Siemens Type GMI circuit breakers are available in 250 MVA through 1000 MVA nominal interrupting classes, and 1200 through 3000 ampere self-cooled, plus 4000 ampere forced air cooled continuous current ratings.

Maintenance Features

The GMI circuit breakers incorporate many features designed to reduce and simplify maintenance, including:

- Virtually Maintenance-Free Vacuum Interrupter
- 5-Year Maintenance Interval
- Floor Rollout
- Front Mounted Operator
- Common Operator Family
- Simple Barriers
- "Universal" Spare Breaker Concept
- Non-Sliding Current Transfer
- Rugged Secondary Disconnects

Vacuum Interrupters

The GMI circuit breakers use the Siemens family of vacuum interrupters, proven in over 150,000 circuit breakers produced since 1976. The cup shaped contacts have chrome-copper arcing rings, with a unique geometry to provide fast interruption with minimal contact erosion. The chrome-copper contact material assures lower chopping currents than with designs employing copper-bismuth contacts.

5-Year Maintenance Interval

When applied under mild conditions (ANSI "usual service" conditions), maintenance is only needed at 5-year intervals.

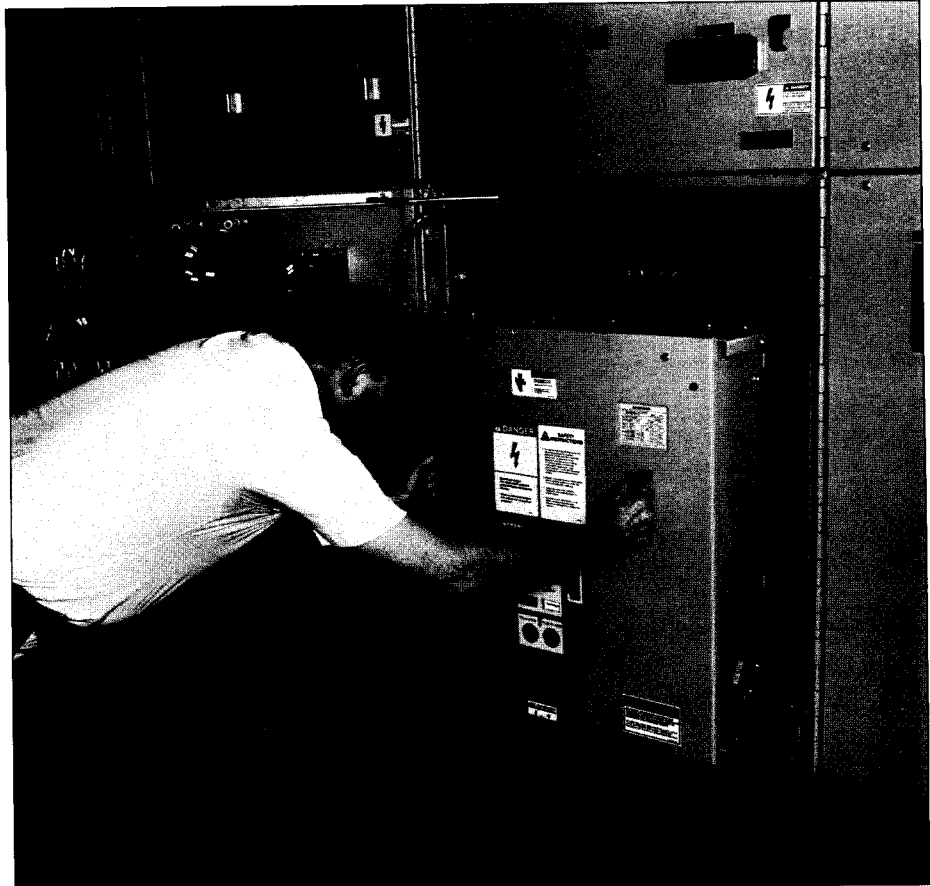
Floor Rollout

When located in the lower cell, the circuit breakers are arranged to rollout directly on the floor in front of the switchgear. No adapter, hoist, or lift truck is necessary.

Stored Energy Operator

The Siemens GMI stored energy operator is simple, for long life, high reliability, and ease of maintenance. Parts used in the manufacture of the circuit

breaker are precision tooled or produced on numerically controlled equipment. The design includes frequent use of inherent alignment techniques.



Removal of Type GMI Circuit Breaker

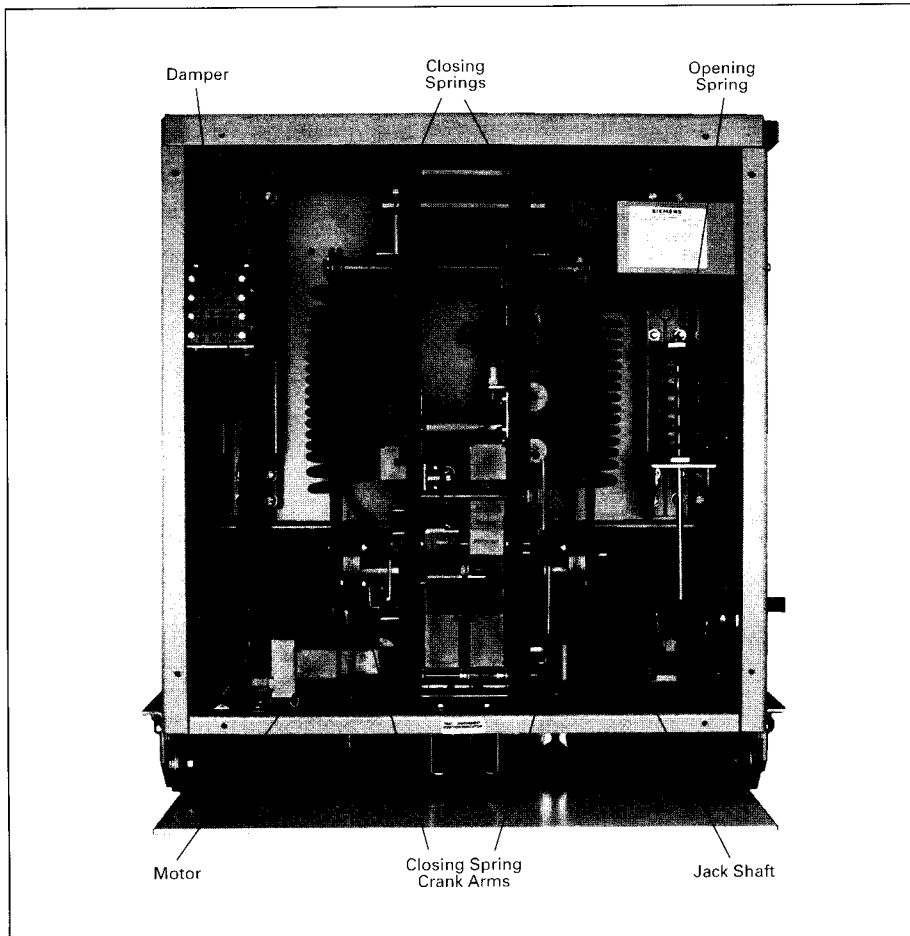
Mechanism Operation

The mechanism is arranged to pre-store closing energy in the closing springs. The closing springs are selected so that they provide sufficient energy not only to close the circuit breaker safely into maximum "close and latch" currents, but also to pre-store the tripping energy necessary to open the circuit breaker. The springs can be manually charged during maintenance or in emergency conditions, but are normally charged electrically automatically after each closing operation.

Interlocks

The racking system prevents racking of a closed circuit breaker, and keeps the circuit breaker trip-free during racking. The racking mechanism can be padlocked to prevent unauthorized operation. Padlocks can also be applied to the cell to maintain the circuit breaker in the trip-free condition.

Vacuum Circuit Breakers



GMI Breaker — Key Components

Manual Controls and Indicators

All breaker manual controls and indicators are conveniently located on the front of the breaker. Standard features include manual close button, manual trip button, open-close indicator, stored energy closing spring charge/discharge indicator, manual spring charging access, and close operation counter.

