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# LET'S BE PACIFIC

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## ***Self-Powered Relay Package for In-Line MAVRiC® Applied for Overcurrent Protection***

Federal Pacific's latest offering of air-insulated vacuum circuit breakers with visible disconnects, the In-Line MAVRiC®, offers an array of positive features that give operating personnel the optimum functional capabilities necessary to perform all the switching and protection requirements demanded on the main-primary feeders and load feeders of underground distribution systems. This newsletter focuses primarily on the Self-Powered Relay and all the features it provides along with the associated low-voltage compartment. In addition, the newsletter will re-focus on some of the key functional aspects of the In-Line MAVRiC® and PVE Pad-Mounted Switchgear.

### ***Self-Powered Relay***

The Self-Powered Relay (SPR) in Federal Pacific's PVE Pad-Mounted Switchgear derives its name from the fact that no independent control-power voltage source (such as a voltage transformer or voltage sensor) is necessary for the relay to perform the protective function of operating to clear overcurrents. Eliminating the on-board power source requirement has considerable economic advantage over schemes that require a control-power source and allows the size of the equipment to be minimized. Instead, for power, the SPR continuously monitors the current, using CTs provided for that purpose. When the current exceeds the trip setting (which is variable and field selected) of the SPR a signal is initiated to trip the magnetic latch that engages the trip lever, which actuates the circuit-breaker to trip open.

After the circuit is cleared, line current is no longer available and, therefore, the relay is not powered. Personnel are dispatched to the trouble area to clear the condition that caused the fault. An external 120v ac power source is required to close the vacuum circuit breaker – a 10-foot extension cord is provided to make the connection. See Figure 3. Trouble-response trucks are typically equipped with a 120v ac source.



*Figure 1. View of PVE-5 that includes a 15kV MAVRiC® — combines a vacuum circuit breaker with an integral In-Line visible disconnect. Low-voltage compartment on side includes, Self-Powered Overcurrent Relay, viewing window to inspect visible disconnect; vacuum circuit-breaker control handle; manual handle for operation of visible disconnect and selector switches and indicators. See Figure 4 for complete details of all items in low-voltage control-compartment. All control functions are isolated from medium voltage, including elbow connectors and cables. There is never a need to enter the cable-termination compartments unless it is necessary to access cables and elbow connectors.*



*Figure 2. Open door view of the Low-Voltage Control Compartment on the PVE-5 that includes a 15kV MAVRiC® with a Self-Powered Relay to provide switching and protection for a load-feeder circuit. Other relay types, which may require a control-power source for operation, are also available.*

Connection of a 120v ac source to the MAVRiC® control module is made through the Convenience Plug on the Control Panel inside the Low-Voltage Compartment on the pad-mounted switchgear. The Internal/External Control-Power Selector switch is turned to External when the control-power source is derived from a source external to the pad-mounted switchgear. With the external power source connected to the Convenience Plug, the MAVRiC® can be closed and opened provided the two green LEDs visible in the recessed slot labeled Control Module Status are illuminated. If the red LED is flashing, the magnetic

actuator must be reset – pull the “T” handle that is marked “PULL” and labeled Overcurrent Reset Handle Pull To Reset.

If it is desired to verify the status of the SPR, a separate 120v ac plug with a 12v output is provided (see Figure 3) for connection to the EXTERNAL POWER jack on the faceplate of the SPR. With the external control-power source connected to the SPR, the LED labeled COM ENABLED on the faceplate of the SPR will be illuminated.

If the trip operation was initiated by an overcurrent on one of the phases,

the applicable phase LED labeled A – B – C will be illuminated.

If the trip operation was initiated by pressing the Manual Trip switch on the faceplate of the SPR, the LED labeled Manual will be illuminated.

If the Magnetic Actuator has been reset and the SPR is appropriately configured to operate in response to an overcurrent downstream of the current transformers, the Ready lamp on the faceplate of the SPR will be illuminated.

