AS SEEN IN
SEPTEMBER 2014 E&P

Using aluminum alloy drillpipe for tophole drilling lightens drillstring

The more flexible aluminum pipe gave the spudder rig an additional 25,000 lb of pullback capacity due to reduced side force loads, allowing the air-drilling rig to reach a deeper KOP.

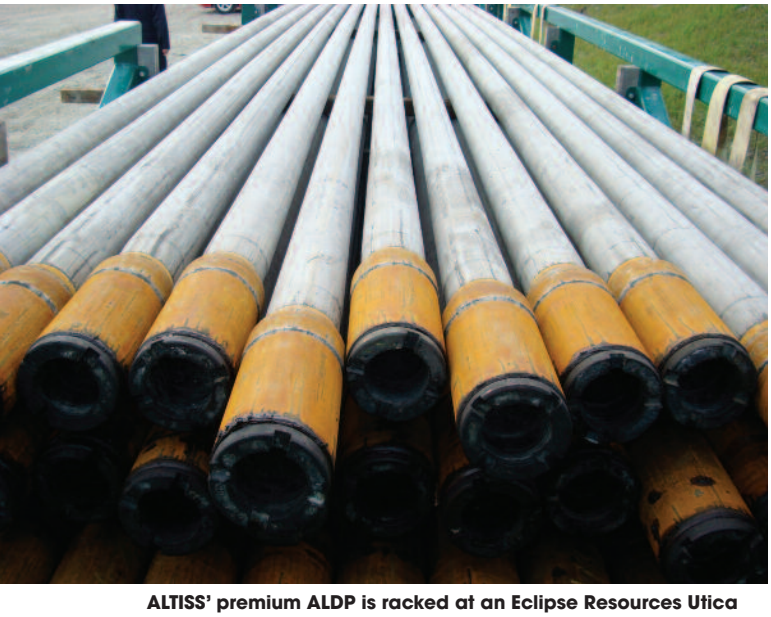
Oleg Tolmachev, Eclipse Resources Corp.; and
John Hansen and **Jacob Porter**, ALTISS Technologies LLC

Technological advances in recent years have made it possible to reach natural resources previously hidden. Aluminum drillpipe (ALDP) is now contributing to this trend. When compared to steel, ALDP's higher strength-to-weight ratio and lower modulus of elasticity allows spudder rigs to extend their reach with significant cost savings per well when pad drilling.

Even though ALDP has been known of for many years, its manufacturing and handling has evolved to the point that it is now feasible and cost-effective to deploy ALDP in strategic locations. This is the strategy that Eclipse Resources Corp. is using in the Utica core area partnering with ALTISS Technologies.

Situational analysis

Eclipse Resources currently uses a spudder rig for air-drilling the tophole sections of its wells in the Marcellus and Utica shales (Table 1). With the preferred bottom-hole assembly (BHA) configuration, the spudder rig often cannot reach the kickoff point (KOP) depth because of the rig's pullback limitations.



ALTISS' premium ALDP is racked at an Eclipse Resources Utica shale well site. (Source: ALTISS)

A larger rig must then reassemble the vertical string to hydraulically drill the rest of the tophole on oil-based mud as opposed to air, then trip the pipe before setting the intermediate casing and starting on the lateral section. This inefficiency is exacerbated if the spudder rig quits above the Clinton Formation, which is often the case.

After the spudder rig reaches its maximum achievable depth, the wellbore needs to be loaded with oil-based mud for borehole stability. This generally means an extra two to four days for the well for the larger rotary rig and higher costs of $150,000 to $300,000 per well. An additional complication is encountered in angled formations, which increase the overall tortuosity of the hole and the drag created by the side forces acting on the drillstring. The KOP was established at 1,981 m (6,500 ft). Using a steel drillstring configuration, the spudder rig has been limited to depths of between 1,676 m and 1,829 m (5,500 ft and 6,000 ft).

ALDP solution

ALTISS Technologies delivered a 4½-in. string of ALDP to Eclipse Resources. Using ALDP reduces string weight. With a modulus of elasticity one-third that of steel pipe, ALDP also reduces side forces acting on the string. The goal was to reduce pullback weight in a tortuous well without sacrificing the integrity of the existing BHA.

The reduction in weight from the 1,798-m (5,900-ft) all-steel string to one with 1,204 m (3,950 ft) of steel drillpipe and 594 m (1,950 ft) of ALDP was approximately 15,000 lb. The mechanical properties of ALDP are shown in Table 2. Because of the deviations in the well, the spudder rig reached its pullback/power limit at a depth of 1,944 m (6,345 ft), slightly short of the 1,981-m target vertical depth to the KOP.

