REFINING BITS FOR RSS

ARON DEEN, MATT CASE AND JOSH CRISWELL, ULTERRA, HIGHLIGHT HOW CUSTOMISED BIT DEVELOPMENT FOR RSS REDUCES TOOL FAILURE.

It is understood that all new technologies struggle in their infancy to gain adoption due to numerous economic and technical reasons. Among these are high cost, problematic reliability, lack of understanding, and marginal value proposition. Over years of learning, development and refinement these hurdles are overcome, and with each step new opportunities open up. No technology has followed this path more closely than rotary steerable systems (RSS), which is finding new value in this historic downturn.

Another facet of technology adoption is the availability of compliments. For example, smartphones need great apps for customers to realise their true value. In much the same way, RSS need to have quality drill bits that are designed to work with them in order for operators to realise their maximum value.

To be sure, there are certainly some obstacles to working across company lines on product development. For example, one of the many aspects of customising bit designs to work perfectly with differing RSS tools is nuanced gauge pad configurations. Different lengths, steps, tapers, helix angles, and wear protection may be advantageous for one RSS application, but producing such a specific product requires

a significant investment of engineering resources and capital. And once created, such a bespoke asset should not be blindly force fit into an improper application to the detriment of another operator. The only long-term path over such hurdles for service companies is to jointly commit to focus first on performance for the customer.

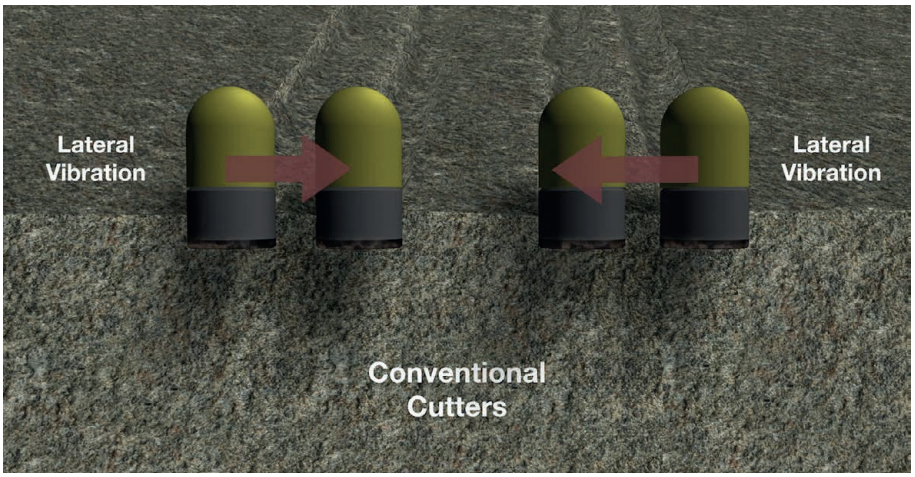

Figure 1. *Traditional PDC cutting structures are laid out to be balanced, or neutral to drilling vibrations.*

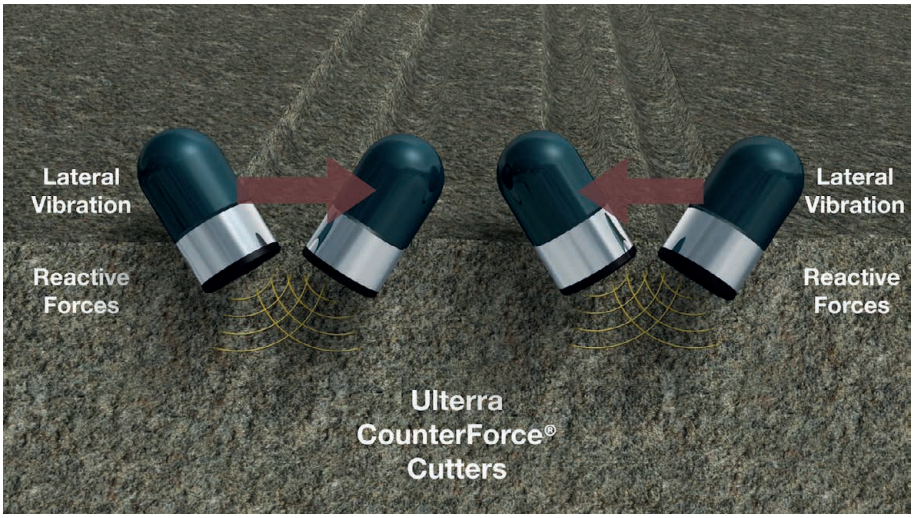

Figure 2. *The cutting structures are engineered to take an active role in damping harmful drilling vibrations.*

