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EE185:
Communications for Protection and Control of Electrical Power Systems

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Training Description:

This intensive training course is designed to provide participants with a detailed and up-to-date overview of communications for protection and control of electrical power systems. It covers the power system control, standardization and the IEC 61850 communication from power system automation; the IEC 61850-6 engineering process; the communication technologies; the substation architectures, protection and control functions; the specification and engineering; and the network architectures, IEDs and tools.

During this interactive course, participants will learn the protection and automation functions; the use of system integration and maintenance; the requirements for conditioning monitoring; the information models and services for transformer; the tap change controller, switch gears and other primary equipment; the IEC 61850 application modeling principles; the IEC 61850-6 engineering process; the communication services of IEC 61850; the extension rules of IEC 61850; and the system configuration language (SCL) and IEC 61850 modeling details.

Training Objectives:

By the end of the training, participants will be able to:

- ✓ Apply and gain an in-depth knowledge in communications for protection and control of electrical power systems
- ✓ Discuss the power system control, standardization and the IEC 61850 communication from power system automation
- ✓ Employ IEC 61850-6 engineering process, communication technologies, substation architectures, protection and control functions, specification and engineering, network architectures and apply IEDs and tools
- ✓ Identify protection and automation functions as well as use system integration and maintenance, requirements for conditioning monitoring, information models and services for transformer, tap change controller, switch gears and other primary equipment
- ✓ Employ IEC 61850 application modeling principles, IEC 61850-6 engineering process, communication services of IEC 61850, extension rules of IEC 61850, system configuration language (SCL) and IEC 61850 modeling details

Training Designed for:

This course is intended for electrical field engineers and electrical maintenance staff who are responsible for substation testing and maintenance. Further, this course is essential for instrumentation, control, systems and applications engineers and technical staff.

Training Program:

DAY ONE:

- ❖ Pre-Test
- ❖ Introduction to Communication for Protection & Control of Electric Power System (IEC 61850)
  - Title and Scope of IEC 61850 (IEC TC 57), Power Delivery System, What Does IEC 61850 Provide? And Motivation for the New Standards
  - IEC 61850 in Brief, Re-Use of IEC 61850 and Tools & System Integration

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- Standardization & Projects, General Observations

❖ Power System Control Basics
- Basics of Power System Information Integration & Automation Covering Control Centers Substations, Power Generation and Elements of the Power System: Substations
- Power Generation, Transmission and Distribution
- System Architecture, Functions and Communications
- System Engineering and Device Configuration

❖ Standardization
- IEC Activities Related to Power System Standardization, IEC TC 57 & TC 88 and International Organizations for the Power Industry
- IEC Organization & Standardization Work, IEC Activities Related to the Power Industry and CIGRE
- IEEE, UCA Users Group, IEC 61400 User Group, Activities Related to the Power Industry
- International Fieldbus

❖ IEC 61850 Communication for Power System Automation
- Communication Networks & Systems for Power System Automation: General Introduction on Whole Series, Design Objectives & Scope IEC 61850 and Content & Structure of IEC 61850
- Features of IEC 61850, Application Modeling and Information Exchange & Communication Services
- The 16 Parts of the Standard

❖ IEC 61850-6 Engineering Process
- Engineering Process Using the Configuration Language: from IEDs and Single Line Diagram to Configured Substation Automation System
- Systems Specification (Single Line Diagram & Functions), IED Specification (IED Capability Description) and System Engineering
- IED Engineering and Configuration, Use of SCL (Summary), Edition 2

DAY TWO:

❖ Communication Technologies
- Fundamentals of Industrial Ethernet Used for Substations & Beyond Industrial Ethernet Features, Ethernet Requirements for IEC 61850 and Shared Ethernet
- Switched Ethernet, Ethernet Frames, Ethertypes used in IEC 61850
- Priority Tagging, 802.1Q/802.1p

❖ Substation Architectures
- Experience of Pilot Project, Lessons Learned
- Overview & Details of Sample Substation Types to be Equipped with IEC 61850 IEDs & Engineered with IEC 61850 Complaint Engineering Tools

❖ Protection & Control Functions
- Functions Required to be Implemented in Substations that Required IEC 61850 Information Models & Communication Services, List & Present Functions

