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Mechanical Engineering

Combined Cycle Power Plant Operations and Troubleshooting

Course Introduction

This course is devoted to illustrate the high efficiency of the combined cycle compared to other power cycles and methods of increasing this efficiency.

In addition; aspects of operation and control of combined power plants is presented. Furthermore, details of the components including the gas turbines the HRSG, and the steam turbine with its condensing unit are outlined.

Lastly the state-of-the-art technology of combined cycles and the second generations are included in the course.

Target Audience

- Automotive Engineer
- Boiler Engineer
- Ceramics Engineer
- Equipment Engineer
- High-Pressure Engineer
- Marine Engineer
- Mechanical Design Engineer
- Mechanical Engineer
- Naval Architect
- Pipeline Engineer
- Power Engineer
- Rotating Equipment Engineer
- Senior Mechanical Engineer
- Turbine Engineer
- Validation Engineer

Learning Objectives

- Major and Auxiliary components in combined cycle power plant.
- Function and operation of different equipment’s in the plant.
- Efficiency calculations and heat rate of a combined cycle.
- Methods of air inlet cooling and its effect on performance.
- Safety and trip functions in the plant.
- The state of the art modifications in current gas turbine technology.
- Illustrate the control of safe firing procedure.
- Illustrate the turbine synchronization with the grid
- Illustrate the control of turbines load variation.
- Update the information about digital control and principles of advanced control.
- Describe the condenser and condensate system control and problems.
- Describe the penalties of condenser leak.

Course Outline

- **01 DAY ONE**

  Module (01) Combined cycle

  - 1.1 Classifications of Power Plants.
  - 1.2 Types of combined cycles
  - 1.3 A single and Multi-pressure combined cycle plants
  - 1.4 Temperature distribution and efficiency.
  - 1.5 Efficiency calculations for combined cycle
  - 1.6 Efficiency and heat rate of combined cycles
  - 1.7 Selection of appropriate cycle.
  - 1.8 Advantages and economics of combined cycle
  - 1.9 Comparison between combined cycle and conventional power plant.
  - 1.10 Comparison between single and multi-shaft combined cycle
  - 1.11 Advanced combined cycle.
  - 1.12 Second generation of combined cycle plants and state of the art.

- 1.13 Increasing worldwide use of combined cycles.

- **02 DAY TWO**

Module (02) Heat Recovery Steam generator HRSG

- 2.1 Common HRSG arrangements
- 2.2 HRSG components: Drum, Economizer, Evaporator and Super heater
- 2.3 Different designs of evaporator section, namely A,O,D,I and horizontal.
- 2.4 Circulation ratio.
- 2.5 Single, double, triple pressure HRSG,
- 2.6 Arrangement of coils and Evaporator pinch design.
- 2.7 Forced circulation and natural circulation.
- 2.8 Difference between HRSG and conventional boilers.
- 2.9 Quality of water and requirements of purity, Ph values etc
- 2.10 Water treatment and dosing.
- 2.11 Drum Level Controls
- 2.12 Shrink and swell
- 2.13 Types of level control systems
- 2.14 Drum Level Measurements
- 2.15 Live steam temperature control and attemperators

- **03 DAY THREE**

Module (03) Gas Turbines in Combined cycles

- 3.1 Inlet air and filtration systems.
- 3.2 Weather hoods and Bird Screens
- 3.3 Moisture Separators
- 3.4 Different types of Filters
- 3.5 Trash screen, Inlet plenum and pill mouse.
- 3.6 Effect of Compressor fouling on plant heat rate.
- 3.7 Recommended wash and cleaning cycles.
- 3.8 Compressor surge
- 3.9 Inlet guide van (IGV)
- 3.10 Inlet Guide Vane Control System
- 3.11 Pulsation protection control
- 3.12 Turbine Section
- 3.13 Flow through blades
- 3.14 Blade cooling

- 3.15 Case study.
- 3.16 Advanced turbine blades
- 3.17 Gas Turbine Start-up and Shutdown
- 3.18 Starting Systems: Static Starter

- **04 DAY FOUR**

Module (04) Fuel system and combustion chambers in gas Turbines

- 4.1 Types of combustion chambers
- 4.2 Combustion champers components
- 4.3 Ignition system and Flame detector
- 4.4 Emissions from gas turbines and NOx control
- 4.5 Steam/water injection combustion chamber.
- 4.6 Fuel staging and single digit NOx control.
- 4.7 Gas Fuel system 4.8 Liquid fuel system
- 4.9 Diffusion flame 4.10 Premix flame.
- 4.11 Mixed diffusion and premix flame
- 4.12 Dry Low NOx technology combustion systems
- 4.13 Typical example SGT6-5000F ULN burner

Module (05) Performance of Gas Turbine and effect of Inlet cooling

- 5.1 Determining ISO Power and ISO Heat Rate
- 5.2 Correcting for Ambient Temperature, Altitude, Humidity,
- 5.3 Different losses. 5.4 Part load heat rate
- 5.5 Gas Turbine Inlet Air Cooling
- 5.6 Evaporative cooler and Fogging system
- 5.7 Mechanical refrigeration system (direct type)
- 5.8 Mechanical refrigeration system (indirect type)
- 5.9 Absorption chiller
- 5.10 Performance Evaluation of Different Inlet Air Cooling Systems:
- 5.11 Capital Cost Comparisons of Inlet Cooling Systems
- 5.12 Thermodynamic calculation for mechanical chiller system
- 5.13 Power calculation for mechanical chiller system

- **05 DAY FIVE**

Module (06) Condensate System

- 6.1 Steam Surface Condenser
- 6.2 Condenser hotwell level gauge and control
- 6.3 Vacuum Breakers
- 6.4 Condenser vacuum systems
- 6.5 Condenser leaks
- 6.6 Deaerator

Module (07) Combined Cycle Power Plant Control

- 7.1 Elements of Governor.
- 7.2 Why Is Droop Necessary and Droop Curve
- 7.3 Uses of Droop
- 7.4 Isolated Unit
- 7.5 System Tied to a Utility Grid
- 7.6 Principles of hydraulic Amplifiers
- 7.7 Hydraulic Fluid Accumulators
- 7.8 The Valve Actuators
- 7.9 Controlling Type Actuators
- 7.10 Actuator servo valve
- 7.11 The dump valve controller
- 7.12 Non-Controlling Actuators (On-Off control actuators)
- 7.13 Speed Control
- 7.14 The load control
- 7.15 Load Control and Frequency Response of a Combined Cycle
- 7.16 Closed loop load/ frequency control without separate steam turbine control
- 7.17 Steam turbine separate control
- 7.18 Digital electrohydraulic system.
- 7.19 Fast Load Reduction (RUNBACK).
- 7.20 Overspeed Limitation
- 7.21 Over speed protection controller (OPC).
- 7.22 Overspeed Protection:
- 7.23 Mechanical Over Speed Trip
- 7.24 Electronic Overspeed Trips
- 7.25 Emergency trip solenoid valve.

Confirmed Sessions

FROM	TO	DURATION	FEES	LOCATION
May 26, 2025	May 30, 2025	5 days	4250.00 $	UAE - Dubai
July 14, 2025	July 18, 2025	5 days	4950.00 $	England - London
Oct. 19, 2025	Oct. 23, 2025	5 days	4250.00 $	KSA - Riyadh
Oct. 19, 2025	Oct. 23, 2025	5 days	4250.00 $	oman - salalah