

Oceaneering Completes Water Injection Pipeline Repair at Field Offshore Angola

Successful repair enables customer to resume operations and enhance production



Project Overview

In April 2018, an ROV survey detected a leak on a water injection (WI) pipeline located in a deepwater field in the Gulf of Guinea. The field, located approximately 150 km offshore Angola, has water depths ranging from 1,170 and 1,410 meters.

To rectify the leak and bring the pipeline back into service, Oceaneering was contracted

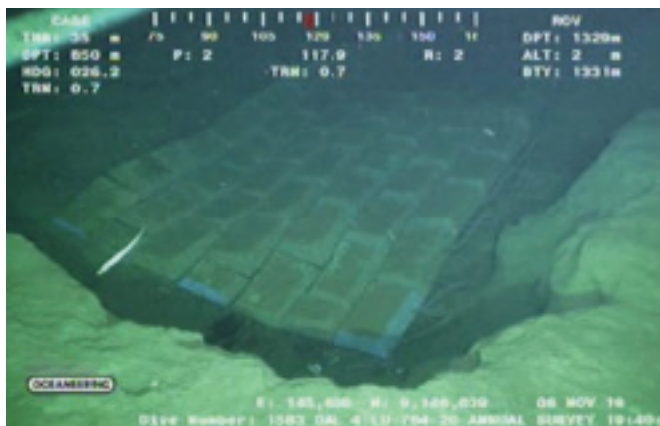
to supply two 12 inch Smart Clamp repair clamps and provide all supporting functions to successfully execute the project scope. This included Oceaneering® Millennium® Plus ROVs, ROV tooling, pipe preparation, site preparation, and subsea inspection services. The pipeline repair scope was completed between December 2019 and February 2020.

Challenges

The project presented a number of unique challenges including seabed condition, pipe weld location, additional pipe defects near the pipe clamp installation locations, and remaining pipe wall thickness.

Seabed Conditions

The seabed conditions in both repair locations was similar and was composed of very soft, highly-plastic clay. The water content was near 120 percent with a plasticity index of 100 to 130 percent. These conditions dictated the requirement for significant site preparations including the use of grout bags and concrete mattress installation.



Pipe Weld Location

Oceaneering reviewed the risk of a potential pipe weld clash at the proposed installation location of the pipeline repair clamp. Cross referencing the data provided by the client, the team established that there was a high risk that there could be a weld at one of the sealing locations of the repair clamp. The project team made the client aware of this information, and, as it transpired, the weld location did not affect the clamp installation.

Identification of Additional Pipe Defects

As part of the project, an inspection of the WI lines was completed. The Post Inspection Interim Report identified the possibility of an additional pipeline defect approximately 480mm downstream from the first pipeline repair location. Another weak spot was identified 520mm downstream from the second repair location. While we notified the customer of these anomalies, they did not affect the team's ability to complete the repair operations.

The Oceaneering Solution

Coating removal at the repair locations was a critical part of the immediate engineering scope. The affected pipeline had an outer diameter of 12.75 inches, was manufactured of carbon steel, and coated with 0.15mm fusion-

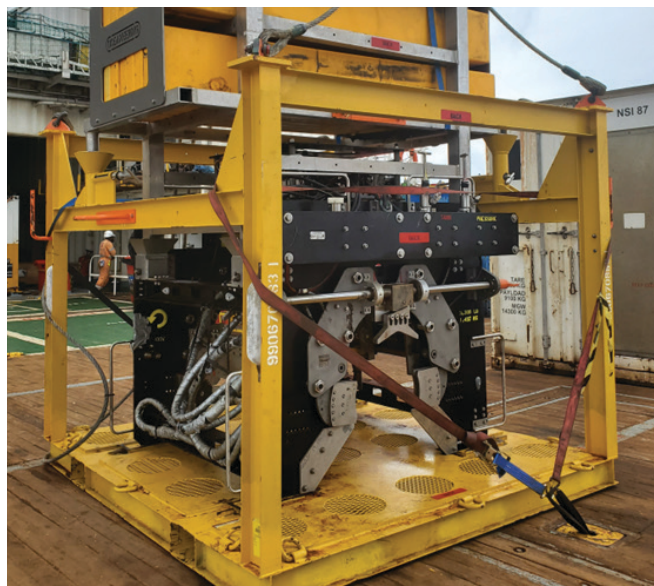
bonded epoxy, 0.20mm of adhesive, and a third layer of 17.50mm polypropylene.

Oceaneering considered several coating removal tools to complete the coating removal, including high pressure jetting; however, due to the operational water depth, the need for a mechanical coating removal tool was identified. Oceaneering completed the design and fabrication of a purpose-built coating removal tool capable of removing the 17.85mm polypropylene coating.

Due to the client's short schedule requirement, the Oceaneering team modified an existing coating removal tool that had similar specifications and geometries to the pipelines in question.

The coating removal tool was designed to remove the coating in three steps.

- » Step 1 – Milling module to remove polypropylene coating
- » Step 2 – Wire brush module to remove remaining polypropylene
- » Step 3 – Abrasive wheel module to remove fusion-bonded epoxy layer



The tool was re-engineered and tested in Q2 and Q3 of 2019 and shipped to Angola in October 2019.

The project also required that finite element analysis (FEA) was completed based on a thinnest wall thickness scenario. The FEA was used to confirm the ability of the pipeline to withstand the seal load applied by the repair clamps, which it successfully did.

The Smart Clamp repair solution is a standard, in-stock product supplied by Oceaneering and the two clamps were mobilized from Houston to Angola in 2018 ahead of project execution. The offshore campaign started in December and lasted till beginning of 2020 with a successful installation of the two Smart Clamps.

Execution Plan

The WI pipeline repair scope was completed between December 2019 and February 2020. The clamps were successfully installed and the WI line was pressure tested in February 2020.