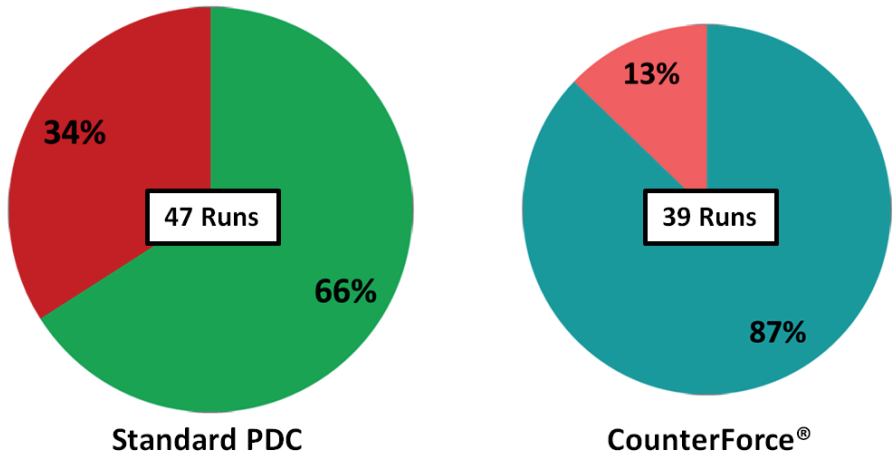

Figure 3. *The percentage of RSS runs pulled for downhole tool failure. Rotary Steerable tool reliability has positively correlated with the use of CounterForce bit technology over a statistically significant data set.*

Reducing vibrations, reducing tool failures

Reducing vibration is particularly important in wells that utilise RSS, which are becoming more popular as well planners are pushing the limits on directional difficulty and lateral lengths. Most RSS tools are highly susceptible to failure due to vibration, which is one of the most common reasons the BHA must be tripped. RSS directional hands will often monitor these vibrations and are forced to reduce drilling parameters, and sometimes stop drilling altogether to pick up off bottom when vibrations get too high. Vibrations in a way act as an ROP ceiling, limiting the driller to lower parameters than what is necessary for maximum ROP.

Ulterra's CounterForce® technology uses the cutting structure to reduce vibrations at the bit, which increases efficiency and reduces bit damage. With the ability of the cutting structure to reduce vibrations, operators can not only reduce the number of trips for tool failures, but can also effectively elevate the ROP ceiling so that they can drill faster and still avoid high vibrations.

The claim that CounterForce can reduce vibrations, and therefore increase ROP and reduce the number of trips has been validated through numerous field runs. A major operator in South Texas utilises the Weatherford Revolution RSS to drill out from under surface through the curve and lateral to TD in one trip. Comparing the U516M verses alternative bits in this application in the years 2014 and 2015, the U516M on average drilled 7% faster. More importantly, RSS runs with standard PDC bits of any manufacturer were nearly three times as likely to be pulled for tool failure (Figure 3). The U516M completed 39 runs within this time frame.

The technology's performance has also been validated through electronic drilling recorder (EDR) analysis. A four well pad in South Texas, again utilising the Weatherford Revolution RSS, ran the U516M on three wells, and a competitor bit on the fourth. The stick-slip magnitude, measured in a rotational value of c/min, was 35% lower for the average of the three CounterForce runs compared to the offset. In addition, the average ROP for the three CounterForce runs was 27% faster than the offset, saving the operator 13 hours on each well the U516M was in the hole.

The technology has also been tested in demanding applications offshore in the Gulf of Mexico. A major operator drilling in the Eastern GoM utilised the 16.50 in. U713M bit to drill a 2600 ft. section through the Base Miocene and Cretaceous formations. This operator was particularly concerned with high vibrations through these formations due to offsets they had drilled in the past. The U713M bit was able to decrease stick-slip vibration by 26% and increase ROP by 12% compared to said offsets.

Going past 'OEM'

In the past several months, operators drilling in the Wolfbone area of the Delaware Basin have been looking more to RSS to reduce the time spent drilling horizontal wells. RSS have become a more affordable option due to their reduced cost in the down market, but improved performance is still required to complete the value proposition.

Upon introduction of the RSS into the application, the RSS manufacturer recommended their own PDC drill bits to be used with the system. Parameters and bit selection were varied over several runs, as were results, with runs being terminated too often and too soon. After multiple attempts to complete the interval in one run without success, some operators chose to seek out other alternatives to push for efficiency gains through competition. Ulterra was challenged to create a bit design that was capable of finishing extended laterals in one run while encountering shale with varying carbonate content. The criteria for success in this application is extremely efficient, high rates of penetration, produce accurate corrections on a motorised push-the-bit system, and withstand the higher RPM capabilities of new rotary steerable systems.

To respond to these requirements, engineers designed an 8.5 in. U616S with CounterForce technology. The U616S also features an extended gauge pad designed to best utilise the features of the specific RSS in use, in this case Schlumberger's PowerDrive Orbit™, to help the bit track in long laterals and reduce corrective actions. This new design also increases the junk slot area by nearly 12% from previous iterations to expedite the removal of cuttings from the cutter faces, allowing higher ROP.

In two consecutive trials, the new 8.5 in. U616S bit completed both intervals successfully in one run, producing an average ROP 15% higher than the RSS manufacturer's own recommended designs. The ability to complete the interval in one run while producing higher ROP reduced operator drilling costs by an average of US$7.24/ft, or a total of over US$67 000 in the lateral section.

Conclusion

Across all industries, most companies usually focus their energy and expertise on their tools and services and leave complimentary performance parts to other experts. This is true for RSS makers like Weatherford, Gyrodata, Scout Downhole, and others. Some companies, however, produce their own OEM (original equipment manufacturer) drill bits, and obviously they will often recommend them with self-benefiting reasons.

In high-cost, high-performance applications, which are often identifiable by the use of RSS, 'stock' equipment is seldom the best option. There are many great car makers, but they all rely on other companies for the best tires in the world. Similarly, independent of the make and model of RSS tools, the evidence is growing that pairing them with a vibration reducing, performance enhancing bit is a good decision.