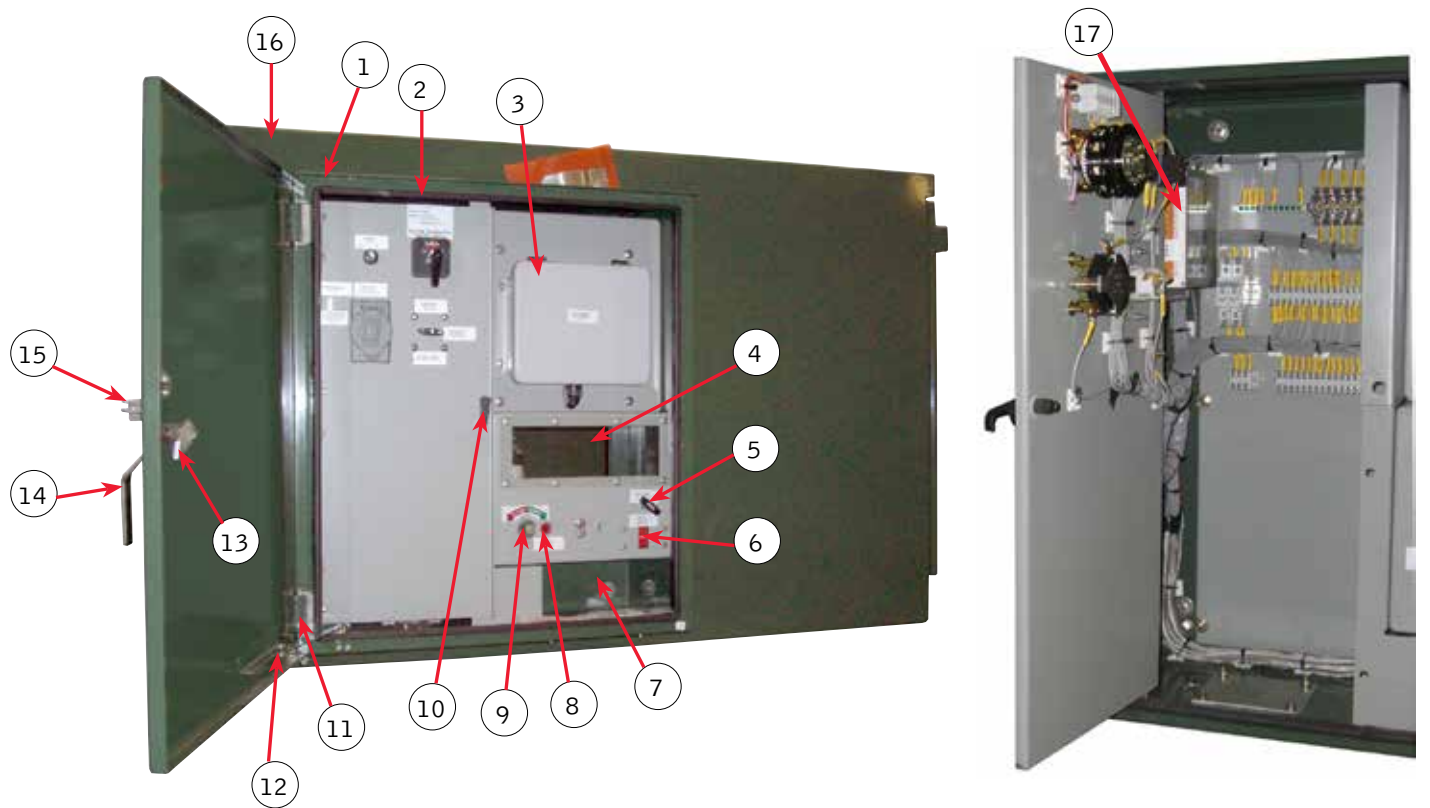
For complete instructions on operation of the Federal Pacific Self-Powered Relay, refer to Instruction Bulletin IB-11A-210.



Figure 3. Faceplate of Self-Powered Relay is at center and Control Panel is at right and both are inside the Low-Voltage Compartment. A ten-foot extension cord (at bottom in left photo) is provided for connection of an external 120vac control-power source and a 120 vac/12v dc power cord (at top in left photo) is provided for control power to the self-powered relay.

