Downhole technology: What do operators want?

Meanwhile, the US Department of Energy announces $7.7 million in matching grants to advance the miniaturization of drilling for shallow exploration and development

DOWNHOLE TECHNOLOGY IS one of the most rapidly advancing areas in drilling. Efficient and reliable downhole tools are critical in getting the bit where it needs to go. But specifically, what do operators want and need downhole?

Rotary steerable systems are among the first to come to mind. According to one drilling manager with a major operator, the benefits of rotary steerable systems (RSS) in high-dollar wells has proven "tremendous". The challenge before the industry, he indicated, is to develop tools for low-cost, bread-and-butter wells, particularly on land.

Blue skying: Operators' wish lists for downhole tools include lower costs on high-dollar rotary steerables to expand their use to plain-vanilla land wells, boosting power downhole, eliminating bit chatter, and speeding bit-to-rig floor data transmission. Photo of Grey Wolf Rig 558 by Mieko Mahi, supplied courtesy of Grey Wolf Drilling Co.

Of course, driving down costs for new technology such as RSS is not an ambition near and dear to the heart of the technology developer. Nonetheless, this is the outcome operators anticipate as more units enter the market and sales volume increases across a broader base.

RSS IN WATER BASED MUDS

A second issue is the ability of RSS to function in water-based muds, when hole enlargement is an issue. This enlargement hampers stabilizer contact between the hole and the tool, thus compromising tool control.

Still, RSS continues to increasingly displace motors, operators observe. "As time evolves, we'll see that rotary steerables will displace motors more and more," a drilling engineer knowledgeable in the topic remarked. "That's happening now in high-dollar wells."

Because RSS allows continuous rotation of the drillstring, the hole stays cleaner and stuck pipe—that longtime bane—is avoided, facilitating much greater step outs.

Nonetheless, RSS are no panacea. The technology does have limits, operators note. The principal drawback is turn radius. Motors can accomplish 13°-15°/100 ft doglegs, while turn radii of rotary steerables are 10° or less.

DOWNHOLE POWER

Another operator cited the need for more powerful motors: "How can we get more power downhole to cut the rock?" he asked. Mud motors are making strides in this area, of course. The number of lobes on downhole motors, analogous to teeth on a gear, is steadily increasing on newer models. Power and torque increase at lower speeds in direct proportion to the number of lobes, as measured in a ratio of stator to rotor lobes. (The rotor always contains one less lobe than its associated stator to allow clearance for rotation.) Motors have advanced from lobe ratios of 1:2 to 8:9, greatly extending power, sources say.

"The question is, how can we advance those tools to give us more horsepower at the bit," said one senior drilling engineer. He added that larger drillpipe has greatly helped improved the transmission of power to the bit.

BIT CHATTER & VIBRATION

Also high on some operators list is an improved bit cutting structure to eliminate chatter and vibrations that ultimately destroy the bit. This is reportedly most problematic with PDC bits.

"We've been making small incremental steps in that direction, but not making the big leap," an operator noted.

DOWNHOLE MEASUREMENT

Making hole quickly and accurately is all well and good, but accurate downhole measurements are just as vital. One of the most widely anticipated commercial debuts in this arena is **Grant Prideco's** Intellipipe. Intellipipe, drillpipe capable of transmitting high-bandwith downhole data and surface-control systems, was developed by Grant Prideco and **Novatek Engineering** under a project funded by the US Department of Energy. The system, capable of transmitting at rates up to 2 MM bits/sec, underwent significant testing in the second half of 2004 with the cooperation of **BP** and **Nabors Drilling USA**.

Going forward, said **Michael Jellison**, Vice President of Engineering for Grant Prideco, Intellipipe's data swivel will be converted to wireless transmission to minimize rig-up time, among other enhancements. Another goal is to enable Intellipipe to transmit depth data to rotary steerable systems to create a closed-loop data system, according to Mr Jellison, who updated attendees at the 4th Quarter 2004 meeting of the Drilling Engineering Association.

DOE: DOWNSIZING DRILLING

Meanwhile, the **US Department of Energy** continues on its quest to "downsize" drilling, at least in terms of rig footprint, environmental impact and overall cost, especially for shallow wells (to 5,000 ft).

Several of these "microdrill" projects center on downhole issues, including sensors, motors, logging tools, and other borehole instruments small enough to fit into the 4 ¾-in. or smaller wellbores.

DOE announced $7.7 million in awards to fund 10 projects. $6.8 million of the estimated $14.5 million total is expected to come from industry partners.

The initiative involves developing technologies to drill wells smaller than 4 ¾ in. in diameter and related downhole micro-instrumentation. The projects will

be managed by the DOE Office of Fossil Energy's National Energy Technology Laboratory (NETL).

"With the microhole technology program, DOE has tapped into an area of significant industry need," said Roy Long, Exploration and Production Technology Manager for NETL.

DOE says that microhole technology has the potential to cut exploratory drilling costs by a third or more and to slash development drilling costs by more than 50%.

In addition, DOE hopes that widespread adoption of microhole technology could "spawn a wave of infill development", potentially recovering as much as 218 B bbl of bypassed oil at shallow depths in mature producing areas.

The technology centers on adapting conventional coiled tubing drilling techniques—in which a drill motor and bit are deployed on the end of tubing coiled around a spool on a trailer pulled by a standard pickup truck—to ultra-small-diameter holes.

The 10 awards were:

Geoprober Drilling Inc to drill three wells with a composite coiled tubing drilling system. The aim is to confirm the capability to drill low-cost, shallow slim/microhole exploration wells in water depths ranging up to 10,000 ft. (DOE share: $1 million; Project duration: 12 months)

Gas Technology Institute to field test a next-generation microhole coiled tubing rig. First deployed for testing in a Kansas gas field last year, the rig was drilled 280–400 ft/hr. (DOE share: $1 million; Project duration: 12 months);

Confluent Filtration Systems LLC, to develop an elastic-phase, self-expanding tubular technology called CFEX. CFS's goal is to develop self-expanding well casings to any diameter. (DOE share: $1 million; Project duration: 36 months);

Tempress Technologies to develop a small, mechanically assisted, high-pressure waterjet drilling tool. (DOE share: $800,000; Project duration: 24 months);

CTES LP to improve performance and reliability of microhole coiled tubing drilling bottomhole assemblies. (DOE share: $700,000; Project duration: 24 months);

Technology International Inc to develop an effective downhole drive mechanism and a novel drill bit for drilling with coiled tubing. (DOE share: $800,000; Project duration: 24 months);

Ultima Labs Inc to combine MWD and LWD technologies into an integrated, inexpensive system for small-diameter coiled tubing drilling. (DOE share: $800,000; Project duration: 36 months);

Baker Hughes Oilfield Operations Inc to provide a wireless system to help steer drilling in a microbore. (DOE share: $800,000; Project duration: 24 months);

Gas Technology Institute (2nd award) to design and develop a counter-rotating motor drilling system ideally suited for reducing costs associated with drilling wells with coiled tubing and target unconventional gas. (DOE share: $600,000; Project duration: 24 months);

Confluent Filtration Systems (2nd award) to develop a concept for a self-expanding, high-flow sand screen that could be constructed from a wide range of materials. (DOE share: $200,000; Project duration: 24 months);