



MOE110

Subsea Pipeline Engineering

Course Introduction:

The course will provide a complete and up-to-date overview of the area of marine pipeline engineering, taking delegates through the pre-design phase, design, construction, installation, operation and maintenance. It will give a complete picture of the work of design engineers and pipeline construction companies, using actual case studies from around the world to highlight the topics discussed.

While the course requires no previous experience, this is not a superficial overview. The lecturers are experts in their fields and have vast experience in lecturing on the subject of marine pipeline engineering. All delegates will receive a full set of course notes providing an invaluable reference for use after the course.

Course Objectives:

Upon successful completion of this course, the delegates will be able to:

- ✓ Apply an in-depth knowledge on subsea pipeline engineering
- ✓ Discuss marine pipeline construction, route selection, hydraulics and flow assurance
- ✓ Demonstrate the design exercise including pipeline configuration, diameter and route selection
- ✓ Explain the design for strength as well as insulation and temperature control
- ✓ Recognize the marine environment and discuss the carbon steel line pipe, material of service and increasing corrosion resistance
- ✓ Differentiate the internal corrosion, external corrosion and coatings as well as the significance of cathodic, microbiological corrosion and spans
- ✓ Employ the proper method of shore approaches and describe the design for stability
- ✓ Evaluate the design exercise and conclusion and discuss welding and decommissioning including pipeline construction
- ✓ Explain mishap, risk and repair including trenching and burial
- ✓ Classify the future development, inspection and monitoring for subsea pipeline

Who Should Attend?

This course provides an overview of all significant aspects and considerations of subsea pipeline engineering for engineers from oil and gas companies, construction companies, pipe and service suppliers and regulatory authorities, who are newly qualified, have recently moved into pipeline engineering or hold broad responsibilities that include pipelines.

Course Certificate:

International Center for Training & Development (ICTD) will award an internationally recognized certificate(s) for each delegate on completion of training.

Course Outline:

Day 1:

- **DESIGN OVERVIEW AND INTRODUCTION TO MARINE PIPELINE CONSTRUCTION**
 - Introduction to design sequence and its interaction with the different topics covered in the course
 - Film on construction and connection of an offshore pipeline
- **ROUTE SELECTION**
 - Principles of route selection
 - Constraints imposed by oceanographic, geotechnical, environmental, safety and political factors
- **Shore Approaches**
 - Influence of coastal topography, geotechnics, tides and waves
 - Alternative construction techniques
 - Horizontal drilling and tunnel
- **INTRODUCTION TO DESIGN EXERCISE**
 - The design exercise is a pipeline system off the coast of the USA. It presents several route selection, design and construction problems
 - Participants will work in small groups, and will select the system design and route, and carry out preliminary design and assessment for construction methods.

Material Selection

- Fabrication of API pipe
- Increasing the strength of pipeline steel
- Balancing strength, toughness and weldability

- Pipeline steels for sour service: sulfide stress cracking and HIC
- Appropriate specification of pipe material.
- **Increasing Corrosion Resistance**
 - Methods of improving corrosion resistance
 - Available solid corrosion resistant alloys
 - Evaluating corrosion resistance
 - Methods of fabrication of clad pipe
 - Welding of clad pipe
 - External protection
- **Flexible Pipe**
 - Fabrication
 - Carcass
 - Liner
 - Pressure containment
 - Armoring
 - Sheath
 - Connectors
 - Lengths of pipe sections
 - Internal corrosion
 - External corrosion
 - Failure modes of flexible pipes
 - General failure mechanisms
 - Inspection of flexible pipes

Day 2:

- **Marine Pipeline Construction**
 - Construction methods
 - Laybarge
 - S-Lay and J-Lay
 - Reelship
 - Mid-depth tow, bottom tow and surface tow
 - Advantages and disadvantages of different methods.
- **Hydraulics and Flow Assurance**
 - Single-phase flow, oil and gas
 - Calculation of pressure drop and effect on optimal line size
 - Influence of compressibility, temperature change and profile, two phase flow;
 - Flow regimes, correlations, profile effects, terrain-induced slugging, slugging in risers.
 - Surge
 - Hydrates and wax

