IEC 61850 WITH VIRTUAL SUBSTATION
A TRUE HANDS-ON TRAINING EXPERIENCE

System Specification & Configuration. Process Bus SV. GOOSE. MMS Client/Server. PRP/HSR. All live on your computer! You are equipped with every software TOOL you need.
YOU ARE EQUIPPED WITH TOOLS YOU NEED

Each student is provided with a trial license for the IEC 61850 engineering software necessary for enabling our virtual substation journey.

RELEVANCY-ORIENTED LEARNING

Straight to practice! Our training does not focus purely on theory, instead focusing on a complete practical learning experience allowing you how to design, configure, and troubleshoot a working IEC 61850 system.

LEARN ALL COMM PROFILES & ENTIRE ENGINEERING PROCESS

Learn to effectively design and engineer the entire process, including areas such as: MMS Client, MMS Server, GOOSE, Process Bus Sampled Values, PRP/HSR. Experience all the COMM profiles on your personal computer.

UNDERSTAND INTEROPERABILITY ISSUES

Vendor agnostic design is a fundamental aspect of IEC 61850 design. Our training will provide you with the skills necessary to distinguish products that conform to the standard requirements from the ones that do not.
Learn about the IEC 61850 ACSI Models & Services.

The program starts by introducing concepts of ACSI Class Models. These include properties of:

- The IEC 61850 Server
- Logical Devices
- Logical Node
- Control Blocks
- DataSets
- Data Objects
- Data Attributes

The ACSI Services designed to operate on ACSI class models are also covered in the program. You will learn how to read an instantiated IED configuration as well as the IED’s capability file in order to understand its IEC 61850 capabilities.

Learn to understand potential interoperability issues in your system design. The program refers to the ACSI Model Conformance Statements so that engineers can evaluate functional capabilities of an IED regarding what it can or cannot do.

LAB 1: BROWSING THROUGH THE MODELS & SERVICES

Ed1/Ed2 Conformance Compliant IEC 61850 Client software “Discovery” will be installed on your PC.

You will use “Discovery” to browse through several IED configuration files in order to experience the ACSI Models and Services. You will learn how to check individual Properties and Services of the ACSI models of an IED, and how to compare them against the IEC 61850 Standard requirements.
COMMUNICATION PROFILES

TWO WAY & MULTICAST ASSOCIATION MODELS.

Client/Server MMS, GOOSE & SV Publisher/Subscriber.

In this lab the concepts of Client/Server and Publisher/Subscriber communication profiles are covered. Learn in detail how the MMS Client and the MMS Server interact when a connection is established. Data reporting techniques such as Buffered and Unbuffered Reporting and Data Logging will also be covered. Finally, multicast messaging of critical events from GOOSE or SV Publishers to their Subscribers will be explained.

SYSTEM ENGINEERING PROCESS


In this part of the program IEC 61850 Engineering processes are explained in detail. Learn about the System Specification & System Configuration processes. Mandatory and optional engineering tools and their functionality will be covered. The program continues with a lab that covers the System Configuration Conformance process providing a practical understanding of how to use the engineering tools to evaluate your system design against the Standard Conformance requirements.
LAB 2: SYSTEM SPECIFICATION

Learn how to generate a System Specification .SSD file.

“SCL Matrix”, our Ed1/Ed2 IEC 61850 compliant system configuration software will be installed on your PC. In this LAB you will learn about the Top Down engineering process. Your task will be to draw a Single Line Diagram (SLD) by connecting electrical equipment and apparatus within mandatory Substation, Voltage and Bay sections. You will also learn how to describe Protection & Control functions used in the system by allocating Logical Nodes to the SLD Equipment and Apparatus.

LAB 3: GOOSE ENGINEERING

Learn how to create Individual GOOSE Definitions. Learn the GOOSE System Engineering process.

“SimLab”, our Ed1/Ed2 IEC 61850 compliant MMS Server simulation software will be installed on your PC. You will learn how to create GOOSE Control Blocks, map IED Data into the DataSets and how to define Publishing policy. Using the SCT tool “SCL Matrix” you will then complete the GOOSE system engineering by creating Publisher-Subscriber relationships. Finally, SimLab will simulate your resulting IED and System files allowing you to observe GOOSE messaging live on the LAB network.
LAB 4: GOOSE MONITORING

Learn how to monitor and troubleshoot GOOSE messages.

LAB 4 focuses on live monitoring of the GOOSE system messages. Properties of Ethernet packets including VLANs will be examined here. You will learn how to recognize important components of GOOSE messages including Test and Simulation bits. You will also learn about purpose of the Ed2 LGOS nodes. Using our gooseAir network test tools, the LAB Network will be placed under abnormal and avalanche conditions. These test environments allow you to observe performance metrics of GOOSE messages under different network traffic loads.

LAB 5: SAMPLED VALUES ENGINEERING

Configure SV Publisher & SV Subscribers.

“gooseAir”, our network test tool software will be installed on your PC. Learn how to create SV Publishing with Control Blocks and DataSets. The SV definition created in this step will be used by gooseAir to Simulate Process Bus data on the LAB Network. You will also learn how to engineer the SV Subscription component to perform live network monitoring of the SV traffic sent by our gooseAir tool which will be simulating a Merging Unit.
LAB 6: SAMPLED VALUES MONITORING

Learn how to generate SV stream with fault conditions. Learn how to Monitor SV data streams.

