MASTERCLAD™ Medium Voltage Metal-clad Switchgear with Type VR Vacuum Circuit Breakers
As a leading manufacturer of electrical distribution equipment for over 100 years, Groupe Schneider has long had a reputation for quality, service and technical innovation. Today, as a major switchgear manufacturer in the international marketplace, Groupe Schneider continues to lead the industry. Along with high-quality equipment, we offer an engineering and support staff that is considered the best in the industry.
The Reliability of a Quality Design

The quality of Federal Pioneer MASTERCLAD™ medium voltage metal-clad switchgear stems from a design and manufacturing process that focuses on long-term switchgear performance with the highest degree of reliability.

Reliable performance and safety is enhanced by the rugged construction of MASTERCLAD switchgear. Each switchgear assembly consists of individually grounded, compartmentalized steel structures (with 11-gauge barriers between vertical sections and major parts of each primary circuit) to protect operating personnel.

Based on specific customer application needs, Federal Pioneer engineers and technicians select the appropriate standard sections and bus configurations, with the ability to customize where needed. After the specified circuit breakers, instrument and control power transformers, relays, meters and other components are selected and approved, all are factory-assembled, wired and tested as a complete assembly. This testing is performed to insure reliability by energizing the control circuits and verifying the specified sequence of operation for each metal-clad switchgear project along with applicable ANSI, CSA, EEMAC and IEEE Production Tests.
Applications
MASTERCLAD medium voltage switchgear is used in a wide variety of switching, control and protective applications including electric utility generation and distribution systems, industrial plants, commercial buildings, hospitals, municipal pumping stations, wastewater treatment plants, transportation systems, and pipeline stations. Transformers, motors, generators, capacitors, distribution lines, and feeder circuits are protected by this class of switchgear. Significantly, most of the MASTERCLAD switchgear specified for these applications is relied upon to provide the critical main service entrance protection and controls.

Standardization
Standardization of the design incorporates a series of basic modular units, control packages, and instrumentation. For most switchgear ratings, circuit configurations and functions, one basic size unit is used. These features provide application flexibility, versatility, efficiency and economy in minimizing engineering time to plan and lay out the switchgear.

Front view with lower breaker installed.
**Features and Benefits**

**Long Life/Minimum Maintenance**
Reliability is the main priority. The VR vacuum circuit breakers are designed for long life. The interrupter’s copper-chromium contacts, hermetically sealed for life in a vacuum, are protected from external atmospheric influences. Dust, moisture, and all other possible contaminants are sealed out. This state-of-the-art vacuum interrupter design is capable of 20-100 full fault interruptions (varies by rating).

The high dielectric strength of the vacuum environment allows a very short clearing time during fault interruption to limit the energy dissipated into the arc. Total fault clearing time is less than 3 cycles and contact travel is only 3/8 to 1/2 inch, depending on the ratings of the circuit breaker. The short stroke produces less mechanical shock to the operating mechanism.

For evaluation of wear on the main contacts over the life of the circuit breaker, contact erosion indication is provided on each interrupter pole assembly.

Together with a total commitment to quality, these features provide long life with high reliability.

**Safety Barriers and Interlocks**
Full compartmentalization is supplied with primary functions separated by grounded metal barriers. All bussing is insulated and live parts are not exposed.

Safety interlocks work with the circuit breaker racking system. These protective features furnish integrity to the equipment and provide safety for operating personnel.

**Floor Space Economy and Application Flexibility**
The two tier configuration permits feeder circuit breakers to be stacked two high to save valuable floor space, or stacked one high combined with auxiliary units for the ultimate in application flexibility.

**Convenient Handling**
The VR circuit breaker is a horizontal drawout type designed to provide long life, reduced maintenance and ease of handling. The circuit breaker truck has wheels for easy movement into a lower cell (indoor switchgear) without use of any lifting device. A lifting truck is provided for installation of a circuit breaker into an upper cell. Typical circuit breaker weight is 159-218 kg (350-480 lbs).

