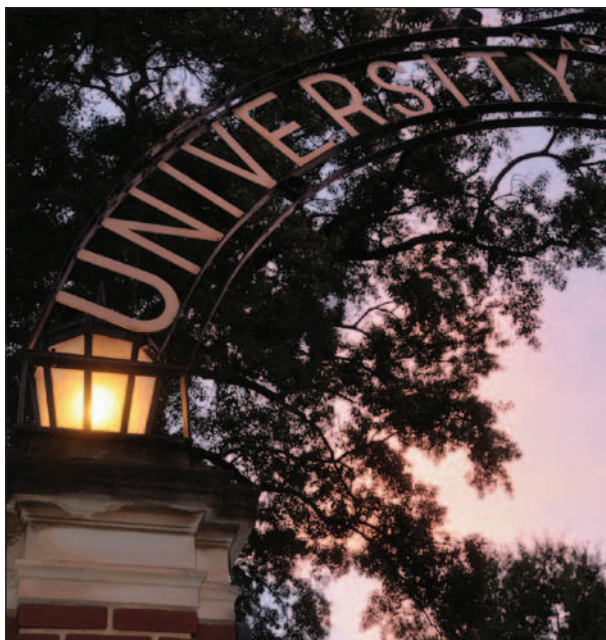


SEL
UNIVERSITY

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SEL University

Curriculum Guide 2012

Training the Next Generation
of Power Systems Engineers



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Overview

Mission

Since its inception, SEL University’s purpose has been clear—to provide the education and training needed to make electric power safer, more reliable, and more economical. SEL University develops programs to help you meet the technical challenges of integrating digitally based technologies into your expanding power system infrastructure. SEL University is committed to providing unprecedented quality, depth, value, and experience to meet your power system training needs. Whether you attend courses scheduled in a nearby city or a tailored training program at your site, SEL University can help you optimize the value of your protection system investment by teaching you how to get superior performance from your system.

Course Structure and Delivery

SEL University offers instructor-led classroom courses, either at scheduled locations or at your site, and e-learning courses, both as self-paced courses and with live, remote instructors.

Many SEL University courses are organized into programs consisting of one or more tracks. Tracks are a recommended sequence for engineers, technicians, power system specialists, and managers concerned with protection, monitoring, control, automation, metering, and management of utility and industrial electric power systems.

Fundamentals

SEL University offers a fundamentals course and protection courses that explore a range of topics, from power system protection theory to the latest advances in power

protection technology. Whether you are a technician, engineer, or manager, SELU has a power system course that will suit your learning needs. Other courses deal with the unique requirements of distribution, transmission, generation, industrial power, and high-voltage transformer and bus protection.

Application and Testing

SEL University product application and testing courses provide you with the skills you need to apply and test SEL products in cost-effective power system protection solutions. You will learn how to effectively use advanced features so you can get the most out of your products and systems. These courses cover relay setting, testing, commissioning, and troubleshooting.

Communications and Systems

Communications and Systems courses help you plan, design, and implement your system communication, security, and automation schemes. Communications courses provide a conceptual introduction to the communication and security requirements of modern system design. Systems courses walk you through step-by-step, hands-on instruction using SEL product features, and help you configure system networks, implement a defense-in-depth security posture, and visualize and act on system data in real time.

SEL University Training at Your Location

Consider an on-site course to dramatically reduce travel expenses. You supply the training room, and SEL University brings the equipment, course materials, and instructor. SEL University offers standard courses for the more widely used products and can tailor courses for the products in your system.

E-Learning

E-learning is training enhanced by computer technology. SEL University's e-learning program offers skills-based online technical training—a flexible option for students with time and budget constraints. Courses include interactive, self-paced, and live online technical training.

Our e-learning resources help students develop the knowledge and job-relevant skills required for power system protection, monitoring, communication, and control. With engaging and realistic simulations, settings exercises, and knowledge assessments, these courses offer a comprehensive training experience.

mySELU Online Training

Your mySELU online training plan is an individualized list of your purchased SEL University online courses. Once you have purchased an online training course, it will automatically be added to your mySELU online training plan. Use your mySELU online training plan to:

- View and sort your SEL University online courses
- Access your online courses
- View your online training completion status

Continuing Education

SEL University, through its affiliation with the International Association for Continuing Education and Training (IACET), is authorized to provide continuing education units (CEUs) for all courses.

Programs

Technician

Engineer

System Specialist

Technician Program

The SEL University Power System Protection for Technicians program is designed for those involved in setting, testing, and troubleshooting power protection relays.

The program begins with a power system fundamentals course where students explore the methods and devices used in power system protection. This course is followed by an introduction to relay testing basics and courses on methods for testing SEL relays.

