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EE020:
Economic Dispatch of Power Plants

Training Description:

A major challenge for all power utilities is to not only satisfy the consumer demand for power, but to do so at minimal cost. Any given power system can be comprised of multiple generating stations, each of which has its own characteristic operating parameters. The cost of operating these generators does not usually correlate proportionally with their outputs, therefore the challenge for power utilities is to try to balance the total load among generators that are running as efficiently as possible.

Further, the power station has incremental operating costs for fuel and maintenance; and fixed costs associated with the station itself that can be quite considerable. Things get even more complicated when utilities try to account for transmission line losses, and the demand fluctuation within shorter time. In all of these cases, however, the basic objective is to operate the system as inexpensively as possible.

The economic dispatch program optimally allocates load demand specifying real power and reactive power to be generated by a power plant among various power generators in a manner so that each of the power generators are operated within its optimal operating conditions as defined by a reactive capability curve. Allocating a power demand with consideration of the reactive capability curves of the power generators results in optimal generation of real power and reactive power as specified by the load demand. Alternatively, the economic dispatch program allocates load demand specifying real power and reactive power to be delivered by a power grid among various power plants wherein one or more of the various power plants have capacity limits exhibited by reactive capability curves. The classic problem is the economic dispatch of the generation systems to achieve minimum operating cost. This problem area has taken on a subtle twist as the public has become increasingly concerned with environmental matters, so that “economic dispatch” now includes the dispatch of systems to minimize pollutants and conserve various forms of fuel, as well as to achieve minimum costs. In addition, there is a need to expand the limited economic optimization problem to incorporate constraints on system operation to ensure the “security” of the system, thereby preventing the collapse of the system due to unforeseen conditions.

This intensive training course is designed to introduce and explore a number of engineering and economic matters involved in planning, operating, and controlling power generation and transmission systems in electric utilities. This course is designed to provide a good overview of the economic dispatch problem in power generation. It covers Power generation characteristics, Economic dispatch problem, Thermal unit economic dispatch and methods of solution, Optimization with constraints, Using dynamic programming for solving economic dispatch and other optimization problems, Transmission system effects, The unit commitment problem and solution methods, Generation scheduling in systems with limited energy supplies, Production cost models, Automatic generation control, Interchange of power and energy, Power system security techniques, Least-squares techniques for power system estimation, and Optimal power flow techniques and illustrative applications.

Training Objectives:

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

- ✓ Apply and gain an in-depth knowledge on economic dispatch of power plants
- ✓ Identify the characteristics of power generation units and introduce them to the economic dispatch of thermal units and the methods of solution
- ✓ Discuss the transmission system effects, unit commitment and the generation with limited energy supply

- ✓ Implement the production cost models and be able to adapt the control of generation
- ✓ Explain the interchange of power and energy and their types and discuss the factors affecting the power system security
- ✓ Estimate power systems and calculate the optimal power flow
- ✓ Use new techniques for solving old problems and new problem areas that are arising from changes in the system development patterns, regulatory structures, and economics
- ✓ Solve complicated problems, involving both economic analysis and network analysis and illustrate the solving techniques with relatively simple problems

Training Designed for:

This course is intended power system analysts and engineers, generation and transmission planners, protection engineers, ISO/RTO technical staff, and operations supervisors. Others who will benefit include power developers and marketers, power exchange personnel, regulatory staff, economic and management consultants.

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."

Contents can be adapted to your specific wishes. It is therefore possible to focus on specific modules of the training course as per client's learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Program:

DAY ONE:

- ❖ Introduction
- ❖ Characteristics of Power Generation Units
  - Characteristics of Steam Units
  - Variations in Steam Unit Characteristics
  - Cogeneration Plants
  - Typical Generation Data
- ❖ Economic Dispatch of Thermal Units and Methods of Solution
  - The Economic Dispatch Problem
  - Thermal System Dispatching with Network Losses Considered
  - The Lambda-Iteration Method
  - Gradient Methods of Economic Dispatch
  - Newton's Method
  - Economic Dispatch with Piecewise Linear Cost Functions
  - Economic Dispatch Using Dynamic Programming
  - Base Point and Participation Factors
  - Economic Dispatch Versus Unit Commitment
  - Optimization within Constraints
  - Dynamic-Programming Applications

DAY TWO:

- Transmission System Effects
  - The Power Flow Problem and Its Solution
  - Transmission Losses
  - Power Flow Input Data for Six-Bus System
- Unit Commitment
  - Constraints in Unit Commitment
  - Unit Commitment Solution Methods
  - Dual Optimization on a Nonconvex Problem
- Generation with Limited Energy Supply
  - Take-or-Pay Fuel Supply Contract
  - Composite Generation Production Cost Function
  - Solution by Gradient Search Techniques
  - Hard Limits and Slack Variables
  - Fuel Scheduling by Linear Programming

DAY THREE:

- Production Cost Models
  - Uses and Types of Production Cost Programs
  - Probabilistic Production Cost Programs
  - Sample Computation and Exercise
  - Probability Methods and Uses in Generation Planning Problems
- Control of Generation
  - Generator Model
  - Load Model
  - Prime-Mover Model
  - Governor Model
  - Tie-Line Model
  - Generation Control

DAY FOUR:

- Interchange of Power and Energy
  - Economy Interchange between Interconnected Utilities
  - Interutility Economy Energy Evaluation
  - Interchange Evaluation with Unit Commitment
  - Multiple-Utility Interchange Transactions
  - Other Types of Interchange
  - Power Pools
  - Transmission Effects and Issues
  - Transactions Involving Nonutility Parties
- Power System Security
  - Factors Affecting Power System Security
  - Contingency Analysis: Detection of Network Problems
  - Calculation of Network Sensitivity Factors
- Practical Sessions

- This hands-on and includes real-life case studies and exercises

DAY FIVE:

- ❖ Estimation in Power Systems
  - Power System Estimation
  - Maximum Likelihood Weighted Least-Squares Estimation
  - Estimation of an AC Network
  - Estimation by Orthogonal Decomposition
  - Introduction to Advanced Topics in Estimation
  - Application of Power Systems Estimation
- ❖ Optimal Power Flow
  - Solution of the Optimal Power Flow
  - Linear Sensitivity Analysis
  - Linear Programming Methods
  - Security-Constrained Optimal Power Flow
  - Interior Point Algorithm
  - Bus Incremental Costs
- ❖ Impacts of Free–Market Pricing on Economic Dispatch Decisions
- ❖ Course Conclusion
- ❖ POST-ASSESSMENT and EVALUATION

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, Gamification, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

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

Training Fees:

TBA 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 - 13:00	Recess (Prayer Break & Lunch)
13:00 - 14:00	Last Session

For training registrations or in-house enquiries, please contact:

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