

Case study: Captain Field, North Sea

EasyReach Lubricant enabled intervention in horizontal, sand-screen-completed well

An operator working in the North Sea was experiencing scale buildup in a sand-screen-completed horizontal injector well. The customer needed to remove the scale and acid wash the screened injection zones. Because coiled tubing (CT) had never been used to intervene in the well, the native friction between the coiled tubing and the completion had not been established. The well was completed with 5 ½-in. tubing reaching from surface to 6,340 ft (1932 m), and a 6 ⅝-in. sand screen running from the end of the tubing to total depth (TD) at 11,000-ft (3353 m).

The operator conferred with at least one provider, and was advised that CT intervention to TD in this well was not feasible. But before giving up on the plan, the operator asked Baker Hughes for an independent technical assessment of the operation's feasibility.

It initially appeared that, because of the well's long sand screen section and large completion size, excessive friction would prevent the CT from traveling to the full measured depth. Using **CIRCA™ modeling and simulation software**, Baker Hughes determined that running the bottomhole assembly (BHA) on 2-in. CT would result in friction lock at around 9,500 ft (2896 m). This created concern that, as the CT was pushed deeper into the well, its relatively small size compared with the larger completion would allow it to helically buckle from the friction caused by the sand screen.

Though a larger CT could potentially mitigate this risk, lifting limitations of

the crane at the wellsite meant the operator could not move a reel of any CT larger than 2-in.

The CIRCA model also showed that reducing the coefficient of friction (CoF) by 25% would enable the BHA to reach total depth. A metal-to-metal lubricant might accomplish this, but there was very little existing data for determining how well a metal-to-metal lubricant would work across the sand screen.

Given previous successes, Baker Hughes proposed adding **EasyReach™ extended-reach CT services** to reduce the CoF and improve well access. The EasyReach service has been proven to reliably overcome friction, enabling CT operations to access previously unreachable depths in long laterals.

As the job was planned, Baker Hughes added EasyReach lubricant and hammer tool properties to the initial CIRCA models. The team also tested and verified that the lubricant was compatible with the sandstone acid and the 15% hydrochloric acid blends being used for the acid wash. Live and spent acids were tested, and all modeling indicated that pumping the EasyReach lubricant would enable access to the 11,000 ft TD.

Onsite, CT was deployed into the well with a BHA consisting of a 2½ in. **RotoJet™ jetting tool** and a 2⅞-in. EasyReach fluid hammer tool. The hammer tool was run as a contingency option for extending reach even further if the lubricant proved insufficient. In the initial run, EasyReach lubricant was spotted in the build and lateral sections of the well (from 3,000 to

Challenges

- Clean scale, acid wash, and log a purportedly unreachable lateral
- Accommodate crane limitations by intervening with maximum CT size of 2-in.
- Mitigate the CT tendency to helically buckle across the comparatively large wellbore
- Overcome increased friction caused by sand screens

Results

- Delivered scale cleanout, acid washing, and logging operations by reducing CoF by more than 40%
- Saved 6 hours rig time and 220 gallons of lubricant by performing on-site force-matching between runs
- Prevented CT helical buckling and BHA friction lock
- Enabled operator to conduct a successful similar intervention on a second, nearby well

11,000 ft) while running in hole. After force matching the actual job data from the run, the team determined that the lubricant alone had reduced the CoF by 40 to 50% (figure 1), without needing to engage the hammer tool. Because of this result, the lubricant pumping schedule for subsequent runs was adjusted: lubricant would only be spotted between 6,340 ft (1932 m) and 11,000 ft. This reduction saved the customer from pumping a total of 220 gallons of lubricant, eliminating an estimated 6 hours of rig time.

After the acid wash operation concluded, the operator ran production logging tools to assess water injectivity through the sand screen. After logging was complete and all lubricant had been displaced from the well, the decision was made to assess whether

the operation could have been completed without lubricant. CT was run in hole, and the surface weight gauge was continually monitored. From 6,200 ft to 7,500 ft (1889 m to 2286 m) the CT friction levels were notably higher than they had been in lubricated runs. At 7,500 ft, enough data had been gathered and the CT was tripped back out of the hole.

Engineering personnel force matched the data from this run, and compared the results to the CoF inputs in the pre-job CIRCA models. This data confirmed the initial friction estimates and further validated that the EasyReach lubricant had reduced the friction and made the intervention possible (figure 2).

Because of the lubricant's performance, the customer asked

Baker Hughes to intervene in an additional well with a similar scope of work. The team added data from the first well to the CIRCA software models to further improve lubricant use and CoF reduction. The matched CoF yielded a similar 40–50% reduction in friction for the subsequent well.

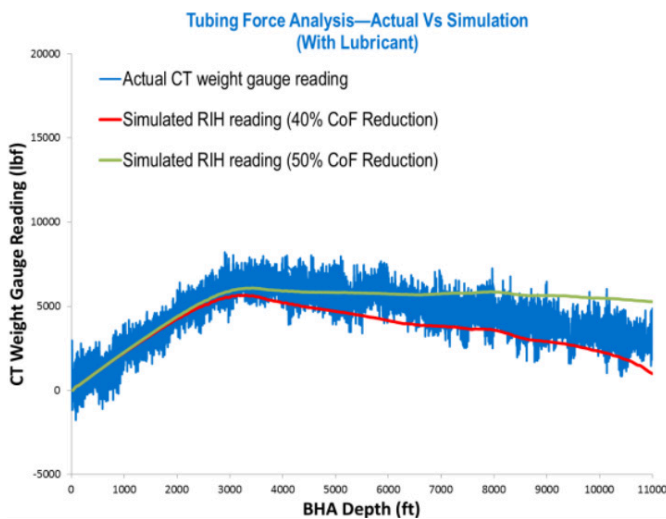


Figure 1. Post-job force matching with the CIRCA software validated that the lubricant reduced friction between from 40 to 50%.

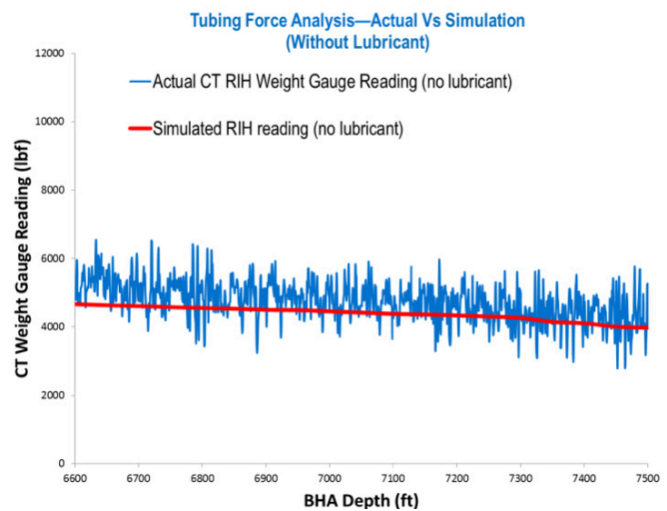


Figure 2. Initial CIRCA models were validated with no lubricant in the wellbore, helping strengthen the job models and enable better planning on the next well.