❖ Specification & Engineering
- Present the Methods of Functional Specification Applied

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- Study Examples in Order to Demonstrate the Impact of IEC 61850 System Testing: Present the Requirements and Methods of Functional & System Testing
- Maintenance: Present the Requirements & Methods of Maintenance & Service

❖ Network Architectures
- Architectures of Communication Networks Required for the Typical Substations be Equipped with IEC 61850 Technology
- Communication with Network Control Center

DAY THREE:

❖ IEDs & Tools Applied
- IEC 61850 Compliant IES, Tools & Network Infrastructures Used for the Various Substation & Bat Types
- Engineering Tools to be Used for System Design, Engineering & Documentation
- Information Models Used & Signal Designation (Functional Naming & IED Naming)
- Extensions of Models Taking the Different Philosophies of the Vendors Account

❖ Protection & Automation Functions
- Use of IEC 61850 Solutions of the Various Vendors IEDs for Functions (Using Goose, Client-Server…), Vendors Specifies in Modeling & Naming

❖ System Integration
- Impact of IEC 61850 on the System Integration of Substation Automation Control Systems
- Tools to be Used

❖ System Maintenance
- Impact of IEC 61850 on the System Maintenance of Substation Automation & Control Systems, Tools to be Used

❖ Requirements for Conditioning Monitoring
- General Approach for Information of the Condition of the Various Assets

❖ Practical Sessions

DAY FOUR:

❖ Information Models & Services for Transformer
- Information & Communication Mechanisms Required

❖ Information Models & Services for Tap Change Controller
- Information & Communication Mechanisms Required

❖ Information Models & Services for Switch Gears & Other Primary Equipment
- Information & Communication Mechanisms Required

❖ IEC 61850 Application Modeling Principles
- Modeling Protection, Substation Automation
- Other Applications (Logical Nodes, Data & Data Attributes, Function Modeling, Extension of the Models, Monitoring)
- The Elements of the Data Model, Acquisition of Measured Information
- Controlling of Switchgear Equipment, Protection Functions and Edition 2 Updates
- Example of a Model

❖ IEC 61850-6 Engineering Process
- Engineering Process Using the Configuration Language: From IEDs & Single Line Diagram to Configured Substation Automation System

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DAY FIVE:

- Communication Services of IEC 61850
  - Information Exchange with the ACSI According to IEC 61850-7-2, Basics, Information Flow Through IEDs
  - ACSI in Detail (IEC 61850-7-2), Server, Logical Device
  - Logical Node, Data, Data Set and Control Blocks (Reporting, Logging, GOOSE, SV)
  - Control, Conformance Statement and Recording (IEC 61850-7-4)
- Extension Rules IEC 61850
  - The Extension Rules of Logical Nodes, Data & Common Data Classes, The Name Space Concept and Scope
  - Instantiation of Existing Information Model Classes, New Information Models, Name Space Concept
- System Configuration Language (SCL)
  - System Configuration Language: Basics and Details: Engineering Process & SCL
  - SCL Object Model, SCL Syntax (IEC 61850-6(SCL)): SCL Edition 2
  - The Object Model & Content of the SCL Files Examples, Binding Models to Real World
  - Inputs & to Outputs, The Data Flow Engineering
- IEC 61850 Modeling Details
  - Modeling of Protection, Switch Gear
  - Metering & Power Quality Equipment & Other Substation Automation Applications
  - Basic Principles, Protection Functions and Protection Related Functions
  - Control, Example
- Case Study
  - Use Cases from Substation Automation Like Measuring of Current & Voltage, Protection, Operation of a Switch, Creation of a Sequence of Events
  - Use Case 1–Measuring Current & Voltage and Use Case 2– Operate Switchgear
- Course Conclusion
- Post-Test and Evaluation

Training Requirement:

"**Hand's on practical sessions, equipment** and **software** will be applied during the course if required and as per the client's request."

Please note that the above topics can be amended as per client's learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Software & General Discussions
- Pre and Post Test

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Training Certificate(s):

Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

As per the course location - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:30	Recess (Prayer Break & Lunch)
13:30 - 15:00	Last Session

For training registrations or in-house enquiries, please contact:
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Training & Career Development Department