Case Study

World-first completion of a deepwater remote vertical repair using mechanical connectors

Two 4" (101.6 mm) gas lift risers at the base of a hybrid riser system were damaged during the original deepwater installation operations in the Atlantic Ocean. To ensure future production, it was essential that the damaged sections were bypassed. Hydratight, working with Connector Subsea Solutions (CSS), developed a complete solution using its industry-leading MORGRIP® Mechanical Connectors to carry out the world’s first remote vertical riser repair. The success of the project represents a number of technical breakthroughs for the industry.

The Challenge
Located in water depths varying between 1,200 meters and 1,500 meters, the damage to the risers was at 1,300 meters making this one of the deepest repairs ever attempted and with the risers secured in the bundle near the base of the tower, would require a completely new repair strategy.

Hydratight’s track record for supplying remote mechanical connectors is unparalleled within the industry so the challenge lay not with the design of the permanent repair method, but the means of installation. The damaged pipe would have to be released from the riser bundle, the coating would then have to be removed and the correct cuts made. Without overstressing the riser, the connector would then have to be aligned, installed, activated and tested allowing the new flexible jumper bypass to be attached.

To support the repair, a high-load structural clamp would have to be permanently fixed to the riser bundle, providing a means to limit the motion of the new repair spools. All work would need to be conducted by ROV in 1300mwd, a mere 50 meters above the seabed which further increased the level of difficulty.

The Solution
Working within a formal collaboration, Hydratight and CSS developed a bespoke solution to meet these challenges. Through supplying both the connector and the installation system under the same contract, the Collaboration was able to develop the systems alongside one another—ensuring that the key interface points were carefully managed to reduce operation risk and increase the level of assurance provided to the project.

A complete solution was designed, tested and supplied; the high load clamps and remote clamp installation tools, the coating removal tools, the connectors and the alignment and installation frames. To enable the repair to take place, other new systems needed to be developed, including a 3D buoyancy milling tool that could machine enough space in the buoyancy to enable the risers to be accessed. All equipment had to be ROV compatible and supported with an ROV skid and control systems.

The decision was taken to supply two connectors with two remote installation frames. One spare production connector would also be supplied as a contingency measure along with a dedicated test connector.

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Neil Forster
Project Lead for the Operating Company

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The Operator and partners had to be convinced of the permanency of the repair solution, which took detailed analysis, extended testing, documented and video evidence as well as various levels of technology review. The use of a metal graphite composite seal was a key differentiator as it has been proven superior to an elastomeric seal.

The Project
Hydratight built the connectors at its Axcess 10 headquarters in the UK before an eight-week Extended Factory Acceptance Testing program at an independent facility. This stage included 12 pipe activations, hydrotests, gas tests, temperature/pressure cycling and external load application. The connectors then travelled to Norway for site integration testing, when a production connector was interfaced with CSS’s installation frame and tooling. The final stage was shallow water testing involving the use of an ROV to remotely activate and hydrotest the complete system.

The regulatory process from the operator and industry bodies required a stringent Technology Readiness & Acceptance process to ensure the technology was mature. Video animation was provided to detail each step of the repair process and showcase the planned operations to mitigate any risks at an early stage.

“Hydratight and CSS provided an excellent technical solution to a very challenging problem. Project management and engineering was excellent throughout, with elements of the project delivered against a very tight time frame. The testing regime was well planned and managed and the tools and hardware worked as per design, achieving the functional requirements without re-work” said Neil Forster, Project Lead for the Operating Company.

Once in location, the system was deployed over a one month timeframe during favorable weather windows, leading to the successful repair of both risers. The installation became an innovation milestone for the industry. It was a vertical, deepwater, high pressure repair with specific design requirements, environmental challenges and legislative scrutiny.

“In partnership, both Hydratight and CSS proposed innovative solutions to a complex riser repair project. They prepared a robust testing program which provided confidence to successfully perform the repair on a live system. The delivery was underpinned by very good project planning and execution” stated Wadih Malouf, Subsea Engineer for Operating Company.

“This transferred through to the field, where the tooling and connectors performed very well and achieving first time leak tight connections on both connectors” added Mr Forster.

Overall, it was a project the team was proud to be part of and has raised the bar in terms of what is possible with this technology and expertise.

For more information, visit hydratight.com.