Oil and Gas Investor

A HART ENERGY PUBLICATION/OCTOBER 2014

Chalk talk: How the E&Ps stack up

TRIED, TRUE, SIMPLE AND NEW

Extended reach laterals and more frack stages are prompting a build cycle for land rigs along with revised tools and fracture stimulation techniques to improve completions.

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Oil and gas is the MacGyver of industries, fashioning ingenious solutions under pressure to overcome mechanical challenges surrounding the economic extraction of hydrocarbons.

Although the sector prides itself on technological prowess, the industry historically has been slow on technology uptake. Tried-and-true trumps novel-and-daring, particularly when well costs range up to $13 million.

However, transformational change has come to oil and gas during the last three years in the form of productivity gains as drilling rigs generate more wells per year while the completion process cycles more stages per year. The change originates in part from the move to pad drilling and batch completions, which incorporate multiple wells on a single pad site, eliminating repetitive steps, capturing performance efficiencies, and reducing cost, though some cost reduction came from an oversupply of equipment and services.

Like all transformative events, the productivity revolution is altering how vendors provide goods and services in an era where the term "execution" has become a differentiator on Wall Street.

The productivity revolution dates to 2012, when operators began spotlighting drilling efficiency, or cycle-time reduction for drilling wells. Better PDC bits, greater mudpump hydraulic horsepower, and rotary geosteerables had improved the horizontal drilling cycle. Subsequently, the industry moved to multiwell pads in 2013. In December 2012, less than 20% of horizontal wells were drilled on pads. That number exceeded 70% in 2014. Currently, industry emphasis has shifted from drilling efficiency to completion effectiveness, or greater recovery of the original hydrocarbon in place in liquids reservoirs.

Today operators are extending horizontal laterals from 4,500 feet previously to 7,500 feet and beyond, when acreage permits, while increasing the number of stimulation stages per lateral from 17 or 18 previously to more than 30, and placing stages closer together. Extended reach laterals are creating demand for higher spec technology rigs, usually with self-moving capability, often featuring 1,500 horsepower drawworks and hoist capacity of 750,000 pounds, enhanced fluid systems, integrated automation, larger top drives, and the ability to rack more than 25,000 feet of five-inch drillpipe while moving about on a drilling pad.

Demand for higher spec units has rekindled a newbuild cycle among drilling contractors with more than 165 units under construction as of August 2014, the largest backlog in new land rig construction since the 2010-2012 buildout when contractors added nearly 300 rigs to the

Driller Danny Bullard, left, floor hand Richard Swan, center, and assistant driller Jack Schleter confer inside the climate-controlled drillers' cabin on Latshaw Rig 42 prior to a pipe change in Glasscock County, Texas. Facing page, the floor crew on Latshaw Rig 42 adds a section of pipe using a 500-ton NOV top drive. The top drive is essential for drilling extended length horizontal laterals.

Above, a close-up view of the NOV Steeltoe hydraulic jack walking system on Latshaw Rig 42, also pictured at right. The walking system allows the rig to move in any direction on a multiwell pad.

fleet, and more than 600 higher spec units since 2006.

Latshaw Drilling Rig 42 is a member of that original class. In August 2014, the 1,500 horsepower NOV ADS-10SD unit was drilling the third 7,400-foot horizontal wellbore, the Glass 22 A Aeromotor 27 (alloc) #7SU 782143, on a three-well pad for Laredo Petroleum Corp. in Glasscock County, Texas. The state-of-the-art rig features dual fuel Caterpillar 3512C engines that run a mixture of field gas and diesel, an upgraded 7,500 psi fluid circulating system with twin NOV FD-1600 horsepower pumps, and a NOV Steeltoe hydraulic jack walking system, the first installed as an integrated component on the NOV Ideal rig package.

The walking system allows the rig to move in any direction within a zone that is 150 feet by 40 feet without relocating the back yard with its fluid system, engines and AC VFD unit that allocates power around the rig. Walking capability is integral to exploiting stacked formation plays in the Permian Basin. If lease ownership is checker boarded and the terrain flat, Rig 42 can literally walk from lease to lease.

