

# **Tele-control Protocols for the Power Industry**

## **Technical Training Program Overview**

**Version 4.0**

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## 1. Introduction

This document detail the technical training program provided by Kalki in the areas of tele-control protocols. The document details the training program highlights, the course objective and course contents, course schedule and the contact information for the training program.

## 2. Kalki Overview

Kalki Technologies is a pioneer in the tele-control protocol domain in Asia. Kalki has carried out a number of telemetry protocol implementations, validations, conformance consulting, end-user training etc., to the utilities industry, both to the OEM's and Utility customers. Kalki also works closely with Triangle Microworks Inc., USA to promote their products and solutions in the Asian market.

The main highlights of Kalki's training program in the tele-control domain stems from Kalki's in-depth understanding of the standard together with the expertise of developing the standards for a host of major OEM's in the world. Together these standards understanding and implementation expertise enable Kalki to provide the best of breed training to its clients.

## 3. Training Objective

The tele-control-training program at Kalki is divided into two sets: Introductory courses and advanced courses. Introductory courses are meant for the end-users of the tele-control standards who would be interested in knowing about the standard in general and how to use this knowledge in using standards based products in their work.

The advanced training is intended for engineers, implementers and other personnel who would like to get a detailed understanding of the standard so as to help them to get a head-start in their implementation or validation activities. This course enables the participants to understand in depth about the standards, how to implement a standard using source code libraries, and how to use test tools and protocol analyzers for their validation and testing requirements.

## 4. IEC 60870-5 Series Protocols

### 4.1. Course Objective

This course is intended at advanced users who are interested in understanding in detail the features of the IEC 60870-5 series protocol specifications in its totality. This course would help the participants in the following manner

- a. Provide an overview of the entire IEC60870-5 series protocols
- b. Enable the trainees to understand the layering and protocol architecture

- c. Enable them to analyze the implication of implementing an IEC protocol for their requirement
- d. Enable them to do a make or buy decision for a future protocol implementation
- e. Enable them to evaluate the issues involved with integrating a given protocol for their requirements
- f. Gives an overview of using testing tools and simulators to understand, test and evaluate slave and master protocols

## **4.2. Course Duration**

The course duration is 5 days.

## **4.3. Course Details**

### **4.3.1. Introduction to IEC 60870-5 Series Protocol**

- Protocol Definition
- Protocol Layers
- Three Layer EPA Model
- General Introduction to the companion standards

### **4.3.2. Companion Standards**

- IEC60870-5-1 Transmission Frame Formats
- IEC60870-5-2 Link Transmission Procedures
- IEC60870-5-3 General Structure of Application Data
- IEC60870-5-4 Definition and Coding of Application Information Elements
- IEC60870-5-5 Basic Application Functions

### **4.3.3. IEC 60870-5-101 Basic Tele-control Tasks**

- Overview
- Protocol Structures
- Layering
- Companion Standard Selections for implementing IEC 60870-5-101
- Issues in implementing the IEC 60870-5-101 Series Protocol
- Conformance Validation of IEC 60870-5-101
- Using Test Tools for IEC 60870-5-101

#### **4.3.4. IEC 60870-5-102 Transmission of Integrated totals in electric power systems**

- Overview
- Protocol Structures
- Layering
- Companion Standard Selections for implementing IEC 60870-5-102
- Issues in implementing the IEC 60870-5-102 Series Protocol
- Conformance Validation of IEC 60870-5-102
- Using Test Tools for IEC 60870-5-102

#### **4.3.5. IEC 60870-5-103 Informative Interface of protection equipment**

- Overview
- Protocol Structures
- Layering
- Companion Standard Selections for implementing IEC 60870-5-103
- Issues in implementing the IEC 60870-5-103 Series Protocol
- Conformance Validation of IEC 60870-5-103
- Using Test Tools for IEC 60870-5-103

#### **4.3.6. IEC 60870-5-104 Transmission Protocols – Network Access for IEC 60870-5-101 using standard transport profiles**

- Overview
- Protocol Structures
- Layering
- Companion Standard Selections for implementing IEC 60870-5-103
- Issues in implementing the IEC 60870-5-103 Series Protocol
- Conformance Validation of IEC 60870-5-103
- Using Test Tools for IEC 60870-5-103

### **5. IEC-60870-6 Inter Control Center Protocol (TASE.2 )**

#### **5.1. Course Objective**

This course is intended at advanced users who are interested in understanding in detail the features of the IEC 60870-6 series protocol specifications in its totality. This course would help the participants in the following manner

