



## **Training Program:**

**Smart Operation And Observability at The Electric  
Power Distribution, Automation, Protection, And  
Control – Distribution Management Systems**

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## Who Should Attend?

Personnel working in all areas of electricity section who wish to understand the various aspects of smart metering and smart grid, Managers, network and distribution engineers, Instrumentation engineers, senior technical staff, plant designers, plant managers, Energy Management System, etc

## CASE STUDY

- Control and operation
- Transmission line
- Areas of Distribution Automation System Implementation
- Distribution Substation
- Feeder Automation
- Distribution Automation Products
- Advanced Distribution Automation
- Case Study for installation

## Objective:

This course is intended to introduce distribution engineering as a growing area suitable for studying new trends in computation, automation, and control techniques. The idea is to present the basic concepts for assessment, design, formulation, and analysis of

distribution performance. This is timely, given the growing research interest, the desire for automation, and the commitment to build an efficient and cost-effective distribution system in a competitive utility environment.

The growth of the industry has led to many innovations, including economy of scale from large hydro, fossil fuel and, recently, small independent power producers (IPP), in what is called distributed generation. The designs of distributed generation have been based on criteria to improve its reliability, load management, and system performance in response to various disturbances.

New solutions to the protection, control, and monitoring of power systems are being put to work all the time, by scientists, engineers, and technicians in utilities and industry around the world. The expansion of the existing interconnected electric power transmission systems offers significant advantages with respect to operational security, integration of renewable energy, as well as energy trading.

Smart Grids are regarded as the pre-requisite for meeting the challenges of the electricity supply of the twenty first century with its significant share of renewable energy sources (RES) in the annual electricity consumption, most of which are volatile and dependent on the weather conditions.

## Course Outline

### **MODULE-01: Introduction to Distribution Automation Systems**

- Historical Background
- Distribution System Topology and Structure

- Distribution Automation (DA) and Control

## **\_MODULE-02: DISTRIBUTION AUTOMATION**

- Distribution automation objectives
- Automatic throw-over schemes
- Distribution network fast-restoration schemes
- Centralized distribution automation systems
- Examples of distribution protection and automation systems
- Faulted Circuit Indicators
- Benefits of faulted circuit indicators
- Faulted circuit indicator applications
- Combine faulted circuit indicators and relays for fast fault location
- Restricted Ground Fault Protection
- Transformer overload protection
- Communications
- Networking interfaces - 10Mbps Ethernet, RS232, RS485 and RS422 ports
- Ethernet port, 10Mbps
- Multiple protocols - ModBus™ RTU, ModBus™ RTU TCP/IP, DNP 3.0 Level 2

## **\_MODULE-03: Protection Systems**

- Relay

- Instrument Transformers
- Accounting for Saturation in CT
- Reclosers
- Fuses
- Sectionalizer
- Protective Relay Technology
- Digital Relaying
- Overcurrent Relays in a Radial System
- Example 2, Radial System Protection
- System Protection in General
- System Protection for Different Power System
- Zone Components
- Line Protection with Impedance Distance Relays
- Directional Overcurrent Relay
- Impedance Relay
- Generator, Buses, and Transformer
- Generator Protection
- Bus Protection with Differential Relays
- Transformer Protection with Differential Relays
- Illustrative Examples

- Example 1
- Example 2
- Example 3

#### **MODULE-04: Distribution Automation and Control Functions**

- Demand-Side Management
- Voltage/VAr Control
- Methods of Voltage/VAr in Distribution Automation
- Evaluation of Methods Used for Voltage/VAr Control
- Modeling of Voltage/VAr Control Options
- Formulation of Voltage/VAr
- System Operating Constraints
- Fault Detection (Distribution Automation Function)
- Detection Techniques
- Harmonic Sequence Component Technique
- Amplitude Ratio Technique
- Phase Relationship Technique
- Restoration Functions
- Reconfiguration of Distribution Systems
- Power Quality

- Optimization Techniques
- Illustrative Examples

#### **MODULE-05: Intelligent Systems in Distribution Automation**

- Distribution Automation Function
- Artificial Intelligence Methods
- Expert System Techniques
- Artificial Neural Networks
- Intelligent Systems in Distribution Automation
- DSM and AI
- Voltage/VAr Control
- Network Reconfiguration via AI
- Fault Detection, Classification, and Location in Distribution Systems
- Use of AI Techniques for Fault Analysis

#### **MODULE-06: Renewable Energy Options and Technology**

- Distributed Generation
- Working Definition and Classification of Renewable Energy
- Renewable Energy Options
- Solar

- PV Systems
- V-I Characteristics
- Wind Turbine Systems
- Impact of Tower Height on Wind Power
- Emission Control Technologies
- Small and Micro Hydropower
- Fuel Cell
- Operation of Fuel Cells
- Ocean Energy
- Geothermal Heat Pumps
- Microturbine and Sterling Engine
- Distributed Generation Concepts and Benefits
- Categories of DG
- Criteria for DG Concepts
- DG Benefits
- Illustrative Examples

#### **MODULE-07: Distribution Management Systems**

- Introduction to EMS
- DMS and EMS



- Functions of EMS
- SCADA (Supervisory Control and Data Acquisition)
- RTU (Remote Terminal Units)
- Distribution Management System (DMS)
- System Hardware for DMS Station
- SCADA System Functions for DMS
- DMS Functions
- Substation and Feeder SCADA
- Feeder Automation
- Fault Location, Isolation, and Restoration (FLIR)
- Voltage/VAr Control
- Voltage Control
- Substation Automation (SA)
- Trouble-Call and Outage Management (TCOM)
- Reconfiguration Function
- Distribution System Analysis (DSA)
- Load Management System (LMS)
- Geographic Information System (GIS)
- Customer Information System (CIS)
- Automatic Meter Reading (AMR)

- Advanced Billing
- Special Features and Benefits of AMR and AMI
- Advancement in AMR and AMI Technology
- Advances in Billing Technology
- Cost-Benefit Analysis (CBA) in Distribution Systems
- Cost-Benefit Analysis Methodology
- Function/Payback Correlation

#### **MODULE-08: Communication Systems for Distribution Automation Systems**

- Communication Modulation Techniques
- Communication Networking
- Frame-Relay Communications
- Communication Standards Overview
- Distribution Network Protocol (DNP3)
- Utility Communication Architecture (UCA)
- Power-Line Carrier Communication

### **Accreditation:**

**BTS** attendance certificate will be issued to all attendees completing a minimum of 80% of the total course duration.