**Comprehensive Test Program**
Federal Pioneer development engineers have performed a comprehensive design testing program. The switchgear and circuit breakers are designed and tested in accordance with all applicable ANSI and CSA Standards. The switchgear and circuit breakers meet the requirements of ANSI, CSA, EEMAC and IEEE, and generally exceed IEC standards.
Hinged Front Door
Relays and metering instruments are mounted on the doors in standardized arrangements to satisfy customer requirements. Each circuit breaker compartment door provides a racking access port to allow moving the circuit breaker to or from the connected position with the door closed. (Option for single full-height door with “one-high” construction.)

Horizontal Drawout Circuit Breaker
VR vacuum circuit breakers utilize the horizontal drawout design. Test/disconnected and connected positions are provided.

Control Power Transformers
Control power transformers rated up to 15 kVA are drawer mounted and can be completely withdrawn from the front of the switchgear for ease of maintenance. A secondary circuit breaker mechanical interlock is provided and must be opened before the transformer can be withdrawn for access to primary fuses.

Voltage Transformers
Front accessible, drawer mounted voltage transformers can be completely withdrawn on extension rails. For operator safety, the voltage transformers are disconnected and grounded during movement to the withdrawn position.

Racking System
The high quality gear-driven racking mechanism is center-mounted on the cell floor, providing balanced movement of the circuit breaker between cell positions. The racking system is coordinated with safety interlocks to prevent movement of the circuit breaker unless the main contacts are in the open position.

Federal Pioneer Metal-clad Switchgear is designed and manufactured in facilities that are Registered to ISO 9001.
Cable Space
Top or bottom power cable entry space is provided. The quantity of cable termination devices and space for surge arresters vary with the ratings of circuit breakers selected for each vertical section.

Compartment Barriers
Grounded metal barriers separate the main compartments — circuit breaker, main bus, cable, instrument/relay (low voltage area), and auxiliary (VT and/or CPT).

Main Bus and Insulation
Main bus and runbacks are insulated with a track-resistant, flame retardant epoxy coating by the fluidized bed process. Bus support standoff insulators are resin based. Bus joints are insulated by flexible resin boots. Access covers are provided for main bus inspection from front and rear.

Main Bus Barriers
Main bus barriers between bays are track-resistant, flame retardant glass polyester.

Automatic Shutters
When the circuit breaker is withdrawn from the connected position, the racking mechanism linkage positively rotates the grounded metal shutters into a position which covers the energized components.

Frame and Housing
Precision-formed steel frames and inner panels, painted by the superior TGIC Polyester Powder Coating Process, provide a strong rust-resistant structure with rigid alignment of components.
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Control Wiring
All secondary/control wiring, including terminal blocks, CT shorting blocks, and other devices are located in the instrument compartment at the front of each breaker section, isolated from the primary voltage areas. Each section has provisions for control wiring entry from top or bottom.

Cell Switch—T-O-C
(Optional) Stationary-mounted switch, 6 or 10 contacts, provides electrical indication of the position of the circuit breaker in the cell — connected position or test/disconnected position.

Auxiliary Switch—M-O-C
(Optional) Stationary-mounted switch, 6 or 10 contacts, maintains the same position as the circuit breaker-mounted auxiliary switch — indicating if the circuit breaker is open or closed.

Current Transformers
(Mounted behind shutters) Bushing type current transformers are front accessible—located behind the shutters (shown in open position*, in photo at left) and mounted on the primary insulating bushings. Space will permit one or two current transformers on both sides of each circuit breaker — up to four total with ANSI standard relay accuracy class rating; two maximum with higher relay accuracies.

Secondary Control Receptacle
Self-aligning receptacle automatically engages the control plug when circuit breaker is racked to the connected position.

Auxiliary Switch Actuator
Operates M-O-C Auxiliary Switch when the circuit breaker is in the connected position and in the test position (unless otherwise specified).

