



# Boiler Systems PLUS - Combined Operation, Safety, Reliability and Efficiency

## Summary:

This (3) three day course is designed to assist in the education and development of the individual that has the responsibilities for the day to day operation and maintenance of their boiler and the ancillary equipment. This individual will gain the knowledge and understanding of how to properly operate the equipment safely but more efficiently. This course will also provide the proper sequence of operation or timing that will assist in the troubleshooting area and reduce downtime and increase reliability. The program extends out into the plant to include key components of steam distribution and recovery piping, focusing on optimizing energy, efficiency and safety.

## Objectives:

Gain knowledge and understanding of boilers, ancillary equipment and their operation

Understanding of electrical circuitry and sequencing to expedite troubleshooting

Optimizing system efficiency, reliability and safety

Preventative maintenance scheduling

## Detailed Outline:

- **Thermodynamics**
  - Thermodynamic principles
  - BTU definition
  - Two states of heat
  - Steam tables
  - Boiler Horsepower definition
  - Impact of feedwater
  - Heat transfer
- **Boiler Overview (site specific)**
  - Types and applications
  - ASME codes
  - Boiler design and principles of operation
    - Firetube boilers – Dryback vs. Wetback
    - Industrial water tube boilers – D, O and A types
    - Commercial water tube boilers
    - Modular boilers
  - Enhanced Design elements



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- **Combustion and Burners (site specific)**
  - Theory and chemistry of combustion
  - Guidelines for setting combustion
  - Flue gas analysis
  - Effects of ambient air on combustion settings
  - Types and construction of burners
  - Integral head Burner
  - Gun Burner
  - Turndown
  - Cams and linkages
  - Single point positioning
  - Parallel positioning
- **Low Water Cutoffs**
  - Primary and auxiliary: type and function
  - ASME code water level requirements
  - Maintenance and inspection
  - Blow down procedures
  - Evaporation test procedure
  - Power of steam
  - Boiler relocations
- **Steam Load Demand**
  - Maximum instantaneous demand
    - Startup load vs. running load
  - Impact on boiler capacity
  - Shrink and swell
  - Tube and tube sheet stress
  - Possible solutions
- **Boiler Operating Controls**
  - Operating limit control
  - High limit control
  - Modulating control
  - Control terminology
  - Sequence of operation and burner interface
  - Fuel delivery systems
    - Gas and Oil components
- **Boiler Room Equipment**
  - Cost of steam
  - Ancillary equipment
  - Efficiency gains



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- **Water Softeners and Dealkalyzers**
  - Water Softeners
    - Ion exchange process
    - Softener types
  - Dealkalyzers
    - Anion exchange process
    - Cycles of concentration
  - Reverse Osmosis system
- **Feed Systems and Deaerators**
  - Feed Systems
    - Design, operational principles and application
    - Function and limitations
    - Sizing and selection criterion
    - Stand height and pump NPSH requirement
  - Deaerators
    - How deaeration works
    - Types
    - Effects of oxygen and carbon dioxide
    - Deaerator vs. Feed System
    - Deaerator controls
    - Feedwater control
    - Selection and sizing criterion
- **Feed Pumps**
  - Pump cavitation cause and effects
  - Pump types and applications
  - Calculating NPSH available
  - How to read pump curves – sizing example
- **Water Treatment Overview**
  - Boiler Boilout
  - Examples of poor water treatment
  - Impurities in the water
  - The water cycle
  - Sacrificial Anodes
  - Chemical treatment and injection points
  - Types of in-plant tests



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- **Understanding the Steam System**
  - Supporting the piping system
  - Velocity of steam
  - How condensate is formed
  - Carbonic acid formation
  - Water Hammer
  - Effects of air in a steam system
  - Oxygen pitting
  - Condensate removal
  - Steam traps
- **Total System Efficiency**
  - High efficiency boiler
  - Measuring efficiency
  - Rules of Thumb for efficiency gains
  - Optional economizer and payback
  - What affects efficiency
  - Steam leaks
  - Feedwater temperatures
  - Increasing efficiencies
- **Capturing Parasitic Losses**
  - Vessel and Piping Insulation
  - Proper Combustion Settings
  - Draft Control
  - Stack Economizers
  - Blowdown Heat Recovery
  - Flash Steam Recovery
  - Condensate Return
  - Proper Water Treatment
  - Steam Trap Monitoring & Maintenance
  - VSD – Variable Speed Drives
  - Parallel Positioning
- **Wiring Diagrams (site specific)**
  - How to read an electrical control diagram
  - Symbols and definitions
  - Electrical safety
  - Nomenclature
  - Component location and identification
  - Boiler operating circuits
  - Alarm circuits
  - Troubleshooting scenarios



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- **Flame Safeguards (site specific)**
  - Definition and function of a flame safeguard system
  - Sequence of operation
  - Types of flame safeguards (Honeywell / Fireye)
  - Programmable Logic Control boiler management system
- **Boiler Shutdown, Isolation and Lay-up – Wet & Dry**
  - Shut down and isolation
  - Wet lay-up
  - Dry lay-up
- **Cutting Boilers into Cold or Hot Systems – Safely**
  - Cold start procedure
  - Hot start procedure
- **Checking Boiler Safeties**
  - What is a safety control?
  - Safeties checked during the ignition sequence
  - Safeties checked while burner is firing
  - Gas valves
  - Safety valves
  - Safeties on Oil Fired boilers
- **Maintenance**
  - General maintenance
    - Equipment biographies
    - Housekeeping
    - Procedures
  - Recommended preventative maintenance best practices
    - Daily, weekly, monthly, semi- annually, annually
  - Maintaining a boiler room log