Common Operator Family

Since the entire GMI range of ratings uses a common stored energy operating mechanism design, less training of maintenance personnel is required, and stocking of spare parts is reduced.

Front Accessible Operating Mechanism

The GMI stored energy operator is

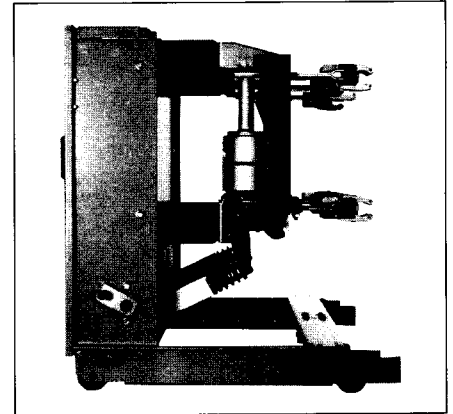
located at the front of the circuit breaker. The front cover can be easily removed to expose the operator for inspection and maintenance. This feature eliminates the need to tilt or turn over the circuit breaker for normal service.

True Trip-Free Design

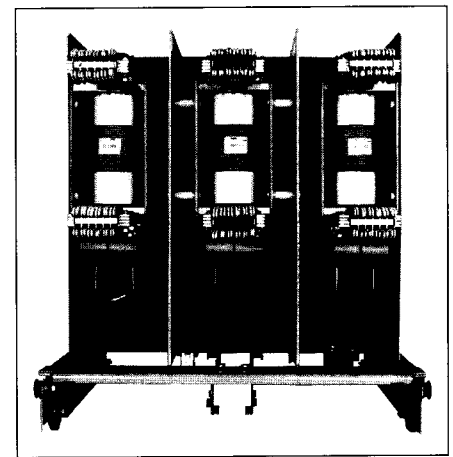
Both electrically and mechanically the mechanism is truly trip-free — even if the circuit breaker is in the midst of a closing operation, it can respond to a trip command. Unlike some oil and gas filled breakers, it is not necessary for the contacts to close before the tripping operation can begin.

Plug-in Connections

Connections to the close coil, trip coil, and the spring charging motor on the



GMI Breaker — Side View (1200A) —
(Outer barriers removed)



GMI Breaker — Rear View (2000A)

circuit breaker are by means of convenient captive plug type connectors, greatly simplifying replacement or inspection of these devices.

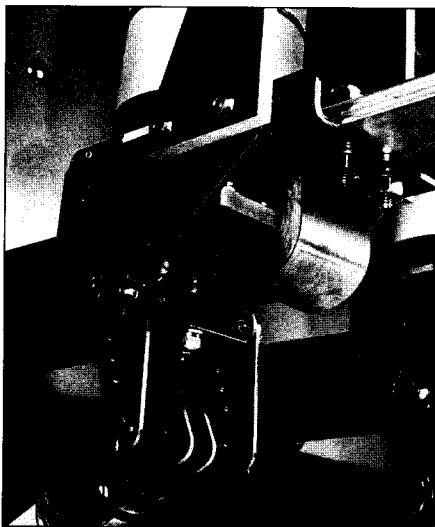
Simple Barriers

To simplify maintenance, interphase barriers are not required for 1200 ampere circuit breakers. Outerphase barriers, and interphase barriers (when provided), are of very simple design, and located on the circuit breaker, allowing the cell to be free of barriers, except the current transformer barrier located in front of the shutters. The barriers on the circuit breaker remove quickly and easily for maintenance which can be done with the barriers in place.

Vacuum Circuit Breakers

Non-sliding Current Transfer

The vacuum interrupter movable stem is connected to the lower disconnect stud of the circuit breaker by a reliable flexible connector, a method pioneered by Siemens in the 1970's. This provides a low resistance current transfer path, not subject to the wear and contamination problems associated with sliding or rolling joints used in some designs.



Current Transfer Path

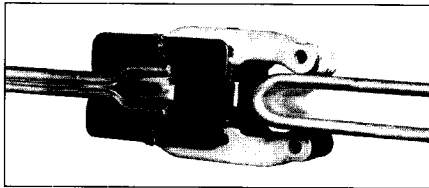
Primary Disconnects

The primary connection between the circuit breaker and the cubicle is made of multiple sets of silver-plated copper finger contacts which engage with silver-plated copper stationary contacts. The cubicle primary disconnect studs have a rounded leading edge, which contributes to smooth racking of the circuit breaker.

The contacts, mounted on the ends of the breaker disconnect studs, have multiple fingers and are compression-spring loaded (one spring per double pair of fingers). This arrangement offers a large number of contact points to ensure proper alignment. The breaker finger assemblies are withdrawn with the breaker, and are available for inspection without de-energizing the switchgear main bus.

"Universal" Spare Breaker

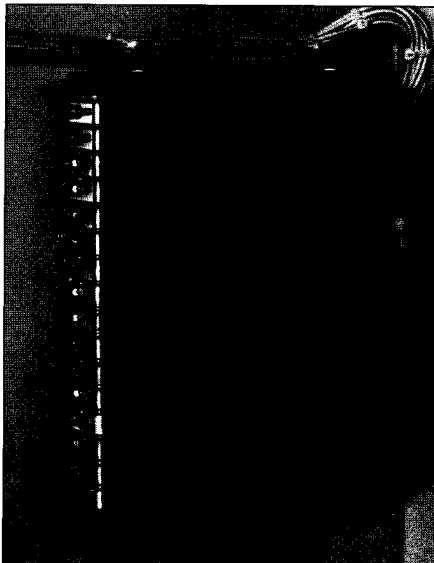
The physical configuration and interlock logic allow the use of a single circuit breaker to serve as a "universal" spare breaker at an installation site. The interlock logic checks the four principal rating characteristics (continuous current, maximum voltage, interrupting current, and close & latch current), and allows a circuit breaker to be inserted in a breaker cell provided that the circuit breaker equals or exceeds the ratings required by the cell.



Primary Disconnects

Secondary Disconnects

Circuit breaker-to-cubicle secondary disconnects are of the sliding finger design. The secondary disconnects are automatically engaged as the circuit breaker is racked into the test position. They remain engaged as the circuit breaker is racked to the connected position. Since the secondary disconnects automatically engage in both the test and connected positions, there is no need to operate a separate linkage for testing, as other designs require.



Secondary Disconnects (Cubicle portion on left, Breaker portion on right)

The secondary disconnects are located on the side of the circuit breaker element, where they are shielded from accidental damage. They are of an extremely rugged design, in contrast to other designs, which employ light duty electronics-style disconnects, located in hidden or inaccessible locations. Alignment of the disconnects can be visually observed, if desired, allowing positive verification of secondary integrity, a feature not possible with designs employing a disconnect underneath or behind the breaker.

Auxiliary Switch (Breaker Mounted)

An eight stage auxiliary switch assembly is mounted on the vacuum circuit breaker with contacts for use in the circuit breaker control circuit and as spare contacts for other use. Normally, four auxiliary switch contacts, two NO and two NC, can be wired out for purchaser use.

Mechanism Operated Cell (MOC) Switch

When required, 6, 12, 18, or 24 stages of MOC auxiliary switch can be mounted in the circuit breaker cell. This switch is operated by the circuit breaker mechanism, so that the switch contacts change state whenever the circuit breaker is closed or tripped. Normally, the MOC switch is operated only when the circuit breaker is in the connected position, but provisions for operation in both the connected and the test positions can be furnished.



Truck Operated Cell (TOC) Switch

When required, 4, 8, or 12 stages of truck operated cell switch can be mounted in the circuit breaker cell. The TOC switch contacts change state when the circuit breaker moves into or out of the connected position.

