



# SEL-351S Relay Guideform Specification

The microprocessor-based relay shall provide a combination of functions including protection, monitoring, control, fault locating, and automation. Relay self-checking functions shall be included. Specific operational and functional requirements are as follows.

**Phase Fault Overcurrent Protection.** The relay shall incorporate phase and negative-sequence overcurrent elements for detection of phase faults. For added security, the relay shall provide directional elements, load encroachment logic, and torque-control capability (internal and external).

**Adaptive Phase Overcurrent Elements.** The relay shall incorporate adaptive phase overcurrent elements that perform reliably in the presence of current transformer saturation, dc offset, and off-frequency harmonics.

**Ground Fault Overcurrent Protection.** The relay shall incorporate residual ground and neutral ground overcurrent elements for detection of ground faults. For added security, the relay shall provide directional elements and torque-control capability (internal and external).

**Directional Ground Protection.** The relay shall incorporate directional ground elements for ungrounded, Petersen Coil-grounded, and impedance-grounded systems, using a neutral current channel that can withstand 500 A for one second (thermal rating).

**Under- and Overvoltage Elements.** The relay shall incorporate undervoltage and overvoltage elements for creating protection and control schemes, including but not limited to the following: voltage checks (e.g., hot bus/dead line) for reclosing; blown transformer high-side fuse detection logic; control schemes for capacitor banks.

**Sequence Voltage Elements.** The relay shall incorporate positive-, negative-, and zero-sequence voltage elements that can be logically configured for either under- or overvoltage applications.

**Under- and Overfrequency Protection.** The relay shall incorporate six levels of under-/overfrequency elements for detection of power system frequency disturbances. Each setting level shall use an independently set timer for load shedding or generator tripping schemes.

**Autoreclosing Control.** The relay shall incorporate a four-shot recloser. It shall include four independently set open time intervals, an independently set reset time from reclose cycle, and an independently set reset time from lockout.

**Synchronism Check or Broken-Delta Voltage Input.** The relay shall include two synchronism check elements with separate maximum angle settings (e.g., one for autoreclosing and one for manual closing). The synchronism check function shall compensate for breaker close time and constant phase angle differences between the two voltage sources used for synchronism check (phase angle differences settable in 30-degree increments). Alternatively, the relay shall accept a broken-delta (zero-sequence) voltage input (in place of a synchronism check voltage) to use as a polarizing source for the zero-sequence voltage-polarized ground directional elements.

**Selectable Wye or Delta Voltage Inputs.** The relay shall operate with either wye-connected (four wire) or open-delta-connected (three wire) potential transformers.

**Coordination With Downstream Reclosers.** The relay shall include 38 standard recloser time-overcurrent curves and sequence coordination logic for secure and dependable operation for faults beyond a line recloser.

**Operator Controls.** The relay shall include 10 operator controls on the relay front panel; these functions shall also be accessible in the relay control logic. The operator control panel shall include pushbuttons and LEDs with the following markings: Ground Enabled, Reclose Enabled, Remote Enabled, Alternate Settings, Lock, Hot Line Tag, AUX 1, AUX 2, Close/Breaker Closed (or AUX 3), and Trip/Breaker Open (or AUX 4).

**Independent Trip/Close Pushbuttons.** The relay shall include independently operated breaker trip/close switches and indicating lamps. The switches and breaker status lamps shall be functional regardless of the relay status.

**Event Reporting and Sequential Events Recorder (SER).** The relay shall be capable of automatically recording disturbance events of 15 or 30 cycles with settable prefault duration and user-defined triggering. Events shall be stored in nonvolatile memory. The relay shall include an SER that stores the latest 512 entries.

**Fast SER Protocol.** The relay shall be capable of communicating unsolicited binary SER messages.

**Status and Trip Target LEDs.** The relay shall include 16 status and trip target LEDs.

**Overload and Unbalance Alarms.** The relay shall include user-settable demand current thresholds for phase, negative-sequence, neutral, and residual demand measurements.

**Circuit Breaker Monitor.** The relay shall include a breaker wear monitor with user-definable wear curves, operation counter, and accumulated interrupted currents by phase.



**Substation Battery Monitor.** The relay shall measure and report the substation battery voltage presented to the relay power supply terminals. Two user-selectable threshold parameters shall be provided for alarm and control purposes.

**Fault Locator.** The relay shall include a fault locating algorithm to provide an accurate estimate of fault location without communications channels, special instrument transformers, or pre-fault information.

**Digital Relay-to-Relay Communications.** The relay shall have eight send and eight receive logic elements in each of two communications ports for dedicated relay-to-relay communications.

**Automation.** The relay shall include 16 local control elements, 16 remote control logic points, 16 latching logic points, and 16 display messages in conjunction with a local display panel included in the relay. The relay shall have the capability to display custom messages.

**Power Elements.** The relay shall include four independent directional power elements that can respond to either real or reactive power.

**Voltage Sag/Swell/Interruption Report.** The relay shall include automatic monitoring of system disturbances, triggered by settable voltage thresholds as a percentage of the predisturbance voltage. The report shall be stored in nonvolatile memory.

**Relay Logic.** The relay shall include programmable logic functions for a wide range of user- configurable protection, monitoring, and control schemes.

**Communication.** The relay shall include three independent EIA-232 serial ports and one EIA-485 serial port for external communications.

**Distributed Network Protocol (DNP).** The relay shall incorporate compliant DNP3 Level 2 Slave protocol communications capability.

**IRIG-B.** The relay shall include an interface port for a demodulated IRIG-B time synchronization input signal.

**PC Interface.** The relay shall be capable of being set by Windows<sup>®</sup>-based graphical and ASCII terminal interfaces.

**Synchrophasors.** The relay shall include operation as a phasor measurement and control unit (PMCU).

**Warranty.** The relay shall have a minimum 10-year worldwide warranty.

