4Subsea is a leading expert on structural assessment and advanced analysis of flexible pipe damages and failures. We help operators maintain safe operation and reduce operational downtime. 4Subsea develops and refines analytical tools and methods based on extensive accumulated experience.

4Subsea offers a wide range of engineering services related to risers and flowlines, umbilicals and power cables. We cover all life cycle phases, starting with technology development and conceptual design through FEED and detailed design, procurement, construction, installation, operation, and decommissioning.

**KEY DELIVERABLES**

- Structural capacity of flexible pipes, considering anomalies by performing advanced finite element analysis (2D & 3D fully non-linear)
- Modelling as-built geometry and material with observed damages
- Planning and execution of full- and small scale test of flexible pipes
- Planning, execution and evaluation of material tests
- Root cause investigation
- Operational feed-back
4Subsea is a Norwegian technology company specialised in production riser systems and subsea well systems. We deliver solutions to maintain production from subsea oil and gas fields, enabling cost reduction and increased service life of existing installations. We also provide our specialist services within offshore wind turbines and wave power systems.

4Subsea combines expert knowledge and practical experience with software and instrumentation to optimise operation of production risers and subsea wells, aiming to be in the forefront of digitising the oil and gas industry.

The company was established in 2007, and clients include all the major oil and gas operators as well as the large suppliers of subsea equipment. 4Subsea has offices in Oslo, Bergen, Kristiansand, and Trondheim.

4Subsea - Share ideas, move forward

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Advanced Finite Element Analyses
4Subsea uses capabilities within finite element analyses (2D and 3D) and experience with operation and damage investigation of flexible pipes to provide expert advice for flexible pipe incidents.
• Impact
• Over bending
• Buckling
• Carcass collapse
• Bore blockage
• Thermal induced axial load

Tools
• Detailed FE analysis using MARC
• 2D model and axis symmetric modelling
• 3D model for validation and non-axi symmetrical cases

Structural Assessment
• Advisory services
• Capacity estimates
• Blockage position
• Material properties/ageing issues
• Cross section interlayer geometry/friction
• Operational history, pressure & temperature scenarios
• Basis for risk assessment
• Operational guidelines

Validation by Testing
4Subsea has unique experience with full- mid- and small scale testing and validating of established guidelines and FE analysis. This includes material tests, carcass tests and in total six full scale tests of bore blockage in recovered full length flexible risers and flowlines.
• Planning and execution of full scale test
• Small scale test - material
• Data for validation of FE analysis