Latshaw Drilling Co. LLC obtained Rig 42 as part of the 24-rig Keen Drilling acquisition in October 2012, bringing Latshaw's fleet to 41 units. When owner Trent Latshaw re-entered the contract drilling business in 2003 after nearly 20 years refurbishing legacy higher spec rigs for a domestic and international customer base, he initially built a National 80B, a conventional mechanical Kelly-drive model with a history as the most popular rig in the domestic oil patch. The 1,000 horsepower unit had the capability of drilling two-thirds of the wells in the market at that time. But the market changed. Today Latshaw is building four more units identical to Rig 42, which are under contract in the Permian, and plans seven similar rigs in 2015 as the market for extended reach laterals on multiwell pads grows.

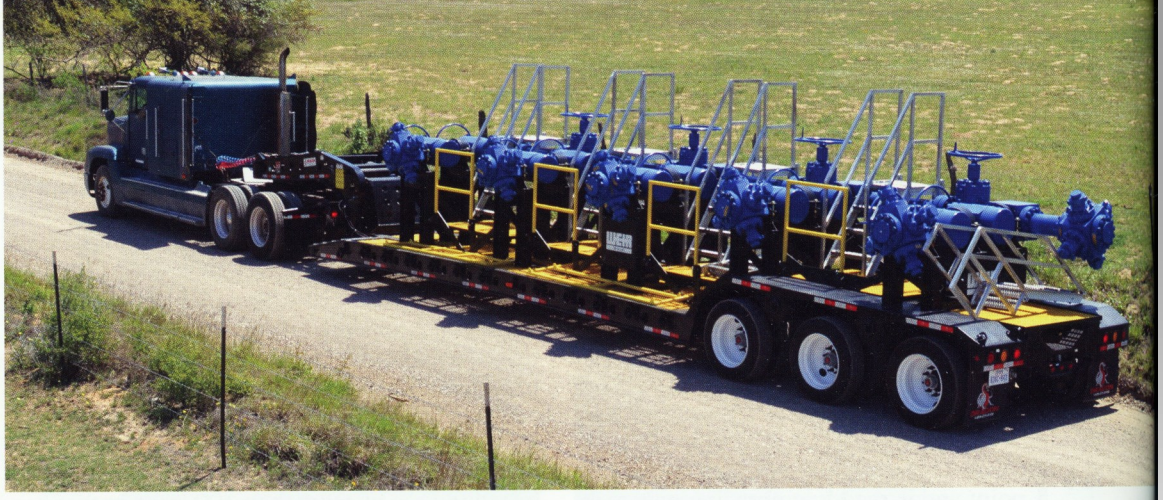
"We are absolutely collaborating with operators in creating the drilling rig they want for the future," said Bill Cobb, vice president, contracts, for Tulsa-based Latshaw Drilling. Units like Rig 42 with their climate-controlled driller cabin, ST-80 iron roughneck, and self-elevating masts and substructure are part of a broader effort at continuous improvement in drilling efficiency. Cobb pointed to a recent record run for a rotary steerable 10,000-foot lateral in the Delaware Basin on a Latshaw rig.

"How does that happen? It's a team effort," he said. "But it all comes down to the communication between rig crews, the directional drillers, the mud engineer and the company man on location. The more you drill for somebody, the greater the efficiencies."

For context, picture a drilling rig as a $22 million portable industrial system that manufactures a single product. That product is a hole in the ground. As prosaic as that sounds, it is the most critical part of oil and gas. While the industry creates substantial wealth, none of that is possible until a five- to seven-man crew and a drilling rig—people and iron—bore that hole in the ground.

Rig specialization

The transition to multiwell pad drilling is sometimes characterized by rig specialization in which a smaller rig drills the top hole and occasionally drills the intermediate section and



A driver transports a four-well zipper manifold to a well stimulation site. The zipper manifold enables operators to fracture stimulate one well while performing preparatory work on adjacent wells.

