
Graduate Certificate in Subsea Engineering

Risers and Umbilicals

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Risers

Risers are critical components in subsea engineering, connecting the surface facilities to the subsea wells. They play a crucial role in transporting fluids, such as oil, gas, and water, between the seabed and the surface. Risers are designed to withstand various environmental conditions, pressures, and temperatures encountered in offshore operations.

There are several types of risers used in subsea engineering, including production risers, drilling risers, and export risers. Each type serves a specific purpose and has unique design considerations.

Production Risers: Production risers are used to transport hydrocarbons (oil and gas) from the subsea wells to the surface facilities. These risers must be able to handle the flow of fluids under high pressures and temperatures. Production risers can be categorized into flexible risers, steel catenary risers (SCRs), and hybrid risers.

Drilling Risers: Drilling risers are used during the drilling phase of subsea operations to connect the drilling rig on the surface to the subsea well. These risers must be able to withstand the dynamic forces and movements associated with drilling operations. Drilling risers can be classified into top-tensioned risers (TTRs) and marine drilling risers (MDRs).

Export Risers: Export risers are used to transport produced hydrocarbons from the surface facilities to shore or to an offshore facility for processing. These risers are designed to handle large volumes of fluids and are typically larger in diameter compared to production risers.

Key challenges in riser design include managing fatigue, vortex-induced vibrations (VIV), and external loads such as waves, currents, and ice. Engineers must carefully consider these factors to ensure the safe and efficient operation of risers in subsea environments.

Umbilicals

Umbilicals are another essential component in subsea engineering, providing power, control, and communication between the surface facilities and subsea equipment. Umbilicals consist of multiple components, including hydraulic lines, electrical cables, and fiber optics, housed within a protective sheath.

There are different types of umbilicals used in subsea applications, each designed to meet specific requirements based on the project's needs. These include steel tube umbilicals, thermoplastic umbilicals,

and hybrid umbilicals.

Steel Tube Umbilicals: Steel tube umbilicals are commonly used in deepwater applications due to their high-pressure capabilities. They are robust and can withstand harsh environmental conditions, making them suitable for long-term subsea operations.

Thermoplastic Umbilicals: Thermoplastic umbilicals are lightweight and flexible, making them ideal for shallow water applications. They are cost-effective and easy to install, making them a popular choice for subsea projects with limited budgets.

Hybrid Umbilicals: Hybrid umbilicals combine the benefits of steel tube and thermoplastic umbilicals, offering a balance between strength and flexibility. These umbilicals are versatile and can be customized to meet specific project requirements.

Umbilicals play a crucial role in subsea operations, providing vital connections for controlling subsea equipment, monitoring performance, and transmitting data between the surface and the seabed. Proper installation and maintenance of umbilicals are essential to ensure the reliable and efficient operation of subsea systems.

Key Terms and Concepts

- **Dynamic Positioning (DP):** Dynamic positioning is a technology used in offshore operations to automatically maintain a vessel's position and heading using thrusters. DP systems are essential for subsea operations where precise positioning is required.
- **Subsea Control Systems:** Subsea control systems are used to monitor and control subsea equipment, such as valves, pumps, and sensors, from the surface facilities. These systems play a crucial role in ensuring the safe and efficient operation of subsea assets.
- **Subsea Trees:** Subsea trees are complex structures installed on the seabed to control the flow of oil and gas from subsea wells. They consist of valves, chokes, and sensors to regulate the production process.
- **Subsea Manifolds:** Subsea manifolds are distribution points on the seabed that connect multiple subsea wells to a central production facility. Manifolds help streamline the flow of fluids and facilitate production optimization.
- **Subsea Boosting Systems:** Subsea boosting systems are used to increase the pressure of hydrocarbons coming from subsea wells to improve production rates. These systems can help enhance recovery from mature or challenging reservoirs.
- **Riser Tensioning Systems:** Riser tensioning systems are used to maintain the tension in risers to prevent buckling and ensure proper alignment between the surface facilities and subsea equipment. Tensioning systems play a critical role in riser integrity and performance.

- Riser Monitoring Systems: Riser monitoring systems are used to assess the condition of risers in real-time, detecting any potential issues or anomalies that may compromise their integrity. Monitoring systems help improve riser reliability and safety.
- Subsea Insulation: Subsea insulation is used to protect subsea equipment and pipelines from low temperatures, hydrate formation, and corrosion. Insulation materials help maintain the integrity and performance of subsea assets in harsh environments.
- Subsea Well Intervention: Subsea well intervention involves performing maintenance, repair, or enhancement activities on subsea wells to optimize production or address issues. Well intervention techniques include wireline, coiled tubing, and hydraulic workover operations.
- Subsea Integrity Management: Subsea integrity management involves assessing and maintaining the integrity of subsea assets to ensure safe and reliable operations. Integrity management programs help identify and mitigate risks to subsea infrastructure.
- Subsea Flow Assurance: Subsea flow assurance focuses on ensuring the uninterrupted flow of hydrocarbons from subsea wells to the surface facilities. Flow assurance measures include preventing hydrate formation, wax deposition, and pipeline blockages.
- Subsea Decommissioning: Subsea decommissioning involves safely shutting down and removing subsea infrastructure at the end of a field's productive life. Decommissioning activities include well plugging, riser removal, and platform dismantling.

Conclusion

Risers and umbilicals are essential components in subsea engineering, facilitating the transport of fluids, power, and data between the surface and the seabed. Understanding the design, operation, and challenges associated with risers and umbilicals is crucial for ensuring the safe and efficient operation of subsea systems. By mastering key terms and concepts related to risers and umbilicals, engineers can effectively design, install, and maintain subsea infrastructure to maximize production and minimize risks.