A LDI Training Course

Plant Piping and Pipeline Systems

Learn how to Design, Install, Test, Inspect, Repair and Trouble-Shoot

Dr. Maurice Stewart, P.E., CSP

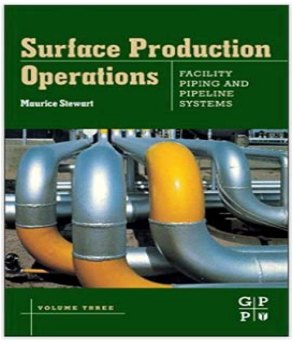
WHAT YOU WILL LEARN

- How to **determine pressure drop, wall thickness** and **optimize** line **size** for **gas, liquid and two-phase lines**
- How to **apply** international design codes / standards such as **ASME/ANSI B31.3, ASME / ANSI B31.4, ASME ANSI B31.8, ASME Section VIII, Division 1 & 2, ANSI B16.5, API RP 14E, API RP 14C and API RP 14J, API RP 520 Part 1 & 2, API 521, API 526, API 2000, API 1104 and NACE MR-01-75**
- How to **select** the appropriate **ANSI / API pressure/temperature ratings** for pipe flanges, valves and fittings
- How to **analyzepiping systems** so as to determine piping "**spec breaks"**
- How to design and analyze new and existing piping systems for **expansion, supports, pumping, compression, manifolds, pigging and insulation requirements**
- How to **design, specify, inspect and test piping and pipeline systems**
- How to **specify and design** a **pipeline pigging system**
- How to **detect, monitor and control pipeline corrosion**
- How to **evaluate** a piping system for **Stress and Dynamic Loading**
- **How to select the appropriate relief device and set pressure for each application and size the device for the worst case condition such as: blocked discharge, gas blow-by and fire**

NOTE: The course maintains a **balance between lecture and in-class exercises, and between theory and application.** In-class exercise sessions are evenly displaced throughout the course to emphasize the principles covered.

Dr. Stewart has a **storehouse of knowledge and experience that he passes along to help the participants get a unique multidiscipline approach** to combine electrical, mechanical, civil and petroleum **methods in solving the problems associated with piping and pipelines.**

COURSE MATERIALS



Each participant will receive a copy of ASME/ANSI B31.3, B31.4 and B31.8; API RP 14E, API RP 14C, API RP 14J, NACE MR-01-75, API 520 Part 1 & 2, API 521, API 526, API 2000 and API 1104

A comprehensive set of lecture notes for after course reading and reference

An extensive set of practical in-class "case study" exercises specifically developed by Dr. Stewart that emphasizes the design and "trouble-shooting" pitfalls often en-countered in the industry. The suitability and applicability of the case studies is recognized as one of the best in the industry.

COURSE CONTENT

Fluid Flow Design

- Types and Functions of Piping Systems
- Fluid Flow, Types and Characteristics
- Flow Conditions
  - ♦ Flow Potential
  - ♦ Laminar Vs. Turbulent
  - ♦ Velocity Limitations
  - ♦ Temperature Considerations
- Special Considerations
  - ♦ Emulsions
  - ♦ Pigging
  - ♦ Corrosion Protection
  - ♦ Cleaning and Monitoring
  - ♦ Water Hammer and Line Pack
- Networks

Pressure Drop Calculations

- Development of Basic Equations and Factors
  - ♦ Bernoulli's Equation
  - ♦ Darcy's Equation
  - ♦ Reynolds Number
  - ♦ Liquid and Gas Viscosity
  - ♦ Relative Roughness
  - ♦ Friction Factor- Equations and Charts
  - ♦ "Z" Factor Correlation's
- Basic Pressure Drop Equations
  - ♦ General and Empirical Hazen-Williams Equations for Liquids
  - ♦ Isothermal, General, Weymouth and Panhandle Equations for Gases
  - ♦ Approximate Equations for Small Pressure Drops
  - ♦ Spitzglass Equation for Very Low Pressure Lines
  - ♦ Fritzsch's and Babcock Equations for Steam Flow
  - ♦ AGA, API RP 14E and other Empirical Equations for Two-Phase Flow
  - ♦ Application of Pressure Drop Equations
  - ♦ Effects of Elevation on Pipeline Pressure Drop
- Head Loss in Valves and Fittings
  - ♦ Resistance and Flow Coefficients
  - ♦ Equivalent Length Determination

Choosing a Line Size and Wall Thickness

- Line Size Determination
  - ♦ Flow Rate and Surge Factor Considerations
  - ♦ Pressure Drop Considerations
  - ♦ Maximum/Minimum Velocities
  - ♦ Erosional Velocity
  - ♦ Single-Phase Liquid and Gas Line Sizing
  - ♦ Two-Phase Line Sizing
- Wall Thickness Determination
  - ♦ Industry Standards and Design Code Requirements
  - ♦ General Hoop Stress Formula
  - ♦ ASME/ANSI B 31.3; B 31.4 and B31.8 Equations
  - ♦ Location Class Determination
  - ♦ ASME/ANSI B31.3 and B31.8 Comparison