Power System Protection for Technicians Track

Required:

PROT 301 — Protecting Power Systems for Technicians

TST 101 — SEL Relay Testing Basics

TST 103 — SEL Feeder Relay Testing

TST 107 — SEL Transmission Substation Relay Testing

Optional Elective Course:

TST 700G — SEL-700G Generator Relay Testing



"This is definitely one of the better technical training courses that I have attended. This training provided an excellent overview tutorial on a challenging topic — clearly and concisely — and kept it at a level such that both more experienced and less experienced engineers can understand and benefit from it."

Kenneth Caldwell

Principal Engineer, Duke Energy — Catawba Nuclear Station

Engineer Program

The SEL University Power Protection Program for Engineers consists of multiple tracks of both power system fundamentals and product application courses. These tracks are for individuals who want to specialize in a specific area of the power protection system.

Each track includes an optional introduction to power system fundamentals (PWRS 400), which can serve as a prerequisite for engineers who need an introduction to power systems or a refresher of basic power system protection concepts. Each track begins with power system protection (PROT 401), where students learn the basic concepts involved in designing power protection systems. Those who seek more in-depth study may choose from the following tracks:

- Generation System Protection
- Transmission Line Protection
- Substation Equipment Protection
- Distribution System Protection
- Industrial Power System Protection

Students can apply the concepts learned in the protection courses by choosing from a list of SEL relay application course electives for each track.

Generation System Protection Track

Optional Introductory Course:

PWRS 400 — Power System Fundamentals for Engineers

Required:

PROT 401 — Protecting Power Systems for Engineers

PROT 409 — Generation System Protection

Electives (choose one of the following courses):

APP 300G — SEL-300G Generator Relay

APP 700G — SEL-700G Generator Protection Relay

Transmission Line Protection Track

Optional Introductory Course:

PWRS 400 — Power System Fundamentals for Engineers

Required:

PROT 401 — Protecting Power Systems for Engineers

PROT 407 — Transmission Line Protection

Electives (choose one of the following courses):

APP 311L — SEL-311L Line Current Differential Relay

APP 421 — SEL-421 Protection, Automation, and Control System

Substation Protection Track

Optional Introductory Course:

PWRS 400 — Power System Fundamentals for Engineers

Required:

PROT 401 — Protecting Power Systems for Engineers

PROT 411 — Substation Equipment Protection

Electives (choose two of the following courses):

APP 87 — SEL-387 and SEL-587 Percentage Restrained Differential Relays

APP 487B — SEL-487B Bus Protection Relay

APP 487E — SEL-487E Transformer Protection Relay

APP 487V — SEL-487V Capacitor Protection and Control System

Distribution System Protection Track

Optional Introductory Course:

PWRS 400 — Power System Fundamentals for Engineers

Required:

PROT 401 — Protecting Power Systems for Engineers

PROT 403 — Distribution System Protection

Electives (choose two of the following courses):

APP 403 — Enhancing Distribution Protection Using SEL-351S

APP 351 — SEL-351 Directional Overcurrent and Reclosing Relay

APP 351R — SEL-351R Recloser Control

APP 651R — SEL-651R Advanced Recloser Control

Industrial Power System Protection Track

Optional Introductory Course:

PWRS 400 — Power System Fundamentals for Engineers

Required:

PROT 401 — Protecting Power Systems for Engineers

PROT 405 — Industrial Power System Protection

Electives (choose two of the following courses):

APP 405 — Protecting Induction Motors Using the SEL-701 and the SEL-710

APP 787 — SEL-787 Transformer Protection Relay

APP 751A — SEL-751A Feeder Protection Relay

APP 700G — SEL-700G Generator Protection Relay

System Specialist Program

SEL University offers courses designed to provide power system professionals with the fundamental and applied skills they will need to design and implement a modern and secure protection, monitoring, and control system.

The systems specialist program is comprised of three course types: Communications (COM), Application (APP), and Systems (SYS). Communications courses are designed to provide a foundational introduction to the communication technology and security leveraged in the modern system. Application courses build on Communications courses and apply foundational skills in a hands-on setting using SEL equipment. Finally, Systems courses tie everything together by expanding the fundamental planning discussion and hands-on configuration to SEL devices typically used to visualize, monitor, and control at the system-level.

Topics addressed are:

- Real-time system visualization
- Real-time control
- NERC CIP compliance requirements
- Cybersecurity
- SONET-based communications
- IEC 61850 standard and applications
- IEEE C37.118 and applications

COM 201 — Multiplexing and SONET-Based Communications

COM 203 — SEL Cybersecurity Best Practices for Critical Infrastructure

COM 403 — IEC 61850 Technology

APP 3620 — Sensible Cybersecurity Using the Ethernet Security Gateway

APP ICON — SEL ICON™ Integrated Communications Optical Network

APP 3530 — SEL-3530 Real-Time Automation Controller (RTAC)

SYS 303 — Integrating Substation Systems Using SEL-2032

SYS 310 — Modern Synchrophasor Visualization, Control, and Analysis

SYS 403 — Practical IEC 61850 Application



North American Training Centers



Courses

Fundamentals

Protection

Application

Systems

Communications

Testing

On-Site

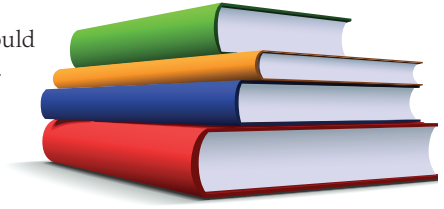
Visit www.selinc.com/selu for updated course listings and schedule.