- **Internal Corrosion and Its Prevention**
 - Sweet corrosion mechanisms: pitting and mesa attack
 - Evaluating a suitable corrosion allowance
 - Effects of flow on corrosion
 - Moderators of corrosion
 - Corrosion inhibition and its relation to flow morphology
- **External Corrosion and Its Prevention**
 - Coating for submarine pipelines: enamels, FBE, triple coats, extruded coatings and elastomers
 - Inspection of coating integrity
 - Concrete weight coatings
 - Field Joints and infills
- **Pipeline Materials For Sour Service**
 - Pipeline steels for sour service: sulfide stress cracking and HIC
 - Appropriate specification of pipe material
- **Design For Stability**
 - Hydrodynamic forces on pipelines in steady and unsteady flow
 - Lateral resistance
 - Design for stability; RPE305 recommended practice
 - Interaction with seabed instability
- **Pipeline Structural Analysis**
 - Internal pressure, code requirements
 - External pressure; bending; bending buckling; collapse and buckle propagation; denting and gouging; allowable strain design; impact damage

Day 3:

- **Cathodic Protection**
 - Conjoint protection by coating and CP
 - Mechanism of CP
 - Design of sacrificial anode CP systems
 - Thermal effects on CP performance
 - Interactions between CP systems
- **Microbiological Corrosion**
 - Sulfate-reducing bacteria
 - Microbiological corrosion mechanisms
 - Evaluation of the problem
 - Housekeeping and treatment
- **Internal Inspection and Corrosion Monitoring**
 - Inspection prior to and during installation and commissioning
 - Inspection in service

- Intelligent pigging
- Corrosion monitoring
- Analysis of corrosion monitoring data
- **Marine Environment**
 - Design currents
 - Waves
 - Geotechnics
 - Earthquakes
- **Mishaps, Risk and Repair**
 - Failure incidents

Day 4:

- **Pipeline Installation**
- **Upheaval and Lateral Buckling**
 - Driving force for upheaval and lateral buckling
 - Analysis of risk of buckling
 - Alternative design and construction options to eliminate problems
- **Insulation**
 - Need for insulation
 - Types of insulation
 - Conductive Heat Transfer
 - Convective Heat Transfer
 - Interaction with other design factors
- **Trenching and Burial**
 - Alternative Construction methods
 - Trenching and burial methods jetting, mechanical cutting, plowing, rock dumping, backfill, dredging
- **Span Assessment and Correction**
 - Description of span occurrence and possible systems
 - Analysis; vortex-excited oscillation, overstress, hooking
 - Span monitoring and correction

Day 5:

- **Welding**
 - Welding of carbon manganese pipeline steels
 - Welding of duplex and clad pipe. Inspection of weldments
- **Decommissioning**
 - Legal framework. Legislation
 - Decay mechanisms. Re-use
 - Methods of recovery

- Alternatives to Recovery
- Disposal materials
- Costs

Course Fees:

To be advised as per the course location. This rate includes participant's manual, Hand-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Methodology:

A variety of methodologies will be used during the course that includes:

- (30%) Based on Case Studies
- (30%) Techniques
- (30%) Role Play
- (10%) Concepts
- Pre-test and Post-test
- Variety of Learning Methods
- Lectures
- Case Studies and Self Questionnaires
- Group Work
- Discussion
- Presentation

Course Timings:

Daily Course Timings:

08:00 - 08:20	Morning Coffee/Tea
08:20 - 10:00	First Session
10:00 - 10:20	Coffee/Tea/Snacks
10:20 - 12:20	Second Session
12:20 - 13:30	Coffee/Tea/Snacks
13:30 - 15:00	Last Session