AXIS ENERGY SERVICES

Fact Sheet

STICK PIPE DRILL OUTS

Optimizing long lateral completions with advanced stick pipe drill outs.

Longer laterals extending past 10,000 feet are an increasingly attractive drilling target in unconventional wells, promising greater production for relatively little additional investment. As an alternative to coiled tubing, which delivers greater risk as lateral lengths increase for post-fracturing drill outs, stick pipe drill outs are a more reliable and cost-effective option in extended-reach laterals.

Axis Energy Services has pioneered a turnkey, cost-savings approach to completions utilizing stick pipe drill outs of frac plugs in long laterals, combining integrated services with pre-job planning, real-time drilling data, special-purpose equipment, and experienced, cross-trained crews to drive improved operational efficiencies during stick pipe drill outs and reduce cycle times at the well.

▪ **RELIABLY CONSISTENT PERFORMANCE ALL THE WAY TO THE TOEOF THE WELL** Stick pipe affords the operator greater control over weight on bit, helping to ensure the consistent weight and rate of penetration required for a smooth drill out.

▪ **ENHANCED HOLE CLEANING** Stick pipe's larger diameter, coupled with its continuous rotation, improves hole cleaning efficiency.

▪ **LOWER LIKELIHOOD OF LOCKUP** Stick pipe's constant rotation helps minimize the risk of lockup in the wellbore. Unlike coiled tubing, which has a higher risk of getting stuck, using stick pipe saves operators time and money by not requiring the use of an agitator to shake tubing free.

▪ **A STRONGER STRING** Stick pipe's constant rotation minimizes the risk of generating flat spots and fatigue-induced damage to the pipe wall.

CORE TECHNOLOGY

Stick pipe completions provide reliably consistent performance all the way to the toe of the well.

▪ Running coiled tubing in longer laterals raises the risk of helical buckling and becoming stuck in the hole, which not only increases the fatigue stresses of the coil, but also slows the drill bit's rate of penetration, extending the time to drill out each plug.

▪ Stick pipe completions avoid complications that coiled tubing presents, as the full torque of the power swivel is transmitted to the drill bit which ensures the drill pipe can rotate and work through downhole obstacles.

▪ Stick pipe affords the operator greater control over weight on bit, helping to ensure the consistent weight and rate of penetration required for a smooth and efficient drill out.

Stick pipe uses a stronger string.

▪ Coil fatigue becomes more likely in longer laterals because, unlike jointed stick pipe, the tubing string cannot be rotated as it moves through the well casing, which creates greater risk of generating flat spots and thinner wall sections on the low side of the coiled tubing. Eventually, this can lead to fatigue-induced pinhole leaks or even complete parting of the tubing string.

▪ This event can eventually result in a costly and time-consuming operation to retrieve the tubing string with a workover rig, adding days or weeks to the cycle time at the well and millions of dollars to the complete operation.

▪ Stick pipe's constant rotation, by contrast, minimizes the risks of generating flat spots and fatigue-induced damage to the pipe wall.

Stick pipe provides enhanced hole cleaning.

▪ Coiled tubing string, which has a smaller diameter than stick pipe, does not rotate in the hole, resulting in a reduced annular velocity, limiting its ability to carry sand, plug debris, and other well solids to surface and properly clean out the hole. Sand buildup at the heal can restrict the flow of produced fluids to the surface, effectively acting as a choke on the wellbore.

▪ The cleanliness of a wellbore is necessary in order to remove sand, which can build up and restrict the flow of produced fluids of the well and cause early failures in downhole artificial lift systems.

▪ Stick pipe's larger diameter, coupled with its continuous rotation, improves hole cleaning efficiency.

▪ Stick pipe's rotation creates a viscous coupling effect that carries solids from the side of the wellbore up to the high side, where the fluid stream's flow rate is greatest. This in turn improves wellbore cleaning and production by more efficiently moving solids and fluids out of the well when compared to the smaller diameter of coiled tubing.

Stick pipe has a lower likelihood of lockup.

▪ In laterals not properly cleaned out or having significant tortuosity, coil has a higher risk of getting stuck. The ability to push or pull the coiled tubing string free is limited by its tendency to flex or bend. Operators can deploy an agitation system which helps shake the tubing free; however, these agitators are typically not effective if coil gets stuck toward the toe of a 12,000+ foot lateral.

▪ Stick pipe's constant rotation helps minimize the risk of lockup in the wellbore. In the event it does become stuck, the pipe sting provides greater pulling strength than coiled tubing, making it better able to pull free—without the use of an agitator.

> "We primarily use stick pipe to drill out our composite plugs, partly because it is more resilient than coiled tubing. Stick pipe is also easier to maneuver in our longer laterals. In terms of the total cost of our drill out operations, using stick pipe on a well service rig is cheaper than bringing in coil."
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> ***-Operator in the Permian Basin***

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