DRILL BIT Q&A

ARON DEEN, ULTERRA, USA.

PDC technology

From Saudi Arabia to the Permian Basin, many operators are pushing PDC bits harder than they have ever been pushed before. New motors are putting out two to four times more torque than previous generations. New rigs and rig pumps are also capable of pushing multiples of previously normal pressures. In some applications, WOB is reaching double the manufacturer's recommended maximums, in some cases over 80 000 lb WOB.

Based on the new demands, Ulterra is preparing to launch its XtremeParameter PDC bit technology. During the past year, the company's engineering team has been researching and testing new materials, manufacturing processes, PDC cutters and design concepts to create a PDC bit framework that will endure the most extreme drilling parameters.

Everything is changing in the oilfield, and the pace of change is faster than ever. Every day drilling records are being broken because of operators that are pushing the envelope in every way. The last thing they need to worry about is if the bit is going to come out of the hole in one piece. The aim of the new technology is to give operators confidence when they need to push their PDC Bit to the limits.

Figure 1. *The LightSpeed cutter development process ensures that new cutter technology is tested and deployed to the field several times per year rather than once every few years.*

Cutter configuration and design

PDC bit designs are still ever changing. This should be no surprise, though, as product design is constantly in a race to take advantage of improving materials, manufacturing technology, and evolving customer application demands.

All bit companies, for the most part, utilise different forms of simulation and to different extents. The more complex the simulation, the more dependent it is on assumptions. Because all variables can never be known, simulation, while useful, will always lack accuracy.

Actual iteration and field testing still drives product development and performance improvement. The ability to iterate as quickly as drilling plans evolve is key to consistently creating value for the operator.

From the beginning of the downturn to the bottom, the US land rig count dropped from over 2000 to less than 400. That kind of shift quickly turns six months of bit inventory into a two-to-three year overhang of potentially obsolete designs and cutters. To avoid a conflict of interest from suppliers dumping old inventory, operators are wise to ask how old the designs and cutters are. To accelerate its ability to iterate and innovate, Ulterra has organised its entire business model around maintaining a very lean inventory. Because the company has no bloated inventory of obsolete designs, it can continue to help drive operator performance improvements.

PDC cutter development

In spite of what many flashy marketing campaigns would say, there are very few sudden step changes in PDC cutter technology. The vast majority of cutter development is achieved through a continuous, methodical, iterative process. New cutters are developed literally every week.

The main bottleneck in cutter development is in testing. Lab tests are important as initial

indicators of promise and as a catastrophe screen, but there is no battery of lab tests that correlate well with actual performance in real drilling conditions. The only true test for a PDC cutter is in a real drilling environment.

Again, the inventory overhang problem has restricted or halted cutter testing and development for some companies. And even if an improvement is made, there is a long lag between identifying a great new cutter and being able to consistently deliver it to the field in every bit. The inability to consistently deploy cutter improvements often manifests as having one or two great runs followed by a rash of bad runs.

Figure 2. *Ulterra's PDC drill bit going into the hole is the final step of the product development system.*

Having one great run may trigger some celebration, but drilling engineers know that following it up with two bad ones is not worth it. Ulterra's LightSpeed cutter development process was born out of the need to constantly evolve and improve not just cutter technology, but also consistently deploy the newest cutter technology to the field.

Working directly with every major cutter vendor in the world, the LightSpeed process has driven the company to execute nearly 1000 unique tests in field applications just since the beginning of the recent downturn, resulting in the output of a new cutter with improved performance nearly once every two months. The low-inventory, high-utilisation system has also allowed new cutter technologies to be deployed in the majority of the company's bit fleet – including repaired bits – within the first two months of validation.

Directional drilling challenges (and stability and vibration resistance)

Increasingly RSS viability has been recognised across many plays thanks to decreasing tool pricing and more extended reach wells. Some RSS providers initially recommended their own OEM drill bits. To limit competition, some even go so far as to offer so-called 'free bit' bundling schemes or even charge the operator a penalty for using more performance-oriented bits. Operators, however, just as they have in every other area, have been the benefactors of performance gains by allowing competition. In order to realise the full potential of RSS, operators have increasingly sought out drill bit manufacturers that are willing to provide custom bit designs to maximise performance with specific parameters and BHA's.

Being an independent PDC bit company, Ulterra has sought to capitalise on this opportunity by working directly with drilling engineers and directional companies to design and build performance bits for every RSS tool on the market. In the Eagle Ford, for example, a CounterForce bit optimised for Weatherford's Revolution tool, averaged more than 16 000 ft per run in three wells, drilling at a rate of penetration of 87 ft/hr. One particular run in Live Oak County, TX, set a global footage record for the Revolution RSS by drilling 16 234 ft in one run, reaching out to a total depth of 22 700 ft.

In another recent operation the technology helped improve the performance of Baker Hughes' AutoTrak RSS in Abu Dhabi where prior failures were attributed to lateral vibrations. According to the operator, the Ulterra bit delivered, allowing the RSS assembly to drill 824 ft to section TD at an ROP of 23 ft/hr. This run was 66% faster than the average of the two previous bit runs in the mother hole and 230% faster than the average of the two previous bit runs in pilot hole. This performance saved three trips.

Lateral vibration has long been considered the leading cause of RSS tool failure. Yet another recently published study covering 88 runs in one field proved that the rate of downhole RSS tool failures was reduced by 62% due to the company tailoring the PDC drill bit to the operator's specific well plan and RSS system.