Case study: Caspian Sea, Russia

Integrated solution delivers 4-well, multistage hydraulic fracturing completion 8 days ahead of schedule

To confirm reserves existed for production, an operator needed to complete and stimulate four pilot wells in the Caspian Sea's Filanovsky oil field. The low-permeability reservoir contained weak formations consisting of poorly cemented sandstone in the rock matrix. Long, horizontal, extended-reach sections with complex lateral trajectories would be required to determine the best potential completion strategy and optimize the completion design for the gas and water injectors and oil producers.

Aside from the typical offshore delivery challenges and the confined space on the rig deck, this operation was conducted during the COVID-19 pandemic that closed the region's borders. As such, the field personnel on site were required to remain on the rig and conduct all operations, as no additional personnel would be able to reach the rig site.

Aligning the well plan

Engineers from both the operator and Baker Hughes collaborated and laid out the best solution. To optimize injectivity and production, Baker Hughes technical experts agreed that a multistage hydraulic fracturing treatment was the best course of action.

Given the conditions downhole, the two teams realized they needed a unique completion system designed specifically for this project that combined both reclosable frac sleeves and sand screens. Coiled tubing would be required to clean out the wellbore, manipulate the production screens and frac sleeves, and for gas lifting operations. To ensure full lateral reach in the four wells while enabling the selected completion strategy, a robust, 2 ⅝-in. coiled tubing unit with oversized pipe capable of extended-reach and force manipulation operations would be required.

Designing the solution

A major contribution to the project's success was the planning and preparation that leveraged the Baker Hughes Project Readiness Assessment (PRA) process. The Baker Hughes team, in collaboration with the operator, held regular meetings to update the progress, identify and assign action items, and discuss operational readiness.

To address reliable proppant placement and the subsequent fluid production, Baker Hughes designed a series of frac ports and sand control screens with shiftable sleeves. The multistage downhole equipment was rated to withstand multiple cycles of hydraulic fracturing pressures and the opening and closing of the sleeves to maintain pressure integrity.

For the hydraulic fracturing aspect of this campaign, Baker Hughes recommended the delayed **Spectra Frac™ G seawater fracturing fluid system**. This high-performance guar polymer borate-crosslinked system is ideal for conventional fracturing operations in high-shear environments or underpressured formations like the one in the Filanovsky oil field.

Challenges

- Complete and stimulate 4 pilot wells to prove reserves
- Determine the potential completion strategy for a low-permeability reservoir
- Establish a strategy for future field development
- Manage COVID-19 restrictions

Results

- Completed all four wells 8 days ahead of schedule
- Proved the presence of reserves in the reservoir
- Mitigated COVID-19 travel restrictions via remote operations
- Experienced no HSE issues or NPT

Baker Hughes used the **CIRCA™ coiled-tubing software** to model and optimize lateral reach as well as to design the subsequent intervention operations.

The high-strength, damage-tolerant **BakerMesh™ sand screens** provided a simple, reliable, and effective method of preventing sand ingress while maximizing hydrocarbon production. Specialized **CMD™ non-elastomeric sliding sleeves** ensured optimal sleeve performance after multiple opening/closing cycles.

Executing with predictable performance

The operator and Baker Hughes executed the well plan in two phases. Phase one consisted of the drilling, completion, and testing, and lasted for five months. The four-month long phase two focused on the multistage hydraulic fracturing treatments in the four wells.

Field personnel pumped 32 multistage fracturing treatments using the delayed Spectra Frac G seawater system in conjunction with a standard proppant. Due to platform deck limitations, the stimulation equipment was located on a pontoon barge positioned adjacent to the platform. The seawater-based system helped reduce logistics, a key factor in offshore operations.

The sand screens remained closed during the fracturing operation and opened after fracturing was completed. In the open position, the teams were able to evaluate how the wells flowed naturally. A key feature of the BakerMesh sand screens was the ability to open the screens on command several months after installation, validating the screens' durability to withstand the pressure drops, rises, and other variations over time.

To address the challenge of COVID-19 travel restrictions and the inability of certain specialists to travel to the rigsite, Baker Hughes implemented an alternative solution. During the installation phase, smart helmets were used with real-time video/audio capabilities that allowed communication between the field personnel at the Caspian Sea offshore location and Baker Hughes experts in global technical support centers. This continuous technical support significantly contributed to the success of the project.

The four pilot wells were successfully completed and stimulated, helping the operator prove hydrocarbon reserves were in place. Additionally, the methodology used for this stage laid the groundwork for future completion designs.

Despite the offshore environment and COVID-19 protocols, Baker Hughes completed the project eight days ahead of schedule, incurring zero HSE incidents and zero NPT. The evaluation is ongoing, but the operator is planning to move into the development phase using an optimized completion strategy based on the lessons learned from the project.

Baker Hughes