

SEL Falling Conductor Mitigation

Advanced Wide-Area Protection for Distribution Systems



Detect and de-energize falling conductors before they hit the ground

- De-energize overhead power lines within milliseconds of a break, preventing high-impedance faults and hazardous conditions.
- Partner with SEL Engineering Services for a turnkey solution with comprehensive consulting, commissioning, and field-testing services.
- Easily adapt and expand falling conductor detection schemes using an intuitive settings interface.





An Advanced Broken Conductor Mitigation Solution

When an overhead distribution line breaks and the energized conductor falls, it often creates a high-impedance ground fault, which can be difficult or even impossible to detect. Conventional protective devices may not operate until well after the fault has occurred, increasing the amount of time the conductor is on the ground creating hazardous conditions.

SEL's falling conductor mitigation solution is based on specialized algorithms implemented in SEL Real-Time Automation Controllers (RTACs). It is a scalable solution designed for wide-area distribution systems, including single-phase, two-phase, and three-phase circuits.

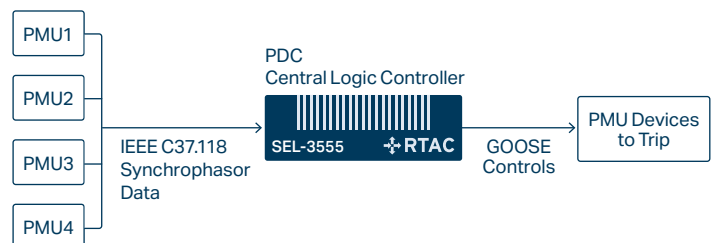
In this solution, the RTAC receives synchrophasor data from phasor measurement units (PMUs) in the field via high-speed communications and monitors the data in real time, detecting changes in voltage to identify falling conductors within milliseconds of a break.

Through outgoing communications, like IEC 61850 GOOSE or MIRRORING BITS® communications protocols, the RTAC sends commands to protective devices to de-energize the broken conductor before it touches the ground, preventing equipment damage and hazardous conditions.

The RTAC also analyzes the synchrophasor data to narrow down the location of the broken conductor and then notifies SCADA, making service restoration more efficient. SEL-5702 Synchrowave® Operations Software can be used to monitor the system in test or live mode and provide helpful tools for post-fault analysis.

Easy to Configure and Expand

With easy-to-use template-based settings, system configuration is simple and does not require any coordination or load flow studies. After initial setup, settings can be easily modified using the intuitive interface in ACSELEATOR RTAC® SEL-5033 Software, allowing you to adapt and expand your system for additional feeders and PMUs.



Typical distribution circuit and data flow

Solution Components

Falling Conductor Detection Algorithms

Synchrophasor measurements from PMUs in the field are sent to the RTAC for time alignment and analysis. The time-aligned data are monitored in real time for specific behavior patterns associated with broken conductors. The system uses multiple methods for detecting falling conductors, including analysis of the voltage change over time, the magnitude of voltage sequence components, and the angle of voltage sequence components. The system can be deployed in supervisory or actionable mode and can be customized to trip after a set number of detection methods.

RTACs

The RTAC acts as both the phasor data concentrator and the central logic processor in this solution. Deployed in substation environments, the RTAC pulls data from PMUs, analyzes the data to identify broken conductors,

