Rotary steerable drilling technology matures

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JUST FIVE SHORT years ago, rotary steerable drilling systems were considered an exotic new technology, commanding what some considered exorbitant daily costs, showing poor reliability and unproven value. For these reasons, the systems were used only on selected projects where benefits from application of the technology were very clear. Additionally, there were only very limited numbers of these tools available and their use was almost exclusively reserved for projects in high cost, high activity areas with short supply chains (e.g., North Sea and Gulf of Mexico).

Integrated BHA

A higher level of integration with MWD/LWD systems allows positioning of LWD sensors closer to the bit while simultaneously minimizing BHA length and increasing reliability.

That was five years ago. Today, the picture is much different. The technology has matured with a wide range of benefits accepted by the industry, value proven and tremendous improvements seen in reliability. Rotary steerable drilling systems are now used the world over with an estimated 7 million feet to be drilled using them this year alone and growing by approximately 50% per year.

TECHNOLOGY OVERVIEW

Conventional directional drilling techniques require the use of bent housing downhole motors to be oriented in the borehole and “slide” along the borehole without rotation of the drillstring to achieve a change in the well’s trajectory. Periods of this “slide” drilling are interspersed with periods of rotary drilling to achieve the desired three-dimensional wellbore trajectory.

Rotary steerable drilling is, as its name suggests, technology that enables full three-dimensional directional drilling control to be performed while drilling with continuous drillstring rotation from surface. No “slide” drilling is necessary. This capability requires a special BHA component above the bit to direct the wellpath in the desired direction, maintaining the orientation of the drilling trajectory independent of the rotation of the BHA and drillpipe above it. This component is the rotary steering device.

How the different available rotary steering devices accomplish their task varies from relatively simple gravity-based orientation systems to more sophisticated flexure of internal driveshafts or flexure of the lower portion of the BHA by appl-

Each different system has its own merits with regards to drilling efficiency, predictability of directional control, precision of wellbore placement, physical hole quality and cost effectiveness on a particular application. It is important to recognize that while there is a natural desire to commoditize this technology and not recognize the significance of the differences between the available systems, these differences are fundamentally critical to the cost effectiveness on any particular project.

THE ADVANTAGES

Eliminating the need to drill without drillstring rotation using bent housing motors to achieve directional drilling control has some immediately obvious benefits. These include significant time saving through ROP improvements, continuous effective hole cleaning and drilling of a hole with lower “tortuosity”. Other accepted benefits include drilling of much more ambitious well trajectories (either complex 3D and/or ERD) with lower technical risk to achieving objectives. These benefits are considered “tangible” and it is quite easy to calculate a dollar value for them when establishing the cost effectiveness of applying rotary steerable technology. As experience in the use of these systems has grown, the less obvious or intangible benefits have gained acceptance and are arguably of more value than the immediately obvious benefits indicated above. These less obvious benefits include, but are not limited to, the following:

Safety When drilling with rotary steerable systems, fewer trips in and out of hole of the drillstring should be required. These systems commonly utilize fixed cutter bits where previously Tricone® bits may have been used for directional control reasons. The longer life of fixed cutter bits results in more footage per bit and thus fewer trips for bit change. In addition, continuous rotation at high rotary speeds results in very efficient hole cleaning, removing the need for many short trips. Rotary steerable systems are also much more versatile and should be able to drill all of the required section trajectories (build, drop, tangent, turn) using a single BHA design, resulting in fewer trips for “BHA
The considerable benefits of using rotary steerable technology have been embraced by the industry and reflected in the continuation of exponentially growing demand, irrespective of business cycle. The initially obvious benefits of using these systems has now grown to include a whole host of “less tangible” benefits, which are probably of greater real value than the tangible ones. Bit technology has grown to keep pace with the need to obtain the best performance out of each of the very different available systems. It is becoming increasingly common to tailor-design bits to push performance limits.

So, what’s in store for the future? The technologically leading systems dominate the market with closed loop control and systems integration being keys to superior performance. While enhancements in functionality will continue to be introduced, the focus for the time being is on delivering ever increasing total system reliability.

Further in the future, more closed loop control will be introduced to the BHA. An example of this may be automated drilling dynamics and downhole pressure control systems to deliver the next step change in drilling performance.