A LDI Training Course

Pressure Vessels, Heat Exchangers and Storage Tanks:

“Learn How to Evaluate, Select, Design, Perform In-Shop and In-Service Inspections, Repair, Perform Alterations and Re-Rate”

Dr. Maurice Stewart, PE., CSP.

INTRODUCTION

This intense and practical 5-Day comprehensive workshop studies important topics regarding the evaluation, selection, design, in-shop and in-service inspection, repair, alteration and re-rating of pressure vessels, heat transfer equipment and storage tanks with particular focus on practicality and “how to apply” the provisions of the ASME, TEMA and API Codes, Standards and Recommended Practices. The workshop focuses on the evaluation, selection, basic design, operation and trouble-shooting of different types of separation equipment, heat transfer equipment and storage tanks typically encountered in upstream and mid-stream oil and gas production facilities. All applicable Codes, Standards and Recommended practices will be reviewed in detail, specifically, ASME Sections II, V, VII, IX and API 510; TEMA; API 620, 650, 2000, and 520 Part 1 and 2. The methods outlined in these codes are key if one is to maintain the mechanical integrity of pressure vessel’s, heat transfer equipment and storage tanks throughout the equipment’s design life. The design, inspection and repair techniques contained in the ASME, TEMA and API codes apply to the full range of problems that arise during the life cycle of process equipment.

Operational problems and practical solutions are discussed throughout the workshop. This workshop maintains a balance between lecture and in-class exercises and between theory and application. Sample problems and case study examples are dispersed throughout the workshop to emphasize the principles covered.

Dr. Maurice Stewart has a warehouse of knowledge and experience that he passes along to help the participants get a unique multidiscipline approach in solving the problems associated with process equipment.

WHAT YOU WILL LEARN

- History and organization of worldwide pressure vessel codes
- Step-by-step procedure on how to design, perform in-shop and in-field inspections and repairs, perform alterations and re-rate a pressure vessel
- How to select the appropriate vessel specifications, evaluate associated reports and determine allowable stresses
- How to calculate stresses in pressure vessels
- How to select the appropriate materials of construction for a pressure vessel
How to design a pressure vessel using the ASME Code Section VIII, Division 1 and 2
When Division 2 is justified-How Division adds value-Which Division best fit your needs from one situation to another
How to perform in-shop inspection of welding and fabrication
How to perform in-service inspection using NDE techniques such as: Magnetic Particle (MT), Ultrasonic (UT) and Radiographic (RT)
How to alter, repair and re-rate pressure vessels using NBIC and API 510
How to select, size, install, test, operate and trouble-shoot pressure relief valves
How to select the correct heat transfer equipment for a particular application
How to apply heat transfer principles to design, select and specify heat transfer equipment
How to evaluate the performance of heat transfer equipment and recommend solutions tp problems
How to control schemes for typical heat transfer equipment applications will be reviewed
How to assess the practical aspects of the design, fabrication, site construction, maintenance, inspection and repair of vertical cylindrical storage tanks
How to assess the factors that affect the choice of design and construction
How to recognize and overcome the problems that are associated in building such tanks
How to optimize cost, performance and prevent failures
How to assess the merits of the welding processes available for construction
How to recognize the factors that can cause failures both in-service and during construction
How to determine the appropriate venting requirements
Understand the jurisdiction of API 650, API 620, API RP 14C and API 2000
Understand the electrical area classification ramifications for open roof, fixed roof and floating roof tanks

COURSE CONTENT

INTRODUCTION

Overview of Process Equipment
- Pressure Vessels
  Separation equipment
    Separators
    Scrubbers
  Contact Towers
  Absorber Towers
- Heat Transfer Equipment
  Heater Treaters
  Direct Fired Heaters
  Indirect Fired Heaters
  Waste Heat
- Storage tanks
  Storage
  Skimmers
PRESSURE VESSELS

History and Organization of Pressure Vessel Codes
- Use of pressure vessels and equipment
- Organization of the ASME Boiler and Pressure Vessel Code
- Updating and interpreting the code
- ASME Code stamps
- Organization of the ASME/ANSI B31 Code for Pressure Piping
- Worldwide pressure vessel codes
- ASME Code, Section VIII, Division 1 vs. Division 2
  - Design criteria Section VIII, Division 1
  - Design criteria Section VIII, Division 2
- ASME Code, Section IX, Welding
- ASME Code, Section I, Power Boilers
- Additional requirements employed by users in critical service

Selection of Vessel Specifications, Reports and Allowable Stresses
- Design specification and purchase orders
- Special design requirements
- Design reports and calculations
- Materials specifications
- ASME Code, Section II, Part D “Material Properties”
- Factors of safety
- Allowable tensile stresses in the ASME Code
- Allowable external pressure stress and axial compressive stress
- Allowable stresses in the ASME/ANSI B31 Code for pressure piping
- Allowable stresses in other codes of the world

