



Training modules for public and in-house training courses

IEC 61850, IEC 61400-25, IEC 60870-5/-6, IEC 61968/70 CIM, DNP3, ...

The following list contains the most asked modules of our training services with regard to standards related to power system automation. Depending on the needs of our customers we select the modules to provide the most crucial information for the experts of the customers.

[S-00] – General

00	Welcome and opening	Welcome, opening, roll call of attendees, expectations of attendees, IEC 61850 in brief, market situation
01	Summary	Summary and next steps

[S-01] – Management and automation of the power system (basics)

00	Power system automation basics	Basics of power system information integration and automation covering control centers, substations, power generation, ...
01	Standardization	IEC activities related to power system standardization, IEC TC 57 and TC 88 activities, IEEE
02	System design and specification	Introduction Substation automation system specification, Product requirements for communication equipment from IEC 61850-4, product requirements from IEC 61850-3, substation automation system design
03	System migration aspects and role of system integrator	Stepwise migration from existing systems to solutions compliant to standards, project and migration planning, ...; roles of users, vendors and system integrators
04	Security	Secure communication (data on travel and data stored) (IEC 62351), IED security (IEEE 1686), IEC/TS 62443-1, NERC CIP (critical infrastructure protection), ...
05	System management	Revision control and asset management with IEC 61850
06	Testing devices and systems	Test coverage and steps towards system testing and simulation (from devices to systems)
07	Power Delivery System Basics	Brief Introduction to Power Delivery System and relations to standards from IEC TC 57 and TC 88; mainly intended to give an overview of the power delivery system and power system automation for non-utility experts.

[S-02] – IEC 61850 (and IEC 61400-25) basics

00	IEC 61850 series – overview	Communication networks and systems in substations: general introduction on whole series
01	IEC 61850 Application modeling principles	Modeling protection, substation automation, other applications (Logical nodes, data and data attributes, function modeling, extension of the models, monitoring)
02	IEC 61850-6 engineering process	Engineering process using the configuration language: from IEDs and single line diagram to configured substation automation system
03	Communication services of IEC 61850	Information exchange with the ACSI according to IEC 61850-7-2
04	Implementation of IEC 61850 conformant devices and tools	Device models, design of advanced IEDs, software and hardware architectures, OEM software
05	Device conformance testing	Conformance testing of devices according to IEC 61850-10
06	Extension rules IEC 61850	The extension rules for Logical Nodes, Data, and Common Data Classes, the name space concept
07	Substation configuration language (SCL)	System configuration language: basics and details; Engineering process and SCL, SCL object model, SCL syntax (IEC 61850-6 (SCL)); SCL edition 2
08	Common Data Classes (Ed2)	What is new in part IEC 61850-7-3 Edition 2? New possibilities for information modelers.
50	Mapping of Common Data Classes	Introduction and details of IEC 61850-80-1.

(CDC) to IEC 60870-5-101/104 according to IEC 61850-80-1

The Technical Specification IEC 61850-80-1 gives a guideline on how to exchange information from a CDC based data model (IEC 61850) using IEC 60870-5-101 or IEC 60870-5-104 protocols between substation(s) and control center(s).

[S-03] – Substation automation and protection

00	IEC 61850 modeling details	Modeling of protection, switchgear, metering and power quality equipment and other substation automation applications
01	Applying IEC 61850 for substation automation – use cases	Use cases from substation automation like measuring of current and voltage, protection, operating a switch, creation of a sequence of events
02	Product specifications for substation equipment	Implementation guideline IEC 61850-9-2 “LE”, Product standard for switchgear with integrated IEC 61850 interface (IEC 62271-003)
03	Substation automation system architecture	Communication architecture and topology, device architecture, impact of new technologies; redundancy concepts for switched Ethernet network
04	Substation to substation communication for protection and control with IEC 61850	What will the standard IEC 61850-90-1 (Use of IEC 61850 for the communication between substations) provide? Introduction and current status of work. Interlocking between substations, Distance line protection, Current differential line protection, Out-of-step detection, etc.

[S-04] – Power generation

00	Wind power plants	Overview and introduction of the standard for Communications for monitoring and control of wind power plants – IEC 61400-25
01	Hydro power plants	Overview and introduction of the standard for Communications for monitoring and control of hydro power plants – IEC 61850-7-410
02	Distributed Energy Resources	Overview and introduction of the standard for Communications for monitoring and control of Distributed Energy Resources (DER) – IEC 61850-7-420
03	Application modeling for hydro power plants	Overview and introduction of the standard for IEC 61850-7-410 modeling details; New common data classes for hydro power plants

[S-05] – Communication between field devices and system level and at system level

