



SEL-7000 Guideform Specification

The SEL-7000 Integrated Substation System shall be provided as a complete and functional system including protective relays, communications processors, personal-computer-based HMI, cables, connections, software, and configuration necessary for operation. The Integrated Substation System shall provide graphical HMI, SCADA data and control, remote engineering access, electrical system protection, and time synchronization distribution.

System Features. The system shall be configured to provide the major features listed below.

Star Network. All IEDs shall be connected to communications processors using a star network architecture of independent point-to-point connections. Measurement and status data shall be collected from all IEDs simultaneously.

SCADA Data Access. The SEL-2030 Communications Process shall connect to the SCADA master directly as a DNP 3.0 Level 2 Slave through event and static data types either polled or unsolicited. The DNP interface shall also include control points that cause control actions in station IEDs.

HMI Data Access. Human machine interface (HMI) status and measurement data shall be forwarded to the personal computer serial port using unsolicited data transfer. Control messages shall be sent using Fast Operate commands that include information redundancy and shifting to provide data security and prevent false operations.

IED Cable Connections. IEDs shall be connected via fiber-optic cables. A single pair fiber-optic cable shall carry SCADA/HMI data and control, IRIG-B time synchronization, and ASCII engineering communications to each SEL relay. A second fiber-optic cable shall connect each SEL relay to the protection data network.

Protection Data Network. The protective relays shall be connected to a protection logic processor using MIRRORING BITS™ communications, a patented communications system developed for high-security and high-speed protection functions. The protection data network shall be completely separate and distinct from all other data networks in the substation. The protection data network shall contain only components that meet protective relay environmental standards.

Backup Interface. The relay front panels shall automatically provide text and status point displays that serve as a backup interface to the HMI system. The relays shall also be configured so that front-panel direct action pushbuttons operate as a backup control interface. The control interface shall include a lock function that prevents accidental controls.

Station-Wide SER. The HMI communications software shall collect station SER information on the same serial cable used for data transfer to the HMI. The data shall be stored in a Microsoft® Access database format that allows reading and processing by applications written with Microsoft Access.

Configuration Management. The station computer shall include all software and configuration files used for station IEDs. The station computer shall be configured to allow access to all IEDs for configuration and other engineering uses, including examining equipment monitoring reports and diagnostics.

HMI System. The substation computer is the primary human machine interface (HMI) for monitoring and control of the power system and substation equipment. The substation HMI provides a centralized graphical user interface for viewing system status and measurements and issuing control commands to station IEDs. The HMI shall be implemented on a standard off-the-shelf industrial HMI product such as Wonderware® InTouch®.

HMI Watchdog. There shall be a watchdog timer implemented in each station relay that automatically enables front-panel control if the HMI system fails to reset the watchdog timer.

Calculation Scripting. The HMI system shall be capable of scripting to allow the calculation of substation quantities including power factor.

Clearance Tags. The HMI system shall display the status of protection tags and provide graphical selections for tag application and removal. The system shall collect database records that indicate when tags were removed and which operator was logged on when the tag was removed.

Security. The HMI system shall include a user logon system and the ability to limit rights associated with different users.

Screen Header. All HMI displays shall include a Screen Header that allows selection of other displays as well as system logon and logoff functions and a display of which user is presently logged on.

Alarm Bar. All HMI displays shall include a scrolling display of active alarms and the option to acknowledge alarms. Alarms shall be displayed in different colors based on whether the alarm was unacknowledged or acknowledged. Alarms shall not be displayed after they have been acknowledged.

One-Line Display. Selection of One-Line on the screen header shall display a system one-line that shows all substation equipment and indicates whether any equipment is not in the normal operating state or status. The One-Line display shall also indicate which tags have been applied to the equipment.

Breaker and Relay Control. Selection of a circuit breaker on the system one-line shall display a screen that allows control of the equipment and associated relay including tagging, trip, close, and target reset.

Tag Application Screen. Selection of tag application or removal from the breaker and relay control screen shall display a tag window. The tag window shall include the time that the tag was last applied or removed and allow for entry of a comment and selection of whether to apply or remove the tag.

Targets Screen. Selection of Targets pushbutton from the screen header shall display a screen that shows all active targets on all station relays, as well as the alarm status of the relays and the ability to reset targets on each relay individually.

Communications Screen. Selection of Comm pushbutton from the screen header shall display a system communications screen showing the status of all communications links in the system. The link color shall change dynamically with the status of communications in the system.

Alarm Summary Screen. Selection of Alarms pushbutton on the screen header shall display the alarm summary screen. The alarm summary screen shall list all active alarms, using color to indicate which alarms are active and which have been acknowledged. There shall be a filter function allowing filtering of alarms based on equipment and a button to select display of the alarm history screen.