Fundamentals Course

After taking these courses, the student should be able to perform the tasks listed for each.

PWR5 400 — Power System Fundamentals for Engineers

4-day course; 2.8 CEUs available



- Describe the structure of modern power systems (generation, transmission, subtransmission, distribution, and consumption)
- Describe the basic principles of operation: voltage and frequency control, control of real and reactive power flow, transient and steady-state stability, and economic operation
- Describe modeling of different power system components
- Perform exact analysis of a complex power system using computer models
- Calculate the state of different power system components
- Create conceptual designs and improvements of power systems that satisfy the basic principles of operation

Protection Courses

PROT 301 — Protecting Power Systems for Technicians

3-day course; 2.1 CEUs available

- Explain the importance of symmetrical components in analyzing power systems
- Identify the types of protective systems used for various applications
- Define distribution and transmission line protection principles
- Describe how differential, overcurrent, and mechanical methods are used to protect power transformers
- Use metering and event reporting functions from modern protective relaying systems to monitor protection system performance

PROT 401 — Protecting Power Systems for Engineers

5-day course; 3.5 CEUs available

- Define the basic elements of designing power system protection for distribution lines, transmission lines, transformers, buses, generators, and motors
- Identify the challenges and solutions to power system protection problems
- Analyze power systems for balanced and unbalanced conditions using symmetrical components; understand the limitations of applying this technique on real-world power systems
- Select the appropriate protective systems for various applications, based on reliability, performance, complexity, and cost considerations
- Apply the selection and coordination rules of conventional distribution circuit overcurrent protection devices
- Apply distribution and transmission line protection principles, including basic distance relay protection schemes
- Select and apply wide-area protection schemes such as power swing blocking, out-of-step tripping, and load shedding

PROT 403 — Distribution System Protection

3-day course; 2.1 CEUs available

- Describe the protection requirements of modern distribution systems
- Apply distribution system protection principles
- Identify and select appropriate available tools
- Apply selection and coordination rules to calculate the settings of conventional and modern protective distribution circuit devices
- Use protection principles with relay application and coordination guidelines for distribution substation equipment, including power transformers and low-voltage buses
- Apply modern protection system principles to improve power quality indices
- Identify protection practices and regulations of distribution systems with dispersed generators

PROT 405 — Industrial Power System Protection

4-day course; 2.8 CEUs available

- Describe the protection requirements of industrial medium-voltage power systems
- Calculate settings for thermal and overcurrent protection for medium-size induction motors
- Determine the protection schemes and settings for medium-size transformers
- Apply overcurrent protection and relay coordination concepts to medium-voltage radial lines and cables
- Implement modern protection systems for industrial generators

PROT 407 — Transmission Line Protection

3-day course; 2.1 CEUs available

- Describe the protection requirements of modern power transmission lines
- Identify protection and fault location methods to apply in modern transmission lines
- Identify the strengths and limitations of available tools to protect transmission lines against phase-to-phase and phase-to-ground faults
- Define and address protection problems for high-voltage transmission lines
- Implement modern directional and distance elements into existing protection
- Select the best pilot protection schemes for transmission lines
- Implement directional comparison pilot and line differential protection schemes
- Explain the effect of reclosing (three-pole and single-pole) and breaker failure protection to preserve the stability of high-voltage transmission systems

PROT 409 — Generation System Protection

3-day course; 2.1 CEUs available

- Identify the protection requirements of synchronous generators
- Apply generation system protection principles
- Identify and select appropriate protection schemes for various generator applications
- Determine settings for system backup using phase distance and overcurrent elements
- Apply high- and low-impedance neutral grounding techniques
- Calculate settings for critical generator protection elements, including:
 - Differential and ground fault
 - Out-of-step
 - Loss-of-field, overexcitation, and overvoltage

PROT 411 — Substation Equipment Protection

3-day course; 2.1 CEUs available

- Describe the protection requirements of modern transmission systems
- Specify current transformers for protective relay applications
- Define transformer protection issues, and identify solutions using digital relays
- Define bus protection problems, and identify solutions for digital relays
- Calculate relay settings for bus transformer protection relays
- Design protection for high-voltage power transformers and buses
- Compare overcurrent and differential protection methods

Application Courses

APP 87 — SEL-387 and SEL-587 Percentage Restrained Differential Relays

2-day course; 1.4 CEUs available

- Explain the application considerations of differential protection
- Apply internal or external phase shift and zero-sequence compensation using two different setting methods in both relays
- Use SELOGIC® control equations to customize the relay logic to meet your application requirements
- Analyze Sequential Events Recorder (SER) reports, and generate COMTRADE files from event reports
- Explain testing considerations

