



FE185: Piping Design Fundamentals

Training Description:

This practical training programme is designed to strengthen the practical piping design capabilities of Piping/CAD Engineers involved in onshore and offshore oil & gas projects. It provides a structured understanding of the piping design workflow from **FEED through EPC**, beginning with design basis and engineering inputs and progressing through P&ID interpretation, piping specifications, layout and routing, equipment interfaces, pipe supports, multidisciplinary coordination, 3D modelling, clash detection, isometrics, GA drawings, spools and MTO/BOM development.

The training course places particular emphasis on the practical application of relevant international codes, standards and project requirements, including **ASME B31.3, API 650, ISO 15649 and applicable ASME B16 standards**, together with piping classes, pressure/temperature ratings, schedules, wall thickness and component requirements.

Participants will work through practical exercises and an integrated oil & gas project-based case study, developing and reviewing piping layouts, routing, support concepts, equipment interfaces and 3D models. The final exercise will connect the complete design workflow from **P&ID and design basis → layout/routing → supports → 3D model → isometrics → MTO**, followed by a design quality and constructability review.

Training Objectives:

By the end of the training, participants will be able to:

- ✓ Understand the complete piping design workflow from FEED through EPC
- ✓ Interpret PFDs, P&IDs, line lists and equipment datasheets and extract relevant design requirements
- ✓ Understand piping design basis, piping classes, pressure/temperature ratings, schedules and wall thickness
- ✓ Apply relevant requirements of **ASME B31.3, API 650, ISO 15649 and applicable ASME B16 standards**
- ✓ Select and understand piping components, valves, flanges and fittings
- ✓ Develop practical piping layouts and routing for onshore and offshore facilities
- ✓ Consider equipment nozzle orientation, accessibility, maintenance and operational requirements
- ✓ Develop basic pipe support concepts and understand thermal expansion/flexibility considerations
- ✓ Identify constructability, congestion, accessibility and maintainability issues
- ✓ Improve coordination with **Process, Mechanical, Civil/Structural and E&I** disciplines
- ✓ Understand 2D/3D piping modelling principles using platforms such as **AutoCAD Plant 3D, E3D, PDMS and Smart 3D**
- ✓ Understand model checking and clash detection
- ✓ Understand the preparation and review of isometric, GA and spool drawings
- ✓ Understand BOM/MTO generation and reconciliation
- ✓ Apply the complete piping design process through an integrated practical case study

These objectives directly reflect the SOW's required outcomes, including improved design quality, reduced design errors and clashes, stronger constructability awareness and better multidisciplinary coordination.

Training Designed for:

This training course is intended for Piping Engineers, Piping Design Engineers, Piping/CAD Engineers, Piping Designers, Mechanical Engineers involved in piping design, Plant Layout Engineers, 3D Plant Modelling Engineers/Designers and Engineering professionals involved in oil & gas piping projects.

Recommended prerequisite: Participants should have foundational knowledge of **piping engineering, oil & gas processes and CAD/3D modelling.**

Training Requirement:

“Hand’s on practical sessions, equipment and software will be applied during the course if required and as per the client’s request.”

Contents can be adapted to your specific wishes. It is therefore possible to focus on specific modules of the training course as per client’s learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Program:

DAY ONE:

PIPING DESIGN FUNDAMENTALS, ENGINEERING INPUTS & STANDARDS

1. **Introduction to Piping Design Engineering**
 - Role and responsibilities of piping design engineering
 - Piping design in oil & gas facilities
 - Onshore versus offshore piping design considerations
 - Piping design lifecycle
 - FEED-to-EPC workflow
 - Relationship between engineering, procurement, fabrication and construction
 - Key piping design deliverables
2. **Piping Design Basis**
 - Understanding the project design basis
 - Design conditions and operating conditions
 - Design pressure and design temperature
 - Fluid characteristics and service requirements
 - Material requirements
 - Project specifications and engineering standards
 - Piping design criteria
3. **Understanding Engineering Inputs**
 - PFD interpretation
 - P&ID interpretation
 - Line lists
 - Equipment datasheets
 - Piping specifications
 - Identifying piping requirements from engineering documents
 - Tracing process requirements into piping design
4. **Piping Classes and Components**