Vacuum Circuit Breakers

Surge Limiters

Type 3EF surge limiters are available for use in distribution systems to protect motors, transformers, and reactors from the effects of voltage surges associated with breaker operations. These limiters are not designed to protect equipment exposed to lightning surges, for which surge arrestors should be applied. The 3EF surge limiters prevent the development of excessive overvoltages which can result from multiple reignitions or virtual chopping. This is primarily of concern during the starting of motors and switching of some reactive loads. In general, if the impulse capability (BIL) of the protected equipment matches that of the switchgear, no protection is needed due to the surges produced by the opening of the vacuum breaker. Since dry type transformers and rotating machines are generally of lower BIL, surge protection may be necessary. Refer to Table 1 for minimum application recommendations for surge limiters.

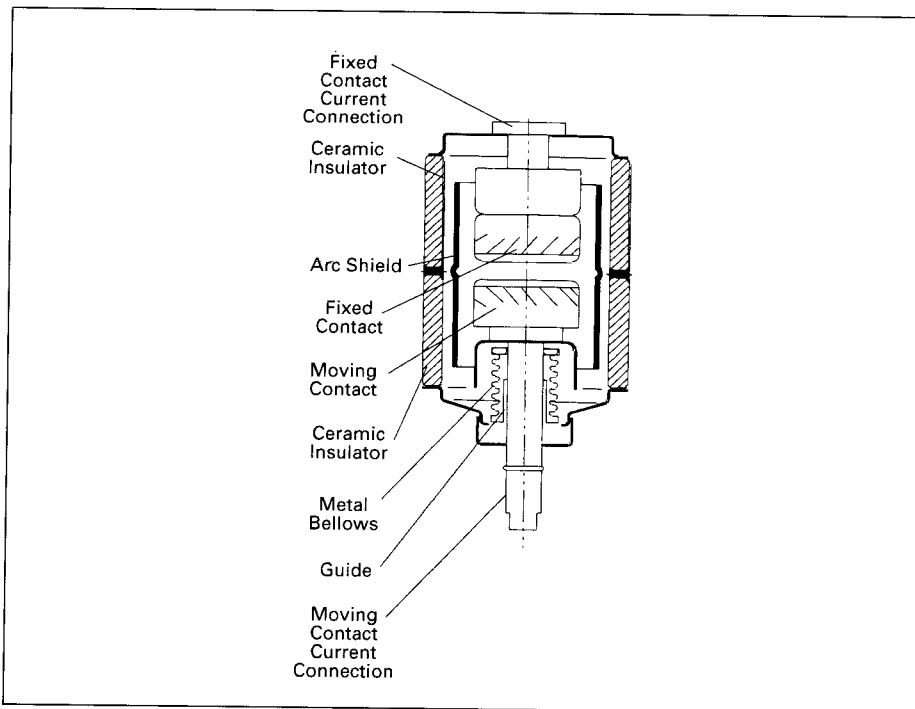
Table 1 — Surge Limiter Recommendations

Protected (Load) Equipment		Surge Limiters Recommended
Liquid Transformers		No
Dry Type Transformers	Standard BIL	Yes ①
	5kV 60kV BIL	No
	7kV or 15kV 95kV BIL	No
Motors	Locked Rotor Current < 600A	Yes ②
	Locked Rotor Current > 600A	No
Reactors		Yes
Capacitors		No

- ① Not necessary if surge capacitors or surge arrestors are located at transformer terminals.
 ② Not necessary if surge capacitors and surge arrestors are located at the machine terminals.

Siemens Vacuum Heritage

The GMI Vacuum Circuit Breakers take full advantage of Siemens long history with vacuum interrupters for power applications. While early work was carried out in the 1920's, a successful vacuum interrupter could not be perfected until the high vacuum pump became available in the 1960's. Focused development effort began in 1969, culminating in the introduction of the type 3AF circuit breaker in 1976. The knowledge gained over years of application of this technology in the 3AF circuit breakers is now available in the GMI design. The advantages inherent in vacuum interruption are summarized as follows.



Vacuum Interrupters

■ Ideal Dielectric

In a vacuum, the dielectric strength across a contact gap recovers very rapidly allowing a small contact separation and an efficient interrupter design. The vacuum does not interact with the arc or its components as do other dielectrics.

■ Quiet Operation

Interruption of currents by a vacuum circuit breaker is very quiet as compared to the loud report which accompanies interruptions in some other types of breakers.

■ Low Current Chopping Characteristics

The chrome-copper arcing ring used in Siemens interrupters limits chopping currents to a maximum of 5 amperes. This low value prevents the build-up of unduly high voltages and results in lower stress on the insulation of load equipment.

■ No Arc Products Vented to the Atmosphere

The sealed vacuum interrupter prevents venting of arc products to the atmosphere, and prevents any possible contamination of the contacts by the atmosphere. The metal vapor of the arc quickly recondenses on the surface of the contacts, although a small amount may recondense on the arc chamber wall. The recondensing metal vapor acts as a "getter" and recaptures more molecules of certain gases that might be liberated during vaporization. This action tends to improve the vacuum in the interrupter during its operating life.

■ Non-Toxic Interruption By-Products

The interruption process occurs entirely within the sealed vacuum interrupter. Even if an interrupter is physically broken, the arc products inside the interrupter are not toxic. In contrast, gas-filled interrupters produce toxic arc by-products, requiring special precautions in the event of a ruptured interrupter housing.

Vacuum Circuit Breakers

■ Fewer Components

The vacuum interrupter pole construction is extremely simple and consists of only seven moving parts within the high voltage area and only two moving parts within the interrupter chamber. This means greater reliability and less maintenance with vacuum interrupters as compared to the greater number of parts in other type interrupters, such as air-magnetic, gas or oil.

■ Long Interrupter Life

The interrupter has a long expected service life due to the careful selection of components. The chrome-copper contacts allow efficient interruption of both diffused and contracted arcs with very little contact erosion.

■ Immunity to Environment

The capability of the vacuum bottle to interrupt current or to withstand voltage is not directly affected by conditions external to the vacuum bottle. High or low altitudes, hot or cold temperatures, moist or dry conditions, or heavy dust conditions do not affect the conditions internal to the interrupter. Conditions external to the interrupter, however, could affect the overall system operation and should be considered in the specifications.

■ Virtually Maintenance Free

Interrupter maintenance requires merely wiping dust or other atmospheric elements from the exterior, visually checking the contact wear indicator, and periodic dielectric testing to confirm vacuum integrity.

■ Lower Force Requirements

The vacuum interrupter has a very low moving mass compared to the that found in air magnetic, gas or oil interrupters. This allows a smaller, more compact stored energy operator leading to long life and low maintenance of the circuit breaker.

Vacuum Interrupter Principles

With Siemens GMI vacuum circuit breakers, the chopping currents are held to 5 amperes or less. This is low enough to prevent the build-up of unduly high voltages which may occur on switching of inductive circuits. The chrome-copper contact material keeps overvoltages to a minimum, so special surge protection is not required in most applications.

When the contacts open, the current to be interrupted initiates a metal vapor arc discharge, and current continues flowing through this plasma until the next current zero.

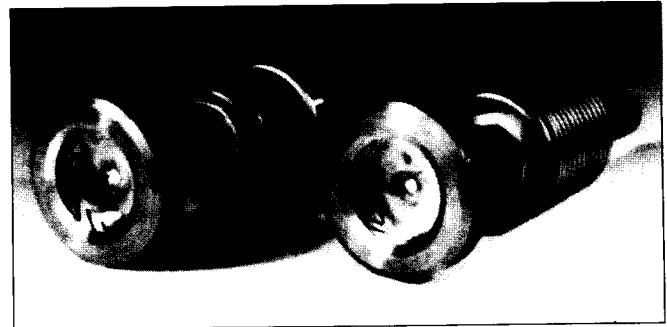
The arc is extinguished near the current zero, and the conductive metal vapor recondenses on the contact surfaces and the arc chamber wall within a matter of microseconds. As a result, the dielectric strength of the break recovers very rapidly and contact erosion is almost negligible.

The arc drawn in the vacuum interrupter is not cooled. The metal vapor plasma is highly conductive and the resulting arc voltage is only 20 to 200 volts. This low arc voltage, combined with very short arcing times, produces only a very small arc energy in the interrupter, accounting for the long electrical life expectancy of the Siemens vacuum interrupter.

