

Oceaneering Completes First Resin-Only Permanent Abandonment Operation in Gulf of Mexico

Innovative Resin-Based, Single-Vessel Intervention for Challenging Deepwater Well Proves Successful



Project Overview

Oceaneering was contacted by a client who required intervention to complete the plug and abandonment (P&A) of a well located in the Gulf of Mexico. The well's integrity was a primary concern and posed significant challenges. An increase in sand production prompted the P&A, but significant

soil erosion around the wellhead further complicated the project plan and its execution. Due to the complex nature of the failure and limitations on the methods available to complete the well kill, an innovative approach was needed.

Issues

While planning the permanent abandonment, several unique risks were identified that required the need to explore unconventional abandonment methods. The main concern was the significant soil erosion around the wellhead. This created structural integrity concerns, and the operator was unsure if the wellhead could withstand the load from attaching a blowout preventer (BOP) to the production tree or wellhead.

The subsequent absence of a BOP, coupled with commutative reservoir pressure, meant that abandonment material needed to be pumped down the production tubing and squeezed into the formation. Further complicating matters was the presence of an obstruction in the flow path that had the potential to limit the injection rate.

The project challenges were substantial, and required detailed planning and precise execution to ensure that a safe and effective well kill was completed.

The Oceaneering Solution

To overcome the challenges posed by the well, the isolation fluid needed to be resilient and to flow around the identified obstruction without separating and packing off. Oceaneering worked with the client to identify possible isolation materials, and compared them against the following performance criteria:

- » Minimal acceptability to contamination with CaCL/CaCr brine
- » Ability to squeeze through small clearances without bridging
- » Mechanical properties sufficient to act as a permanent barrier

Conventional cement, micro-cement and resin were identified as material options, and each of these prospective solutions underwent evaluation to determine their suitability to perform the task.

Resin was identified as the preferred treatment material. Resin's chemical composition results in immiscibility in water-based fluids; therefore, it would not experience any effects from CaCL/CaBr

brine contamination. Also, because resin's liquid phase provides the set mechanical properties, it will still provide isolation below the depth at which bridging occurs.

Once the resin was selected, Oceaneering collaborated with the client's resin provider, CSI Technologies, to develop a single-vessel-based intervention campaign using the **Oceaneering®** Well Stimulation Tool (WST).



Execution Plan

The project required significant planning and testing, as well as approval from the U.S. Bureau of Safety and Environmental Enforcement (BSEE). The activities of the pumping procedure were extremely detailed, and were broken into three distinct categories: displacement of the well to kill-weight brine (KWB), pumping of the resin-based sealant, and completion of pressure testing. Timing, measurements and dissemination of the project plan and its steps were instrumental in ensuring that the plan could be completed as outlined by the project team.

Part of the project plan included seeking regulatory approval to use resin in this application. At the time, cement was the only isolation material recognized by regulations. The client and CSI Technologies completed months of laboratory testing to ensure that there were no compatibility issues and to confirm hardening times over various temperature extremes. It was imperative that they could ensure that the resin would not harden in the topside equipment, well stimulation tool or tree hardware. The client and CSI Technologies

presented laboratory test results and case studies where resin had been used. Strong arguments for the use of resin in this scenario, supported by data, resulted in an exemption being granted to proceed with the first deepwater resin-only permanent abandonment in the Gulf of Mexico.

The approved abandonment plan was to pump 35 bbl of resin down the production tubing. In an attempt to keep the resin at static conditions after placement, Oceaneering first displaced the entire well to 11-ppg brine and checked the pressure at surface. This pressure at surface allowed the exact KWB to be calculated. KWB was then used to displace the resin treatment to ensure that no additional resin was lost into the formation after displacement.

Once the resin was in place, and after the allotted resin hardening time, testing was completed to ensure that the method was successful. The onsite team was then demobilized, thus successfully ending the well kill campaign.

Mobilization of the project began on January 26, 2016, and the project was fully executed, inclusive of a successful plug test, on February 9, 2016.

Challenges

There was some regulatory uncertainty about the use of resin in a P&A operation, as this was the first-ever BSEE approval for the use of resin in a Gulf of Mexico well kill campaign. The project required modifications of topside pumping, mixing and blending equipment prior to mobilization. Because resin is a dry chemical, it required appropriate blending equipment that was capable of mixing the two-part chemical, along with the addition of fluid to complete the resin mix.

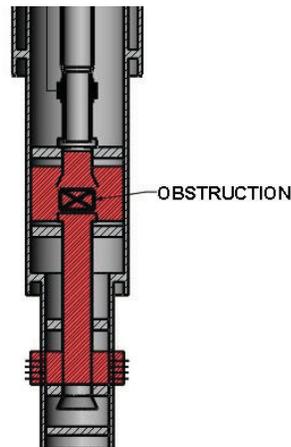
Execution of the well kill was performed during the winter months, which introduced weather concerns, as severe sea-state weather would have postponed the job. The weather was continuously monitored to ensure that the Oceaneering team had at least a 24-hour window to start and finish pumping operations. A partial resin pump would have been detrimental to the project, and would have resulted in the operation having no other

means of adding more resin.

In the absence of a BOP, the Oceaneering® WST and controls had to be configured for an alternate interface to the tree, while not imparting excessive loads to the current tree or wellhead and while also still meeting BSEE well control requirements.

Project Highlights

After successful positive and negative pressure testing, the first resin-only permanent abandonment operation was completed. Resin's unique characteristics allowed the operator to pump it down the production tubing and to squeeze it into the formation in order to abandon the well without compromising the wellhead's structural integrity. This operation ensured safe and environmentally responsible abandonment operations. The latest evaluations in rigless abandonment, combined with an innovative resin-based sealant, overcame this well's abandonment challenges, while also being both financially and environmentally responsible.



Results

The project was completed under budget and ahead of schedule, and saw zero equipment downtime during pumping operations. Real-time monitoring of the tree, well, and WST was supplied to the onshore team to ensure the functionality and safe execution of the project's activities. The use of resin resulted in 100% proven reservoir isolation and gained BSEE approval.



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