Circuit Breaker Alignment Rails
The circuit breaker cell has slotted alignment rails which capture the circuit breaker rail rollers on each side of the circuit breaker to provide assurance of circuit breaker alignment with the cell. Note that the rail rollers are side-mounted and different from the wheels on the circuit breaker truck.

Circuit Breaker Removal Latch Cam
Prevents removal of circuit breaker until handle at bottom front of circuit breaker is pulled by the operator.

Primary Insulating Bushings/Stationary Main Contacts
(Shown with current transformers) Standard glass polyester insulating bushings are used to support the primary stationary disconnect main contacts. The same bushings provide insulated mounting provisions for the current transformers.

Spring Discharge Interlocks
Both opening and closing springs are automatically discharged when circuit breaker is removed from the compartment. Racking arm operates linkage on bottom of circuit breaker.

Circuit Breaker Rating Block
Prevents insertion of a circuit breaker with lower rating, either MVA or continuous ampacity, than the compartment is designed to accept.

Circuit Breaker Position Indicator
The circuit breaker position, either “connected” or “test/disconnected,” is shown by the rotation of a colored indicator wheel driven by the racking mechanism and clearly visible with the cell front door either open or closed.

Shutter Locking Provisions
The safety shutters may be locked closed by padlocking (1 or 2) or by key interlock to prevent installation of a circuit breaker when required by customer maintenance procedures.

Racking Trip Interlock
Maintains circuit breaker trip position during racking between test and connected positions. Racking arm operates linkage on bottom of circuit breaker.

*Note: Shown with shutter barrier removed and shutters in the open position for illustrative purposes only. If access to current transformers is required, the switchgear must be de-energized before the shutters are moved to the open position.
The Square D brand VR circuit breaker with the Type RI advanced design motor-charged stored energy mechanism is a model of reliability with simplicity — virtually maintenance free. With an operating life exceeding the ANSI test requirements, the RI mechanism with synchronizing crossbar is electrically and mechanically trip-free. An integral handle (non-removable) is provided for manual charging and slow-closing during testing.

The VR is completely tested and certified to all applicable ANSI circuit breaker standards.

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The vacuum interrupters of the VR circuit breaker are mounted in high-strength, moulded glass-reinforced polyester insulation/support housings. The moulded housings position the bus runbacks for precise alignment. The completed pole units are bolted directly to the circuit breaker truck. The inherent rigidity and mechanical strength of this circuit breaker design complement the operating mechanism, resulting in high endurance and reliability.
Federal Pioneer Metal-clad Switchgear is designed and manufactured in facilities that are Registered to ISO 9001.

**Weights**

Section, (less c/b): 909 kg (2000 lbs)
1200 A Circuit Breaker: 164 kg (360 lbs)
2000 A Circuit Breaker: 186 kg (410 lbs)
3000 A Circuit Breaker: 218 kg (480 lbs)
For interrupting current ratings at operating voltages other than those listed, use the following formula:

\[ I_{\text{op}} = \frac{V_{\text{max}}}{V_{\text{op}}} \times I_{V_{\text{max}}} \]

The calculated current should not exceed the maximum interrupting current rating, \( I_{\text{max}} \):

\[ I_{\text{max}} = K \times I_{V_{\text{max}}} \]

These values apply with circuit breaker in or out of enclosure.

For Rated Short Circuit Current (at rated Max kV):

\[ I_{\text{cont}} = \frac{V_{\text{cont}}}{V_{\text{op}}} \times I_{V_{\text{max}}} \]

Rating factor is based on circuit breaker speed from initiation of trip signal to contact parting, allowing for 1/2 cycle relay time. To obtain the asymmetrical current interrupting capacity of the circuit breaker, multiply the symmetrical current by 1.2.