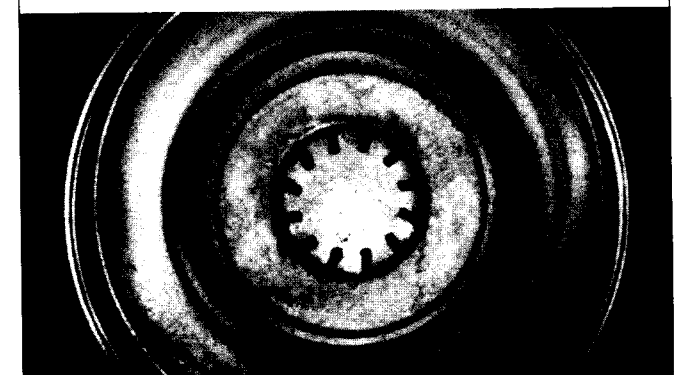
There are two types of arc shapes. Up to approximately 10 kA, the arc remains diffused. It takes the form of a vapor discharge and covers the entire contact surface. Diffused arcs are easily interrupted.

Above 10 kA, the arc is constricted considerably by its own magnetic field, i.e. it contracts essentially to a point arc. If the contracted arc is allowed to remain stationary, it overheats the contact at the arc roots to the point where the molten metal vapor

does not allow the dielectric to rebuild during the current zero, and large magnitude currents can not be interrupted. To overcome this, the contacts are designed in a cup shape with oblique slots, so that a self-generated field causes the arc to travel around the contacts. This prevents localized overheating when interrupting large magnitudes of short circuit current.



Contacts



Contact Condition After Interrupting 25kA 100 Times

Ratings

Table 2 — Type GMI Circuit Breaker Ratings

Measured Parameter				Circuit Breaker Type							
				5-GMI -250	5-GMI -350	7-GMI -500	15-GMI -500	15-GMI -750	15-GMI -1000		
General	Nominal Voltage Class			kV	4.16	4.16	7.2	13.8	13.8	13.8	
	Nominal 3-Phase MVA Class			MVA	250	350	500	500	750	1000	
Rated Values	Rated Voltage	Max. ②		E kV RMS	4.76	4.76	8.25	15	15	15	
		Range Factor ③		K	1.24	1.19	1.25	1.3	1.3	1.3	
	Insulation Levels	Rated Withstand Test Voltage	Low Frequency	kV RMS	19	19	36	36	36	36	
			Impulse	kV Crest	60	60	95	95	95	95	
	Rated Current	Continuous ④			Amperes	1200 2000	1200 2000 3000	1200 2000 3000	1200 2000 3000	1200 2000 3000	
		Short circuit (at rated max. kV) ⑤ ⑥			I kA RMS	29	41	33	18	28	37
		Interrupting Time			Cycles	5	5	5	5	5	5
Permissible Tripping Delay Y			Sec.	2	2	2	2	2	2		
Related Required Capabilities	Current	Rated Max. Voltage Divided by K		E/K kV RMS	3.85	4	6.6	11.5	11.5	11.5	
		Max. Sym. Interrupting ⑦	K Times Rated Short Circuit Current KI	kA RMS	36	49	41	23	36	48	
				kA RMS	36	49	41	23	36	48	
	Closing and Latching (Momentary) ⑧	1.6 K Times Rated Short Circuit Current ⑨		kA RMS	58 & 78	78	66	37 & 58	58 & 77	77	
		2.7 K Times Rated Short Circuit Current		kA Crest	97 & 132	132	111	62 & 97	97 & 130	130	

- ① High close and latch (momentary) rating available for special application.
- ② Maximum voltage for which the breaker is designed and the upper limit for operation.
- ③ K is the ratio of rated maximum voltage to the lower limit of the range of operating voltage in which the required symmetrical and asymmetrical interrupting capabilities vary in inverse proportion to the operating voltage.
- ④ 3000 ampere units available with increased fan-cooled rating of 4000 amperes.
- ⑤ To obtain the required symmetrical interrupting capability of a circuit breaker at an operating voltage between 1/K times rated maximum voltage and rated maximum voltage, the following formula shall be used.

$$\text{Required Symmetrical Interrupting Capacity} = \text{Rated Short Circuit Current} \times \frac{\text{Rated Maximum Voltage}}{\text{Operating Voltage}}$$

For operating voltages below 1/K times rated maximum voltage, the required symmetrical interrupting capability of the circuit breaker shall be equal to K times rated short circuit current.

- ⑥ With the limitations stated in 5.10 of ANSI Standard C37.04-1979, all values apply for polyphase and line-to-line faults. For single phase-to-ground faults, the specific conditions stated in 5.10.2.3 of ANSI Standard C37.04-1979 apply.
- ⑦ Current values in this column are not to be exceeded even for operating voltages below 1/K times rated maximum voltage. For voltages between rated maximum voltage and 1/K times rated maximum voltage, follow 5 above.
- ⑧ Current values in this column are independent of operating voltage up to and including rated maximum voltage.
- ⑨ Included for reference only.

Table 3 — Type GMI Circuit Breaker Control Data

Control Voltages, ANSI C37.06 Tbl. 10			Coil Amperes ①		Spring Charging Motor		
Nominal	Range		Close	Trip	Amperes		Charging Seconds
	Close	Trip			Run (Avg.)	Inrush (Peak)	
48 VDC	38-56	28-56	10	10	8.5	15	10
125 VDC	100-140	70-140	4	4	2.7	10.2	8
250 VDC	200-280	140-280	3	3	1.3	2.4	8
120 VAC	104-127	—	4	—	3.3	10.6	8
240 VAC	208-254	—	3	—	1.7	7.1	8

- ① Current at nominal voltage.

Table 4 — Interrupting Capacity Auxiliary Switch Contacts

Type Switch	Continuous Current Amperes	Control Circuit Voltage				
		120 AC	240 AC	48 DC	125 DC	250 DC
Breaker	20	20	20	20	10	2
TOC	15	15	10	0.5	0.5	0.2
MOC	20	15	10	10	10	5

Table 5 — Voltage Transformers

Volt. Class	Ratio	Accuracy Class at 120V Sec.				VA Thermal Rating
		W,X,Y	Z	ZZ		
5kV	2400/120	0.3	1.2	—	500	
	4200/120	0.3	1.2	—	500	
	4800/120	0.3	1.2	—	500	
15kV	7200/120	0.3	0.3	1.2	1000	
	8400/120	0.3	0.3	1.2	1000	
	12000/120	0.3	0.3	1.2	1000	
	14400/120	0.3	0.3	1.2	1000	
			0.3	0.3	1.2	1000

Table 6 — Current Transformers ①

Ratio	60 Hz Metering Accuracy at Burden				Relay Class
	B0.1	B0.5	B1.0	B2.0	
Type MD Toroidal Standard Accuracy					
100:5	2.4 ②	—	—	—	C 15
150:5	0.6	2.4	—	—	C 20
200:5	0.6	1.2	—	—	C 25
250:5	0.6	1.2	2.4	—	C 35
300:5	0.6	0.6	1.2	2.4	C 40
400:5	0.3	0.6	1.2	2.4	C 60
500:5	0.3	0.3	0.6	1.2	C 75
600:5	0.3	0.3	0.6	1.2	C100
800:5	0.3	0.3	0.6	0.6	C130
1000:5	0.3	0.3	0.3	0.3	C170
1200:5	0.3	0.3	0.3	0.3	C200
1500:5	0.3	0.3	0.3	0.3	C200
2000:5	0.3	0.3	0.3	0.3	C210
2500:5	0.3	0.3	0.3	0.3	C300
3000:5	0.3	0.3	0.3	0.3	C240
Type MDD Toroidal Special Accuracy					
75:5	2.4 ②	4.8	—	—	C 20
100:5	1.2	2.4	—	—	C 30
150:5	0.6	1.2	2.4	4.8	C 40
200:5	0.6	1.2	1.2	2.4	C 60
250:5	0.3	0.6	1.2	2.4	C 80
300:5	0.3	0.6	0.6	1.2	C100
400:5	0.3	0.3	0.6	0.6	C130
500:5	0.3	0.3	0.3	0.6	C160
600:5	0.3	0.3	0.3	0.3	C210
800:5	0.3	0.3	0.3	0.3	C270
1000:5	0.3	0.3	0.3	0.3	C340
1200:5	0.3	0.3	0.3	0.3	C425
1500:5	0.3	0.3	0.3	0.3	C510
2000:5	0.3	0.3	0.3	0.3	C460
2500:5	0.3	0.3	0.3	0.3	C580
3000:5	0.3	0.3	0.3	0.3	C660

- ① 1-Second through-current and momentary current are equal to the ratings of the associated circuit breakers.
- ② Exceeds ANSI C37.20.2 Accuracy Limit.

