Subsea Pipeline and Riser Engineering: DNV-ST-F101 Design, Installation and Umbilicals

1 – 12 November 2027
Amsterdam - Zuidas business district hotel



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Introduction:

Subsea pipeline and riser engineering decisions made early, such as route, wall thickness, stabilisation, lay method and riser concept, fix most of the cost and risk of an offshore development, yet they are often split between pipeline, riser, installation and controls teams working from different data. This Core Concept course takes experienced engineers through route and survey data, DNV-ST-F101 limit state design, stability, spans, buckling, insulation, installation methods, steel catenary, flexible and hybrid risers, umbilicals, pre-commissioning and integrity. Participants build a Pipeline-and-Riser Concept Design Package for a case field.

Course Objectives:

- Select a subsea pipeline route from bathymetry, geophysical and geotechnical survey data and record the design basis for flowlines and export lines
- Calculate wall thickness and verify pressure containment, collapse, propagating buckle and combined loading limit states using the DNV-ST-F101 LRFD format
- Assess on-bottom stability, free spans, vortex-induced vibration and thermal buckling risk and specify stabilisation, span rectification and buckle mitigation
- Compare S-lay, J-lay, reel-lay and tow installation for a given pipe size, water depth and field layout and review installation analysis results
- Screen steel catenary, lazy wave, flexible and hybrid riser concepts for hang-off, touchdown fatigue and VIV and define umbilical and subsea control system architecture
- Plan flooding, gauging, hydrotest and dewatering and set ROV and in-line inspection scope for the subsea system in service

Target Audience:

- Subsea pipeline design functions responsible for route, wall thickness, stability and span calculations
- Riser engineering functions responsible for riser concept selection, dynamic analysis and fatigue assessment
- Offshore installation engineering functions responsible for lay method selection, lay analysis and vessel procedures
- Umbilical and subsea controls functions responsible for umbilical specification and control system interfaces
- Subsea integrity and commissioning functions responsible for pre-commissioning, ROV surveys and inspection planning
- Technical authority and design verification functions responsible for reviewing subsea design reports

Course Outline:

Day 1: Subsea Pipeline Systems, Route Selection and Survey Data

- Subsea Production System Layout: Flowlines, Export Lines, Spools, Manifolds and PLETs
- Desktop Route Study Using Bathymetry, Geological Maps and Fishing Charts
- Geophysical and Geotechnical Survey Deliverables: Side-Scan Sonar, Sub-Bottom Profiler and CPT Data
- Seabed Hazard Screening: Sand Waves, Megaripples, Submarine Landslides and Debris
- Pipeline Design Basis Register: Fluid, Pressure, Temperature, Design Life and Metocean Inputs

Day 2: Wall Thickness and Limit States to DNV-ST-F101

- DNV-ST-F101 Scope, Lifetime Phases and Structural Assessment Approach
- Safety Class, Location Class and Fluid Category Selection
- LRFD Format: Load Effect Factors, Resistance Factors and Characteristic Values
- Pressure Containment, Collapse and Propagating Buckle Wall Thickness Checks
- Combined Loading Check Under Bending Moment, Axial Force and External Pressure

Day 3: On-Bottom Stability, Free Spans and VIV Screening

- Hydrodynamic Drag, Lift and Inertia Loads on Seabed Pipe From Waves and Steady Current
- Pipe-Soil Interaction and Lateral Resistance Models for Sand and Clay
- Stabilisation Options: Concrete Weight Coating, Trenching, Rock Dump and Mattresses
- Free Span Assessment: Span Length, Seabed Gap and Static Bending Stress
- Vortex-Induced Vibration Screening and Span Rectification With Seabed Levelling and Post-Lay Supports

Day 4: Thermal Expansion, Buckling, Insulation and Flow Assurance Interface

- Effective Axial Force, End Expansion and Virtual Anchor Point Calculation
- Upheaval Buckling Overview: Burial Depth and Rock Cover Mitigation
- Lateral Buckling Overview: Planned Buckle Initiators, Sleepers and Distributed Buoyancy
- Thermal Insulation Systems: Wet Insulation Coatings, Pipe-in-Pipe and Electrical Heat Tracing
- Flow Assurance Interface: Cooldown Time, Hydrate and Wax Management Inputs to Pipe Design

