



PARTNERSHIP LEADS TO INCREASED WELL EFFICIENCY AND SIGNIFICANT COST SAVINGS

Overview

The technology advances available to operators in the oil and gas industry has changed the methods and practices of completing wells. With the adaptation of changing times, laterals have reached lengths that were unprecedented just a few short years ago. With the extended reach well laterals, many operators are facing challenges using coiled tubing reaching total depth (TD) in a traditional method of milling plugs following a plug-and-perf style fracturing system. Failing to reach TD will leave multiple frac stages unable to produce in addition to adding total costs to the well.

A major operator in the Bakken Shale began experiencing the inability to reach total depth using coiled tubing in extended reach wells. The completion design of the wellbores were traditional multistage plug-and-perf techniques. Legend Energy Services, LLC and Mountain Supply and Service, LLC combined knowledge and expertise to provide a solution and reduce completion cost. Both companies teamed up to study the well profile and developed a coiled tubing drill out to optimize fluid rheology.

The operator had a multi-well pad and identified two wells that possessed the characteristics of potentially having the inability to reach the total depth. In the vertical of both wells, a 7" casing was used with a 4 ½" casing in the horizontal with no tie back. This is a very problematic design which makes the carrying capacity of a gel and coil tubing operation experience very important to ensure the success without lockup. Legend Energy Services confirmed the possibility of lockup using their Well Intervention Simulation Model. On both wells, factors of .20F/Co pumping at 3 bbl/min and BHA of 2.875 Motor and 3.75 Mill with Thru Tubing Solutions XRV G3 Agitator were used. On well "A" the projected lockup was a depth of 20,533' leaving 683' from TD and four plugs in the wellbore. Well "B" projected lockup was a depth of 20,964' leaving 296' from TD and two plugs in the wellbore.

Methods and Procedures

Use of Legend Energy Services "Super String", a custom designed coil string tailored to maximize extended reach as well as provide more set-down force in long laterals, and Mountain Supply and Service line of superior quality completion fluids. The fluids administered during the drill out were the FR 900, GEL 1100, Lube 204 and LG 100. Legend Energy Service employees supervised the application of the completion fluids and provided real-time monitoring through Legend Live, a proprietary remote access program. This software enables all key channels such as the depth, speed, weight, circulating pressure and wellhead pressures to be monitored off-site during the job; thus, providing the customer transparency to the operations as well as ability to be involved with the procedures. Mountain Supply and Service trained service technicians were on location to ensure water compatibility, proper rates and performance of the

chemicals by continuous monitoring the friction properties, viscosity and the removal of debris from the wellbore. As job and water conditions change, the properties of the fluids were continuously adjusted to maintain optimal wellbore cleaning parameters. Data was collected and recorded by both Legend Energy and Mountain Supply and Service personnel.

FR 900

Friction reduction is very important to maintain throughout the job regardless of the type of water that is being mixed. Pressure control is equally important and becomes a huge burden when the coil string is deep in the extended lateral. At the rate of one quart per 10 bbls throughout the job, the FR 900 worked flawlessly as the hydration was consistent and rapid with no issues of abnormal pressure.

GEL 1100

The superior suspension ability and rapid hydration of the GEL 1100 creates a viscous gel to remove solids and provide a clean wellbore. An added benefit is the friction reducing capabilities and lubricity characteristics. A mix ratio of 2.5 gals of GEL 1100 per 10 bbls was used through the entire drill out. Large and plentiful plug/slip parts were observed and because of the quality gel characteristics, Legend Energy Services found the weight to be very good and ideal; therefore, eliminating the need for wiper runs or short trips throughout the drill out to further reduce drill time and costs.

Lube 204 and LG 100

Proven effectiveness of the LG 100 when used in conjunction with Lube 204 reduces the torque and drag and extends the reach of the coiled tubing. Prior to projected lockup depth, Lube 204 and LG 100 were added to the fluid recipe with the FR 900 to help combat the upcoming torque and drag. A continuous application of one quart of FR 900, one quart of Lube 204 and one quart of LG 100 were treated per 10 bbls of water for the remainder of the job.

