Steam Boilers and Steam Systems: Operation, Water Treatment and Troubleshooting

29 November – 3 December 2026
Dammam - Eastern Province five-star



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Introduction:

Steam boilers fail in predictable ways: drum level swings trip the unit, poor water chemistry leaves scale and corrosion on tubes, carryover fouls downstream users, failed steam traps waste fuel and safety valves go untested. Each event costs production and raises the risk of a pressure-part failure. This Core Concept course trains boiler house staff and utilities engineers to run fire-tube, water-tube and waste heat boilers within safe limits, control feedwater and blowdown, survey the steam and condensate network and diagnose recurring faults. Participants complete a Boiler House Operating Log and Steam System Survey Pack.

Course Objectives:

- Distinguish fire-tube, water-tube and heat recovery steam generator designs and explain how drum, downcomer, riser, superheater and economiser circuits behave in service
- Operate boiler start-up, warm-up, load change and shutdown sequences, including purge, light-off permissives and low-water cutoff checks
- Control drum level, feedwater flow, deaerator operation and continuous and bottom blowdown to hold water chemistry within target limits
- Survey steam mains, pressure reducing stations, steam traps and condensate return lines and record losses on a site survey sheet
- Estimate boiler efficiency by the direct and indirect methods and rank flue gas, blowdown, radiation and trap losses
- Diagnose tube leaks, scaling, carryover, priming and water hammer from operating symptoms and inspection findings

Target Audience:

- Operators who run boilers, feedwater pumps and deaerators on shift in utilities and boiler houses
- Shift supervisors who authorise boiler start-ups, respond to alarms and trips and sign off operating logs
- Utilities engineers who set steam system operating limits and monitor boiler performance and fuel use
- Water treatment staff who sample feedwater and boiler water and adjust chemical dosing and blowdown
- Maintenance and inspection staff who service burners, valves and traps and prepare boilers for statutory inspection

Course Outline:

Day 1: Boiler Types, Steam Generation Principles and Boiler House Baseline

- Saturated and Superheated Steam Properties Using Steam Tables and Enthalpy Values
- Fire-Tube Shell Boilers: Pass Arrangements, Steam Space and Storage Capacity
- Water-Tube Boilers: Steam Drum, Mud Drum, Downcomers and Natural Circulation
- Waste Heat Boilers and Heat Recovery Steam Generators in Process and Cogeneration Plants
- Boiler House Baseline Checklist: Nameplate Data, Operating Pressures and Fuel Records

Day 2: Boiler Codes, Controls Architecture and Protective Devices

- ASME Boiler and Pressure Vessel Code Structure and Boiler Construction Sections
- Three-Element Drum Level Control: Level, Steam Flow and Feedwater Flow Signals
- Combustion Control Loops: Firing Rate Demand, Air-Fuel Ratio and Oxygen Trim
- Burner Management Interlocks: Purge Timer, Flame Scanner and Fuel Shut-Off Valves
- Safety Valve Sizing Basis, Set Pressure, Blowdown Ring and Lift Testing

Day 3: Boiler Operation, Water Chemistry and Steam Distribution Practice

- Cold Start, Warm-Up Rate, Venting and Bringing a Boiler On Line to the Header
- Feedwater Deaeration With Spray and Tray Deaerators and Oxygen Scavenger Dosing
- Boiler Water Sampling: pH, Conductivity, Phosphate and Total Dissolved Solids Limits
- Continuous and Bottom Blowdown Rate Calculation and Flash Heat Recovery
- Steam Main Drainage, Pressure Reducing Stations and Insulation Condition Checks

Day 4: Steam Traps, Efficiency Losses and Boiler Failure Diagnosis

- Mechanical, Thermostatic and Thermodynamic Steam Trap Selection and Ultrasonic Testing
- Condensate Recovery, Flash Steam Vessels and Water Hammer Prevention
- Boiler Efficiency by Direct and Indirect Methods and a Heat Loss Balance
- Scale, Oxygen Pitting and Caustic Corrosion Mechanisms on Boiler Tubes
- Fault Tree for Tube Leaks, Carryover, Priming, Foaming and Low-Water Incidents

Day 5: Boiler House Walkthrough and Steam System Survey Pack

- Boiler Front Walkthrough: Gauge Glass Blowdown, Low-Water Cutoff Test and Valve Line-Up
- Steam Trap and Condensate Line Survey Using a Trap Condition Register
- Annual Shutdown Inspection Plan for Drums, Tubes, Refractory and Mountings
- Food, Refinery and Hospital Boiler Case Reviews of Recurring Trips and Tube Failures
- Boiler House Operating Log and Steam System Survey Pack Peer Review

Skills You Will Gain:

- Steam Table Interpretation
- Drum Level Control
- Burner Interlock Verification
- Boiler Water Chemistry Control
- Blowdown Management
- Steam Trap Testing
- Boiler Heat Loss Analysis
- Boiler Failure Diagnosis

Why Attend This Course:

- Return with a Boiler House Operating Log and Steam System Survey Pack prepared for boilers and steam lines on your own site
- Cut fuel and water use by finding failed traps, excess blowdown and uninsulated steam lines during routine rounds
- Handle start-ups, alarms and trips with a clear understanding of what each interlock and safety device is protecting
- Compare boiler house practice with operators and engineers from process industries, utilities, food production and healthcare facilities

Conclusion:

Safe, efficient steam boilers depend on sound control of level, combustion and water chemistry and on a steam network that returns its condensate. The course moves from boiler types and steam generation principles, through the construction code, control loops and protective devices, to start-up, deaeration, sampling, blowdown and steam distribution, then trap testing, efficiency losses and tube failure diagnosis. The final day applies these checks in walkthroughs and case reviews and produces a Boiler House Operating Log and Steam System Survey Pack.