00	Telecontrol protocols I	Fundamentals of Telecontrol equipment and systems – Part IEC 60870-5-101 and Part IEC 60870-5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard profiles
01	Telecontrol protocols II	Fundamentals of DNP3; comparison with IEC 60870-5-101/104
02	Substation to control center communication with IEC 61850	What will the standard IEC 61850-90-2 (Using IEC 61850 for the communication between substations and control centres) provide? Introduction and current status of work.
03	Inter control center communication (ICCP)	Fundamentals of the use of IEC 60870-6-TASE.2 (ICCP); a comprehensive stand-alone seminar is available as well, ask for details.
04	Webservices	Fundamentals of the definition of Webservices for IEC 61400-25-3 (and IEC 61850-7-2) as specified in IEC 61400-25-4.
05	Comparison of protocols	Detailed comparison of the protocol suites IEC 60870-5, DNP3, ICCP (TASE.2), IEC 61850

[S-06] – Power system level applications

00	IEC 61970 / 61968 series	Energy management system application program interface (EMS-API) / System interfaces for distribution management – introduction
01	IEC 61970-301 CIM	Energy management system application program interface (EMS-API); focus on Part 301: Common Information Model (CIM) and harmonization with IEC 61850
02	Dynamic and static use of the CIM Model	Component Interfaces for information exchange, use cases for the CIM: GID, EAI, Network models
03	Tooling for the Common Information Model CIM	Available tools, platforms, experiences with power delivery systems Overview of existing OS tools: CIMTool, Xpetal, CIMVT, CIMValidate, CIMSpy; Available commercial tools; Flaws and future tools
04	UML Modeling basics	Introduction of the modeling basics required for CIM
05	UML demonstration of the CIM	Using the free viewer of the Spax Enterprise Architect Modeling and Design Tool to visualize the current CIM (IEC 61970-301 Edition 2009). Free viewer will be provided for all attendees.
06	CIM Users Group	Activities of the CIM Users Group
07	Application examples and projects	Presentation of implemented and planned applications; projects

[S-07] – Communication and SCADA aspects and protocol implementations

00	Extracting data from field devices	General SCADA services – configuration of logs, reports, ... (IEC 61850-7-2)
01	Monitoring for SCADA applications	Fundamentals of special SCADA services (IEC 61850-7-2): model basics for monitoring,

		event reporting, event logging, ...
02	Communication technologies	Fundamentals of Industrial Ethernet used for substations and beyond
03	Information presentation and encoding	Fundamentals of UML, XML, ASN.1, ...
04	Protocol details	Fundamentals of ISO 9506 (MMS), Webservices, IEC 60870-5, DNP3, ICCP
05	Protocol implementations and Mappings for IEC 61850-7-2	Details on how to implement protocols and information models? MMS, ASN.1 BER, Web services, ..., simple MMS clients; IEC 60870-5, ICCP, DNP3
06	Demonstration of compliant software	Demonstration of IEC 61850 compliant client and server software
07	MMS client and server implementation – the basis for IEC 61850	Comprehensive training on the implementation of MMS clients and servers for all basic services required by TC 57 standards: Association, NamedVariable, NamedVariableList, Read, Write, Information Report, ... This module usually requires a 2 day course
08	ICCP (IEC 60870-6 TASE.2 Protocol)	Use of MMS for realizing the TASE.2 services

[S-08] – Products and projects

00	Practical experience	IEC 61850 devices, tools, and projects in reality; penetration of IEC 61850 (61400-25) in the market
01	Tool support	Tools for IEC 61850, SCL, IEC 61400-25, Ethernet, TCP/IP, MMS, ASN.1
02	User support	UCA international users group, quality measures and TISSUE process, why to join the users group?
03	Current and future standardization	Introduction of current and future application domains using and extending IEC 61850; Update on ongoing and planned standardization activities
04	SCL demo with compliant software	Use of SCL files for building data model in an IED, extension of model (new data); including live demonstration
05	Products offered by major vendors	What is the situation on the market? What products are offered by the major vendors (ABB, Areva, GE, Siemens, ... Doble, Omicron, ... Beckhoff, Phoenix Contact, ... RuggedCom, Hirschmann, ...)
06	Multivendor projects and turn key projects of single vendor	Experiences after two years substation automation and protection with IEC 61850; turn key projects, ... User's view and requirements for the future. Are the users' expectations met?
10	Tools for the engineering of IEC 61850 conformant systems	The engineering process of IEC 61850 requires several tools for the various aspects of engineering: system design, IED design, system engineering, IED configuration, testing, ... The presentation introduces the typical engineering process using tools. More details can be found in the hands-on training [H-0104]
11	Second edition of IEC 61850 and other extensions	The first edition of IEC 61850 had 14 parts and was published between 2002 to 2005. In the meantime many extensions have been defined and published as standards or draft standards. This presentations presents the many new definitions in information models, services, configuration, mappings, and applications.
50	Quality process and user group	The UCA international users group represents all major vendors, many utilities, system integrators and consultants to support the various standards. The crucial objective is the support of the quality assurance process for testing, certification and lab accreditations.

