

Case study: Middle East

First abrasive perforation restores productivity in highly sour oil well, saving 15 days and \$4.3 million USD

An operator of an offshore, extended-reach well experienced casing collapse at the beginning of the horizontal section. The collapsed casing closed off the productive section of the lateral behind it. If left in this state, the production decline could eventually force the operator to abandon the well entirely.

The operator considered a sidetrack operation to restore the well's production rate. But due to the fixed surface location and close proximity of active producing wells, a sidetrack would be a complex, time-consuming, and expensive operation.

The highly sour nature of the reservoir posed further health, safety, and environmental (HSE) risks to the well intervention operation.

The operator originally approached another service provider to perform detailed well diagnostics using a coiled tubing unit (CTU). However, the high angle from the vertical to lateral,

coupled with the 26,000 ft (7925 m) MD of the well, prevented the competitor from accurately locating the collapsed casing point.

The operator asked Baker Hughes **Integrated Well Services (IWS)** for an alternative solution to get the well back into production, at minimal cost and risk. Baker Hughes was the operator's approved integrated rigless solutions provider and had a proven track record of designing and executing challenging intervention operations.

Aligning on the well plan

The Baker Hughes IWS team accepted responsibility for managing the full scope of this project.

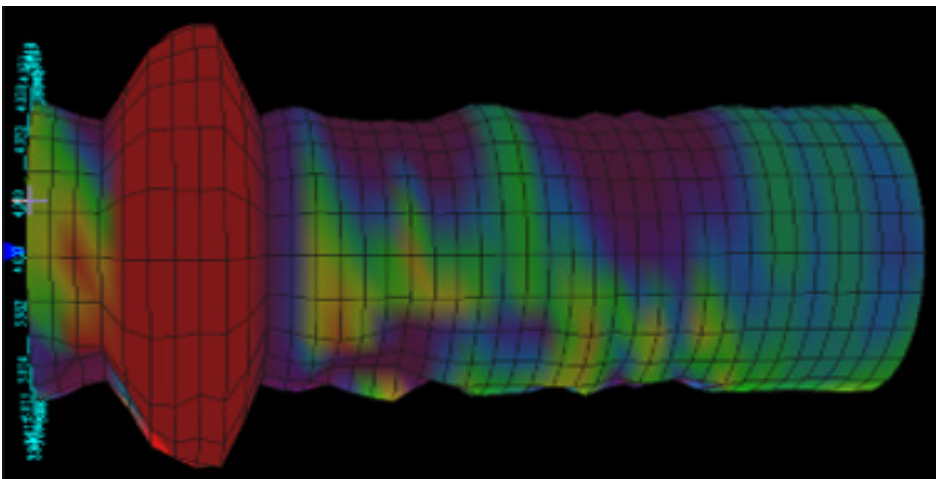
IWS proposed a solution in partnership with the operator: using a nonexplosive, sand-jet abrasive perforation technique via CTU to bring the well back into profitable production rates—without compromising HSE or well integrity. This technique transports

Challenges

- Offshore, deep extended-reach well was underperforming due to inactive completion compartments
- Reinstatement well production without compromising HSE, well integrity, or well costs
- Highly sour reservoir added challenges for sand management, well diagnostics, and intervention

Results

- Saved 15 days of rig time and \$4.3 million USD
- Avoided the need for a complex and expensive sidetrack operation
- Restored production to profitable levels with 100% HSE compliance and zero nonproductive time



A 3D image of processed data from an MFC log indicating liner collapse.

a low concentration of abrasive material in a viscous fluid through the coiled tubing. The abrasive fluid exits a specially designed nozzle assembly as a high-velocity jet. This fluid jet impinges on the casing to create a perforation that opens productive sections of the formation to the wellbore.

While the solution is well known and widely applied in unconventional wells, this marked the first application for the operator in a highly sour offshore oil well.

Designing the solution

IWS worked closely with several Baker Hughes product lines, and both internal and external service partners, to develop a fully integrated solution for the well. The Wireline and CTU product lines performed a diagnostic intervention to confirm collapse of

the liner at the heel of the lateral. IWS also worked with **Reservoir Technical Services** and the operator's reservoir teams to gain a full understanding of the sour formation and review completions in previous wells to align on the final perforation solution.

