TECHNICAL ENGINEERING COURSES

Planning, Operation & Protection | Grounding of Distribution Systems | Power Quality Assessment | And More...

Distribution Systems: Planning, Operation and Protection

Introduction

This course deals with the essential aspects of distribution system engineering, starting from how to estimate the loads on the network to the detail design of the distribution system networks. The contents of this course are divided into four categories; Planning, Design, Protection and Operation. In the planning part load forecasting, and planning strategies as well as distribution automation are discussed. The design part includes the design of sub-transmission lines, distribution substations, and primary and secondary systems design considerations. The operation part includes the voltage drop and power loss calculations, voltage regulation and application of capacitor to distribution systems.

Course Language:
English

Duration:
5 days

Instructor:
Dr. Magdy M.A. Salama

CYME Technical Engineering Courses Program Director:
Dr. Atef S. Morched

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What you will learn

The objective of this seminar is to provide a clear understanding of the electrical power distribution system parameters and operation and to study the state-of-the-art techniques to improve the system performance and efficiency.

- To provide a good understanding of different distribution system elements
- To introduce the state of the art techniques in planning and automating the distribution systems to power engineers
- To train distribution engineers on how to operate, optimally, distribution networks
- To enhance the design aspects of distribution system components.

Audience

- Consulting engineers,
- Plant managers,
- Electrical power distribution engineers,
- Electrical power system engineers,
- Project engineers,
- Operating and maintenance engineers and
- All personnel involved in the planning and operating of electrical distribution systems who have a concern for increasing their performance.

Course Outline

Day 1

- **Distribution System Load Characteristics**
  - Basic definitions
  - Classifications of loads
  - Load characteristics
  - The relationship between load and loss factors.
  - Maximum diversified demand
  - Load demands and diversity effect
  - Typical loads in distribution systems
  - Load characteristics applications
- **Load Forecasting**
  - The factors that affect load forecast
  - Spatial load forecast
  - Data collection and preprocessing for load forecast faults
  - Classification of load forecasting methods
  - Naïve approach
  - Regression-based load forecast
  - State space and Kalman filter based load forecast
- **Distribution System Planning**
  - Definitions of terms
  - Factors affecting distribution system planning
  - Distribution system planning process
  - Distribution system planning procedure
  - Planning process classification
  - Planning, model, technique and approaches
  - Deviations between research and practical techniques

Day 2

- **Distribution System Automation & Demand Side Management**
  - The problem
  - Energy management system
  - Introduction to distribution system automation
  - The basic elements of distribution system automation
  - Components of distribution system automation
  - Power market deregulation and distribution system automation
  - Load management
  - Demand side management
  - Compatibility of load management with system design and operation
- **The Deregulation of the Electricity Supply Industry and Distribution Systems**
  - Current status of deregulation around the world
  - Benefits from a competitive electricity market
  - Power system operation in competitive environment
  - The impact of the deregulated environment on the distribution system operation
- **Distribution System Lines**
  - Distribution line construction specifications
  - Distribution line construction standards
  - Distribution conductor support
  - Overhead distribution systems
  - Underground distribution systems
  - Residential distribution layout
  - Industrial distribution load
- **Distribution System Substations**
  - Substation layout
  - Substation construction
  - Substation bus schemes
  - Substation location
  - The rating of distribution substation
  - Substation application curves

Instructor

Magdy M.A. Salama holds a Ph.D. in Electrical Engineering since 1977. He is currently a University Research Chair Professor in the Electrical and Computer Engineering Department at the University of Waterloo. Dr. Salama's taught several courses on distribution systems engineering: design, performance and protection and has acted as an adviser, in these areas, to government agencies, electric utilities and electrical industry in Canada, USA, Europe and the Middle East. Dr. Salama is a registered professional engineer in the Province of Ontario and was awarded an IEEE Fellowship "For Contributions to the Advancement of Distribution System Performance".

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Day 3

- Substation Transformer Characteristics
  - Standard transformer capacity and voltage ratings
  - Types of distribution transformers
  - Electrical characteristics of typical single-phase distribution transformers
  - Regulation
  - Transformer efficiency
  - Transformer polarity
- Substation Transformer Operation
  - Distribution transformer loading guides
  - Equivalent circuits of transformer
  - Single-phase transformer connections
  - Three phase connections
  - The autotransformer
- Distribution System Protective Equipment
  - Classification of high voltage fuses
  - Interrupting ratings of open-fuse cutouts
  - Automatic circuit reclosers
  - Automatic line sectionalizers
  - Circuit breakers
  - Lightning protective devices
  - Metering equipment
- Distribution System Protective Scheme
  - Objective of distribution system protection
  - Coordination of protective schemes
  - Fuse-to-fuse coordination
  - Fuse-to-circuit breaker coordination
  - Recloser-to-recloser coordination
  - Recloser-to-fuse coordination
  - Recloser-to-substation transformer high side fuse coordination
  - Recloser-to-circuit breaker coordination

Day 4

- Faults in Power Systems
  - Types of faults in power system
  - Three phase faults
  - Unbalanced faults
  - Line to line faults
  - Single line to ground faults
  - Two line to ground faults
- Underground Transmission
  - Background
  - High voltage cable insulation
  - Thermal performance and current rating
  - Conventional AC power cables
- Cable Testing
  - Testing of extruded cables
  - Maintenance tests
  - Partial discharge measurements
  - Fault locating
- Voltage Drop
  - Sources of voltage drop in distribution system
  - Impact of voltage drop on system performance
  - Practical methods for calculating voltage drop in distribution system
- System Regulation
  - Definition of voltage regulation in distribution system
  - The practical permissible limits of voltage regulation
  - The practical formulas for calculating voltage regulation in distribution system

Day 5

- Application of Capacitors to Distribution Systems
  - Power capacitors basic definitions
  - Effects of series and shunt capacitors
  - Power factor corrections
  - Determination of the economic power factor using simple computer algorithm
  - Capacitor installation types
  - Types of controls for switched shunt capacitors
  - Types of three-phase capacitor bank connections
  - Economical benefits of capacitors installation
- Distribution System Grounding
  - Definition of power grounding
  - Definition of safety grounding
  - The need for power grounding
  - Substation grounding
- Improving the Quality of Power
  - Voltage dips (sags)
  - Brief interruptions
  - Brief voltage increases (swells)
  - Transients
  - Voltage fluctuations
  - Voltage flickers
  - CBEMA and ITI curves
- Alternative Measure to Improve Distribution System Performance
  - Reconfiguration
  - Reconductoring
  - Conservative Voltage Reduction (CVR)

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