"The well had way too much deviation," said Eclipse Resources' drilling consultant Shawn Burns. "It was only because of the aluminum that we got to 1,944 m."

After experiencing the potential benefits of using

Engine	Detroit Diesel, 760 bhp (567 kW) @ 1,800 rpm
Weight	95,000 lb
Hookload	200,000 lb
Top Drive	• Four two-speed disc-valve type hydraulic motors • Infinitely variable rotation speed • 3.5:1 reduction gear • 0-90 revolutions per minute @ 17,750 ft-lb. • 0-180 rpm @ 7,670 ft-lb
Feed System	• 15 m (50 ft) top head travel • 30 m (100 ft) per min. pull-up speed rapid-feed • 32,000 lb pull-down capacity • 4 m (14 ft) per min. pull-down speed slow-feed • 61 m (200 ft) per min. pull-down speed rapid-feed • 15 m (48.8 ft) working clearance floating sub to table
Drill pipe and Casing	• Range 3 pipe up to 14 m (47 ft) • Range 3 casing up to 30-in. diameter • 30.25 in. max. diameter through slip box
Winch	• 9,600 lb bare drum line pull • 46 m (151 ft) per min. speed

TABLE 1. These specifications are for a spudder rig for air-drilling the tophole sections of Eclipse Resources' wells in the Marcellus and Utica shales. (Source: ALTISS)

ALDP, Eclipse Resources optimized its steel-plus-aluminum string by drilling with only 792 m (2,600 ft) of 4½-in. steel pipe and adding 1,006 m (3,300 ft) of ALDP. As a result, the combined steel/aluminum string weight was reduced by 17% vs. a standard steel string.

More notable, however, was the benefit provided by ALDP's lower modulus of elasticity. The more flexible aluminum pipe gave the spudder rig an additional 25,000 lb of pullback capacity due to reduced side force loads. Eclipse Resources was able to successfully drill to the KOP of 1,954 m (6,410 ft), demonstrating the potential for expanded use of ALDP in much deeper spudding operations in other regions.

Technical considerations when using ALDP

ALDP's ability to achieve a high tensile load limit is partly derived from an extruded tapered tube with a steel tool joint on each end. This somewhat unique geometry combined with aluminum's lower hardness relative to steel necessitates the use of ALTISS-modified drill slip equipment, which must be installed by the rig personnel before running ALDP. This change took less than five minutes. The rig crew reported that the lighter pipe was easier on the equipment and easier to use than their typical steel drillpipe.

ALDP's lower hardness requires that the rig crews exercise greater caution when handling the pipe to avoid gouges and other surface damage, which can reduce the life of the ALDP. In general, after the rig crews were instructed on the care and use of the ALDP, no gouging or unusual damage was observed. It must be noted that damage can occur when the rig crews grab with or wrap chains onto the ALDP body instead of the steel tool joints when handling the pipe. Surface gouges on ALDP can be crack propagation points, so it is extremely important that the custom handling equipment provided by ALTISS, which is a rental service provider of premium ALDP, be used at all times when drilling with ALDP. Additionally, it is very important that the rig's rotary slip/bowl be oriented directly over the center of the wellbore.

An additional consideration when using ALDP is its sensitivity to pitting corrosion when exposed to high-pH substances or used for drilling in high-pH well environments. As a general rule, prolonged exposure of ALDP to pH levels above 10 is to be avoided. Care must be taken to avoid getting high-pH stabilizer substances such as quick lime on the surface of the pipe. When some of these lime-based additives combine with water vapor, pH levels can rise to as high as 13.5. ALDP also should not be used in wells where there is exposure to temperatures greater than 149 C (300 F).

Overall conclusions

Eclipse Resources found that ALDP's high strength-to-weight characteristics and low modulus of elasticity, combined with relative ease of use, allowed the spudder rig to drill efficiently without any modifications to the preferred BHA configuration and reach depths that were unattainable with 100% steel strings. Additionally, the margin of overpull in the mixed steel/ALDP string was increased, significantly adding to the safety of the drilling operation.

Feedback from the rig crew suggests that the custom slips provided by ALTISS Technologies to handle and protect the ALDP are lighter than those used for the steel drillpipe, which helped reduce operator fatigue. This creates a safer working environment. E&P

Pipe Body	New	Premium
Tensile strength, lb	400,000	312,000
Torsional strength, ft-lb	36,100	27,900
Collapse pressure, psi	12,200	9,580
Internal yield pressure, psi	11,400	10,900
Adjusted weight in air, lb/ft	12	12

TABLE 2. The mechanical performance is shown for 4½-in. ALDP. (Source: ALTISS)