Enclosure Dimensions

Weights and Dimensions are Approximate

Table 7 — Cubicle Dimensions — Per Vertical Section

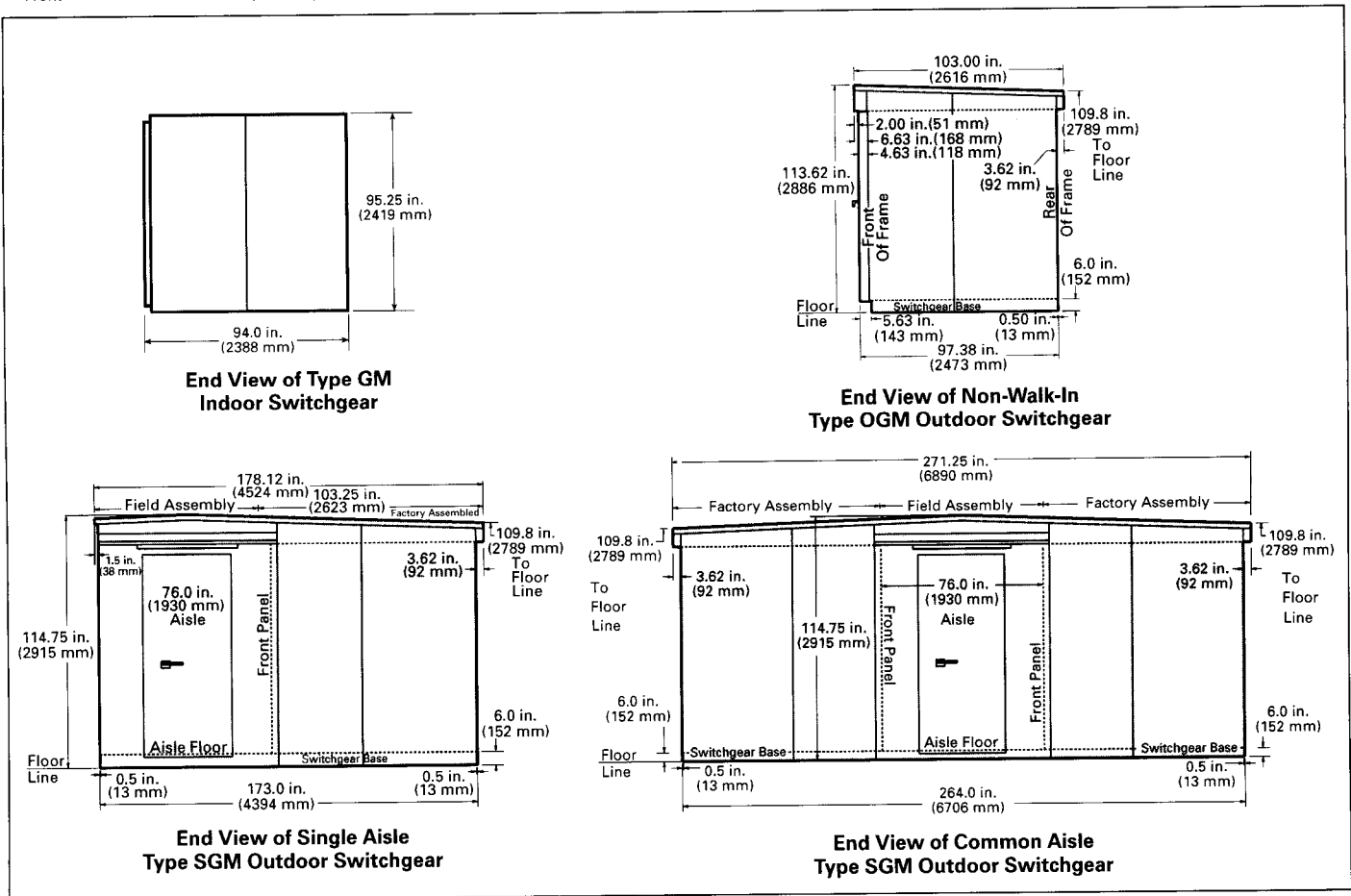
Type		Dimensions in inches (mm)				Weight in lbs. (kg)
		Height	Width	Depth	Drawout Aisle	
Indoor	GM	95.25 (2419)	36.0 (914)	94.0 (2388)	76.0 (1930) Recommended ②	2450 (1114)
Shelter-Clad Single-Aisle	SGM	114.75 (2915)	36.0 (914) ①	173.0 (4394) ③	76.0 (1930) Included	4150 (1886)
Shelter-Clad Common-Aisle	SGM	114.75 (2915)	36.0 (914) ①	264.0 (6706) ③	76.0 (1930) Included	7350 (3341)
Aisle-Less Non-Walk-In	OGM	113.62 (2886)	36.0 (914)	94.0 (2388) ③	76.0 (1930) Recommended ②	3100 (1409)

Table 8 — GMI Circuit Breaker Weights in lbs. (kg)

Cont. Current Amps	Circuit Breaker Type					
	5-GMI-250	5-GMI-350	7-GMI-500	15-GMI-500	15-GMI-750	15-GMI-1000
1200	385 (175)	440 (200)	425 (193)	415 (189)	425 (193)	440 (200)
2000	425 (193)	480 (218)	465 (211)	455 (207)	465 (211)	480 (218)
3000	—	575 (261)	560 (255)	—	560 (255)	575 (261)

- ① Add 6 in. (152 mm) to each end of lineup for aisle extension (12.0 in. (305 mm) total)
- ② 76 in. (1930 mm) aisle space recommended allows room for interchange of breakers. Minimum aisle space required for handling circuit breaker with lift truck is 61 in. (1549 mm). Minimum aisle space required if all breakers are at floor level is 50 in. (1270 mm).
- ③ Add for roof overhang

	Non-Walk-In	Shelter-Clad
Rear (Cable Side)	3.62 in. (92 mm)	3.62 in. (92 mm)
Front	5.37 in. (136 mm)	1.5 in. (38 mm)