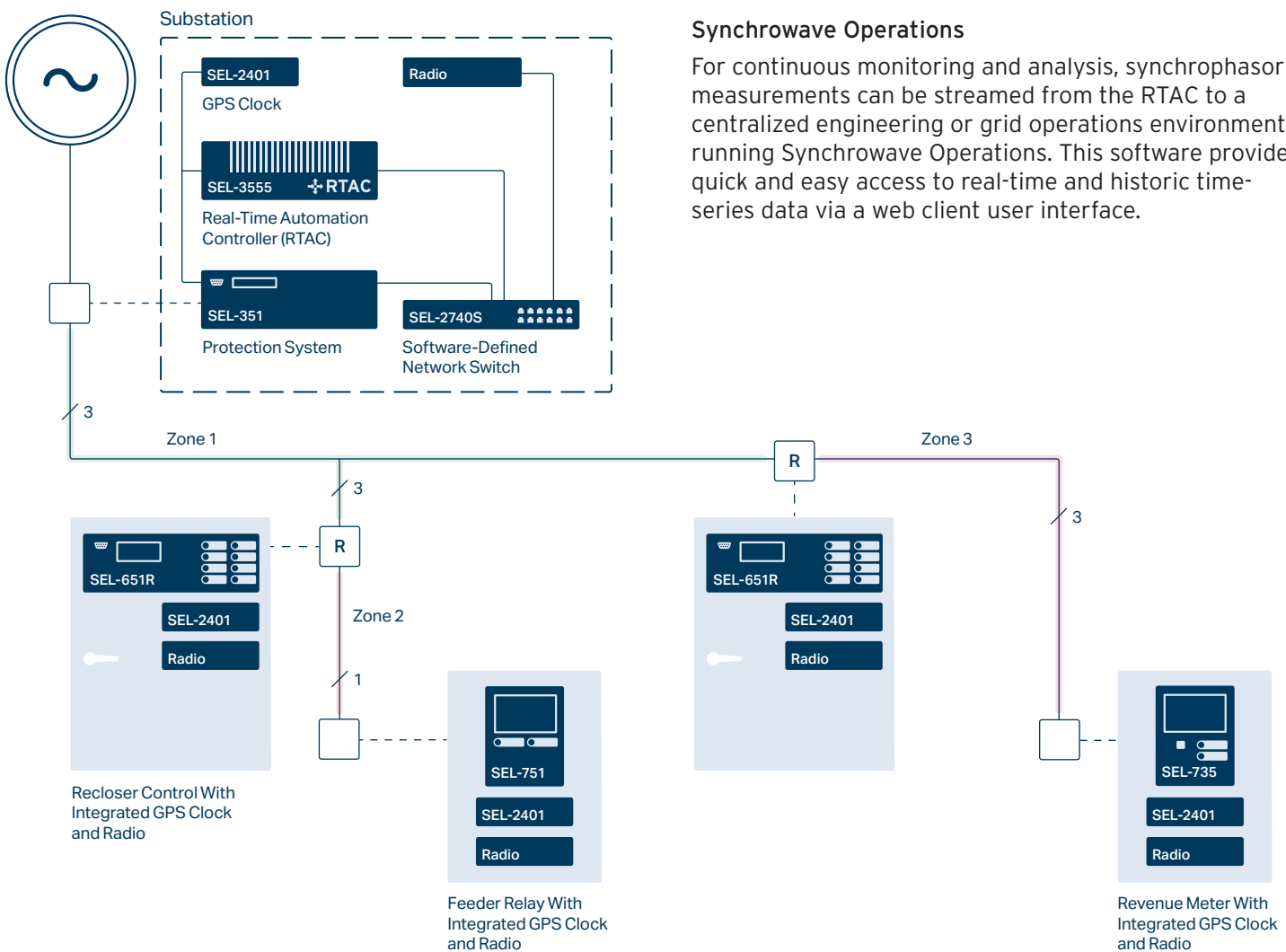
and issues control commands to protective devices in the field. The RTAC's easy-to-use HMI provides comprehensive data visualization, and its variety of hardware options offers the flexibility to choose the form factor and processing power that best suits your application. In distribution systems where an RTAC is already implemented, the falling conductor detection algorithms can be added with a software upgrade.

PMUs

PMUs throughout the distribution system stream synchrophasor measurements to the RTAC at a rate of 30 to 60 messages per second using available high-speed communications paths, such as Ethernet radio or fiber. Each RTAC can support up to 100 PMUs. A wide range of SEL devices offer PMU functionality, including the SEL-351 Protection System, the SEL-651R Advanced Recloser Control, and the SEL-751 Feeder Protection Relay. In addition, this solution is interoperable with PMUs from other manufacturers.

Synchrowave Operations

For continuous monitoring and analysis, synchrophasor measurements can be streamed from the RTAC to a centralized engineering or grid operations environment running Synchrowave Operations. This software provides quick and easy access to real-time and historic time-series data via a web client user interface.



Engineering Services

SEL Engineering Services provides turnkey solutions, supporting all project stages from planning through final commissioning. We offer consultations to assist with system design, PMU placement, communications infrastructure, and cybersecurity. In addition, we help specify equipment and develop settings and commissioning plans.

All solutions are validated through extensive factory acceptance testing using hardware-in-the-loop (HIL) simulations, which customers are invited to attend. Field support is provided during installation and commissioning, and ongoing support and training are available throughout the life of the solution.



For more information about the SEL falling conductor mitigation solution, contact Engineering Services.

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