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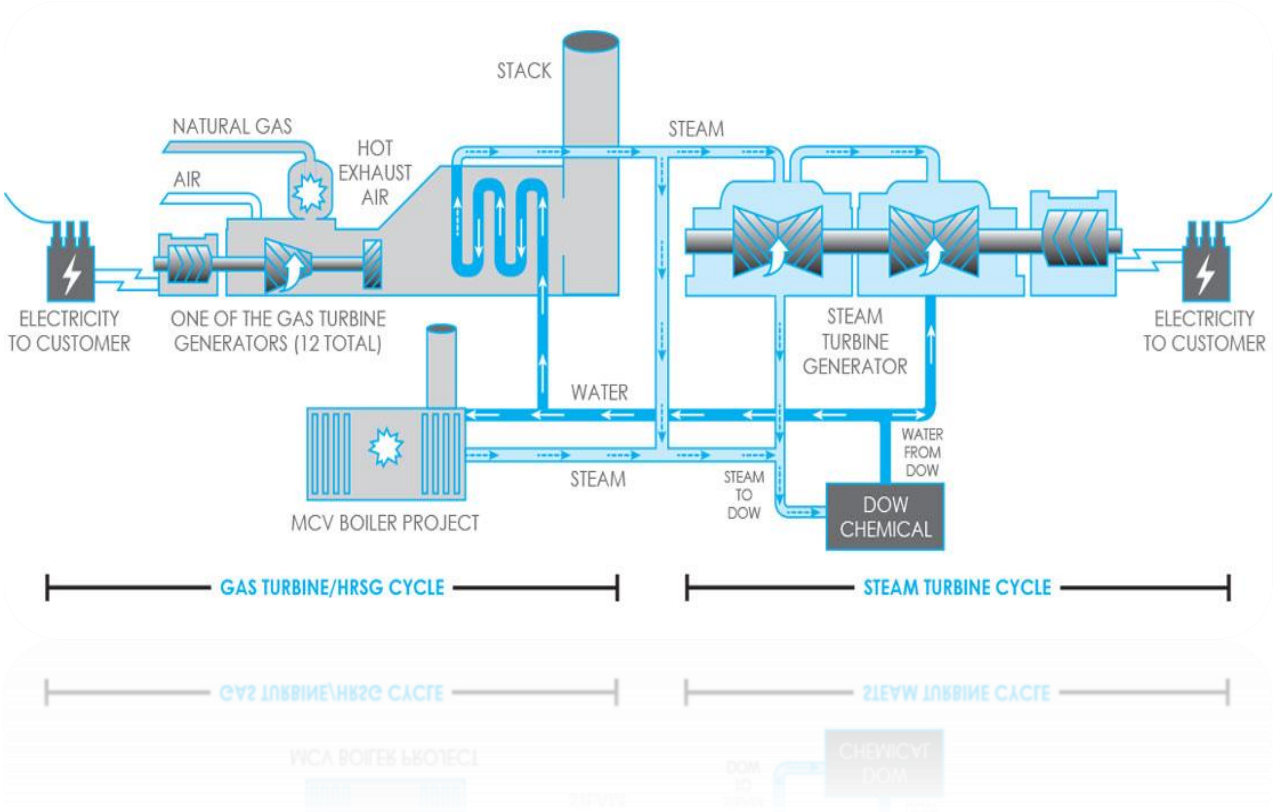

MUE203

Basic Operation and Theory of Steam & Gas Turbines, Co-Generation & Combined Cycle Plants

Course Introduction:

This course will cover all aspects of steam power plants, gas turbines, co-generation, combined cycle plants, wind and solar power generating plants. This seminar will cover in detail all the components of these types of power plants such as: compressors, gas and steam turbines, heat recovery steam generators, de-aerators, condensers, lubricating systems, instrumentation, control systems, transformers, and generators. The design, selection considerations, operation, maintenance, pay-back period, economics of co-generation plants and combined cycles, as well as, emission limits, reliability, monitoring and governing systems are also covered in detail. This seminar will also provide up-dated information in respect to all the significant improvements that have been made to co-generation, combined cycles plants, wind and solar power generating plants during the last two decades.

Course Objectives:

Upon successful completion of this course, the delegates will be able to:

- ✓ Gain a basic understanding of the main components and subsystems of gas turbine systems, steam power plants, co-generation, and combined cycle plants
- ✓ Learn to critique the advantages, applications, performance, and economics of co-generation and combined cycle plants
- ✓ Learn about various auxiliary systems including instrumentation, controls and monitoring systems, deaerators, and feed water heater systems
- ✓ Learn some basics about transformers and generators
- ✓ Discover the basics required in minimizing operating cost and optimizing efficiency, reliability, and component longevity for gas turbine and steam power plants
- ✓ Learn about the monitoring and control of environmental emissions
- ✓ Gain some insight into predictive and preventive maintenance, reliability, and testing
- ✓ Discover some of the latest technology in all of the above
- ✓ Identify methods for self-improvement

Who Should Attend?

