POWER SYSTEM OPERATION (LDC) ELC011

COURSE DESCRIPTION

The objectives of the course of Power System Operation (LDC) include the desire to acquaint electric power engineers and qualified technicians with Load dispatching center and the role of independent system operator in pool versus bilateral market. The active and reactive power control is also the main desire of this short course as well as the voltage control. This includes a functional description of the transmission system, control, maintenance, and lightning protection as well as the routine maintenance requirements of the overhead lines and underground cable. The course will include another objective for lightning over voltages and physical phenomenon of lightning, interaction between lightning and power system, and switching over voltages.

Advanced load-flow methods, especially, power system state estimate, security-constrained economic dispatch, active and reactive power dispatch and optimal capacitor allocation have been included.

COURSE GOAL

To enhance the participants' Knowledge, Skills and abilities necessary to understand and operate Load dispatching centers.

COURSE OBJECTIVES

By the end of this course, participant will be able to:

- Understand the role and function of Load Dispatch Centers (LDC) and Independent System Operators (ISO) in power systems
- Control active and reactive power, and maintain voltage control in power systems
- Conduct lightning protection and maintenance of transmission systems, overhead lines, and underground cables
- Use advanced load-flow methods including power system state estimation, security-constrained economic dispatch, active and reactive power dispatch, and optimal capacitor allocation
- Analyze power system security and contingency, and apply measures to minimize the impact of disturbances
- Understand electricity deregulation and competitive markets for electricity generation
- Identify and mitigate harmonics and sub-harmonics in power systems.

WHO SHOULD ATTEND

All engineers and technicians involved in the power sectors and power station operation, planning, and maintenance, and also in the factories, and enterprises, especially in dispatching load center.

COURSE DURATION

5 Working Days

COURSE OUTLINES

1. Introduction
    - Characteristics Influencing Generation and Transmission
    - Loads
    - Representation of Power Systems
    - Nature of Transmission and Distribution Systems
    - Statistics of Systems
    - Distribution Systems
    - Use of Digital Computers
2. Forecasting T&D Load
    - Spatial Load Forecasting
    - Load Growth Behavior
    - Important Elements of A Spatial Forecast
    - Improvements to Multiple Regression Curve-fitting
    - Selecting a Forecast Method
3. Overview of Economic Operation Functions
    - Different Criteria that Govern Power System Operations
    - Overview of EMS Functions
    - Generation Functions
    - Network Analysis Functions
    - Power Flow Control
4. Characteristics of Power Generating Units
    - Characteristics of Power Generating Units
    - Automatic Generation Control
    - Parallel Operation of AC Generators
5. Formulation of the Economic Dispatch Problem
    - Objective Function of EDP for Thermal Units
    - Constraints of EDP
    - Equal incremental cost loading

- Accounting for Transmission Losses
- The General Loss Formula
- Optimal Solution to EDP with Losses
- All Thermals System, with no losses
- Accounting for Losses
- The Lambda Iteration Method
- First Order Gradient Search
- Linear Programming Based Economic Dispatch

6. Power Flow Studies

- Power Flow
- Evaluation of Penalty Factors
- Optimal Power Flow
- Conventional Optimal Economic Scheduling
- Conventional OPF Formulation
- Operational Requirements for On-Line Implementation
- Conclusions

7. Unit Commitment

- General Considerations
- Problem Formulation
- Priority List Unit Commitment Scheme
- A Simple Merit Order Scheme
- Dynamic Programming Unit Commitment Schemes
- Need for Approximations
- Lagrangian Relaxation Approach
- Single Unit Relaxed Problem
- Lagrangian Relaxation Procedure
- Requirement for Economic Dispatch
- Modified Formulation Dispatch and Solution
- Candidates for Shut-down

8. Optimization Techniques

- Optimization of Constrained Functions and Functional
- Non-Linear Programming
- Interior Point Methods
- Linear Programming

9. Optimal Preventive and Corrective Actions

- Introduction
- Optimization in Security Control
- Optimization Subject to Security Constraints
- The Time Variable
- Using an Optimal Power Flow Program
- Power System Security and Contingency Analysis
- Development of the Concept of Security
- Two Perspectives of Security Assessment
- Security Assessment Defined
- Implications of Security
- Security Analysis
- Historical Methods of Contingency Analysis
- Selection of Contingencies to be studied

10. Fault Analysis

- Introduction
- Calculation of Three-phase Balanced Fault Currents
- Method of Symmetrical Components
- Representation of Plant in the Phase-sequence Networks
- Bus Impedance (Short circuit Matrix) Method

11. Disturbances in Power Systems

- Sudden Disturbance
- Predictable Disturbances
- Forms of System Failure
- Definitions and Concepts Used in Emergency Control
- The Effects of Various Types of Fault or Disturbance on System Performance
- Typical Pattern of the Development of a Sudden Disturbance
- Conceptual Forms of Emergency Control
- Design Criteria for Emergency Control Facilities
- Measures to Minimize the Impact of Disturbances
- Factors in Onset, Severity and Propagation of a Disturbance
- Measures in the Operational Timescale to Minimize the Risk and Impact of a Disturbance
- Special Protection Schemes
- Reduction in the Spread of Disturbances
- Measures to Minimize the Impact of Predictable Disturbances

12. Restoration

- Introduction
- The Range of Disturbed System Conditions
- Some General Issues in Restoration
- Recovery from an Abnormal Operating Situation, Local Islanding or Localized Loss of Demand
- The 'Black Start' Situation
- Strategies for Restoration of the Whole System
- Aids in the Restoration Process
- Problems Found in Restoration
- Analysis, Simulation and Modeling in Black start
- Restoration from a Foreseen Disturbance

13. Electricity Deregulation

- Competitive Markets for Electricity Generation
- Competitive Generation
- The Advantages of Competitive Generation
- Competitive Pricing of Electricity
- The Market Response to Risk
- Conclusion
- Electricity Deregulation

14. Harmonics in Power Systems

- Introduction
- The Nature of Harmonics
- The Generation of Harmonics
- The Effects of Harmonics
- The Limitation of Harmonics
- Ferro resonance and Sub harmonics