Materials Selection for Pressure Vessels
- General considerations
- Design factors
- ASME Code, Section II, Part D, “Material Properties”
- Temperature limitations
- Design to prevent brittle fracture
- Guidelines for materials selection

Mechanical Design of Pressure Vessels
- Owner/User’s and manufacturer’s responsibilities
- ASME Code, Section VIII, Division 1, “Pressure Vessels”
- ASME Code, Section VIII, Division 2, “Alternate Rules”
- Determining design conditions
- Design pressure
- Mechanical design
- Design for internal pressure
- Design for external pressure
- Openings and nozzle reinforcement
- Bolted flanged connection
- Minimum wall thickness and nominal plate sizes
- Design of welded joints

Fabrication, Welding and Inspection
- ASME Code, Section IX, “Welding and Brazing Qualifications”
- Plate materials
- Forming of shell and head components
- Nozzles
- Fabrication welds
- Welding processes and practices
- In-shop inspection

In-Service Inspection by Non-Destructive Examination (NDE)
- Code requirements
- National Board Inspection Code
- API 510 Pressure Vessel Inspection Code
- ASME Code, Section V, “Non-Destructive Examination”
- Forms of deterioration
- Fitness-for-service analysis
- Non-destructive examination (NDE) techniques
  - Magnetic Particle (MT)
  - Ultrasonic (UT)
  - Radiographic (RT)

Repair, Alteration and Re-Rating
- Code requirements
- Repairs
- Alteration
- Re-rating

HEAT TRANSFER EQUIPMENT

Typical Process Heating and Cooling Applications

Basic Heat Transfer Theory
- Fluid Properties
- Heat Transfer principles
  - LMTD Determination
  - Overall Heat Transfer Coefficient
  - Process Heat Duty
  - Sensible heat
  - Latent heat
  - Heat of vaporization
  - Inside/Outside Film Coefficient
  - Fouling Factors

Heat Exchanger Configurations
- TEMA Considerations
- Shell-and-Heat Exchangers
  - Plate-and-Frame
  - Printed Circuit
  - Welded Plate
- Brazed Aluminum Exchangers
- Cold Box
- Fired Equipment
  - Furnace type
Firetube
  Indirect Fired Heaters
  Direct Fired Heaters
  - Waste-Heat
  - Operating problems and practical solutions
  - Typical control schemes

Fin-Fan Air Coolers
  - Induced Draft
  - Forced Draft

Equipment Selection and Sizing

Operating Problems

Typical Control Schemes

STORAGE TANKS

General Information
  - Tank types
  - Roof selection
  - Bottom selection
  - Industry codes and standards

Material Selection
  - Selection of materials for service conditions
  - Selection of materials for brittle fracture prevention
  - Selection of steel
  - Internal and external corrosion problems

Tank Design
  - General design considerations
  - Basic data
  - Tank sizing
  - Safe oil height and low pump out determination
  - Bottom design
  - Shell design
  - Seismic and wind design
  - Roof design
  - Review case studies

Foundations
  - Soil considerations
  - Concrete ringwall
  - Crushed stone (gravel) ringwall
  - Concrete slab
  - Pile-supported concrete slab
  - Leak detection and secondary containment
  - Review case studies

Fabrication and Construction
  - Foundation
  - Bottom construction
  - Shell construction
- Roof construction
- Erection sequences
- General considerations
- Review case studies

**Inspection and Testing**
- Inspection philosophy
- Inspection during fabrication
- Inspection after tank is in operation
- Inspection and testing techniques
- Non-destructive testing
- Recommended inspection methods for various repairs
- Review case studies

**Fire Protection**
- Common causes of fires
- Design considerations for fire fighting
- Location and spacing
- Drainage and impounding
- Fire suppression systems
- Design requirements related to fire protection
- Lightning protection
- Grounding requirements

**Venting and Vapor Relief**
- Venting requirements
  - API RP 14C
  - API 2000
- Determining venting requirements
- Means of venting fixed roof tanks
- Venting floating roof tanks
- Frangible joints

**Maintenance and Repair**
- Construction and testing failures
- In-service failures and repairs
- Out-of-service replacement or repairs
- Shell repair
- Bottom replacement or repair
- Fixed roof repair or replacement
- Weld repair
- Tank jacking
- Tank lining

**WHO SHOULD ATTEND**

- Personnel engaged in projects or operations who are or will be responsible for evaluating, selecting, designing, specifying, inspecting, altering or re-rating pressure vessels, heat transfer equipment and storage tanks
- Managers and specialists who are responsible for facilitating facility engineering design and management efforts.
- Company personnel responsible for organizing, leading and managing facility engineering functional groups.
- Personnel whose job responsibilities include
- Supervising or Advising,
- Monitoring and Auditing,
- Implementing,
- Evaluating,
- Designing, or
- Operating

company surface production facility efforts in the office or in the field.