Special hands-on Training opportunities

[H-00] – General hands-on training for in-house courses

00	Extended modeling of non-standardized information	Build your own extended model. The use of the extension rules of IEC 61850 to model application information outside standards
01	Design and engineering of a substation	Engineering of substations, IEDs and other systems using SCL tools
02	Real models	Analysis of existing real models; design of the model for your application
03	Analyzing the communication	Analyzing the communication according to IEC 61850: client-server, GOOSE, SV; communication testing
04	IED communication	Hands-on training of the use of communication services (ACSI) using an IED Simulator and common IED Browsers. The communication comprises all ACSI services except Sampled Values; ; communication with real IEDs (if IEDs are available and accessible); Network infrastructure and PCs are required; one PC per two attendees; training software will be provided in advance

[H-01] – IED and Engineering tools hands-on training in cooperation with STRI, Ludvika/Sweden

This hands-on training is offered as public or in-house events. The duration is usually 4 days. Contact NettedAutomation for details, dates and locations.

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| 00 | Module 1 | <p>Gives an introduction to the IEC 61850 standard together with a summary with real applications and the demonstration of STRI facilities for multivendor interoperability testing.</p> <p>Introduction to IEC 61850, the basics of the standard series, updates and other extensions. Presentation of the STRI multivendor application with ABB, Areva and Siemens IEDs for a typical substation. Demonstration of compliant IEC 61850 software, devices and test procedures in STRI's Independent IEC 61850 laboratory.</p> |
| 01 | Module 2 | <p>Gives an independent and more detailed update on the IEC 61850 standard for substation and device modeling as well as communication principles with real examples. IEC 61850 substation and device modeling and communication principles (GOOSE, Sample Values, Client/Server applications). What you need to know for specification, evaluation, verification and maintenance of IEC 61850 systems (whole substations and IEDs).</p> |
| 02 | Module 3 | <p>Presents possible functional allocation and architecture of a typical substation with state of the art IEDs from different manufacturers (ABB, Areva, Siemens) as well as available test sets (Omicron, Doble, Programma) with group sessions on how to optimize the solution.</p> <p>Review of available functions and possible architectures for substation automation. Optimized application of IEC 61850 in power utilities with examples based on the STRI multivendor application with ABB, Areva and Siemens IEDs for a typical substation. Morning session with theory and afternoon with group workshop to design and specify typical substation functions.</p> |
| 03 | Module 4A
IED interoperability workshop | <p>IEC 61850 hands-on workshop demonstrating inter-operability of protection and control devices from ABB, Areva and Siemens.</p> <p>The intention is to create a small system demonstrating interoperability of protection and control devices from ABB, Areva and Siemens. The participants will be divided in three subgroups with the task of browsing the IED model of each device (using self-description, validation of model and SCL file) and creating outgoing GOOSE messages from their relay. After lunch the network traffic is jointly analyzed and the reception of GOOSE messages will be configured in smaller groups. Finally the system is tested through e.g. simple multi-protection tripping schemes and the use of IEC 61850 compatible test devices.</p> <p>Participant gets hands-on experience of at least two vendors IEC 61850 implementation in IEDs and tools. Experience in system debugging and network traffic analysis using third party and open source tools is gained.</p> |
| 04 | Module 4B
Substation Configuration Language (SCL) workshop | <p>Substation Configuration Language (SCL) hands-on workshop. Learn what you need to know for specification, evaluation, verification, and maintenance of IEC 61850 substations and IEDs.</p> <p>The workshop focuses on the design of typical substation functions and the engineering of the substation and IEDs according to the engineering process described in edition 2 of IEC 61850-6 (SCL). The participants will use third-party functional specification, design and engineering tools to design ICD files, substation sections, communication sections, IED sections and DataTypeTemplates. The participants will create a SCD file that is used to generate a fully functional IED (IEC 61850) server simulator. The SCD file is also used as import file for an IED configuration tool to configure a real IED (data model, server and GOOSE message). During the last hour of the workshop the two groups join for the IED configuration by use of the SCD file created by the SCL group.</p> <p>This workshop 4B requires participants to bring their own notebooks (at least one for two attendees). The demo tools (from third parties) required will be provided by NettedAutomation prior to the beginning of the event.</p> |

Date and locations for public events: <http://www.nettedautomation.com/seminars/uca/sem.html#standardpublic>

In-house courses: <http://www.nettedautomation.com/seminars/uca/sem.html#inhouse>

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IEC 61850 Blog: <http://iec61850-news.blogspot.com>

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