COMBINED CYCLE
Power Plant Simulator Operation
Course Introduction:

This COURSE will cover all aspect of combined cycle power plants. All the equipment of combined cycle power plants such as: compressors, gas and steam turbines, combustors, heat recovery steam generators, deaerators, condensers, lubricating systems, instrumentation, control systems, transformers, and generators will be covered in detail. The design, selection considerations, operation, maintenance, pay-back period, economics of combined cycles, as well as, emission limits, reliability, monitoring and governing systems will also be covered thoroughly. This seminar will also provide up-dated information in respect to all the significant improvements that have been made to combined cycle power generating plants during the last two decades.

This seminar will illustrate through sophisticated computer simulation how gas turbines, and combined cycle plants perform under steady-state and transient conditions. In addition, the delegates will learn how to use the computer simulation program which provides the following benefits:

- Allow the operator to extend the combined cycle power plant operating period by avoiding unnecessary outages and maintenance activities.
- Determination of essential combined cycle power plant maintenance activities to reduce the duration of outages.
- Profit optimization of combined cycle power plants.
- Minimization of the environmental emissions of combined cycle plants

Course Objectives:

Upon the successful completion of this course, each participant will be able to know:-

- **Combined Cycle Power Plant Computer simulation:**
  Gain a thorough understanding of computer simulation of gas turbines, and combined cycle power plants.

- **Combined Cycle Power Plant Equipment and Systems:**
  Learn about all equipment and subsystems of the various types of combined cycle power generating plants such as: compressors, combustors, gas turbines, heat recovery steam generators, steam turbines, condensers, deaerators, feedwater heaters, transformers, generators, and auxiliaries

- **Combined Cycle Power Plants Economics:**
  Examine the advantages, applications, performance and economics of combined cycle power plants

- **Combined Cycle Power Plant Maintenance:**
  Learn all the maintenance activities required for combined cycle power plants including maintenance and refurbishment of gas turbines, compressors, steam turbines, combustors,
heat recovery steam generators, transformers and generators to minimize their operating cost and maximize their efficiency, reliability, and longevity.

- **Combined Cycle Power Plant Environmental Emissions:**
  Learn about the monitoring and control of environmental emissions.

- **Combined Cycle Power Plant Instrumentation and Control Systems:**
  Learn about the latest instrumentation and control systems of gas turbines and combined cycle power plants.

- **Combined Cycle Power Plant Reliability and Testing:**
  Increase your knowledge of combined cycle power plant predictive and preventive maintenance, reliability and testing.

- **Combined Cycle Power Plant Selection and Applications:**
  Gain a detailed understanding of the selection considerations and applications of combined cycle power plants.

- **Combined Cycle Power Plant Profitability:**
  Learn about the reliability, life cycle cost, and profitability, refurbishment, and life extension methods for all types of combined cycle power plants.

**Who Should Attend?**

This course is designed for control room operators who wish to improve their skills operating a combined cycle power plant under a variety of normal and abnormal operating conditions, as well as assistant operators who are preparing to assume responsibilities for unit operation.

**Course Outline:**

**DAY ONE:**

**Steam Power Plants, Steam Generators, and Steam Turbines**

- Review of Thermodynamics Principles
- Steam Power Plants
- Steam Generators
- Steam Turbines
- Reheaters
- Condensers
- Feedwater Heaters
- Efficiency and Heat Rate
- Supercritical Plants
- Co-generation Plants
- Arrangement of Co-generation plants
- Economics of Co-generation Plants
- The Fire-Tube Boiler
- The Water-Tube Boiler
- The Steam Drum
- Superheaters and Reheaters
- Once-Through Boilers
- Economizers
- Fans
- The Stack
- Steam Generator Control
- Feedwater and Drum-Level Control
- Steam-Pressure Control
- Steam-Temperature Control
- Mechanisms of Energy Conversion in a Steam Turbine
- Turbine components
- Rotating and Stationary blades
- Thrust bearings
- Labyrinth seals
- Turbine controls
- Testing of Turbine blades
- Quality Assurance of Turbine Generator Components
- Assembly and testing of turbine components

**DAY TWO**

**Steam Turbines and Auxiliaries, and Gas Turbines**

- Turbine Types
- Compound Turbines
- Turbine Control Systems
- Steam Turbine Maintenance
- Steam Generators, Heat Exchangers, and Condensers
- Power Station Performance Monitoring
- The Turbine Governing Systems
- Steam Chests and Valves
- Turbine Protective Devices
- Turbine Instrumentation
- Lubrication Systems
- Gland Sealing System
- Frequently Asked Questions about Turbine-Generator Balancing, Vibration Analysis and Maintenance
• Features Enhancing The Reliability and Maintainability of Steam Turbines
• Gas Turbine Fundamentals
• Overview of Gas Turbines
• Gas Turbine Design
• Gas Turbine Calculations
• Gas Turbine Applications in Power Stations, Gas Turbine Protective Systems, and Tests
• Gas Turbine Compressors
• Dynamic Compressors Technology
• Compressors Auxiliaries, Off-Design Performance, Stall, and Surge
• Centrifugal Compressors–Components, Performance Characteristics, Balancing,
• Surge Prevention Systems, and Testing
• Dynamic Compressors Performance
• Compressor Seal Systems
• Dry Seals, Advanced Sealing Mechanisms, and Magnetic Bearings

DAY THREE

Gas Turbine Components and Auxiliaries, Computer

• Simulation of Gas Turbines
• Gas Turbine Combustors
• Axial-Flow Turbines
• Gas Turbine Materials
• Gas Turbine Lubrication and Fuel Systems
• Gas Turbine Bearing and Seals
• Gas Turbine Instrumentation and Control Systems
• Gas Turbine Performance Characteristics
• Gas Turbine Operating and Maintenance Considerations
• Gas Turbine Emission Guidelines and Control Systems
• Effects of ambient temperature and pressure on gas turbine performance
• Simulation of effects of component deterioration on engine performance
• Power Augmentation
• Simulation of engine control system performance
• Profits, Revenue and Life Cycle Cost Analysis
• Non-Dimensional Analysis
• Computer Simulation Applications
• Computer Simulation of Gas Turbines and Combined Cycles – Exercises and Solutions

DAY FOUR

Combined Cycles Power Generating Plants
• Combined Cycles
• Integrated Gasification Combined Cycles
• Single-Shaft Combined Cycle Power Generating Plants
• Steam Turbine Selection for Combined Cycle Power Systems
• Absorption Chillers
• Selection of The Best Power Enhancement Option for Combined Cycle Plants
• Economic and Technical Considerations for Combined Cycle Performance
• Enhancement Options
• Applications of Co-generation and Combined Cycle Plants
• Selection Considerations of Combined Cycles and Co-generation Plants
• Co-generation Application Considerations
• University of Toronto Central Steam, Co-generation and District Heating Plant
• Economics of Combined Cycles Co-generation Plants

DAY FIVE

Transformers and Generators
• Fundamentals of Electric Systems
• Introduction to Machinery Principles
• Transformers
• Transformers Components and Maintenance
• AC Machine Fundamentals
• Synchronous Generators
• Generator Components, Auxiliaries, and Excitation
• Generator Testing, Inspection, and Maintenance
• Multiple-Choice Questions

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 Certificate:**

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

**Course Fees:**

*To be advised as per course locations.* 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  
  Coffee / Tea / Snacks
- 10:20 - 12:20  
  Second Session
- 12:20 - 13:30  
  Lunch Break & Prayer Break
- 13:30 - 15:00  
  Last Session