- ① Ready Lamp (at left) and Manual Trip switch (at right)
- ② Phase-Trip Indicator (labeled A-B-C) Lamps (at left) and Manual-Trip Indicator Lamp (at right)
- ③ SPR External Power Input jack (at left) and COM ENABLED lamp (at right)
- ④ Control Switch for Vacuum Circuit Breaker (at top) and Selector Switch for Internal/External Control-Power Source
- ⑤ Input Convenience Plug for Connection of 120v ac External Control Power Source
- ⑥ Control Module LED Status Indicator Viewing Port
- ⑦ Dip Switches (at top) and Rotary Selector Switch (at right) Allow Choice of Relay or Fuse Curves and Trip Settings

- ⑧ Control-Switch Indicator Lamps
  - Green Lamp - Circuit Breaker has tripped open
  - Amber Lamp - Not Ready Status (Visible Disconnect is Open or Magnetic Latch has Tripped)
  - Red Lamp - Vacuum Circuit Breaker is closed
- Operating Handle
  - Trip - Opens Vacuum Circuit Breaker
  - Close - Closes Vacuum Circuit Breaker



**Figure 4. Features of Low-Voltage Control Compartment — All components are isolated from medium voltage and from the environment. A hinged access cover is provided over low-voltage wiring and terminal blocks.**

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| <p>① Low-Voltage Control Compartment — Features heavy, 11-gauge sheet steel</p> <p>② Gasket — Around entire door opening, seals out the environment</p> <p>③ Self-Powered Relay (SPR) — Secure in a non-metallic housing; gasket seals cover to prevent entry of dust and water</p> <p>④ Viewing Window of clear Polycarbonate — Provides view of disconnect position, to verify that circuit is isolated or energized</p> <p>⑤ Reset Handle — Pull handle to reset magnetic actuator to be ready for next trip-open operation</p> <p>⑥ Vacuum Circuit Breaker Position Indicator — Displays green target when vacuum circuit breaker is open; red target when vacuum circuit breaker is closed</p> <p>⑦ Manual Crank Handle — For operation of visible disconnect is of two-piece construction and is secured to enclosure by a stainless-steel cable and mounted on stainless-steel clips to keep off bottom</p> <p>⑧ Visible Disconnect Position Indicator Target (Green-open; red-closed)</p> <p>⑨ Manual-Crank Operating Shaft — Position manual-crank handle on shaft and rotate in the direction indicated on label to open/close</p> | <p>⑩ Access-Cover Handle — Flip handle up to access wiring and terminal blocks</p> <p>⑪ Stainless-Steel Hinges and Hinge Pins — Secure door to enclosure</p> <p>⑫ Wind Brace — Secures compartment door open from wind or accidental impact</p> <p>⑬ Latch — For low-voltage compartment door.</p> <p>⑭ Stainless-Steel Door Handle</p> <p>⑮ Padlock Tab</p> <p>⑯ Low-Voltage Compartment — Sealed to enclosure</p> <p>⑰ Control Module with LED Status Indicator Lamps</p> <ul style="list-style-type: none"> <li>• Green LED Lamp at Top — Module has Control Power</li> <li>• Red LED Lamp in Middle — Flashing Indicates a Malfunction or a Trip Operation has Occurred and the Control Module Must be Reset (Reset by Closing the Visible Disconnect if it is open and Pulling the Reset Handle to Reset the Magnetic Latch)</li> <li>• Green LED Lamp at Bottom — Flashes Green and then Goes Solid when the System is Ready for a Subsequent Closing or Opening Operation</li> </ul> |
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Optional Two Bushings per phase — one 600-amp and one 200-amp allows connection of grounding elbows and elbow arresters or specify two 600 amp bushings for two conductors per phase.

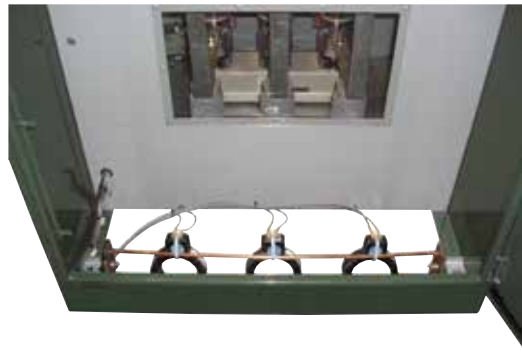


Figure 5. Incoming cable termination compartment is pictured at left. Incoming compartment can be optionally provided with 2-600 amp bushing per phase or 1-600 amp bushing and 1-200 amp bushing well with the 200-amp bushing well suitable for connection of grounding elbows and elbow-connected surge arresters (elbows, inserts and arresters not included). Outgoing cable-termination compartment (at top right) includes 600/5 CTs (at bottom above) for sensing load and fault currents and for powering the Self-Powered Relay.