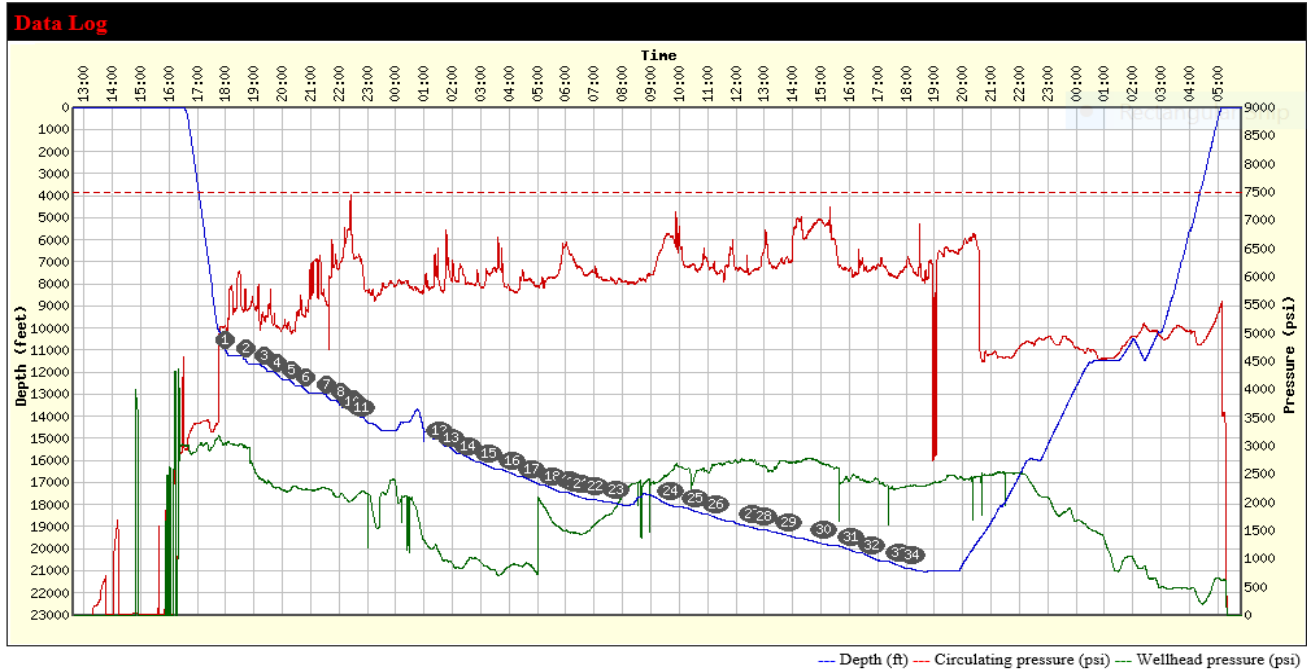
Conclusion

Well "A" had a projected lockup of 20,533' but total depth was successful at 21,216' drilling out all frac plugs. Well "B" had a projected lockup of 20,964' but total depth was successful at 21,260' drilling out all frac plugs. The wells were completed at an average of 35 hours from open to close valve and 45 hours total rig up to swing over to the next well. Although both wells were identified to have complete lockup with severe torque and drag, the collaboration of Legend Energy Service and Mountain Supply and Service were able to successfully complete both wells with no major issues identified.

The combination of Legend Energy Services "Super String" design and the superior quality of Mountain Supply and Service chemicals provided a significantly enhanced job performance to the operator. Total depth was reached on all wells on the pad in record time; thus, the operator was able to realize a significant cost savings through reduced job time and chemical consumption.

Well A

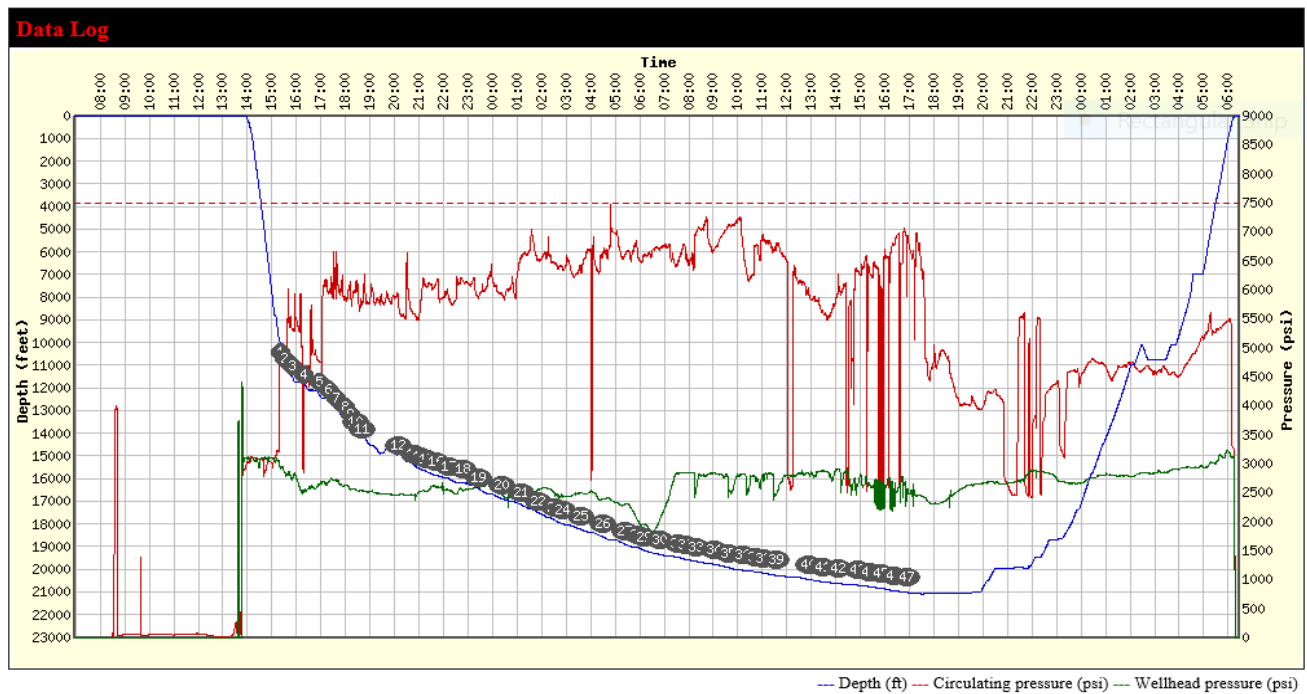
Depth and Pressure Data



Note: Fluctuations of wellhead pressures depicted on the graphs are due to faulty pressure gauge. Wellhead pressures were monitored throughout the job by communicating with the flowback company.

Well B

Depth and Pressure Data



Note: Fluctuations of wellhead pressures depicted on the graphs are due to faulty pressure gauge. Wellhead pressures were monitored throughout the job by communicating with the flowback company.