	• Application Examples
Pressure Ratings and Determining Pressure Breaks Values • Piping Components ♦ Methods of Connecting Pipe ♦ Fittings	• Design Procedure • ANSI B16.5 and API 6A Pressure Ratings • Determination of Pressure Breaks
Pipe, Valve and Fittings Specifications • Valve Specifications • Valve Terminology • Block Valves • Plug Valves • Ball Valves • Globe Valves	• Butterfly Valves • Special Purpose Valves • Valve selection • Materials of Construction • Factors Modifying the Valve Type
Piping Systems • Terminology • Steel Lines ♦ Material Specification ♦ Pipe Manufacturing Methods • Non-Metallic Lines ♦ Material Specification ♦ Joining Methods ♦ Standards, Codes and Recommended Practices	• Design Practices ♦ Transmission, Flowlines and Distribution Lines ♦ Manifolds • Plant Piping Systems • Designing Loop Systems ♦ Loop Capacity and Length ♦ Equivalent Diameter ♦ Flow Splitting and Branch Lines ♦ Complex Liquid and Gas Gathering Systems • Offshore Design Practices
Piping System Design • Piping Layout • Pipe Support Spacing • Anchor Blocks • Manifolds • Foundation Integrity • Piping Vessels, Heat Exchangers and Fired Heaters • Piping Machinery ♦ Centrifugal and Reciprocating Compressors ♦ Centrifugal and Reciprocating Pumps ♦ Gas Engines and Turbines	• Pipe Stress ♦ Weight Stress ♦ Internal Pressure Stress ♦ Thermal Stress ♦ Expansion Piping ♦ Pipe Dynamics ♦ Special Piping Considerations ♦ Hot Tapping ♦ Hydrostatic Testing Stubs • Dynamic Loading
Pipeline and Gathering Systems Design Considerations • Right-of-way Considerations • Pipe Selection • Design Considerations • Construction Considerations	• Ditch and Coating Considerations • Burying and Crossings • Cathodic Protection
Inspection and Testing • ASME/ANSI B31.3; B31.4 and B31.8 Code Requirements • Hydraulic/Pneumatic Tests	♦ Test Pressure Requirements ♦ Test Records • X-Ray Requirements

♦ Equipment Requirements	• Visual Examination
Pipeline Pigging • Principles and Objectives • Pigging During Construction • Pigging During Operation • Inspection Pigging • Pigging for General Maintenance and Repair • Pigging During Renovation/Rehabilitation	• Types and Sizes • Designing a Pipeline for Pigging • Pig Traps and Stations • Equipment Description and Uses • Designing and Running a Cleaning Program
Control of Pipeline Corrosion • Fundamentals of Corrosion ♦ Reactions, Electrolyte Composition and Physical Variables ♦ Types of Corrosion • Corrosion Inhibitors ♦ Theories and Characteristics ♦ Selection • Cathodic Protection ♦ Basic Principles ♦ Current Requirements ♦ Components and Operating Characteristics of Galvanic and Impressed ♦ Current Systems ♦ Evaluation of System Performance, Interpretation of Data and Common ♦ Measurement Errors	• Metallurgy and Materials Selection ♦ Metallurgical Principles, Heat Treatment and Alloys ♦ Materials Selection • Coatings Linings and Non-Metallic's ♦ Types of Coatings, Selection and Application ♦ Selection and Use of Non-Metallic Piping • Corrosion Monitoring ♦ Coupons, Nipples Resistance, Polarization, Galvanic and Hydrogen Probes ♦ Iron Counts and other Chemical Tests ♦ Clipper Tools and Wall Thickness Calculations
Relief Valves and Pressure Vacuum Relief Devices • Relieving Devices, Applications and Limitations • Relief Valve Sizing • Pressure Vacuum Relief Sizing • Installation Considerations	• Relief System Piping Design • Venting Considerations • Applicable Codes, Standards and Recommended Practices
Flare and Vent Disposal Piping Systems • Back-pressure Considerations • Applicable codes • Flare and Vent Piping Systems	**Pipeline Repair** • In-Service Temporary Repairs • Permanent Repairs • Case Studies

WHO SHOULD ATTEND

- New engineers, asset management team members, design and construction engineers, team leaders/coordinators, operations engineers, construction coordinators, maintenance team leaders/engineers, operations team leaders, senior operations and maintenance personnel and other personnel who are or will be responsible for designing, selecting, sizing, specifying, installing, testing, operating and maintaining plant piping and oil and gas pipelines
- Experienced professionals who want to review or broaden their understanding of facility piping and pipelines
- Professionals with little to moderate piping or pipeline design and operations background
- Other professionals who want a better understanding of the subject matter

YOUR COURSE INSTRUCTOR

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 respectedfor his teaching excellence and series of widely acclaimedtextbooks** 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 relatedcompanies 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, PetronasCarigali, Petronas Gas, Sarawak Shell, Gas Malaysia, BP, DeltaAfrik, Occidential 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 Unlimited, PTTEP, Chevron Nigeria Ltd., Chevron Overseas Producing Inc., Chevron USA, Chevron Thailand, Pertamina, UNOCAL Indonesia, UNOCAL USA, Unocal Thailand, Unocal Indonesia, Spirit Energy 76 ,ChevronTexaco, Medco, Migas, Total Indonesie, TotalFinaElf Myanmar, Total Fina Elf, Total E&P, Sonangol P&P, Exspan, Tengizchevoil, Exxon Mobil, Spirit Energy 76, 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.