Pressure Equipment Engineering Fundamentals

Potential PDH: 32

Description:

This 3 day course provides students essential knowledge for managing process equipment in a plant environment. Design and post-construction considerations for pressure vessels, heat exchangers, fired heaters, boilers, piping, and tanks are presented with an applied emphasis. For example, rather than focusing on the many design rules in Section VIII Division 1, students learn to check flange ratings as the first step of a rerate. Practical information is brought to life with case-studies, examples, and practice problems throughout the course, taught by expert instructors with many combined decades of plant experience and learnings.

Outline:

What is Pressure Equipment?

Regulations, Codes and Standards

- Jurisdictions
    - State regulations and NBIC vs. the ASME B&PV Code
    - Code states and non-code states
    - RAGAGEP
- Design codes
    - Design responsibility
    - Company standards
- In-Service Codes and Standards
    - FFS vs. rerating
    - API 510 and API 570
    - Design guidelines in conflict with design codes

Pressure Vessels

- Codes & standards – basis and margin
    - ASME VIII-1
    - ASME VIII-2 and ASME I
    - Code cases
- Loads
    - Pressure and temperature
    - System loads
    - Wind and Seismic

    - External pressure/vacuum
    - Thermal Stress
- Special services
    - Creep
    - Fatigue
    - Hydrogen
    - Cryogenic
- Supports and internals
    - Horizontal vessels
    - Vertical vessels
    - Internal support and allowable
- Rerates
    - Flanges ratings
    - Carbon steel and temperature rerates
    - Pressure rerates
    - Legacy materials
- Undocumented equipment
- Specifying new equipment
- Piping
    - Codes and standards
    - Conditions beyond design
    - Supports
    - Piping vs. pipelines
    - Vibration mitigation

Heaters Transfer Equipment

- Heat exchangers
    - ASME VIII-1 vs TEMA
    - Common design details
    - Design rules of thumb
    - Troubleshooting
    - Vibration
- Fired Heaters
    - Design and in-service codes
    - Tube rupture
    - Fired boilers and ASME I
    - Unfired steam generators and ASME VIII vs. ASME I

Bolted Joints

- ASME VIII-1 Mandatory Appendix 2 vs. ASME PCC-1
- ASME PCC-1 and integrity program basics

- Selecting bolting
- Selecting gaskets
- Common problems and solutions

Tanks

- Codes and standards
- Common damage
- Inspection

Maintenance and Turnarounds

- Reliability basics (MI programs, RBI)
- Repairs and ASME PCC-2
- API 510 and API 570
- Nondestructive Examination (NDE)
- Refractory lined equipment
- Fitness-for-Service
    - Common damage mechanisms
    - Levels
    - Level 3 triggers
    - Required information
    - Data needs and collection
    - Brittle fracture (screening)
    - Hot spots
    - Introduction to fracture and creep
- Developing maintenance packages
- Checking 3rd party work

Damage Mechanisms

- Introduction, Goals, Outcomes
- Intro. to Metallurgy and Properties, Heat Treatment
- Crude/Vac Unit Overview
    - Desalter and crude overhead corrosion, incl. vac tower organic acid issues
    - Sulfidation (Organic) and Naphthenic Acid corrosion
    - Ammonium Cl and HCl Corrosion
    - Permanently installed corrosion probes
- Naphtha HT and Cat Reformer Overview
    - HTHA
    - Heater tube oxidation and creep
- Diesel HT/Hydrocracker Overview
    - High temperature H2/H2S corrosion
    - NH3BS corrosion (sour water) and REAC's

- Temper Embrittlement and Minimum Pressurization Temperature
- PAUT inspection
- Wet H2S Cracking WFMT and Surface Eddy Current and FFS of wet H2S damaged equipment
- Cl SCC and PASCC and downtime protection (soda ash washing), low pt drains, caustic SCC

- FCC Overview
  - Erosion
  - Carbonate SCC and wet H2S cracking and AUT
  - CUI
- Coker
  - Thermal Fatigue
  - Carburization
- Amine and Sulfur Units
  - Amine SCC
  - Amine corrosion

Additional Topics Ad-Hoc

- Hydrogen Plant
- HF Alkylation
- Sulfuric Acid Alkylation
- NDE

Who Should Attend:

The *Pressure Equipment Engineering Fundamentals* training is ideal for professionals involved in the design, operation, maintenance, and inspection of pressure equipment across various industries. This includes mechanical and process engineers, maintenance and reliability engineers, inspection and integrity specialists, plant operators, and supervisors responsible for ensuring the safety and reliability of pressure vessels, boilers, and piping systems. The training provides foundational knowledge of pressure equipment design principles, operational best practices, and regulatory requirements, equipping participants with essential skills to prevent failures, enhance safety, and ensure compliance with industry standards for pressure equipment.

Subject Matter Expert (SME):

Everett Chatham has over 20 years of experience with deep bolted joint and mechanical expertise across plant equipment in the refining, petrochemical, and chemical industries from his many years at Shell, Lyondell Houston Refinery, and Dow Chemicals. Everett developed scope of work for repairs and alterations to pressure equipment including vessels, piping, tanks and bolted joints analysis. He holds a BS degree in Science Mechanical Engineering from Texas A&M University.

Nasser Sheikhi, a refinery mechanical Integrity Expert with 41 years of experience at BP. His roles included site metallurgist, TAR inspection lead, inspection & reliability superintendent, and corporate metallurgy & corrosion advisor. He played a key role in risk-based inspection, unit DMRs, CCD reviews, and audits of RBI-related work. Nasser, a dual-degree holder in BS Metallurgical Engineering and Chemical Engineering from the University of Minnesota, has actively contributed to API and NACE STG 34, STG 39, and TEG 205X.