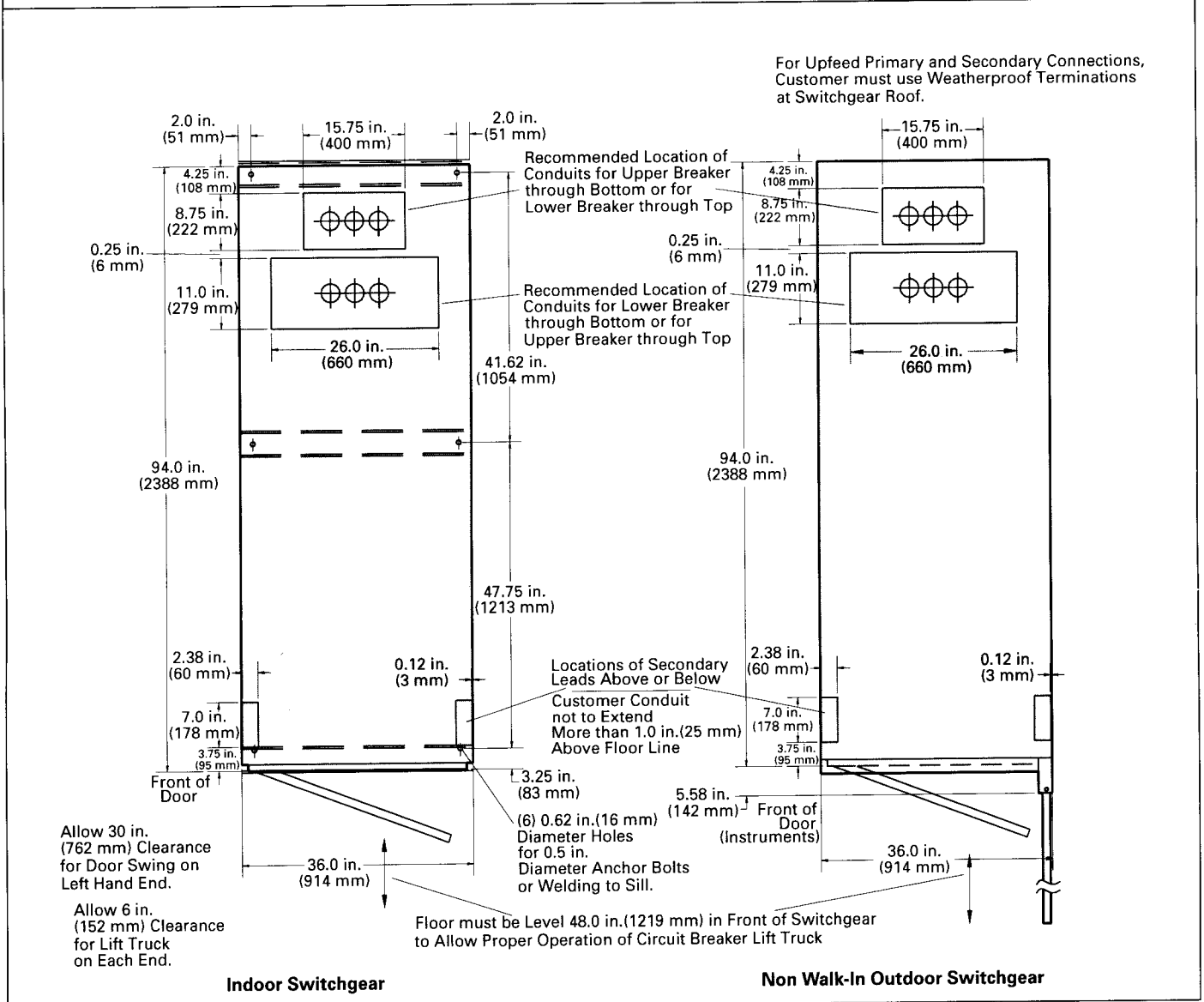


Floor Plans

1200A Brkr.	1200A Brkr.	Aux.	1200A Brkr.	2000A Brkr.	2000A Brkr.	Aux.	2000A Brkr.	Vented Aux. Note 2	3000A Brkr.	Aux.
1200A Brkr.	Aux.	1200A Brkr.	2000A Brkr.	1200A Brkr.	2000A Brkr.	2000A Brkr.	Aux.	3000A Brkr.	Aux. Note 2	Aux.

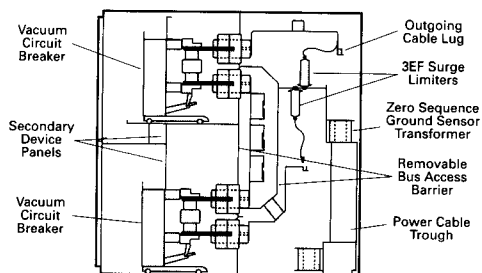
Notes:

1. Main bus sizes 1200A, 2000A, 3000A, or 4000A.
2. No rollout auxiliaries allowed in upper cell if lower cell has 3000A breaker. If 3000A breaker is located in upper cell, one rollout auxiliary may be located in the lower cell.
3. Auxiliary cells may each contain 2 rollouts (except as indicated in notes 2 and 5).
4. Fuse rollout for stationary control power transformer must be located in lower rollout position in lower auxiliary cell.
5. For fan cooled 4000A rating, breaker (3000A self-cooled, 4000A fan-cooled) is located in lower cell and fan cooling equipment is located in upper cell.
6. Stacking arrangements are available as shown. Total circuit breaker loading in a vertical unit may not exceed main bus rating. Consult Siemens for specific application assistance regarding total load limits in each unit.

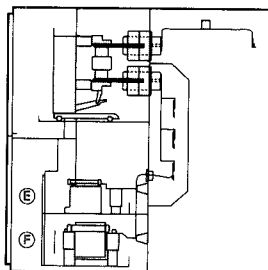


Side Views

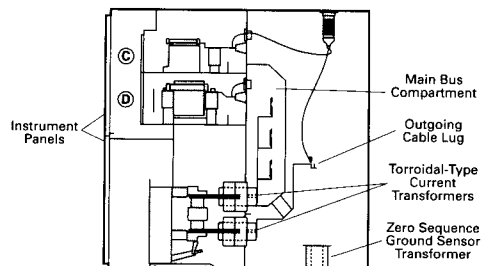
1200, 2000, 3000A Breakers / Auxiliary



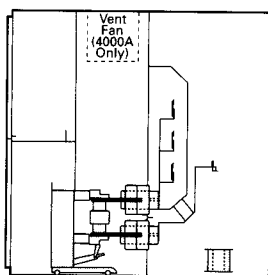
1200A or 2000A Breaker / 1200A or 2000A Breaker



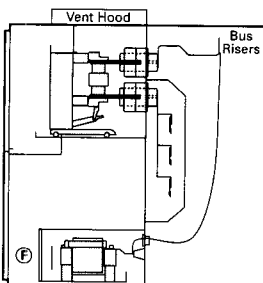
1200A or 2000A Breaker / Auxiliary



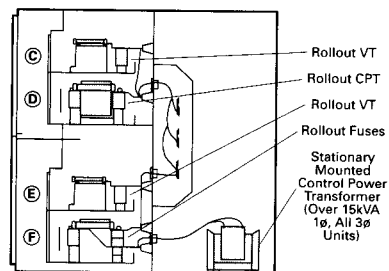
Auxiliary / 1200A or 2000A Breaker



Blank / 3000A Breaker (4000A with fan cooling)

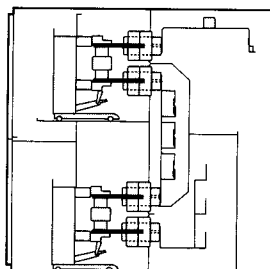


3000A / Auxiliary (VTs or CPT in position F)

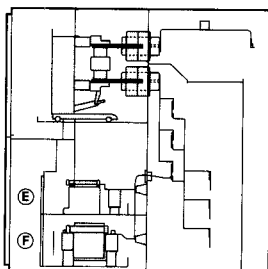


Auxiliary / Auxiliary

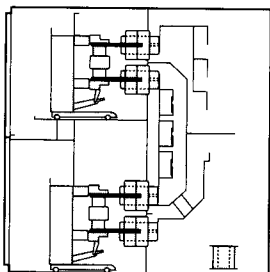
Bus Tie Breakers



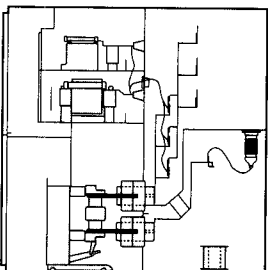
Unit with Bus Tie Breaker in Lower Compartment



Unit Adjacent to Lower Bus Tie
NOTE: Position "F" suitable for VTs or CPT only.