The preparation and installation of the clamps was performed in three phases.

» Phase 1 - Completed Q4 2019

The objective of Phase 1 was to prepare the seabed around the leak areas. This included excavating, using a grout bag to fill a crater at one of the repair locations, and the installation of concrete mattresses at both locations. The seabed was stabilized to ensure it was able to bear the weight of the clamp installation frame and the ROV's impact while it was working in the vicinity of the pipeline during clamp installation tasks.

» Phase 2 - Completed December 2019/January 2020

The objective of phase 2 was to prepare both repair locations on the pipeline for installation of the Smart Clamps. The preparation included coating removal, surface cleaning, and pipeline straightness checks. During phase 2, the pipeline, at both locations, was returned to bare metal finish in clamp installation areas.

» Phase 3 - Completed February 2020

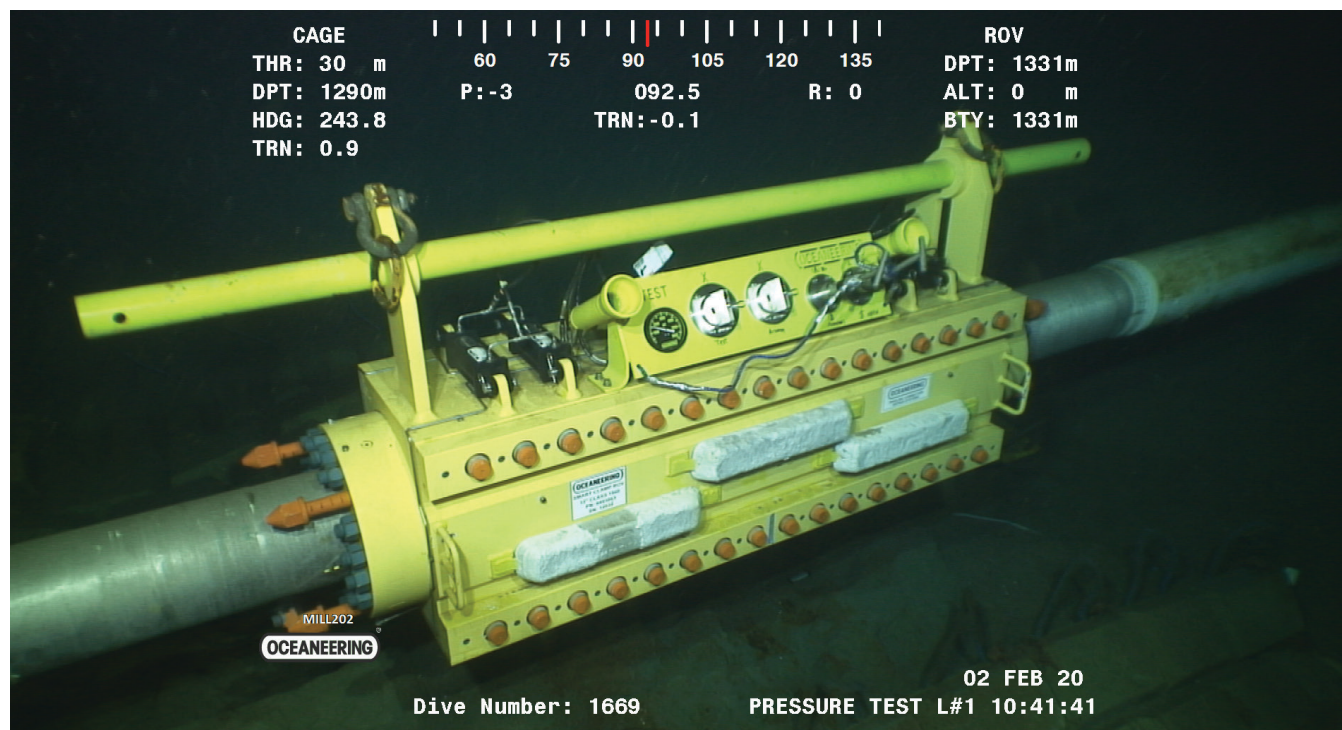
The objective of phase 3 was the preparation and installation of the 12 inch repair clamps. The phase included the inspection and spot cleaning of the pipeline surfaces, as required, clamp installation, and clamp seal verification.

Challenges

During the project's onshore preparation phase and the offshore execution phase, the engineering team faced several challenges that required innovative solutions to ensure the client's tight project schedule was maintained.

One of the biggest and most important involved securing a sample or replica of the WI pipeline being repaired. The team needed to establish that the coating removal tool's design and functionality was suitable for the job, and having a sample was critical. Unfortunately, a direct match could not be sourced. The team was able to prove the design of the tool by splitting testing into stages and testing functionality in discrete packages.

While offshore, the coating removal tool did encounter a few small hurdles, all of which the Oceaneering team was able to rectify while on the job.



Results

The two Smart Clamps were successfully installed and passed subsequent pressure testing in February 2020. This enabled the client to bring the WI line back online at reduced pressure.

The latest inspection reports issued post clamp installation identified additional anomalies located on the WI line which will be addressed in 2020.

Project Highlights

This project marked the deepest global repair using an Oceaneering diverless Smart Clamp. The clamps also boasted the highest pressure rating (138bar / 2,000psi) of any Smart Clamp installed to date. The clamps were successfully installed on laminated pipelines with very thin wall thickness without the need for any specialized ROV tooling. The expedited installation time of the clamps (one day from

overboarding to installation) ensured project deadlines were met.

The integration and effort of all teams from various Oceaneering service lines proved pivotal to the project's success. By leveraging the expertise and experience of Oceaneering team members based at global locations and support from the locally-based team in Angola, the project was completed successfully.



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