Alarm History Screen. Selection of Historical Alarms pushbutton from the Alarm Summary screen shall display the alarm history screen showing a scrolling record of system alarms. The screen shall include the ability to display alarm history or active alarms, to filter and sort alarms, and to display alarms based on dates.

Relay Protection Schematic Screen. Selection of the Protection pushbutton on the screen header shall display the relay protection schematic. The schematic shall show all relays and instrumentation connections for relays. This screen shall also include a protection scheme description function that displays hypertext-style links to text descriptions of system protection.

System Performance. The system must meet or exceed the following performance guidelines. All guidelines must be supported by measurements or field experience data that shall be available upon request.

Response to Control. A control input at the HMI shall produce a change in the output contacts of a station relay with an average time of 200 ms.

Change of State Response. A change of state on the discrete input of a station relay shall produce a change in the HMI display with an average time of 0.75 seconds.

IED Polling. The system shall poll every IED within 1 second or less.

System Defects-per-Thousand. The system defect rate per thousand installations shall be a maximum of 9 when calculated based on equipment experience MTBF data.

Relay Power Up. All relays shall power up, begin executing protection algorithms, and be capable of tripping operations within 10 seconds.

Communications Processor Power Up. The communications processor shall power up and begin providing data to the HMI within 4 minutes.

Time Synchronization Accuracy. All station IEDs shall be time synchronized with an accuracy of 5 ms.

SER Resolution. SER data shall be collected with a time-stamp resolution of no more than 1 ms.

Self-Testing. All station protection equipment shall be capable of self-testing and reporting internal errors that affect protection operation. This equipment shall be able to signal through communications and output contacts if protection functions have been disabled.

Equipment. The system shall contain all components required for complete system operation. All devices shall be configured, programmed, and installed to provide complete system operation.

Protective Relays and Transformer Monitor. All protective relays and equipment monitors shall be provided by SEL for the specific purposes required. Each product must also meet all requirements in the SEL Guideform Specification for that product.

Communications Processor. The SEL-2030 shall be the system communications processor and shall provide HMI data, SCADA data, IED data collection and control, time-synchronization distribution, and engineering access through a star network. The communications processor must meet all requirements in the SEL-2030 Guideform Specifications.

Protection Logic Processor. The protection logic processor shall be an SEL-2100 and shall use the SEL Mirrored Bits communications system for secure and reliable data exchange with protective relays. The Protection Logic Processor must meet all requirements in the SEL-2100 Guideform Specification.

Fiber-Optic Transceivers. Fiber-optic transceivers shall operate on port power and require no configuration. Fiber-optic transceivers shall also automatically multiplex IRIG-B time-synchronization signals on the same fiber-optic cable pair as other communications.

Fiber-Optic Cable. The fiber-optic cable shall be hard-clad silica multimode cable. The cables shall be connected to transceivers using a connector system that allows field termination without the need for polishing, epoxies, or field testing using an OTDR

or other test equipment. The fiber-optic cable shall be available in a PVC jacketed style for conduit installations or a zip-cord style for use in open wire ways and control panels.

HMI Communications I/O Server. The I/O server shall use the native communications protocol of the communications processor and include the capability to collect and store unsolicited SER data from the system. Real time data shall be available to the HMI via the Microsoft Windows® DDE and Wonderware SuiteLink protocols.

HMI Software. The HMI software shall be a commercially available standard HMI product that has the ability to collect data from a third-party I/O server using the Microsoft Windows DDE or WonderWare Suitelink protocols.

[Author: Select either Local or Enterprise Power System Report Manager]

Enterprise Power System Report Manager. Event report data shall be automatically collected by the SEL-5040 Power System Report Manager Software. The system shall provide a summary of data as well as sort, store, index, and catalog both long and short event report formats from SEL relays. All equipment shall be configured and tested for operation with SEL-5040 software installed in a central office.

Local Power System Report Manager. Event report data shall be automatically collected by the SEL-5040 Power System Report Manager Software. The system shall provide a summary of data as well as sort, store, index, and catalog both long and short event report formats from SEL relays. The data shall be collected and stored locally on the station computer.

IRIG-B Time-Synchronization Source. The time-synchronization source shall be a substation GPS receiver that is capable of being powered directly from substation battery dc voltage and that produces a standard output in either modulated or demodulated IRIG-B format.

Station Computer. The station computer shall be an off-the-shelf personal computer using the Windows 2000 Professional operating system or newer. The computer shall include three EIA-232 ports, a modem, and an Ethernet network interface.