APP 300G — SEL-300G Generator Relay

2-day course; 1.4 CEUs available

- Apply the SEL-300G Relay protection, monitoring, and control features
- Communicate with the relay through front-panel controls and serial ports
- Calculate and enter settings for the relay
- Determine data requirements for relay settings and resistance temperature detectors (RTDs)
- Retrieve data from the relay using HyperTerminal®
- Analyze fault records and relay element response, using ACSELERATOR Analytic Assistant® SEL-5601 Software and other software programs
- Analyze SER reports

APP 311L — SEL-311L Line Current Differential Relay

2-day course; 1.4 CEUs available

- Calculate and apply settings for line current differential protection
- Set the SEL-311L Relay using HyperTerminal and ACSELERATOR QuickSet® SEL-5030 Software
- Use SELOGIC control equations to customize the relay logic
- Apply backup protection, reclosing, and synchronism-check features of the SEL-311L Relay
- Analyze SER reports
- Implement relay-to-relay logic communications via the MIRRORED BITS® communications protocol

APP 411L — SEL-411L Advanced Line Current Differential Protection, Automation, and Control System

2-day course; 1.4 CEUs available

- Navigate ACSELERATOR QuickSet Software
- Identify settings calculation formulas and terminology for 87L applications
- Determine effective line differential protection settings for example systems
- Configure communications channels between terminals for 87L applications
- Create SEL-411L Relay logic equations for 87L protection functions
- Monitor system performance with real-time metering using HMI tools
- Test 87L protection schemes and verify proper relay operation
- Retrieve and analyze events using COMTRADE files and sequential events recorder

APP 351 — SEL-351 Directional Overcurrent and Reclosing Relay

2-day course; 1.4 CEUs available

- Apply the SEL-351 Relay protection, monitoring, and control features
- Communicate with the relay through front-panel controls and serial ports
- Use ACSELERATOR QuickSet Software to apply relay settings, program SELOGIC control equations, and analyze fault records and relay element response
- Analyze SER reports
- Implement relay-to-relay logic communications via the MIRRORED BITS communications protocol
- Identify multiple applications for the SEL-351 Relay family
- Differentiate between SEL-351, SEL-351A, and SEL-351S Relay features

APP 351R — SEL-351R Recloser Control

2-day course; 1.4 CEUs available

- Upgrade existing substation and pole-mounted recloser controls
- Communicate with the recloser control through front-panel and serial port interfaces
- Use ACSELERATOR QuickSet Software to apply EZ settings, program SELOGIC control equations, and analyze event reports
- Implement relay-to-relay logic communications via the MIRRORED BITS communications protocol
- Coordinate with upstream feeder relays for high-speed fault clearing on distribution circuits
- Apply high-side transformer, blown-fuse detection logic to protect customers from potentially damaging unbalanced voltages
- Use the fault detection capability to identify feeder trouble points

APP 403 — Enhancing Distribution Protection Using the SEL-351S

2-day course; 1.4 CEUs available

- Select the correct SEL relay to meet various distribution protection needs
- Explain the uses and limitations of the SEL fast-bus protection scheme and other common bus protection practices
- Coordinate and apply negative-sequence overcurrent protection with confidence
- Implement breaker failure protection into your relay schemes with no additional relays
- Apply methods learned in class to provide backup and redundant protection for every relay in the substation without adding additional relays
- Implement annunciator and transformer alarm monitoring into transformer protection relays
- Apply methods learned in class to troubleshoot and commission new substation protection schemes
- Analyze SER and relay event reports

APP 405 — Protecting Induction Motors Using the SEL-701 and the SEL-710

3-day course; 2.1 CEUs available

- Communicate with relays through the front-panel and serial port interfaces
- Calculate and apply settings for the thermal model and thermal overload protection element
- Retrieve and analyze motor trends, start reports, and event reports
- Determine the best motor relay options and settings to meet varied motor protection and RTD requirements in order to maximize motor performance and safety
- Apply methods learned in class to troubleshoot and commission motor protection

APP 421 — SEL-421 Protection, Automation, and Control System

3-day course; 2.1 CEUs available

- Apply the SEL-421 Relay protection, monitoring, metering, and control features, including current and voltage selection logic
- Communicate with the relay using the SEL-2701 Ethernet Processor
- Use SELOGIC control equations with math and comparison variables in the independent protection and automation areas
- Apply relay settings, program SELOGIC control equations, and analyze fault records and relay element responses using ACSELERATOR QuickSet Software
- Analyze SER reports, and utilize COMTRADE files
- Implement relay-to-relay logic communications via the MIRRORED BITS communications protocol
- Map and retrieve critical analog and digital information in the DNP3 Level 2 protocol
- Communicate with the relay via the front panel and HMI, including pushbuttons and associated LEDs, display points, targeting LEDs, and front-panel metering

