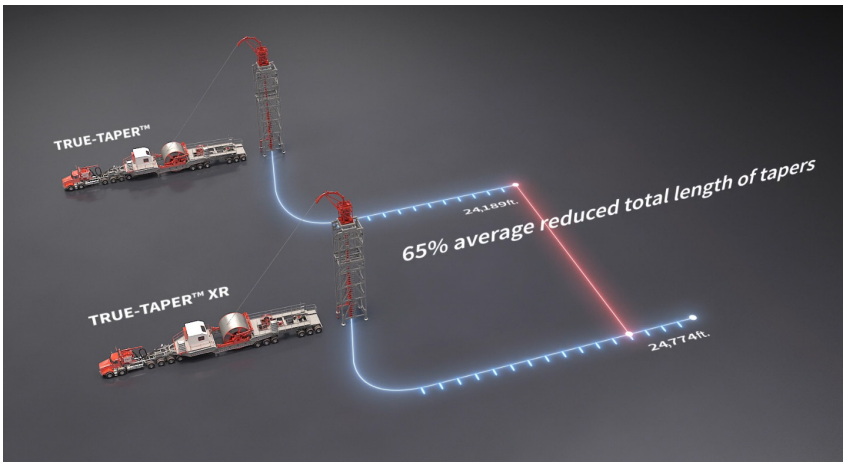
Case Study

TRUE-TAPER XR Helps Achieve Record Depth



Background

The success of deep plug mill outs depends on the job design, planning, and execution of the procedure to complete the objectives required. Paying attention to the details before the job begins allows for the greatest chance of success.

A customer in the Delaware basin had an objective to mill out a total of 78 plugs in a well measuring 26,785 ft with a 15,973-ft lateral and other challenging design features. Of the 78 plugs in the well, 64 were composite and the remaining 14 were dissolvable plugs. A fish was also among the 14 dissolvable plugs, and part of the objective was to push the fish as far downhole as possible.

The uncommon geometry of this well was anticipated to affect the behavior of the fluid which, in turn, dictated the selection of coiled tubing, equipment, and chemicals.

Product details

- 28,607-ft 23/8-in. QT-1400 coiled tubing string with TRUE-TAPER XR strips
- HR-6140 injector head
- Cerberus™ modeling software

Well details

- Measured depth: 26,785 ft
- Average true vertical depth: 10,490 ft
- Depth to true vertical depth ratio: 2.55
- Vertical section: 9,815 ft
- Curve section: 997 ft
- Lateral section: 15,973 ft
- Plugs: 78 plugs; 64 composite and 14 dissolvable

Solution

A critical step taken to ensure a successful job was to design a 28,607-ft 2⅜-in. QT-1400 coiled tubing string with TRUE-TAPER™ XR strips. This coiled tubing string was specifically designed and selected by the customer due to its pressure resistance, yield strength, extended-reach capabilities, and weight-on-bit transfer capabilities. TRUE-TAPER XR allows for shorter taper sections to achieve better results for customers operating in extended-reach applications. These strips achieve a linear taper by gradually varying the thickness of the flat steel strip, reducing stress concentrations and bias welds while optimizing safety factors and strength-to-weight ratio.

The TRUE-TAPER XR enhancement has more precise string-weight distribution in the lateral, which allows customers to maintain higher performance levels with longer strings while meeting stricter weight requirements. In an early project, a TRUE-TAPER XR string design allowed a customer to reduce the number of tapered sections in their string from four to two; additionally, the total average length of the tapers was reduced by almost 65%.

Deeper wells increase the weight seen when pulling out of hole, requiring stronger coiled tubing and injector heads. The customer selected a HR-6140 injector head because of its capability to handle the mechanical properties of QT-1400.

Results

Several actions were taken during the course of the job in order to ensure that the operation was a success. This involved understanding the relationship between the vertical and lateral and how that would affect the performance of the coiled tubing. Analyzing the dynamic nature of this relationship influenced the approach to other challenges that were presented by this well.

Continuous monitoring of parameters such as pressures, fluid rates, rate of penetration, chemical injection rates, pickups, and solid returns was necessary in order to evaluate performance. This was critical for the performance which lead to zero NPT and job delays.

The customer maintained circulating pressures below 7,000 psi for the entire operation. The average circulating pressure was 6,750 psi while maintaining an average flow rate of 3.75 bpm for this job. This flow rate kept the annular velocity at 179 ft/min which allowed proper hole cleaning. The wellhead pressure was also maintained at a constant 2,300 psi during the entire operation.

For the 64 composite plugs milled out, the customer averaged a mill-out time of 9 minutes and 36 seconds. The average run time between composite plugs was 40 minutes and 36 seconds. This resulted in an average stage time of 50 minutes and 12 seconds from plug to plug.

As the coiled tubing continued to run in hole, there was no indication that the dissolvable plugs were obstructing the wellbore. Once coiled tubing reached the depth where the fish was expected, there was also no indication that the fish was there. So, the orders were given to continue to run into the hole as deep as possible. Upon tagging a depth of 26,605 ft, the customer then picked up and retagged 26,605 ft to confirm that bottom was reached. After circulating 30 minutes, the customer successfully pulled out of the hole.

A successful well completion was possible due to the field-proven equipment and designs chosen for this job, strong experience of the crews, and the support of the operations team.