Unit with Bus Tie Breaker in Upper Compartment



Unit Adjacent to Upper Bus Tie

Auxiliary Positions:

- (C) For VT's
- (D) For VT's or CPT
- (E) For VT's
- (F) For VT's, CPT, or Rollout Fuses for Stationary CPT

Application Notes Regarding Bus Tie Breakers

1. Bus tie breaker (1200A, 2000A, or 3000A) may be in upper or lower compartment, as desired. 3000A bus tie breaker must not have another circuit breaker in the unit which has the 3000A breaker.
2. Adjacent unit must normally have auxiliary compartment at same level as bus tie breaker to accommodate transition bus. Consult Siemens if auxiliary compartment at same level as bus tie breaker is not available.
3. Units with 1200A or 2000A bus tie breakers may have a feeder breaker 1200A or 2000A located in the same unit.
4. Units with 3000A bus tie breaker in lower cell must have a vented auxiliary compartment (no rollout auxiliaries) above the breaker. Units with 3000A bus tie breaker in upper cell may have one rollout auxiliary in position "F".
5. Maximum main bus size 4000A.

Guide Form Specifications

Note: This specification form requires information to be supplied by purchaser. Those items preceded by check box are alternates or are optional. These items denoted preceded by a _____ require a quantity or data to be added.

General Description of Switchgear — Units and Rating

The equipment outlined in this specification shall consist of indoor non-walk-in outdoor Shelter-Clad Single-Aisle Shelter-Clad Common Aisle outdoor Metal-Clad switchgear with horizontal drawout, vacuum circuit breakers. General construction features shall be of a coordinated design so that shipping groups are easily connected together in the field into a continuous line-up. Necessary standard connecting materials shall be furnished. Shipping groups ordinarily will not exceed 15 ft. (4572 mm) in length.

The general arrangement and single diagram of the equipment shall be as indicated on Sketch Number dated _____.

Codes and Standards

The equipment covered in this specification, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

- ANSI American National Standards Institute
- ASTM American Society for Testing and Materials
- IEEE Institute of Electrical and Electronic Engineers
- NEC National Electric Code
- NEMA National Electric Manufacturers Association

Service

The switchgear sections shall be 5kV 7kV 15kV class, with a maximum design voltage of 4.76kV 8.25kV 15kV. This equipment shall operate on a service voltage of _____ volts, 3 phase, 3 wire, 60 hertz.

Insulation Levels

The assembled switchgear structures shall be designed for the following insulation levels:

- Maximum Design Voltage
 4.76kV 8.25kV 15kV
- Insulation Test, (60 Hertz)
 19kV 36kV 36kV
- Full-wave Impulse Test (BIL)
 60kV 95kV 95kV

Dimensions

Approximate dimensions of the switchgear shall be as shown on the sketch included with this specification. The circuit breakers shall be removable from the control panel side. An aisle space of 76 in. (1930 mm) is recommended to permit withdrawal of the circuit breaker element.

Circuit Breakers

The vacuum circuit breakers shall be:

- Nominal Voltage class — _____ kV, RMS
- Nominal 3 Phase MVA Class _____
- Rated Maximum Voltage — _____ kV, RMS
- Rated Continuous Current at 60 Hz — Amp, RMS _____
- Rated Short Circuit Current at Max Voltage — kA, RMS _____
- Rated Interrupting Time in Cycles _____
- Maximum Symmetrical Interrupting Capability — kA, RMS _____
- Short-Time (3 Sec.) Current Carrying Capability — kA _____
- Closing and Latching Capability — kA, peak _____

The circuit breaker shall be three pole, single throw, mechanically and electrically trip free, with position indicator, operation counter, auxiliary switches, primary and secondary disconnecting devices, and mechanical interlocks to prevent making or breaking load current on the primary disconnects.

The circuit breakers shall be equipped with a stored energy operator. The control voltages shall be:

- Spring Charging Motor:
 48 125 250 volts DC
 120 240 volts AC

- Spring Release (Close) Coil:
 48 125 250 volts DC
 120 240 volts AC

- Trip Coil:
 48 125 250 volts DC
 120 240 volts AC capacitor trip

The source of control power shall be a battery provided in the switchgear a control power transformer in the switchgear a separate supply provided by the purchaser a battery located in the vicinity of the switchgear.

Meters and Relays

All instruments, meters and relays shall be standard switchboard type for mounting on the steel panels. All

meters and relays, if provided as standard, shall be of the drawout type with built-in test devices. Indicating and recording instruments, meters and relays shall be of the rectangular type, semi-flush mounted.

Control and Instrument Switches

All switches furnished shall be switchboard type and shall be of the rotary-type construction, with two contacts per stage.

Basic Structure

The switchgear assembly shall consist of one or more vertical sections, each of which shall have a main bus compartment and two vertically stacked equipment cells. The cells shall be arranged for circuit breakers or auxiliary devices or shall be blank as indicated in the detailed specification.

Each main bus compartment shall contain a set of 1200 2000 3000 ampere copper (silver plated at electrical connection points), 3 wire insulated main bus and connections.

Each circuit breaker cell shall contain a manually operated screw type drawout racking mechanism, circuit breaker operated automatic shutters and safety interlocks and shall also include:

- a. Hinged front panel.
- b. Primary and secondary disconnecting devices.
- c. Control circuit cutout device.
- d. Necessary terminal blocks, small wiring and control buses, where required.
- e. Engraved nameplate, as required.

Each auxiliary cell shall include:

- a. Hinged front panel, suitable for relays and instruments.
- b. Necessary terminal blocks, small wiring and control buses, where required.
- c. Engraved nameplate, as required.

High Durability Finish

The framework and the panels shall be chemically cleaned, hot phosphate treated, and rinsed, and shall be given an electrostatically applied coat of ANSI 61 polyester urethane paint.

Production Tests

All switchgear assemblies and circuit breakers shall be inspected and tested as part of the regular manufacturing procedure. The tests and inspections shall conform to ANSI C37.20.2 (clause 5.3) for Metal-Clad Switchgear Assemblies and ANSI C37.09 (clause 5) for AC High-Voltage Circuit Breakers.

Guide Form Specifications

Weatherproof Housing (Select one weatherproof enclosure design):

- Shelter-Clad Single Aisle Design
- Shelter-Clad Common Aisle Design
- Non-Walk-In Outdoor Design

Shelter-Clad Design — Single Aisle

The Shelter-Clad Single Aisle Switchgear shall consist of indoor type circuit breaker and auxiliary cell located in a weatherproof steel housing having an operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test or maintenance. An access door shall be located at each end of the aisle, with provision for padlocking on the outside, but also arranged so that the door can be opened from the inside regardless of whether or not it has been padlocked on the outside. The aisle space shall have adequate incandescent lighting receptacles which shall be controlled by means of a three-way switch at each access door.

Included in the switchgear shall be the following:

- a. One (1) space heater, 240 volts AC in each cell and cable compartment.
- b. Two (2) utility duplex receptacles with integral ground fault protection, one at each aisle access door, for electric tools, extension cords, etc.

The switchgear shall be shipped in convenient groups for erection in the field, and shipping groups ordinarily shall not exceed fifteen (15) feet (4572 mm) in length.

The weatherproof enclosure for the aisleway shall be shipped in sections for erection in the field. The front wall of the aisle shall be shipped attached to the front of the cubicle assembly for ease of handling. Necessary erection hardware will be furnished.

Shelter-Clad Design — Common Aisle

The Shelter-Clad Common Aisle Switchgear shall consist of two (2) lineups of indoor type circuit breaker and auxiliary units located in a weatherproof steel housing having a common operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test or maintenance. An access door shall be located at each end of the aisle with provision for padlocking on the outside, but also arranged so that the door can be opened from the inside regardless of whether or not it has been padlocked on the outside. The aisle space shall have adequate incandescent lighting receptacles which will be controlled by means of a three-way switch at each access door.

Included in the switchgear shall be the following items:

- a. One (1) space heater, 240 volts AC in each cell and cable compartment.
- b. Two (2) utility duplex receptacles with integral ground fault protection, one at each aisle access door, for electric tools, extension cords, etc.

The switchgear shall be shipped in convenient groups for erection in the field, and shipping groups ordinarily shall not exceed fifteen (15) feet (4572 mm) in length.