For Close and Latch Rating (Momentary) Amps rms = (1.6K) Rated Short Circuit Current. Additional Close and Latch Rating in kA Crest = (2.7K) (Rated Short Circuit Current).

### Circuit Breaker Ratings Data Chart

<table>
<thead>
<tr>
<th>Type of Breaker</th>
<th>Nominal Rating</th>
<th>Rated Cont.</th>
<th>Rated Voltages</th>
<th>Insulation Level</th>
<th>Interrupting Ratings</th>
<th>Short Time</th>
<th>Close &amp; Latch</th>
<th>Interrupting Time</th>
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<td>Max. Voltage Amps rms</td>
<td>Range Factor K</td>
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General
The (indoor) (outdoor non-walk-in) (outdoor walk-in) Metal-clad Switchgear described in this specification is intended for use on a (2400) (4160) (4800) (6900) (13800) volt 3-phase (3) (4) wire (grounded) (ungrounded) 60 Hertz system. The switchgear shall be rated (4160) (7200) (13800) nominal volts and have VR horizontal drawout circuit breakers. The switchgear and circuit breakers, individually and as a unit, shall have a BIL (impulse) rating of (60) (95) kV. The momentary rating of the switchgear bus shall be equal to the close and latch rating of the circuit breakers. The entire switchgear assembly including circuit breakers, meters, relays, etc., shall be completely factory tested and the circuit breakers of like ratings shall be interchangeable.

Applicable Standards
The switchgear covered by this specification shall be designed, tested, and assembled in accordance with the applicable standards of ANSI, CSA, EEMAC and IEEE.

Stationary Structure
The switchgear shall consist of __ sections including __ circuit breaker compartments and __ auxiliary compartments assembled to form a rigid, self-supporting, completely enclosed structure providing steel barriers between sections. The sections are divided by metal barriers into the following separate compartments: circuit breaker, instrument, main bus, auxiliary device, and cable. Each section may have up to two circuit breaker compartments.

Circuit Breaker Compartment
Each circuit breaker compartment shall be designed to house a VR horizontal drawout (4160) (7200) (13800) volt vacuum circuit breaker. The stationary primary disconnecting contacts are to be silver-plated copper and mounted within glass polyester support bushings. The movable contacts and springs shall be mounted on the circuit breaker element for ease of inspection/maintenance. Entrance to the stationary primary disconnecting contacts shall be automatically covered by metal shutters when the circuit breaker is withdrawn to the test or disconnected positions or removed from the circuit breaker compartment. The metal shutters shall be operated by direct mechanical linkage to the floor-mounted racking mechanism. The ground bus shall be extended into the circuit breaker compartment to automatically ground the circuit breaker frame when in the test and connected positions with high-current spring type grounding contacts located on the circuit breaker chassis. Slotted guide rails for positioning the circuit breaker and all other necessary hardware are to be an integral part of the circuit breaker compartment. The circuit breaker rail rollers shall be held captive on both top and bottom by the slotted guide rails to provide assurance of circuit breaker alignment with the cell, while preventing vertical movement of the circuit breaker truck during normal operation and under short circuit conditions. A circuit breaker position indicator (“connected” or “test/disconnected”) shall be driven by the racking mechanism and be visible with the front door either open or closed. Blocking devices shall interlock circuit breaker frame sizes to prevent installation of a lower ampere rating or interrupting capacity element into a compartment designed for one of a higher rating. It shall be possible with indoor or outdoor walk-in switchgear to install a circuit breaker into a bottom compartment without use of a transport truck or lift device.

Cable Compartment
( Clamp type cable lugs) (Potheads) (Cable terminators) shall be furnished as shown on plans. The copper ground bus shall extend through this compartment for the full length of the switchgear.

Main Bus Compartment
The main bus is to be rated (1200) (2000) (3000) amperes and be fully insulated for its entire length with an epoxy coating by the fluidized bed process. The conductors are to be copper with silver-plated joints and be of a bolted (not welded) design. Access to this compartment is gained from the front or rear of the structure by removing a steel barrier. Bus support standoff insulators shall be resin based. Bus joints shall be insulated with flexible resin boots.