APP 487B — SEL-487B Bus Protection Relay

2-day course; 1.4 CEUs available

- Determine busbar classifications, and interpret station diagrams
- Establish a busbar protection philosophy
- Describe differential bus protection schemes, principles, and performance standards
- Determine the input information needed for protection zone selection
- Assign relay inputs using SELOGIC control equations and alias names
- Develop settings for different busbar configurations
- Program front-panel LEDs to indicate latch-bit status
- Access the relay status and event history for multiple relays

APP 487E — SEL-487E Transformer Protection Relay

3-day course; 2.1 CEUs available

- Set the SEL-487E differential element for a variety of transformer types and applications
- Use ACSELERATOR QuickSet Software to manage settings, control operations, and monitor transformer performance
- Set restricted earth fault (REF), overcurrent, and volts/Hz elements to protect the transformer
- Calculate test quantities, simulate fault conditions, and verify protection settings
- Use Commissioning Assistant Software to simplify installation and testing
- Use SEL event analysis tools to retrieve and analyze event records captured by the SEL-487E Relay
- Monitor the transformer once in service using SER, thermal, and through-fault monitors

APP 487V — SEL-487V Capacitor Protection and Control System

2-day course; 1.4 CEUs available

- Navigate ACSELERATOR QuickSet Software and settings tools
- Calculate system and data settings, such as capacitor bank nameplates
- Enable grounded-wye or ungrounded capacitor bank applications
- Determine settings for 60P and 60N current unbalance protection
- Test SEL-487V differential and unbalance tripping operations
- Isolate the location of the faulted phase and section

APP 651R — SEL-651R Advanced Recloser Control

2-day course; 1.4 CEUs available

- Upgrade existing substation and pole-mounted recloser controls
- Communicate with the recloser control through the front-panel and serial port interfaces
- Apply settings to implement Automatic Network Reconfiguration
- Determine several protection methods based on course application examples
- Create and use ACSELERATOR QuickSet Designer® Software Application Designs
 - Enable and disable protection features and settings in Application Designs
 - Apply an SEL-651R EZ Settings Application Design
 - Set the DNP3 map using an Application Design

APP 700G — SEL-700G Generator Protection Relay

2-day course; 1.4 CEUs available

- Use ACSELERATOR QuickSet Software to read and send settings to the relay
- Enter system and generator data into configuration software
- Set two-zone stator and field (rotor) ground detection schemes
- Determine effective settings for differential, current unbalance, overexcitation, and loss-of-field protection
- Protect small generators and large (387 MVA, 22 kV), unit-connected generation systems
- Synchronize generator-breaker close operations

APP 734 — SEL-734 Advanced Metering System

2-day course; 1.4 CEUs available

- Communicate with the meter through the front-panel and serial port interfaces
- Identify basic metering terms, such as meter forms and elements
- Set the meter using ACSELERATOR QuickSet Software
- Determine meter functions and settings to meet system monitoring requirements

APP 751A — SEL-751A Feeder Protection Relay

2-day course; 1.4 CEUs available

- Determine phase, ground, and neutral overcurrent settings for high- and low-resistance grounded systems
- Implement a secure arc-flash detection system
- Complete hands-on application and testing of undervoltage, underfrequency, and breaker failure protection schemes
- Implement RTD-based protection for thermal monitoring and tripping
- Create customized SELOGIC protection functions and display points

APP 787 — SEL-787 Transformer Protection Relay

2-day course; 1.4 CEUs available

- Use ACSELERATOR QuickSet Software to read and send settings to the relay
- Determine system and transformer winding data and configuration settings
- Calculate CT compensation, operate and restraint, and harmonic blocking settings
- Test high- and low-voltage CT configuration settings using Commissioning Assistant Software
- Determine settings for through-fault protection and monitoring
- Apply effective protection against restricted earth fault (REF), overexcitation, undervoltage, and underfrequency
- Use the SEL-787 Relay to test settings during event simulations

APP 3530 — SEL-3530 Real-Time Automation Controller (RTAC)

2-day course; 1.4 CEUs available

- Describe the expectations of modern integrated protection and control systems
- Describe system applications
- Configure the web interface for reading status and alarm logs from the RTAC
- Efficiently manage the RTAC settings and database for common integration needs
- Identify and properly configure DNP3 and Modbus® applications settings
- Configure the RTAC Device Definition Files (DDFs) to maximize efficiency of new project settings management
- Establish transparent communications to connected intelligent electronic devices (IEDs)
- Create advanced logic processing functions with the IEC 61131 programming language
- Program the RTAC for redundant communications connections
- Manage security and logic settings for NERC CIP requirements

APP 3620 — Sensible Cybersecurity Using the Ethernet Security Gateway

2-day course; 1.4 CEUs available

- Describe the security expectations of modern integrated protection and control systems
- Apply the roles of various cyberassets within the defense-in-depth strategy
- Configure local network security
- Commission the SEL-3620 using the web interface
- Create user accounts for authenticated privileges, and link the SEL-3620 into a Microsoft® Active Directory® environment
- Configure syslog event collection for regulatory compliance
- Configure secure communications using certificate-authenticated IPsec VPNs
- Create firewall rules to filter incoming packets