Surveys of operators in U.S. unconventional plays indicate zipper fracks are used in a majority of horizontal wells on multiwell pads in most markets outside of Appalachia.

Zipper Frack Market Share

Region	Zipper Frack %
Eagle Ford	78%
Niobrara	78%
Permian	68%
Bakken	59%
Midcontinent	56%
Marcellus	39%

Source: Hart Energy Market Intelligence Surveys

"The market for zipper manifolds, especially in the Eagle Ford and Bakken, continues to grow," said Joe Boyd, rental sales account manager with Weir Oil & Gas Seaboard.

technological innovation in the move towards greater completion efficiency—and improved completion effectiveness—is decidedly less glamorous. It is the humble zipper manifold, which allows operators to complete wells faster.

"Due to pad drilling and enhanced drilling technologies, operators were drilling wells faster than they could complete them, so they had a mass inventory of uncompleted wells," recalled Joe Boyd, a rental sales account manager with Weir Oil & Gas Seaboard in Houston. "That's where the zipper manifold, or the process of zippering wells during completions, came into existence."

Fracture stimulation involves multiple intervening steps including setting isolation plugs, conveying and firing perforator guns, and retracting wireline and gun conveyors. For much of this time, high-cost frack equipment sits idle, an expense that multiplies across two-dozen stimulation stages per lateral, or more.

The zipper manifold places a series of valves and other pressure containing equipment between the pumping equipment and the frack trees, allowing completion crews to isolate the frack flow to individual wells so intervening steps can be completed in one well while fracture stimulation occurs in the adjacent well. The zipper manifold, in some cases, has allowed the operating company to more than double the number of completed stages per 24-hour period over the past three years.

"The market for zipper manifolds, especially in the Eagle Ford and Bakken, continues to grow," Boyd said, adding that usage in the Permian Basin is also rising quickly.

However, advent of the zipper manifold enabled operators to move beyond zipper fracks as a means of increasing completion efficiency toward achieving greater completion effectiveness. In a zipper frack, operators fracture-stimulate adjacent stages in parallel wellbores, alternating between wells. In theory, the process increases the stimulated reservoir volume (SRV) and generates greater hydrocarbon recovery.

Using the zipper frack to increase completion effectiveness is an outgrowth of a concept originally nicknamed the Texas Two Step, or alternating fracture stimulation along a single wellbore so that, say, stages one, three and five are fractured, before the process moves back to fracture stimulate intervening stages two and four.

Halliburton applied to patent the process in 2009, according to Dr. Mohamad Soliman, who previously oversaw the rock mechanics laboratory at Halliburton and who now holds the George Livermore Chair in Petroleum Engineering at Texas Tech University. Soliman said the Texas Two Step enhanced the complexity of the fracture by changing the surrounding stress fields between individual stages.

"The Texas Two Step is a very, very good technique," Soliman said. "The only problem is people don't like to go back and forth in fracturing. It is operationally very difficult."

The zipper manifold allowed operators to employ a variation on the Texas Two Step by fracture stimulating parallel stages in adjacent wellbores, either simultaneously (simultaneous operations), or staggered (zipper frack) between wellbores to create greater SRV and theoretically improve estimated ultimate recovery.

"I agree with the concept that, yes, the zipper frack helped a lot," Soliman said. "But if we talk about complexity, I don't think the zipper frack does as much as people think. It can get very technical because you have normative stresses and you have shear stresses. You don't benefit at all from the change in normative stress when you are doing regular zipper fracks unless you stagger and overlap the stages, which we call the modified zipper frack."

Rather than a ladder, the modified zipper frack resembles an actual zipper with overlapping alternate stages. "Overlapping is very important," Soliman said. "If you don't overlap you don't change the stresses." Texas Tech applied to patent the modified zipper frack technique in February 2014. □