Federal Pioneer Metal-clad Switchgear is designed and manufactured in facilities that are Registered to ISO 9001.
Doors and Panels — Indoor and Outdoor
Relays, meters, control switches, etc., shall be mounted on a formed front-hinged panel for each circuit breaker compartment. In addition, outdoor sections, EEMAC 3R non-walk-in, have full-height weatherproof front door with 3-point latch. Indoor sections to be furnished with two screw-removable rear panels. Outdoor sections to be furnished with full-height rear-hinged panels.

Circuit Breakers
The VR circuit breakers shall be rated (4160) (7200) (13800) nominal volts, 60 Hertz, (1200) (2000) (3000) amperes and an interrupting class rating of (250) (350) (500) (750) (1000) MVA with one vacuum interrupter per phase. Circuit breakers of equal rating shall be completely interchangeable. The circuit breaker shall be operated by means of a stored energy mechanism which is normally charged by a universal motor, but can also be charged by the integral handle for manual emergency closing or testing. The closing speed of the moving contacts is to be independent of both the control voltage and the operator. Provide a full front shield on the circuit breaker. Positive contact secondary disconnect shall be through automatic self-aligning, self-engaging type plug and contact arrangement. Provision shall be made for control power plug to be manually connected in test position. A minimum of 4 auxiliary contacts (2a, 2b) shall be provided for external use. Provisions shall be made for (6) (10) additional cell-mounted auxiliary contacts (M-O-C type) (and) (T-O-C type) for external use.

An interlocking system shall be provided to make it impossible to rack a closed circuit breaker to or from any position. An additional interlock shall automatically discharge the stored-energy operating mechanism springs upon removal of the circuit breaker from the compartment. The circuit breaker control voltage shall be: (48) (125) (250) volts DC (120) (230) volts AC

Instrument Transformers
Current transformers: each circuit breaker compartment shall have provision for front-accessible mounting of up to four current transformers per phase, two on bus side and two on cable side of circuit breaker. The current transformer assembly shall be insulated for the full voltage rating of the switchgear. Relaying and metering accuracy shall conform to CSA standards.

Voltage transformers are drawout mounted with primary current-limiting fuses and shall have ratio as indicated. The transformers shall have mechanical rating equal to the momentary rating of the circuit breakers and shall have metering accuracy per CSA standards.

Control Wiring
The switchgear shall be wired with Type SIS #14 AWG, except #12 AWG* for current transformers wiring. The switchgear shall be provided with terminal blocks for out-going control connections.

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Standard Finish
After pretreatment to form a primer coating of zinc phosphate on the metal, finish coating shall be an electrostatically applied TGIC polyester powder paint. The process shall be designed to withstand at least 2500 hours of salt spray as tested per ASTM B-117 and ASTM D-1654. Switchgear finish** to be light gray ANSI #61.

Accessories
Standard accessories shall be furnished with the switchgear, including:

Manual charging/slow close handle (on front of each circuit breaker.)
Manual racking crank handle (one per lineup.)
Optional Accessories:
Test cabinet, test cable with jack and plug, 5th wheel, circuit breaker lift truck***, manual ground and test unit (MGTU), automatic/electrically-operated ground and test unit (AGTU), and remote racking motor.

For further information about Federal Pioneer MASTERCLAD Switchgear with Vacuum Circuit Breakers, contact your nearby Groupe Schneider sales office. They are conveniently located in over 680 cities throughout the world and in all major cities across Canada.

* #10 AWG also available for current transformer wiring at additional cost.
** Optional exterior colours also available at additional cost.
*** The lift truck is provided for indoor and outdoor walk-in switchgear with upper compartment circuit breaker cells. The lift truck is also provided for all outdoor non-walk-in switchgear to install circuit breakers over the base channels.