APP ICON — SEL ICON Integrated Communications Optical Network

2-day course; 1.4 CEUs available

- Identify the major features and functions of the SEL ICON
- Set up a node in the SEL-5051 Network Management System (HMI software)
- Configure, test, commission, and troubleshoot the following communications circuits for an OC-48 ring network using SEL-5051 Network Management System Software:
 - RS232
 - IEEE C37.94
 - 10 Mb Ethernet
- Configure GPS time source inputs for SONET frequency (SSM timing) and distributed time-of-day synchronization
- Configure security perimeters in the SEL ICON to help meet NERC CIP requirements
- Perform commissioning testing to validate that alarming, switching, and latency times are within specifications between nodes and around the ring

Systems Courses

SYS 303 — Integrating Substation Systems Using the SEL-2032

4-day course; 2.8 CEUs available

- Integrate SEL and non-SEL IEDs using communications processor settings and database functions
- Identify and utilize settings classes for data acquisition, control, and automatic notification with SEL and non-SEL IEDs
- Recognize and configure multitier applications
- Identify DNP3 Level 2 and Modbus protocols and application settings
- Set the SEL-2701 Ethernet Processor to function in an Ethernet network

SYS 310 — Modern Synchrophasor Visualization, Control, and Analysis

2-day course; 1.4 CEUs available

- Identify common synchrophasor components, applications, and communication schemes
- Identify the IEEE C37.118 standard and communications requirements
- Configure synchrophasor precise-time measurement using the SEL-2407® Satellite-Synchronized Clock
- Configure phasor measurement units (PMUs) using ACSELERATOR QuickSet Software
- Configure phasor data concentration and archiving using the SEL-5073 SYNCHROWAVE® Phasor Data Concentrator (PDC) Software
- Configure custom IEC 61131-3 control logic for data output and control schemes using the SEL-5078-2 SYNCHROWAVE Central Software
- Configure SEL-5078 SYNCHROWAVE Console Software to troubleshoot system data
- Configure wide-area PMU collection using SYNCHROWAVE PDC Software or the SEL-3373 Station PDC

SYS 403 — Practical IEC 61850 Application

2-day course; 1.4 CEUs available

- Organize and configure all SEL IEDs in a substation project
- Configure incoming and outgoing GOOSE messages
- Read IED Capability Description (ICD) and Configured IED Description (CID) files
- Determine available IEC 61850 messaging options
- Load device settings and IEC 61850 CID files into SEL and other IEDs
- Generate ICD files that will provide IED descriptions to support interoperability functions
- Configure protection, logic, control, and communication settings
- Troubleshoot GOOSE message quality and network communications

Communications Courses

COM 201 — Multiplexing and SONET-Based Communications

1-day course; 0.7 CEUs available

- Apply the basics of SONET-based communication technologies to a network design
- Identify the principles of fiber-optic-based transmission and media
- Identify multiplexing considerations and applications
- Describe the fundamentals and importance of time-division multiplexing
- Design a multinode SONET-based network

COM 203 — SEL Cybersecurity Best Practices for Critical Infrastructure

1-day course; 0.7 CEUs available

- Identify modern cybersecurity architectures and strategies
- Identify firewall principles and best practices
- Identify methods to secure Ethernet communications protocols
- Identify network and enterprise authentication methods
- Define regulatory and operational controls needed for secure operation
- Identify the goals of cryptography
- Differentiate between symmetric and asymmetric algorithms
- Define the components required for central authentication

COM 403 — IEC 61850 Technology

1-day course; 0.7 CEUs available

- Differentiate between older utility protocols and IEC 61850 structures
- Identify the limitations of traditional SCADA protocols
- Identify which substation automation functionality is managed by IEC 61850
- Identify the protocols within the IEC 61850 standard
- Identify governing agencies for IEC 61850
- Identify the functional specification of the IEC 61850 standard
- Identify how IEC 61850 satisfies most substation automation system (SAS) requirements
- Identify IEC 61850 applications, conformance testing process, and vendor considerations
- Identify some of the limitations of IEC 61850
- Identify how Ethernet methods enhance IEC 61850 functionality

Testing Courses

TST 101 — SEL Relay Testing Basics

2-day course; 1.4 CEUs available

- Establish a serial communications link with an SEL relay using HyperTerminal and SEL software
- Enter settings into an SEL relay
- Equate Relay Word bits and SELOGIC control equations to traditional relay element outputs and discrete contact logic
- Test, commission, and troubleshoot using metering, sequential events recording, and event reporting features of SEL relays
- Analyze information recorded by the relay using SEL software
- Calculate relay test points to verify responses