Operating Shaft for Visible Disconnect  
 Visible Disconnect Position Indicator  
 In-Line Visible Disconnect Closed  
 Magnetic Latch Pull Reset Handle



Vacuum Circuit Breaker Position Indicator

Manual Operating Handle for Visible Disconnect

In-Line Visible Disconnect Open



Figure 6. Views showing closed position of In-Line visible disconnect at left and open position of In-Line visible disconnect at right. Also shown are position-indicator targets for visible disconnect and vacuum interrupter along with the pull handle used to reset the magnetic latch that initiates tripping of MAVriC<sup>®</sup> when an overcurrent occurs. CTs on outgoing cables sense the overcurrent; the Self-Powered Relay processes the overcurrent condition and sends signal to release the magnetic latch; the plunger of the magnetic latch engages the trip lever on the MAVriC<sup>®</sup> to separate the monostable magnetic actuators, breaking the magnetic field and releasing the spring energy to open/close the vacuum-interrupter contacts.

## **MAVRiC® With In-Line Visible Disconnect**

Federal Pacific's latest MAVRiC® with the In-Line Visible Disconnect expands the pad-mounted switchgear offering in several meaningful aspects. MAVRiC® with the In-Line Visible Disconnect integrates a vacuum circuit breaker and a visible disconnect on an integral common frame to provide operating and construction personnel with several key advantages:

- (1) Dead-Front design provides positive isolation from cables, elbow connectors, and any open energized switching elements
- (2) All local operations are performed from the side of the pad-mounted switchgear - no exposure to cables or elbows
- (3) Positive visual verification, through a viewing window at the side of the unit, that the electric-current path is in an open-circuit condition
- (4) Operating Handle for Visible Disconnect is at the side of the unit in the low-voltage compartment away from cables and elbow connectors, supporting lockout/tagout procedures
- (5) Remote Enable Off/On Selector Switch to prevent/allow operation from a remote location via SCADA or any other means also supporting lockout/tagout procedures
- (6) Common enclosure size to fit the same box-pad of conventional fused PSE Models for all circuit configurations
- (7) Matches the cable-termination height of fused PSE Models
- (8) Keeps the same enclosure height as fused PSE Models
- (9) Mechanical and electrical interlocking to insure correct operating sequence as follows:
  - (a) Prevent opening the disconnect unless the vacuum interrupter is open
  - (b) Prevent closing the vacuum interrupter if the disconnect is open – magnetic actuator cannot engage trip lever
  - (c) Over-center push-arm blocks disconnect travel when open
- (10) Automation (SCADA, Automatic Transfer and Automatic Self-Healing Schemes) without requiring the addition of motor operators, providing significantly greater reliability by eliminating many moving parts and circuits — all controls are isolated from high voltage in an external low-voltage compartment
- (11) Isolation from any open energized protective elements or components — circuit switching and fault Interruption all takes place with the vacuum interrupter
- (12) Resettable Vacuum Fault Interrupter – No fuses to stock, access, or change
- (13) Provides thousands of loadbreak operations needed for Smart Grid designs, automatic transfer, SCADA control, and feeder reconfiguration for optimum fast response to real-time feeder loading profiles
- (14) Extremely fast circuit interruption in 1-2 cycles
- (15) Can be configured to provide fast response to mitigate exposure to arc flash conditions.