This course is for all engineers, technologists, and other operational personnel who currently or may in the future be involved with the technology or business of running a power generation plant. This is regardless of whether the personnel are involved in:

- Large scale commercial power production
- Small power production as a tax incentive or production for in-house needs or
- Merchant power production

It also is independent of whether the personnel are involved in operations, maintenance, repair and overhaul, systems optimization and performance verification, specification, retrofit design, business and management of power systems and personnel, and support of power generation trains and their support systems.
While this course is of major benefit to newer people in the field, it is also valuable as a revision and technology update for more experienced personnel.

Course Outline:

Day 1:

Review of Thermodynamics Laws

- First law of thermodynamics
- Enthalpy, property relationships, vapor-liquid phase equilibrium in a pure substance
- Second law of thermodynamics
- Entropy, Carnot cycle

Steam Power Plant Basics

- Rankine cycle
- Re-heaters, condensers, de-aerators, regeneration
- Feed water heating
- Efficiency and heat rate of power plants
- Co-generation, types of co-generation

Steam Turbine Basic Components and Main Systems

- Steam turbine components
- Lubrication system, bearings

Day 2:

The Steam Turbine Governing System Basics

- Major components
- Turbine operation
- Turbine run up, tripping signals, turbine trip, load rejection, decrease in boiler pressure, hydraulic fluid

Gas Turbines

- Advantages of gas turbines (GT) versus steam turbines operation
- Gas turbine simple cycle
- Gas turbine compressor module
    - Principles of operation of centrifugal and axial flow compressors
    - Surging, choking
    - Internal air system
    - Bleed valves, variable stator vanes, and inlet guide vanes
- Combustor module
- Turbine module
- Gas turbine applications
- GT design for maximizing turbine inlet temperature
- Advances in GT design: "G" and "H" technology
- Accessory drives

Gas Turbine Lubrication and Fuel Systems

- Lubricating systems
- Gas fuel systems
- Liquid fuel systems
- Duel fuel systems
- Fuel types, expanding range of usable fuels
- Treatment for trace metals and sulfur

Day 3:

Combined Cycles and Other GT Cycle Modifications

- Non-ideal Brayton cycle
- Modifications to the Brayton cycle
- Closed cycles, complex cycles, combined cycles
- Regeneration, compressor intercooling, turbine reheat, water injection
- Combined heat and power

Gas Turbine Intake and Exhaust Systems

- Intake systems, inlet air filtration (inlet air fogging: see last topic)
- Exhaust systems

Gas Turbine Instrumentation and Control (I&C) Systems

- Gas turbine protection (including pressure switches)
- Instrumentation and control systems

- Instrumentation used for vibration analysis
- Start-up sequence, normal operation (including temperature/PCD control sequence during start-up and normal operation, power limiting, decel limiting) and shutdown
- Black start system

Day 4:

Gas Turbine Emission Guidelines and Control Methods

- Emissions from gas turbines
- General approach for a national emission guideline, NOx emission target levels
- Low NOx combustors, ultra low NOx combustors
- Power output allowance, heat recovery allowance
- Emission levels for other contaminants
- Size ranges for emission targets water and steam injection, selective catalytic reduction (SCR)

Gas Turbine Performance Verification and Maintenance

- Gas turbine performance verification and basics of performance analysis
- Compressor cleaning
- Gas turbine maintenance methods (predictive, preventive)
- Basics of life cycle assessment

Generator, Exciter, and Other Electrical System Basics

- Generator, cooling systems
- Excitation
- Grid interconnection
- Transformer lubricating oil system
- Electrical and control package, Distributed Control System (DCS)
- 28 VDC system, 125 VDC system

Day 5:

Combined Cycle and Co-Generation Plant Basics

- Heat recovery steam generator basics and requirement of chrome-moly steel
- Equipment availability, maintenance cost, operational cost, turbine cost, training laws
- Heat of condensation
- Pipework to steam host, requirement of steam host
- Economics of combined cycles/cogeneration, guidelines
- Applications of co-generation and combined cycle plants

Economics of Combined Cycle and Co-Generation Plants

- Deregulation and tax incentives, SPPs (small power producers), IPPs (independent PPs), MPPs (merchant PPs)
- Natural gas prices and economic growth
- Financial analysis
- Capital cost, operating and maintenance cost
- Economic evaluation of different combined cycles configurations
- Electricity tariff factors

Course Certificate:

International Center for Training & Development (**ICTD**) will award an internationally recognized certificate(s) for each delegate on completion of training.

Course Methodology:

A variety of methodologies will be used during the course that includes:

- (30%) Based on Case Studies
- (30%) Techniques
- (30%) Role Play
- (10%) Concepts
- Pre-test and Post-test
- Variety of Learning Methods
- Lectures
- Case Studies and Self Questionaires
- Group Work
- Discussion
- Presentation

Course Fees:

To be advised as per the course location. This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Timings:

Daily Course Timings:

08:00 - 08:20	Morning Coffee/Tea
08:20 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:30	Recess (Coffee/Tea/Snacks)
13:30 - 15:00	Last Session