The weatherproof enclosure for the aisleway shall be shipped in sections for erection in the field. Necessary erection hardware shall be furnished.

Non-Walk-in Outdoor Design

The Non-Walk-In Switchgear shall consist of indoor circuit breaker and auxiliary units located in a steel housing of non-walk-in weatherproof construction. Each unit shall be equipped with a hinged front door with provision for padlocking. Each auxiliary cell is also equipped with an inner hinged front door for mounting relays and instruments.

The following equipment shall be furnished within each unit:

- a. One (1) lamp receptacle with on-off switch for interior illumination.
- b. One (1) utility duplex receptacle with integral ground fault protection, for electric tools, etc.
- c. One (1) space heater, 240 volts AC in each cell and cable compartment.

A switch for all the space heaters is located in one cell.

The switchgear shall be shipped in convenient groups for erection in the field, and shipping groups will not exceed fifteen (15) feet (4572 mm) in length. Necessary erection hardware will be furnished.

Detailed Specifications

The group of indoor outdoor switchgear shall include:

- 1 Set _____ ampere, 3 phase, main bus.

- 1 Ground bus.

The circuit breaker cells and auxiliary cells shall be as specified in the following paragraphs:

- Incoming Line Feeder Future Feeder Circuit Breaker Cell(s): (Cell Number(s) _____). (Example: 1-A (in section 1, top cell; 2-B (in section 2, bottom cell))
- Each this cell shall contain the following:

- 1 Provision only for future vacuum circuit breaker vacuum circuit breaker, rated _____ amperes, type _____.

- 1 Mechanism operated cell (MOC) auxiliary switch, 6 12 18 24 stage.

- 1 Truck operated cell (TOC) switch, 4 8 12 stage.

- Current transformer(s) single secondary, _____:5 ampere ratio, single ratio multi-ratio.

- Space heater, 240 volts AC.

- Thermostat.

Mounted in the cable termination area:

- 1 Current transformer, zero sequence, 50:5 ampere ratio.
- Set zinc-oxide surge arrestors, _____ kV, station intermediate distribution class.
- Set cable lugs, _____ per phase, set screw mechanical crimp compression type, for _____ type cable, _____ size, _____ kV for top bottom entry.
- Set potheads, single conductor, _____ kV, for _____ type cable, _____ size, for top bottom entry.
- Set of 3 roof bushings, rated _____ amperes, _____ kV.
- Provision for connection to a bar type bus duct rated _____ amperes, _____ kV, at the top of the unit.
- Provision for connection to the throat of a _____ kVA transformer at the side of the unit.
- Space heater, 240 volts AC.

Guide Form Specifications

Detailed Specifications, Cont'd

Mounted on the hinged front panel of the upper cell:

- Circuit breaker control switch, complete with one red and one green indicating light.
- Digital instrument, multifunction, type 4300.
- Indicating light, amber white blue.
- Voltmeter, single phase, indicating recording, 0-___kV scale.
- Voltmeter transfer switch, 3 phase.
- Ammeter, single phase, indicating recording 0-___ampere scale.
- Ammeter transfer switch, 3 phase.
- Wattmeter, indicating recording ___MW scale.
- Watthour meter, ___-element, with 15 30 minute demand attachment.
- Varmeter, indicating recording ___MVar scale.
- Power factor meter.
- Transducer, current voltage watt var, single three phase.
- Overcurrent relay(s) time, device 51 instantaneous, device 50 time and instantaneous, device 50/51.
- Ground overcurrent relay time, device 51N instantaneous, device 50N.
- Directional relay(s), phase overcurrent, time, device 67.
- Directional relay, ground overcurrent, time, device 67N.
- Thermal overload relay(s), device 49, single phase.
- Current balance relay, device 46.
- Undervoltage and phase sequence relay, device 47.
- Undervoltage relay(s), device 27, single phase.
- Overvoltage relay(s), device 59, single phase.
- Differential relay(s), device 87.
- Lockout relay, device 86.
- Pilot wire equipment, 3 phase, device 87.
- Pilot wire monitoring relay, device 85.
- Underfrequency relay, device 81.
- Auxiliary relay, device No. ___.
- Reclosing relay, with one three reclosure(s), automatic hand reset, device 79.
- Reclosing relay cutout switch, device 79CO.

- Test Block, Current 6 pole Potential 4 pole.

Bus Sectionalizing / Tie Circuit Breaker Cell(s):

- (Cell Number(s) ____). Each this cell shall contain the following:
- 1 Provision only for future vacuum circuit breaker vacuum circuit breaker, rated ___ amperes, type _____.
 - 1 Mechanism operated cell (MOC) auxiliary switch, 6 12 18 24 stage.
 - 1 Truck operated cell (TOC) switch, 4 8 12 stage.
- Current transformer(s) single secondary, ___:5 ampere ratio, single ratio multi-ratio.
 - Space heater, 240 volts AC.
 - Thermostat.
 - Set automatic transfer equipment for transferring secondary control (may be located in adjacent cell).

Mounted in the cable termination area:

- 1 Set of sectionalizing bus work for connection to main bus in rear of adjacent auxiliary cell at the same elevation. (Cell Number ____).
- Set tie bus work for connection to a bar type bus duct rated ___ amperes, ___ kV, at the top of the unit.
 - Set Tie cable lugs, ___ per phase, set screw mechanical crimp compression type, for ___ type cable, ___ size, ___ kV for top bottom entry.
 - Space heater, 240 volts AC.

Mounted on the hinged front panel of the upper cell:

- Circuit breaker control switch, complete with one red and one green indicating light.
- Indicating light, amber white blue.
- Digital instrument, multifunction, type 4300.
- Ammeter, single phase, indicating recording 0-___ ampere scale.
- Ammeter transfer switch, 3 phase.
- Overcurrent relay(s) time, device 51 instantaneous, device 50 time and instantaneous, device 50:51.
- Ground overcurrent relay time, device 51N instantaneous, device 50N.
- Bus differential relay(s), Device 87B.
- Lockout relay, Device 86.
- Test Block, Current 6 pole Potential 4 pole.

Auxiliary Cell(s):

- (Cell Number(s) ____). Each this cell shall contain the following:
- Voltage transformer(s), rollout tray mounted, ___-120 volt ratio, complete with primary current limiting fuses and insulating shutter.
 - Control power transformer, rollout tray mounted, ___kVA (15kVA maximum), single phase 60 Hertz, dry type, ___-120/240 volt ratio, complete with primary current limiting fuses and insulating shutter.
 - Control power transformer, stationary mounted on the floor in the rear area of the vertical unit, ___kVA, single phase (over 15kVA), three phase (any size), 60 Hertz, dry type, ___ volt ratio, complete with rollout tray mounted primary current limiting fuses and insulating shutter. (Rollout fuses tray located in the lower tray of bottom cell only).
 - Battery, ___ volt, lead acid nickel-cadmium type, ___ cells, with a maximum discharge rate of ___ amperes for one minute to ___ volts per cell, complete with rack and standard accessories. (May be located only in lower cell).
 - Battery charger, static type, with without, voltage regulation, complete with ammeter, voltmeter, and/or rheostat, suitable for use with the above battery. (Requires an auxiliary cell which does not contain any rollout auxiliary trays).
 - Space heater, 240 volts AC.
 - Thermostat.
- Accessories: The following accessories shall be supplied, but not housed:
- 1 Manual racking crank
 - 1 Manual spring charging lever
 - 1 Tube contact lubricant
 - 1 Container touch-up paint
 - 1 Lift sling (for breakers if not at floor level)
- The following optional accessories shall also be supplied.
- 1 Split plug jumper
 - 1 Test cabinet
 - 1 Test plug, for drawout relays and watthour meters
 - 1 Lift truck (for circuit breakers if not at floor level)
 - 1 Electric racking motor assembly
 - 1 Spare Circuit Breaker(s) type ___-GMI-___, rated ___ amperes.
 - 1 Ground and test device, manually operated.
 - 1 Fifth wheel device, for handling of circuit breakers

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