Using the gooseAir State sequencer you will learn how to generate Sampled Values with fault conditions, DC components and Harmonics. Once the process bus sampled values are generated, you will connect to the LAB network and observe live SV stream. Current & Voltage values, their harmonics and symmetrical components will be presented for easy monitoring and troubleshooting. You will be able to analyze new values as they occur on the Merging Unit.

LAB 7: MMS ENGINEERING

Learn how to engineer Client/Server MMS relationships.

In this LAB you will learn how to present MMS Server points to an external MMS Client by engineering a new or an existing DataSet. (i.e. a Protection Relay pointing to a HMI or a station Gateway). Learn how to set triggers, how to associate DataSets to Report Control Blocks, and finally, how to map Report Control Blocks to external Clients.
LAB 8: CLIENT/SERVER COMMUNICATION

Observe the MMS Client/Server communication exchange.

To communicate, MMS Client and Server must establish a communication session across the network. Once established, the Client starts retrieving IED model information from the connecting Server. This LAB will highlight functions involved within this important communication process, so that you may learn how to efficiently troubleshoot any future Client/Server communication issues.

LAB 9: MONITOR MMS REPORTING & LOGGING

Learn about retrieval of Buffer/Unbuffer Reports & Data Logs.

In this LAB you will use MMS Client software to enable and confirm collection of Buffered & UnBuffered MMS Reports as they get generated on the connected Server. Bitstring, Triggers, and other Data Report properties will be explained in detail. Learn how to initiate and later query Data logs recorded in the Server Data Log storage.

During the Data Reporting & Logging processes we will observe every ACSI function involved in this process on both the MMS Client and the MMS Server sides. This will help you develop an in depth understanding of the MMS Client/Server data retrieval techniques.
Learn about the IEC 61850 Control types.

This part of the training covers operation of the control models: Direct Operate, Select Before Operate (SBO), Direct Operate with Enhanced Security (DOwE) and SBO with Enhanced Security (SBOwE). Learn how to use Test, Interlocking and Synchrocheck conditions along with these control models.

LAB 10: OPERATE CONTROLS

Learn how to Set and Operate IEC 61850 Controls.

In this LAB you will initiate and monitor operation of all control types. You will also observe how Interlocking, Test or Synchrocheck conditions influence results of the control operations.
**TIME SYNCHRONIZATION**

*SNTP and PTP Time Sync Protocols.*

Learn about the system synchronization requirements, and the differences between the two most common IEC 61850 Time synchronization methods. The training program will give you tips on how to achieve best time sync results for your system. You will learn about the concept of stratum and the SNTP time offset algorithms for SNTP, as well as the use of different clock types in the Precision Time Protocol.

**SCL LANGUAGE**

Learn about SCL language, file types and the configuration process defined by this part of the IEC Standard.

The SCL File types, usage and structure of these files are explained. Here we will refer to the System Specification LAB 2 output (.SSD file) to explain Substation section of the system .SCD file. You will also learn how to read the Communication section with Access Points, Publisher/Subscriber and Client/Server connections defined in the system. SCD file you engineered in previous LABs. Finally, we will go over the IED and DataType Template sections to understand the capability and the model structures of the system IEDs.

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Substation Network Design

Learn about an efficient Substation Network design process and the key network properties.

The IEC 61850 systems rely heavily on the network properties for delivery of critical substation events. In this part of the training you will learn about an effective network design process, and how different network topologies might impact your system. Concepts of Single Point of Failure, Redundancy, Resilience, Switching, Routing, Spanning Tree protocols, VLANs and Quality of Service are explained.

HSR & PRP Redundancy Protocols

High resilient redundancy Networks: HSR & PRP.

Learn about the HSR & PRP principles, when, where and how to design your redundancy network in order to achieve a SPOF free & zero latency environment. Learn how packets are duplicated and processed within dual attached nodes (DAN’s). The functionality and key properties of Redundancy Boxes (RedBox) devices are also explained.
LAB 11: PRP NETWORKS

Monitor & Analyze PRP redundancy traffic.

In this LAB you will connect to our PRP network with the goal of monitoring and troubleshooting PRP trailers and Supervision frames.

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**CONFORMANCE TO THE STANDARDS**

How to evaluate conformance of an IED to the IEC 61850 Standards? What should you look for?

In this last section of the training you will learn about important Conformance Certification process, the IEC 61850 Standard Editions and the Tissues database. Purpose and content of the certification documents like MICS, PICS, TICS, PIXIT and SICS are explained in details. The goal is to make you fully aware of the compatibility of the relays and other IEC 61850 based equipment used in your system.
Grid Software engineers have designed many IEC 61850 systems and are active members of the IEC TC57. We use our extensive vendor neutral experience to develop source code libraries, software, and hardware engineering tools designed specifically for IEC 61850. All in an effort to provide easy to use tools designed for engineers by engineers.

OUR CLIENTS

- GOOGLE DATA CENTERS
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- ABB SINAI
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- SONELGAZ
- EPCOR
- MANITOBA HYDRO
- ENERGOINVEST
- SOUTHERN CALIFORNIA EDISON
- GE ENERGY
- FISHER POWERLINE
- MATRIX POWER
- SHELL CANADA
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- BNF TECHNOLOGY KOREA
- PUPIN AUTOMATIKA