- a. Provide an overview of the entire IEC60870-6 series protocols
- b. Enable the trainees to understand the layering and protocol architecture
- c. Enable them to understand the issues related to the protocol implementation
- d. Enable them to evaluate the issues involved with integrating a given protocol for their requirements
- e. Gives an overview of the standard tools and products available in the market and how to use them for their requirements

## 5.2. Course Duration

Course Duration is 4 days

## 5.3. Course Details

- Overview
- IEC 60870-6-1 Application context and organization of standards
- IEC 60870-6-2 Use of basic standards (OSI layers 1-4)
- Brief Introduction to MMS (ISO 9506)
- IEC 60870-6-503 TASE.2 Services and protocol
- IEC 60870-6-602 TASE transport profiles
- IEC 60870-6-702 Functional profile for providing the TASE.2 application service in end systems
- IEC 60870-6-802 TASE.2 Object models
- Implementing TASE.2 Clients and Servers

## 6. DNP3

### 6.1. Course Objective

This course is intended at advanced users who are interested in understanding in detail the features of the DNP3 (Distributed Network Protocol Version 3) protocol specifications. This course would help the participants in the following manner

- a. Provide an overview of the DNP3 protocol
- b. Understand the protocol layering and framing
- c. Protocol implementation issues
- d. Enable them to evaluate the issues involved with integrating a given protocol for their requirements
- e. Gives an overview of the standard tools and products available in the market and how to use them for their requirements

### 6.2. Course Duration

Course Duration is 5 days

### 6.3. Course Details

- Overview
- DNP3 Data Link Layer
- DNP3 Transport Function
- DNP3 Application Layer
- Data Object Library
- DNP3 Subset Definitions
  - Level 1 Implementation
  - Level 2 Implementation
  - Level 3 Implementation
  - DNP3 Conformance Rules
- DNP3 over LAN and WAN

## 7. Modbus

### 7.1. Course Objective

This course is intended at advanced users who are interested in understanding in detail the features of the Modbus and its various variants. This course would help the participants in the following manner

- a. Provide an overview of the Modicon Modbus Specifications
- b. Enable the trainees to understand the protocol framing
- c. Enable them to understand the issues related to the protocol implementation
- d. Shall carry out sample protocol implementation for the benefit of the participants
- e. Gives an overview of using testing tools and simulators to understand, test and evaluate slave and master protocols.
- f. Gives an overview of the other variants of Modbus supported by various vendors

### 7.2. Course Duration

Course Duration is 2 days

### 7.3. Course Details

- Overview
- Protocol Structures and Layers
- Framing
- Sample Modbus Program Coding
- Performance Issues
- Modbus Variations
- Using Modbus Simulators

## 8. IEC 61850 Introductory Program

### 8.1. Course Objective

This course is intended at users who are interested in understanding in detail the features of the IEC 61850 protocol specifications. This course would help the participants in the following manner

- g. Provide an overview of the entire IEC61850 protocols
- h. Enable the trainees to understand the layering and protocol architecture
- i. Give overview of the new method of sub-station design and architecture
- j. Give an overview on Object Modeling and Inter-operability
- k. Give an overview on how to implement distributed inter-locks
- l. Give an overview on GOOSE
- m. Enable them to analyze the implication of implementing an IEC protocol for their requirement
- n. Enable them to do a make or buy decision for a future protocol implementation
- o. Enable them to evaluate the issues involved with integrating a given protocol for their requirements
- p. Gives an overview of using testing tools and simulators to understand, test and evaluate slave and master protocols

### 8.2. Course Duration

The course duration is 5 days.

### 8.3. Course Details – IEC 61850

#### 8.3.1. Introduction

- Overview of Protocols
- Existing Protocols in Sub-stations
- IEC 61850 Major Differences

#### 8.3.2. Overview of MMS

- MMS Standard
- MMS Model
- MMS Objects
- MMS Communication

#### 8.3.3. Comparison of DNP3 and IEC 61850

- Where they came from/Original purpose
- Standard structure

- Protocol profile
- Services
- Objects

#### **8.3.4. Benefits of IEC61850**

- Substation SCADA
- Control Center –Substation SCADA
- Protection Messaging
- Transducer Networks

#### **8.3.5. Introduction to IEC61850**

- Basic Definition
- Features and Services
- Profiles
- Use of Ethernet

#### **8.3.6. About the Standard**

- Substation architecture
- Structure of the standard and how to read
- Abstraction and mapping