Excessive sand production posed plugging and erosion concerns, both downhole and at the surface. Advanced solids transport modeling guided the job design to mitigate sand-related risks and ensure accurate and safe operations. The engineered design review called for an additional sand separator at the surface as an extra HSE precaution.

For further safety assurances in this highly sour well environment, IWS and the operator conducted a two-day HAZOP workshop prior to the start of work. This multidisciplinary workshop, chaired by independent, third-party

consultants, brought all project stakeholders together to evaluate the potential safety risks of each step of the operation. As a result, all parties planned their activities to ensure high efficiency and 100% adherence to the operator's HSE goals.

The full abrasive perforation assembly was deployed downhole via CTU to the desired depth. The sand/fluid mixture was prepared at surface and then immediately injected through the coiled tubing string to perforate the casing and open access to the formation.

Executing with predictable performance

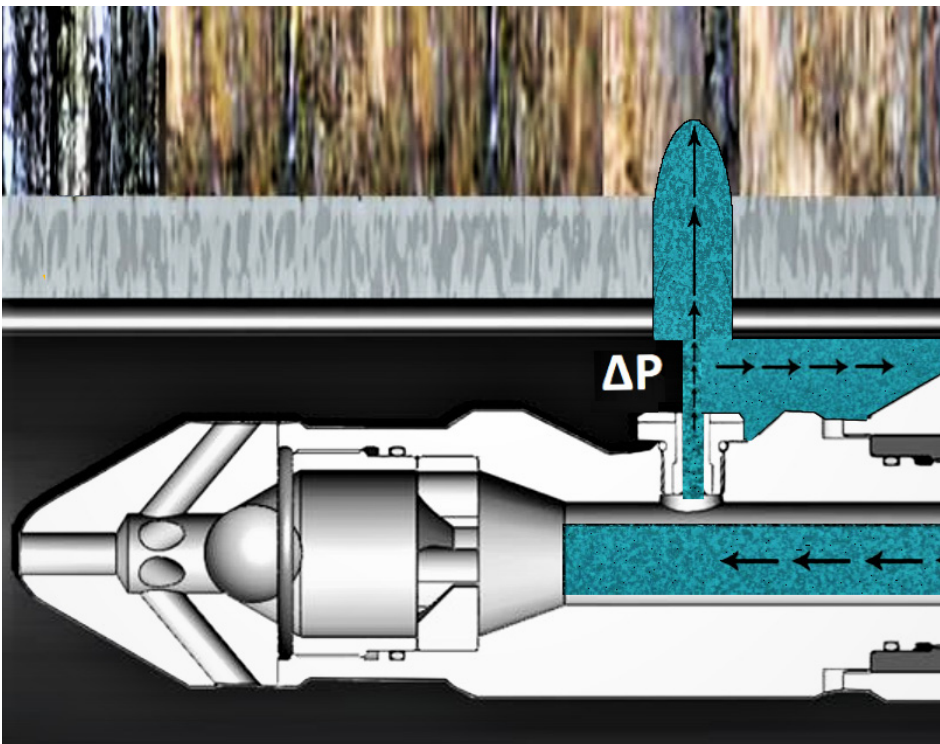
The integrated abrasive perforation job, the first of its kind for the operator, successfully restored the well to 85% of its original production levels.

IWS and the operator worked together to execute the operation with 100% compliance to HSE metrics and with zero nonproductive time.

The operation saved 15 days of rig time by avoiding a conventional sidetrack operation to restore productivity. This saved the operator \$4.3 million USD in the process.

The operation proved that the nonexplosive abrasive perforation technique delivers a safe, reliable, and cost-effective solution for restoring production in deep, extended-reach wells.

The job opened doors for simple rigless intervention methods over conventional rig-based solutions. The operator now has the confidence to deploy this solution in collaboration with the Baker Hughes IWS team in future wells.



A cross section of the abrasive perforation nozzle.

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