TST 103 — SEL Feeder Relay Testing

3-day course; 2.1 CEUs available

- Establish a serial communications link with an SEL relay using HyperTerminal and SEL software
- Enter settings into an SEL feeder relay
- Gain skills required for testing overcurrent, directional, and differential protection relays
- Test, commission, and troubleshoot using metering, sequential events recording, and event reporting features of SEL relays
- Analyze information recorded by the relay using SEL software
- Calculate relay test points to verify responses
- Learn about specific distribution relay testing considerations

TST 107 — SEL Transmission Substation Relay Testing

3-day course; 2.1 CEUs available

- Establish a serial communications link with an SEL relay using HyperTerminal and SEL software
- Enter settings into an SEL transmission relay
- Gain familiarity with the operating principles of SEL transmission protection relays
- Test, commission, and troubleshoot using metering, sequential events recording, and event reporting features of SEL relays
- Analyze information recorded by the relay using SEL software
- Calculate relay test points to verify responses
- Practice testing SEL-321 distance protection relays and SEL-311L line current differential relays

TST 700G — SEL-700G Generator Protection Relay

2-day course; 1.4 CEUs available

- Test, commission, and troubleshoot the SEL-700G Generator Protection Relay
- Establish communications with the SEL-700G using SEL software
- Define basic generator protection principles used in relay testing
- Test relay operation for overexcitation, loss of field, and stator ground fault protection elements
- Develop effective element testing procedures
- Calculate relay test points
- Apply current to validate element operation and time delays
- Retrieve and analyze data recorded by SEL relays
- Ensure relay settings are functioning correctly and protection schemes work

On-Site Course Option

SEL University can arrange training programs conducted at your site. When you have a number of people who need the same training, you can dramatically reduce travel expenses by considering an on-site course.

Many on-site courses include a standard fundamentals or product application emphasis. You supply the training room, and SEL University brings the equipment, course materials, and instructor. Other on-site courses include tailored fundamentals and application classes to meet your specific need. Tailored courses can significantly reduce the time spent in training. You can request a quote by going to the SEL University website at www.selinc.com/seluniversity/onsite.



*"Very concise, efficient, and tailor-made to meet our needs.
Save time, money, and travel expenses."*

K.S. Wong
Electrical Engineering Group Manager
Stanford Linear Accelerator Center

E-Learning

Computer-Based Training

Web-Based Training

Visit www.selinc.com/selu for updated course listings and schedule.

Computer-Based Training (CBT)

CBT facilitates learning through robust and media-rich demonstrations, simulations, and job-relevant exercises. SEL University offers CBT courses that can serve as self-paced product introductory training or preparatory training for attending classroom or web-based courses.



SEL University has nine separate CBT licenses that can be purchased as a corporate version. These CBTs are available for purchase at \$2,000 per title with the following specifications:

- Customers pay full price for up to two titles
- Customers who purchase three to eight titles receive a 10 percent discount on the entire order
- Customers who want the entire library will purchase eight titles at the 10 percent discount and receive the ninth title free
- CBT corporate licenses are valid for one calendar year from the date of purchase
- The cost for corporate renewal fees is \$500 per year—renewals have the same discount structure as stated above
- To receive discount pricing, the CBT licenses must all be purchased at the same time

SEL University will continue to offer our single-user licenses at \$350 per CBT course. These licenses are limited to one end user and never expire. The above discount structure is not available for our single-user licenses.

CBT 101 — Introduction to SEL Relays

0.4 CEUs available

- Establish a serial communications link to retrieve and read data recorded by the relay
- Construct a control equation and scheme using SELOGIC operators to combine relay elements
- Install and configure ACSELERATOR Analytic Assistant Software and SEL-5401 Test System Software
- Run a simple trip test using the SEL-4000 Relay Test System

CBT 102 — Retrieving Event Reports for Technicians

0.2 CEUs available

- Describe the differences and functions of each event report type, including standard, raw, and compressed event reports
- Retrieve an event report using HyperTerminal, SEL-5010 Relay Assistant, and ACSELERATOR QuickSet Software
- Determine the appropriate type of event report required for various conditions and objectives

CBT 103 — Analyzing Event Reports for Engineers

0.2 CEUs available

- Utilize various analysis tools in ACSELERATOR Analytic Assistant Software to analyze event reports
- Manipulate how event report data are viewed in ACSELERATOR Analytic Assistant Software
- Deduce causes for a system fault based on available event report data

CBT 104 — Understanding SEL Relay Logic

0.4 CEUs available

- Analyze logic for real-world power system examples, such as transformer current differential, time-overcurrent, and undervoltage protection
- Set and troubleshoot customized logic equations, including communications-assisted tripping, display points, and trip coil monitoring
- Determine and enter settings into the ACSELERATOR QuickSet Software environment, and get meaningful feedback on your choices

CBT 351 — Introduction to SEL-351 Relays

0.4 CEUs available

- Determine settings for distribution system protection
- Analyze relay logic, and create SELOGIC control equations
- Send settings files to the relay
- Retrieve and analyze event data
- Analyze phasor data and much more