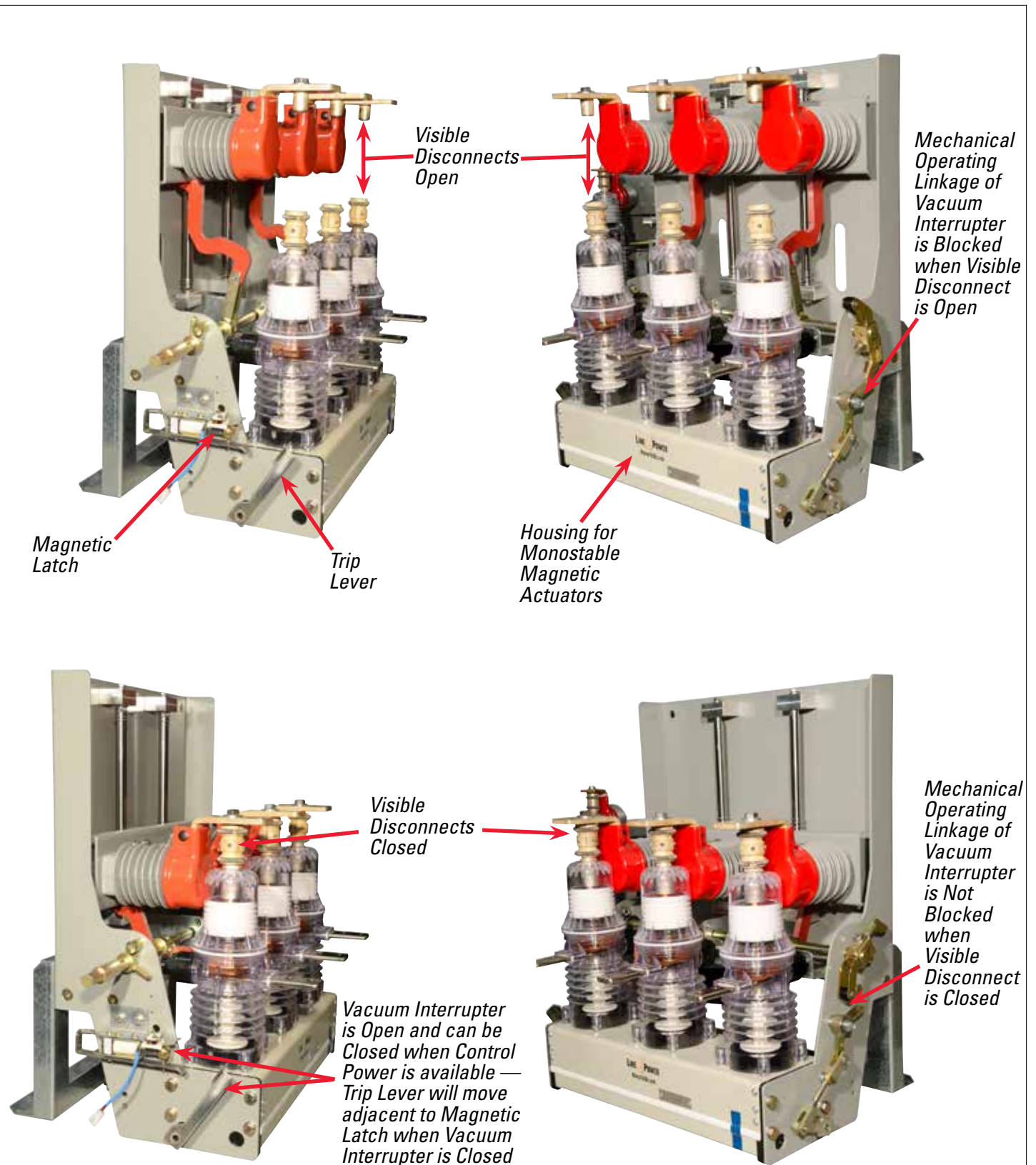


Figure 7. Views at top show left side and right side of a MAVRiC® with the Visible Disconnect Open. With the Visible Disconnect Open, the MAVRiC® (at top right) illustrates the Mechanical Blocking that prevents the vacuum interrupter from closing; the MAVRiC® (at top left) illustrates that the Plunger of the Magnetic Latch, if tripped, cannot engage the Trip Lever and, therefore, both mechanical and electrical interlocking are provided to prevent operation of the vacuum interrupter if the visible disconnect is open. Views at bottom show the left side and right side of a MAVRiC® with the Visible Disconnect Closed. With the Visible Disconnect Closed, the MAVRiC® (at bottom right) illustrates that the Mechanical Blocking linkage is no longer engaged and the Magnetic Latch on the MAVRiC® (at bottom left) can be reset (it is shown in the reset position) and the vacuum interrupter closed (at which time the Trip Lever moves to the left) so that the Plunger on the Magnetic Latch will engage the Trip Lever when a subsequent trip signal is initiated.



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