- Piping classes and specifications
- Pressure and temperature ratings
- Pipe schedules and wall thickness
- Material selection considerations
- Pipes, elbows, tees and reducers
- Flanges and gaskets
- Valves and valve types
- Special piping components

5. Codes and Standards

- Introduction to ASME B31.3
- Practical application of ASME B31.3 requirements
- API 650 considerations for tank-related piping interfaces
- ISO 15649
- Relevant ASME B16 standards
- Relationship between international standards and project specifications

❖ Practical Exercise

❖ P&ID Interpretation and Piping Requirements Extraction

❖ Participants review a sample oil & gas P&ID and extract:

- Line numbers
- Pipe sizes
- Service requirements
- Piping class
- Valves
- Fittings
- Equipment interfaces
- Design requirements

DAY TWO:

PIPING LAYOUT, ROUTING & CONSTRUCTABILITY

1. Piping Layout Fundamentals

- Principles of effective plant layout
- Equipment arrangement and piping considerations
- Onshore plant layout
- Offshore layout considerations
- Pipe rack arrangement
- Main pipe routes and branch routing
- Routing hierarchy and design priorities

2. Equipment Piping Arrangements

- Vessel piping arrangements
- Tank piping arrangements
- Pump piping arrangements
- Heat exchanger piping arrangements
- Equipment nozzle orientation
- Piping interfaces with equipment
- Accessibility around equipment

3. Piping Routing Principles

- Routing from P&ID to physical arrangement
- Line routing considerations
- Horizontal and vertical routing
- Pipe rack routing
- Process and utility piping
- Routing around structures and equipment
- Minimising congestion

4. Valves, Drains, Vents and Slopes

- Valve accessibility
- Valve orientation and operation
- Drain and vent locations
- Low-point drains
- High-point vents
- Piping slope requirements
- Operational and maintenance considerations

5. Safety, Maintenance & Constructability

- Safety spacing
- Access and escape requirements
- Maintenance access
- Equipment removal requirements
- Crane and lifting considerations
- Construction and erection considerations
- Congestion management
- Identification of potential design conflicts

❖ Practical Exercise

❖ Piping Routing and Layout Review

❖ Participants review a piping layout and identify:

- Routing issues
- Accessibility problems
- Maintenance constraints
- Congestion
- Valve access issues
- Equipment interface concerns
- Constructability issues

DAY THREE:

PIPE SUPPORTS, FLEXIBILITY & MULTIDISCIPLINARY COORDINATION

1. Pipe Support Fundamentals

- Purpose and function of pipe supports
- Pipe support philosophy
- Types of pipe supports
- Rest supports
- Guides
- Anchors

- Stops
 - Hangers
 - Spring supports
 - Special support arrangements
- 2. Support Selection and Location**
- Support spacing considerations
 - Selecting appropriate support types
 - Support locations
 - Support loads and structural interfaces
 - Support arrangements around equipment
 - Support considerations for vertical and horizontal piping
 - Practical support design review
- 3. Thermal Expansion & Flexibility Awareness**
- Fundamentals of thermal expansion
 - Effects of temperature changes
 - Thermal movement
 - Expansion loops
 - Guides and anchors
 - Flexibility concepts
 - Equipment nozzle loading awareness
 - When flexibility analysis may be required
- 4. Equipment and Piping Interfaces**
- Pump nozzle interfaces
 - Vessel nozzles
 - Tank connections
 - Heat exchanger connections
 - Equipment accessibility
 - Piping movement and equipment protection
 - Interface management
- 5. Multidiscipline Coordination**
- Coordination with Process
 - Coordination with Mechanical
 - Coordination with Civil/Structural
 - Coordination with E&I
 - Structural steel interfaces
 - Electrical and instrumentation interfaces
 - Identifying design conflicts
 - Design review procedures
- 6. Clash Detection & Model Review**
- Types of clashes
 - Hard clashes and clearance issues
 - Interdisciplinary model review
 - Design coordination meetings
 - Clash identification and resolution
 - Constructability review

- ❖ **Practical Exercise**
- ❖ **Pipe Support Selection & Interface/Clash Review**
- ❖ Participants will review piping arrangements and identify appropriate supports, structural interfaces, equipment interface concerns and potential clashes.