Those personnel include
- Senior Managers and Team Leaders;
- Project Managers and Engineers;
- Foremen, Superintendents, or Supervisors;
- Operations Managers and Supervisors;
- Other Operations Personnel;

YOUR COURSE LEADER

Dr. Maurice Stewart, PE, CSP, a Registered Professional Engineer with over 40 years international consulting experience in project management; designing, selecting, specifying, installing, operating, plant optimizing, retrofitting and trouble-shooting oil, water and gas handling, conditioning and processing facilities; leading hazards analysis reviews and risk assessments.

He is internationally respected for his teaching excellence and series of widely acclaimed textbooks in the areas of designing, selecting, specifying, installing, operating and trouble-shooting: 1) oil and water handling facilities, 2) gas handling, conditioning and processing facilities, 3) facility piping and pipeline systems, 4) gas sweetening, 5) gas dehydration, 6) pumps, compressors and drivers, 7) instrumentation, process control and safety systems, 8) oil and gas measurement and metering systems and 9) conducting safety audits, hazards reviews and risk assessments. Dr. Stewart is one of the co-authors of the *SPE Petroleum Engineering Handbook*. He has authored and co-authored over 90 technical papers and has contributed to numerous conferences as a keynote speaker. To date, Dr. Stewart has taught over 60,000 professionals in 90 countries. He has provided consultation and/or instruction in virtually every oil and gas production sector in the world, including the Middle East, UAE, Northern and Western Africa, Angola, Nigeria, North Sea, Western and Southern Europe, China, Central Asia, Democratic Republic of Congo, Indonesia, Malaysia, Myanmar, Thailand, Brunei, India, Kazakhstan, Central and South America, Australia, Canada and throughout the United States.

He has provided consultation and/or instruction to well over 100 oil and gas related companies worldwide and is currently held on retainer by a number of companies where he regularly provides consultation regarding complex oil and gas issues related to surface production facilities. A partial list of his clients include: Abu Dhabi Oil Company, Exxon USA, Esso Producing Malaysia Inc, Petronas, Petronas Carigali, Petronas Gas, Sarawak Shell, Gas Malaysia, BP, DeltaAfrik, Occidental Petroleum, Kuwait Oil Company, Saudia ARAMCO, AMOCO, ADNOC, Qatar Oil Company, Nipon Oil Company, Shell USA, Conoco Inc., Brunei Shell, DeltaAfrik, Oryax Ecuador Energy Company, Petro-Amazonas, Petro-Ecuador, British Gas, Texaco, Petro China, Petro Viet Nam, Maxus Indonesia, Maxus Ecuador Inc., CNOOC, Cabinda Gulf Oil Company Ltd., Caltex Pacific Indonesia, Vico Indonesia, Mobil Producing Nigeria Unlimted, PTTEP, Chevron Nigeria Ltd., Chevron Overseas Producing Inc., Chevron USA, Chevron Thailand, Pertamina, UNOCAL Indonesia, UNOCAL USA, Unocal Thailand, Spirit Energy 76, ChevronTexaco, Medco, Migas, Total Indonesia, TotalFinaElf Myanmar, Total Fina Elf, Total E&P, Sonangol P&P, Exspan, Tengizchevoil, Exxon Mobil, Mobil USA and Royal Dutch Shell.

He also serves on numerous international committees responsible for developing or revising
industry Codes, Standards and Recommended Practices for such organizations as ANSI, API, ASME, ISA, NACE and SPE. Dr. Stewart is currently serving on the following American Petroleum Institute (API) committees: API RP 14C, RP 14E, RP 14F, RP 14G, RP 14J, RP 500 and RP 75. Dr. Stewart has developed and taught worldwide short courses for API related to Surface Production Operations. In 1985, Dr. Stewart rived the National Society of Professional Engineers “Engineer-of-the-year” award.

He is very active in the Society of Petroleum Engineers (SPE). He served on the board of directors for the Delta Section for over 10 years, chairman and committee member of the professional engineering registration committee for five years and chairman of the continuing education committee for eight years. For twelve years he conducted a review course that prepared petroleum engineers for the “Principles and Practice” examination in Petroleum Engineering. He developed and has taught worldwide short courses for SPE related to Surface Production Operations. For his continuous effort in the advancement of Petroleum Engineering he was awarded the SPE Regional Service Award.

Dr. Stewart holds a BS in Mechanical Engineering from Louisiana State University and MS degrees in Mechanical, Civil (Structural Option) and Petroleum Engineering from Tulane University and a Ph.D in Petroleum Engineering from Tulane University. Dr. Stewart served as a Professor of Petroleum Engineering at Tulane University and Louisiana State University.

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