#### **8.3.7. IEC61850 Object and Device Models**

- Overall Structure
- Server Object
- Logical Devices

#### **8.3.8. IEC61850 Logical Nodes**

- Definition
- Conventions
- LN Descriptions

#### **8.3.9. IEC61850 Common Data Classes**

- Purpose and structure
- Functional Constraints
- Examples

#### **8.3.10. IEC61850 Object Names**

- Circuit Breaker Example
- Mapping to MMS Object Names

- Other Examples

### **8.3.11. Abstract Communication Service Interface (ACSI)**

- Service Descriptions
- Mapping to MMS Services per 8-1
- Reporting
- Controls

### **8.3.12. Multi-cast Messaging**

- Generic Object Oriented Substation Event (GOOSE)
- Generic Substation Status Even (GSSE)
- Applications

### **8.3.13. Sampled Measured Values (SMV)**

- Process bus
- Applications

### **8.3.14. Substation Configuration Language (SCL)**

- File Types
- Applications
- Example SCL file

### **8.3.15. Migration Issues**

- Legacy to IEC61850
- UCA2.0 –IEC61850

### **8.3.16. IEC61850 Testing**

- Interoperability –Conformance
- Test Methods
- Quality Assurance
- UCA International Users Group

### **8.3.17. IEC 61850 Security**

- Environments
- Solutions

### **8.3.18. Introduction to SISCO / KALKI**

- IEC61850 Products

- MMS-EASE Lite –For embedded Systems
- AX-S4 MMS –For Windows SCADA
- Architecture
- IEC61850 Server

### **8.3.19. Hands-On Demonstration**

### **8.3.20. Ethernet Analyzer**

## **8.4. Course Details – Sub-Station Automation, Migration to IEC 61850 and Experiences**

### **8.4.1. Introduction**

- Overview
- Challenges with Introducing Sub-Station Automation
- Primary Equipments in Sub-Station
- Functions of Sub-Station Automation
- Asset Management Issues

### **8.4.2. Sub-Station Architectures**

- Overview
- Sub-Station Structures
- Architecture Models

### **8.4.3. Impact on New Technologies on Sub-Station**

- Overview
- IEC 61850 Migration
- Phasor Measurement Units
- Wide Area Protection
- IEC 61850 for Wide Area Communication
- IEC 61850 Object Model Integration with CIM

### **8.4.4. Experiences with Implementation of IEC 61850 for Indian and Global Customers**

- Overview
- Issues in Integration and Migration
- Project Case Studies

## **9. Introductory Courses**

### **9.1. IEC 60870-5 Series Protocol**

This is a one-day introductory course on each of the IEC 60870-5 series protocols. This course covers the main functionalities of the protocol and its applications.

Protocols Covered:

IEC 60870-5-101  
IEC 60870-5-102  
IEC 60870-5-103  
IEC 60870-5-104

Pre-requisite:

Knowledge of the following companion standards is required for attending the above introductory courses:

IEC 60870-5-1  
IEC 60870-5-2  
IEC 60870-5-3  
IEC 60870-5-4  
IEC 60870-5-5

## **9.2. IEC 60870-6 Series Protocol**

This is a one-day introductory course on each of the IEC 60870-6 series protocols. This course covers the main functionalities of the protocol and its applications.

Standards Covered:

IEC 60870-6-503  
IEC 60870-6-702  
IEC 60870-6-803

## **9.3. DLMS / IEC 62056**

Overview  
Protocol Structures  
Application Services

## **10. Training Faculty Background**

The training faculties from Kalki are experienced trainers and experts in the field of IEC/DNP/ICCP protocol implementation for more than 10 years. They shall be able to provide the participants with an in-depth understanding of the standards as well as the practical issues while implementing, validating or evaluating these protocols.

## 11. Course Fees

Please contact [sales@kalkitech.com](mailto:sales@kalkitech.com) to know the exact price schedule

Training at Bangalore:

- Travel, Lodging, Boarding and other expenses has to be borne by the participants, but Kalki's training department will help out-station participants with these aspects, so that participants feel at home in Bangalore.
- Course Material / Software Tools shall be extra

On-Site Training at Client Premises:

- All travel, boarding lodging and other communication expenses has to be borne by the Client.
- Course Material / Software Tools shall be extra

## 12. Training Contact Information

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