DAY FOUR:

CAD/3D PIPING MODELLING & ENGINEERING DELIVERABLES

1. **2D and 3D Piping Design**
 - 2D piping drawings versus 3D plant modelling
 - Piping design data flow
 - Model setup and project information
 - Modelling sequence
 - Model-based engineering principles
- ❖ **3D Plant Modelling**
- ❖ **Introduction to the principles and workflows associated with:**
 - AutoCAD Plant 3D
 - AVEVA E3D
 - PDMS
 - Smart 3D
- ❖ **Modelling Piping Components**
 - Equipment modelling
 - Pipe modelling
 - Valves
 - Fittings
 - Flanges
 - Special components
 - Pipe supports
 - Connections and interfaces
 - Model data and attributes
- ❖ **3D Model Review**
 - Model checking
 - Design consistency
 - Piping specification compliance
 - Accessibility review
 - Maintenance review
 - Equipment interface review
 - Clash detection
 - Clearance checking
 - Constructability review
- ❖ **Piping Deliverables**
 - Isometric drawings
 - General Arrangement (GA) drawings
 - Spool drawings
 - Piping arrangement drawings
 - Drawing review requirements
 - Revision and document control considerations

❖ BOM/MTO

- Bill of Materials
- Material Take-Off
- Extracting quantities from the model
- Component identification
- MTO reconciliation
- Checking model quantities against drawings
- Common sources of MTO discrepancies

❖ Practical Exercise

❖ P&ID → 3D Model → Isometric → MTO

- ❖ Participants develop/review a piping model and follow the data flow through to an isometric drawing and MTO.

DAY FIVE:

INTEGRATED PIPING DESIGN CASE STUDY & FINAL DESIGN REVIEW

❖ Integrated Oil & Gas Project-Based Case Study

The final day brings together the knowledge developed throughout the programme through a complete piping design exercise based on:

❖ P&ID + Design Basis + Line List + Equipment Data + Piping Specifications

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Layout & Routing

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Pipe Supports & Interfaces

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3D Model / Clash Review

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Isometric Drawings

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MTO/BOM

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Final Design & Constructability Review

1. Case Study Preparation

- Review project design basis
- Review P&ID
- Review line list
- Review equipment datasheets
- Review piping specifications
- Identify design requirements and constraints

2. Layout & Routing Development

- Establish equipment arrangement
- Develop preliminary piping routes
- Review accessibility
- Consider maintenance requirements
- Identify congestion
- Review constructability

3. Support & Interface Review

- Identify support locations
- Select basic support arrangements
- Review structural interfaces
- Consider thermal movement
- Review equipment nozzle interfaces

4. 3D Model & Clash Review

- Develop/review 3D piping arrangement
- Check equipment and piping interfaces
- Identify clashes
- Review clearances
- Resolve design conflicts
- Conduct multidisciplinary model review

5. Isometric & MTO Review

- Review piping isometrics
- Review GA drawings
- Review spool requirements
- Verify piping components
- Review BOM/MTO
- Reconcile model, drawings and quantities

6. Final Design Quality & Constructability Review

- Design compliance review
- Piping specification review
- Accessibility and maintainability review
- Safety review
- Constructability review
- Clash and interface review
- Identification of design errors and potential rework
- Group presentation of design decisions
- Instructor feedback and final technical review

❖ Final Practical Assessment

Participants complete and present an integrated piping design solution and demonstrate their ability to interpret engineering inputs, develop routing and support concepts, review 3D models, identify clashes and assess piping deliverables and constructability.

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Gamification, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

CMCT Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

TBA as per the course location - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:00	Recess (Prayer Break & Lunch)
13:00 - 14:00	Last Session

For training registrations or in-house enquiries, please contact:

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