

Case study: Offshore, United Arab Emirates

EasyReach lubricant enabled CT intervention in deep sour wells without extended-reach tools

An operator working in the offshore artificial islands of the United Arab Emirates (UAE) wanted to perform a coiled-tubing (CT) intervention in an extreme lateral producer to push balls of various composition to total depth (TD). Clearing the wellbore to TD would allow access for further intervention in the well for additional investigation. The balls had been dropped inside the wellbore during the completion phase to land in the float collar and help pressurize the wellbore internally to open the 4 ½-in. inflow control devices (ICD).

For this sour well, Baker Hughes provided an engineered hydrogen sulfide (H₂S)-compatible, 2-in. outside diameter (OD) tapered wall thickness CT string. Software simulation predicted that CT could intervene only to 22,000 ft (6705 m), still short of TD.

Baker Hughes proposed the **EasyReach™ extended-reach coiled tubing lubricant**, a metal-to-metal mechanical friction reducer that helps coiled tubing gain access to long wellbores previously unreachable, even with conventional coiled tubing lubricants. **CIRCA™ coiled tubing simulation software** analyzed tubing forces and lubricant effectiveness to deliver confidence that running the job with the 2-in. CT without waiting for the extended-reach tools or larger CT size (unavailable at that time) was possible.

Coiled tubing was run in the hole with frequent circulation breaks and pull tests until 9,000 ft (985 m). From 9,000 ft onwards, the EasyReach

solution in brine was pumped continuously at 0.3 to 0.5 bpm until a holdup was observed at 22,484 ft (6853 m). The CT was picked up, the pump rate increased to 1 bpm, until the CT reached a TD of 24,359 ft (7424 m). After this run, a diagnosis with a wireline tractor proved unsuccessful as it was unable to reach TD. Thus, several CT memory logging runs (production and corrosion) were performed while pumping the EasyReach solution in brine/water from 9,000 ft onward until TD. The CT was able to gain 100% accessibility in all the runs, enabling critical logging measurements. Based on these results, the customer was able to make improved decisions for future interventions in this well.

After completing operations on the first well, the CT engineering team performed post-job force-matching simulations with the CIRCA software. The results showed that intervention to the achieved depth was made possible only because of the EasyReach lubricant's coefficient of friction (CoF) reduction properties. The ICD liner section CoF was reduced to 0.23 (from a maximum of 0.35 to 0.40 observed in previous wells), a reduction by 35 to 43%. In the runs where the lubricant was pumped from the surface, the upper completion experienced a reduction of 31%, down to 0.18 to 0.19 from a maximum of 0.26.

With the first well operation complete, the customer had to perform a second challenging intervention in an even deeper well. This was the longest well

Challenges

- Perform well interventions in two long horizontal producer wells with 4 ½-in. ICDs and pre-perforated liner sections
- Execute the intervention with 2-in. OD coiled tubing, which, without assistance, could not reach the requisite depths
- Overcome high and unknown CoF

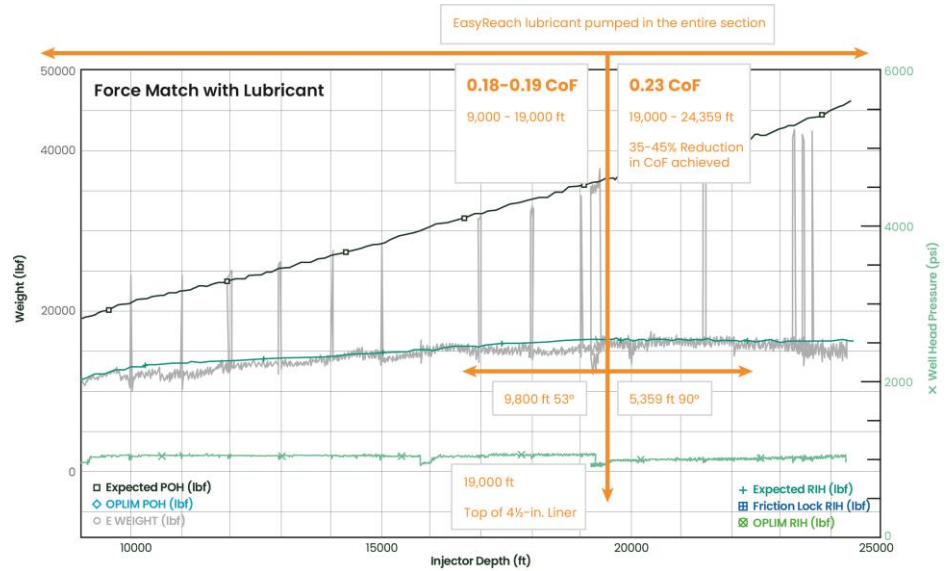
Results

- Achieved desired target depths of 24,359 ft (7424 m) and 26,400 ft (8046 m) on the wells intervened
- Realized maximum CoF reduction observed or obtained approaching 50%
- Enabled customer to perform the first vessel-based job from the jetty, and the largest stimulation job
- Eliminated the need for third-party extended-reach tools—and the downtime waiting for them to arrive—enabling operations to be conducted 2 weeks earlier than planned
- Reduced operational risks
- Experienced no health, safety and environmental (HSE) issues or NPT

drilled in the field with a significant lateral length greater than 16,800 ft (5120 m) with deviations in the range of 75 to 90°. The plug back total depth (PBSD) was 27,086 ft (8255 m). The customer had planned the largest acid job in the field utilizing a vessel-based approach for the first time. Intervening this well to the required depth was a critical component of the entire operation. The success of earlier interventions gave the customer confidence in the EasyReach lubricant's efficacy and Baker Hughes was granted this well displacing other CT competitors.

The CIRCA simulations predicted frictional lock up at 25,900 ft (7894 m), 500 ft (153 m) short of TD/maximum achievable depth due to CT length. With no previous experience of intervening such deep wells with 2-in. CT and a high budget operation in a well with an expected higher but unknown CoF, the customer faced significant uncertainty in the planning phase. Results from this intervention illustrated the lower completion with pre-perforated liner saw a reduced CoF of 0.14 with the EasyReach lubricant (typical CoF values in the pre-perforated liner are 0.30 to 0.35), a reduction more than 50%. Well two consisted of over 15,500 ft at greater than 75°.

The customer's CT successfully reached TD using a simple bottomhole assembly (BHA) without the use of any extended-reach tool, saving the customer nonproductive time (NPT) waiting on third-party tools, eliminating the rental/service costs, and saving on the costs of existing tools and services sitting idle. In addition to adding value to the customer, Baker Hughes decreased the applied fatigue to the coiled tubing by eliminating an extended-reach tool from the BHA to reduce the CT circulation pressures during movement.



The graph (from well 1) illustrates a plot scaled from 9,000 to 25,000 ft., with the PBSD at 24,383 ft. The graph shows a CoF of 0.18 to 0.19 in the tubing section (upper completion) and the CoF of 0.23 in the liner section with ICD (lower completion).