CBT 421 — Introduction to SEL-421 Relays

0.4 CEUs available

- Learn to communicate with the relay
- Create settings and SELOGIC control equations
- Implement a practical stepped-distance line protection scheme
- Manage relay settings files
- Collect event data

CBT 710 — Introduction to the SEL-710 Motor Protection Relay

0.5 CEUs available

- Identify fundamental motor protection principles and settings recommendations
- Implement thermal, phase, ground, and neutral overcurrent protection
- Enter motor nameplate data, and apply settings using ACSELERATOR QuickSet Software
- Program a delayed reset logic scheme for remote applications
- Retrieve and interpret motor reports using the ACSELERATOR QuickSet Software HMI
- Complete step-by-step event analysis

CBT 751A — Introduction to the SEL-751A Feeder Protection Relay

0.4 CEUs available

- Enter power system protection and logic settings using ACSELERATOR QuickSet Software
- Apply neutral overcurrent protection settings
- Implement a secure arc-flash detection system
- Create a settings file, and send settings to the relay
- Retrieve event report data
- Assess your knowledge with pre- and posttests

CBT 2411 — Introduction to the SEL-2411 Programmable Automation Controller

0.4 CEUs available

- Identify the basic features and functions of the SEL-2411
- Identify different applications for the SEL-2411
- Configure SELOGIC variables and timer settings, latch bit settings, and target reset equations
- Configure engineering access and the HMI
- Configure the SER
- Configure front-panel LCD display points and LEDs

CBT 3332 — Introduction to the SEL-3332 Intelligent Server

0.4 CEUs available

- Operate the SEL-3332, and use the embedded application to interface with SEL devices and other IEDs
- Configure a master protocol to collect data from DNP3, Modbus, and SEL devices
- Configure Fast SER and Flex parsing via SEL Fast Messaging
- Configure engineering access using communications via the terminal server
- Configure the dial-up SEL-20XX emulator to access any IED port for engineering access
- Configure the control lockout switch feature, via the SEL-3332 and the embedded application, to enable/disable control for maintenance purposes

Web-Based Training (WBT)

Can't travel? Attend a WBT course from anywhere in the world with a high-speed connection, and receive live instruction from an industry expert. Web-based courses usually include homework, interactive exercises, and virtual classroom sessions. All WBT courses have a CBT prerequisite.

WBT 101 — Event Report Analysis Workshop

WBT 102 — Event Report Analysis Workshop for Distribution Relays

0.3 CEUs available for each WBT 101 and WBT 102

0.2 CEUs available for CBT 103

- Analyze event report data to determine root cause
- Troubleshoot relay operations using ACSELERATOR Analytic Assistant Software
- Differentiate between event report formats and applications
- Discuss regulatory requirements
- Explore the benefits of analysis

WBT 351 — SEL-351 Relay Coordination Techniques

0.4 CEUs available for WBT 351

0.4 CEUs available for CBT 351

- Describe the basic overcurrent device coordination goals, principles, and strategies
- Identify common coordination pairs
- Describe the basic SEL-351 protection and coordination settings, including general, phase, and ground instantaneous; phase and ground definite-time; phase and ground time-overcurrent; and reclosing settings
- Determine SEL-351 coordination settings using provided calculation methods and/or criteria to coordinate with upstream and downstream devices
- Apply coordination strategies to real-world application examples

WBT 421 — Applying Dual-Breaker Reclosing With the SEL-421 Relay

0.3 CEUs available for WBT 421

0.4 CEUs available for CBT 421

- Integrate complete breaker protection and control for two breakers for ring-bus and breaker-and-a-half line configurations
- Evaluate fault scenarios to determine how the relay will respond based on the applied dual-breaker protection design
- Apply dynamic leader/follower breaker logic
- Define and implement reclosing timing based on the requirements of your protection scheme
- Evaluate line reclosing and independent reclosing practices

WBT 2411S — RTU Replacement Using IEC 61850

0.4 CEUs available for WBT 2411S

0.4 CEUs available for CBT 2411

- Identify the basic features and functions of the SEL-2411
- Identify different applications for the SEL-2411
- Configure SELOGIC variables and timer settings, latch bit settings, and target reset equations
- Configure engineering access and local HMI
- Configure display points to appear in the SEL-2411 LCD
- Configure the SEL-2411 front-panel LEDs

WBT 3332 — Configuring Logical Expressions Using the SEL-3332 Intelligent Server and SEL-3351 System Computing Platform

0.3 CEUs available for WBT 3332

0.4 CEUs available for CBT 3332

- Configure, test, and commission the SEL-3332 in the field
- Consolidate and convert SCADA data from DNP3, Modbus, and SEL devices
- Formulate a logical expression that will calculate power factor and pass SCADA data
- Configure the embedded software to pass SCADA data between DNP3 and Modbus protocols



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