5.7 Fault Indicators

A. Description

Fault indicators (FIs) are placed on a cable to indicate that fault current has passed through that point. When it senses a fault, it displays a flashing red light emitting diode (LED), or a red flag. Starting at the substation, the troubleman can trace the path of the fault by following the flashing fault indicators.

Overhead FIs are installed directly on the bare conductor (refer to DAP, AP 600). Underground units mount on insulated conductors, but not on paper-insulated lead-covered cable (PILC) (refer to DUG, TD I00). Underground units include extension fiber-optic cables for remote indication at convenient locations (refer to DUG, TD 100.3 through TD 100.7).

Fault indicators are phase-current sensing devices which are highly reliable. However, FIs are very much dependent on the fault magnitude and duration, which varies from each and every location in the circuit. Therefore, they may not work in some situations where fault duties are not high enough and/or long enough to trip the FI unit.

B. Operation

A tripped circuit breaker or a blown fuse is the first evidence that a fault has occurred. If the circuit breaker tripped due to a fault, then the fault indicators installed on the breaker's associated circuit would trip if the fault current passed through them. The FIs are then used to indicate the path to the fault location.

In general, the segment of the circuit between the farthest downstream flashing FI and the next nonflashing FI indicate the segment where the fault has occurred. The troubleman then opens the appropriate switch or switches to sectionalize and isolate the faulted segment of the circuit. After verifying that no other source paths to the faulted segment exist, the troubleman reenergizes other unfaulted parts of the circuit to restore power to as many customers as possible.

The FIs are commonly made an integral part of the circuit's emergency switching procedures. Their locations are marked on the circuit maps in accordance with Distribution Operations and Maintenance Policies and Procedures (DOM), CO-2.

C. Selection

The *automatic* FI, also known as a *self-adjusting* FI unit, is the only approved FI unit for all new installations.

There are currently two approved self-adjusting FI models—the *Load Tracker* and the *Navigator.*

- The *Load Tracker with Load Memory* is available in both overhead and underground applications. Refer to DAP, AP 600.
- The *Navigator* is only available for overhead applications. Refer to DAP, AP 600.

The Load Tracker with Load Memory has the lowest (50 A) minimum trip rating of the two units approved that should be used in applications where fault duties are low. Both the Load Tracker with Load Memory and the Navigator are self-adjusting type FIs that sample the load current every 72 hours and adjust the set point accordingly based on the peak load current.

D. Placement

Fault indicator locations will be selected to cost-effectively reduce the switching time to isolate a fault based on the established emergency switching procedures. Special circumstances, such as *problem circuits* (circuits with a history of frequent or lengthy outages), and *circuits with critical loads,* may warrant additional FI locations.

Avoid installing FIs at the following locations:

- On any normally open tie line
- On any normally de-energized circuit section
- On minor circuit tap sections and single-phase laterals
- Immediately beyond fuses
- Circuits that are looped
- Downstream of an AR if ground device is enabled

The FIs will be placed in a readily visible and accessible (for resetting) location, at or near a circuit sectionalizing point, on overhead conductors, in selected subsurface locations, or in pad-mounted equipment. FIs may be placed on overhead conductors near underground risers to indicate faults on underground portions of the circuit.

5.8 Sentient Energy MM3 Overhead Remote Fault Indicator (RFI)

The purpose of the Sentient Energy MM3 RFI is to remotely monitor overhead distribution circuits via the Distribution Management System (DMS) by capturing data on the circuit performance and condition of the lines, thereby allowing Engineering and Field Personnel to respond to equipment-related outages, overload conditions, troubleshooting, and reliability issues.

For SCE applications, the Sentient Energy MM3 Remote Fault Indicators may be utilized at any distrubuiton circuit meeting the following criteria:

- Nominal Voltage: 4.16 kV to 33 kV
- Conductors Size: 1/0 AWG to 653.0 kcmil.
- Sensor current range is 15-800 amps. The sensor requires a minimum of 15 amps to operate.

Table 2–1: SAP Numbers for Sentient Energy MM3 RF

Sensor Amperage Range	Conductor Material	SAP
15-800 A	Al	10203814
15-800 A	Cu	10204873

The Sentient Energy MM3 RFI detects, stores, and remotely indicates the following data:

- Fault Current
- Load Current
- Load Direction
- Conductor Temperature

The Sentient Energy MM3 RFI has built-in wireless communication for remote data download via the DMS.

Although this system is normally to be specified by Grid Modernization, Grid Ops, FE, and District Managers, Planners may consult with FE for deployment of the Sentient Energy MM3 RFI on long distribution lines or difficult-to-patrol areas; for example, areas where air patrol is required. The Sentient Energy MM3 requires a minimum of 15 Amps continuous for device operation. The amp calculations should be completed before installing the device to ensure proper operation.

MM3 Overhead RFIs are scoped per Field Engineering. Installations not scoped by Field Engineering require the completion of the Netcomm Radio and RFI Request Form during the planning stages. Completed forms shall be e-mailed to emailDAP@sce.com for processing.

All OH-RFI installations will require the submission of an installation record and a call to the Distribution Automation Hotline at (714)-285-4325 for a radio communication check. The installation record shall be submitted via the Asset Complete Data Capture (ACDC) mobile application by scanning the QR code on each MM3 RFI. If the ACDC mobile application is not available, the RFI Installation Form (See Figure 2–9) shall be filled out completely and emailed to emailDAP@sce.com.

Note: Accurate latitude and longitude are required.

Refer to Distribution Apparatus Construction Standards (DAP), AP 604, for further information.

5.9 Cleaveland/Price Linescope Overhead Line Monitoring System

The purpose of the Cleaveland/Price Linescope Overhead Line Monitoring System is to remotely monitor the status of overhead distribution circuits, providing 3-phase voltage and current measurements along with kW and kVAR telemetry data through wireless communication to the RTU in ADMO Switch Controls for communication to the Distribution Management System (DMS) system. This system requires a new or existing ADMO control in order to install, it is not a standalone system.

The 3-phase telemetry data will assist personnel responding to circuit faults, distribution equipment-related outages, circuit over-load conditions, circuit troubleshooting, and circuit reliability issues.

Currently, the Linescope Overhead Line Monitoring System deployment scope is specified by Field Engineering, with targeted installation locations meeting the following criteria:

- System Voltages: 12 kV and 16 kV
- System: 3-Phase, 4-Wire
- Horizontal Overhead Line Construction
- Line Conductor Size: 1/0 AWG to 653.9 kcmil (fits conductors up to a maximum of 1.2 inches in diameter).
- Sensors installed on overhead conductors within the maximum transmitter range as specified in Table AP 620–3.
- Sensors installed on opposite side of RCS switch from where the control power transformer is tapped and with the ‘Line’ label oriented towards the switch.
- Existing or Anticipated high penetration of Distributed Generation Resources on circuit.
- Sensors installed outside of High Fire Risk Areas (HFRA’s)

The Cleaveland/Price Linescope System detects, records, and transmits the following data:

- 3-Phase Line and Neutral Current