CONCEPT

Combined Cycle Power Plant Operation: Start-Up, HRSG and Heat Rate Performance

31 October – 4 November 2027
Dammam - Eastern Province five-star



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Ref: 142_15056 **Date:** 31 October – 4 November 2027 **Location:** Dammam - Eastern Province five-star **Fees:** 19500 SAR

Introduction:

A combined cycle power plant loses margin quietly: heat rate drifts as compressors foul, HRSG surfaces degrade, starts take longer than planned and load following stresses thick-walled components. Operators often lack a corrected baseline to separate ambient effects from real degradation. This Core Concept course builds the practical skills to run gas turbine, HRSG and steam turbine blocks as one unit, calculate gross and net heat rate, correct performance to reference conditions and rank recovery actions. Participants build a Unit Heat Rate Workbook and Operating Improvement Plan for their own block.

Course Objectives:

- Explain how the gas turbine Brayton topping cycle and the Rankine bottoming cycle interact through the HRSG to set block output and efficiency
- Operate combined cycle start-up, shutdown and load following sequences while respecting HRSG and steam turbine thermal stress limits
- Calculate gross and net heat rate and efficiency on LHV and HHV bases from plant fuel, power and auxiliary load data
- Correct measured performance to reference ambient conditions and separate recoverable from non-recoverable degradation such as compressor fouling
- Apply water and steam chemistry limits and HRSG damage mechanism awareness to protect pressure parts between outages
- Prioritise outage scope, operating changes and reliability actions by their heat rate, output and risk impact

Target Audience:

- Engineers responsible for day-to-day operation of gas turbine, HRSG and steam turbine blocks
- Shift supervisors who direct start-ups, load changes and trip recovery in the control room
- Performance engineers who calculate heat rate, run acceptance and periodic tests and report degradation
- Chemistry and water treatment staff who control cycle chemistry in HRSGs and condensate systems
- Reliability and outage planning engineers who scope inspections and overhauls for generating units

Course Outline:

Day 1: Combined Cycle Fundamentals and Plant Configuration

- Brayton Topping Cycle: Compressor Pressure Ratio, Firing Temperature and Exhaust Energy
- Rankine Bottoming Cycle: Steam Conditions, Condenser Vacuum and Cycle Work
- Block Configurations: Single-Shaft, Multi-Shaft and Supplementary Duct Firing
- Simple Cycle Versus Combined Cycle Efficiency Comparison on an LHV Basis
- Unit Current-State Review: Design Data Sheet Versus Latest Operating Snapshot

Day 2: HRSG, Steam Turbine and Unit Control Architecture

- Triple-Pressure HRSG Layout: HP, IP and LP Economiser, Evaporator and Superheater Sections
- Drum-Type Versus Once-Through HRSG Behaviour and Pinch and Approach Temperatures
- Steam Turbine Bypass System, Attemperation and Condenser Interface
- Distributed Control System Structure: Gas Turbine Controller, Boiler Controls and Coordinated Load Control
- Unit Protection Overview: Trip Logic, Runback Schemes and Fired Equipment Permissives

Day 3: Start-Up, Load Following and Heat Rate Calculation

- Hot, Warm and Cold Start Sequences with Steam Temperature Matching and Hold Points
- Load Following and Minimum Stable Load: Part-Load Heat Rate Penalty and Emissions Window
- Controlled Shutdown, HRSG Purge and Layup Choices Between Dispatch Periods
- Gross and Net Heat Rate Calculation: Fuel Flow, Heating Value and Auxiliary Power
- HHV Versus LHV Reporting and Efficiency Conversion Worksheet

Day 4: Performance Degradation, Chemistry and Operational Risk

- Ambient Correction Curves for Temperature, Pressure and Humidity to Reference Conditions
- Compressor Fouling Diagnosis, Online and Offline Water Wash Economics
- Inlet Air Cooling Options: Evaporative Cooling, Fogging and Chilling Trade-Offs
- Water and Steam Chemistry Control: Feedwater, Drum Water and Steam Purity Parameters
- HRSG Damage Mechanisms: Creep-Fatigue, Thermal Fatigue and Flow-Accelerated Corrosion Risk Review

Day 5: Unit Heat Rate Workbook and Improvement Plan Build

- Workbook Build: Corrected Heat Rate Baseline from a Plant Data Set
- Performance Test Planning Using ASME PTC 46 Overall Plant Performance Principles
- Heat Rate Deviation Loss Tree: Gas Turbine, HRSG, Steam Turbine and Condenser Losses
- Outage Scope and Reliability Action Ranking by Output, Heat Rate and Risk Impact
- Unit Heat Rate Workbook and Operating Improvement Plan Review with Peer Challenge

Skills You Will Gain:

- Combined Cycle Thermodynamic Analysis
- Start-Up and Load Change Execution
- Heat Rate Calculation
- Ambient Performance Correction
- Compressor Fouling Diagnosis
- Cycle Chemistry Control
- HRSG Damage Risk Awareness
- Outage Scope Prioritisation

Why Attend This Course:

- Return with a Unit Heat Rate Workbook and Operating Improvement Plan built on data from your own combined cycle block
- Tell a real efficiency loss from an ambient effect before recommending a water wash or an inspection
- Explain to dispatch and management what faster starts and deeper load cycling cost in heat rate and component life
- Compare operating and performance practice with peers from utilities, independent power producers and industrial cogeneration plants

Conclusion:

Reliable, efficient combined cycle operation depends on understanding how the gas turbine, HRSG and steam turbine act as one unit and on measuring performance against a corrected baseline. The course moves from cycle fundamentals and plant configuration, through HRSG, steam turbine and control architecture, to start-up, load following and heat rate calculation, then degradation, inlet cooling, chemistry and damage mechanisms. The final day builds a Unit Heat Rate Workbook and Operating Improvement Plan ready for plant management review.