Day 5: Crossings, Tie-Ins and Week-One Guided Pipeline Case

- Pipeline and Cable Crossing Design With Separation Supports and Concrete Mattress Ramps
- Tie-In Spools and Expansion Loops: Rigid Jumper Versus Flexible Jumper Selection
- Subsea Tie-In Methods: Diverless Connectors, Clamp Connectors and Hyperbaric Welding
- Guided Case: Export Pipeline Route, Wall Thickness and Stability Calculation Set
- Guided Case: Span, Buckling and Tie-In Review Against the Design Basis Register

Day 6: Offshore Pipeline Installation Methods

- S-Lay Configuration: Stinger, Tensioners, Overbend and Sagbend Strain Checks
- J-Lay Towers for Deep Water: Near-Vertical Lay Ramp and Single Welding Station
- Reel-Lay: Onshore Spooling, Plastic Strain Limits, Pipe Size Limits and Straightening
- Pull and Tow Methods: Surface, Near-Surface, Mid-Depth, Off-Bottom and Bottom Tow
- Installation Analysis Deliverables: Lay Tension, Departure Angle, Weather Window and Abandonment and Recovery

Day 7: Steel Catenary, Flexible and Hybrid Risers

- Riser Concept Screening: Steel Catenary, Steel Lazy Wave, Flexible and Hybrid Riser Towers
- Steel Catenary Riser Hang-Off Design With Flexible Joints and Stress Joints
- Touchdown Zone Fatigue: Dynamic Pipe, Pipe-Seabed Interaction and S-N Damage Accumulation
- Riser VIV Prediction and Suppression With Helical Strakes and Fairings
- Flexible Riser Configurations: Free Hanging, Lazy Wave, Steep Wave and Buoyancy Modules

Day 8: Umbilicals and Subsea Control Systems

- Umbilical Cross-Section Design: Hydraulic Tubes, Chemical Injection Lines, Power and Signal Cables
- Thermoplastic Hose Versus Steel Tube Umbilical Selection Criteria
- Electro-Hydraulic Multiplexed Control: Master Control Station and Subsea Control Module
- Subsea Distribution: Umbilical Termination Assembly, Flying Leads and Hydraulic Distribution Units
- Dynamic Umbilical Sections: Bend Stiffeners, Fatigue Screening and Installation Loads

Day 9: Pre-Commissioning, Inspection and Integrity of Subsea Lines

- Flooding, Cleaning and Gauging Pig Train Design
- System Hydrotest: Pressure Hold Period, Temperature Correction and Acceptance Records
- Dewatering, Drying and Nitrogen Purging Before First Hydrocarbons
- ROV General Visual, Burial and Cathodic Protection Surveys of Pipelines, Risers and Umbilicals
- In-Line Inspection Planning for Subsea Lines and Riser Monitoring Data Review

Day 10: Capstone: Pipeline-and-Riser Concept Design Package

- Capstone Brief: Field Layout, Metocean Data, Survey Results and Fluid Properties
- Pipeline Section of the Package: Route, Wall Thickness, Stability and Span Summary
- Riser and Umbilical Section: Concept Choice, Fatigue Screening and Control System Layout
- Installation and Pre-Commissioning Strategy With Lay Vessel and Lay Method Choice
- Concept Design Package Presentation and Technical Review Panel

Skills You Will Gain:

- Subsea Route Engineering
- Limit State Wall Thickness Design
- On-Bottom Stability Analysis
- Free Span and VIV Assessment
- Lay Method Selection
- Riser Fatigue Screening
- Umbilical System Specification
- Subsea Pre-Commissioning Planning

Why Attend This Course:

- Leave with a Pipeline-and-Riser Concept Design Package covering route, wall thickness, stability, risers, umbilicals and installation for a case field
- Move in week two from seabed pipe design to installation, risers, umbilicals, pre-commissioning and in-service inspection
- Challenge contractor lay analyses, riser fatigue results and span assessments before they are accepted into the design record
- Compare subsea practice with engineers from operators, EPC contractors and installation contractors working in shallow and deep water

Conclusion:

Subsea systems perform when the seabed pipe, the riser, the umbilical and the installation plan are designed from one data set. Week one covers route and survey data, DNV-ST-F101 limit states, stability, spans, VIV, buckling, insulation, crossings and tie-ins, closing with a guided case. Week two adds lay methods, steel catenary, flexible and hybrid risers, umbilicals and subsea controls, pre-commissioning and ROV and in-line inspection. Participants finish with a Pipeline-and-Riser Concept Design Package ready for technical review.