

New tool extends MWD to underbalanced wells

MEASUREMENT WHILE drilling (MWD) and logging while drilling (LWD) technology has been in use in the oil industry for many years. The technology has primarily been applied to "typical" balanced and overbalanced wells.

However, some iterations of the technology and tools cannot withstand the shock and vibrations encountered in increasingly popular underbalanced drilling operations, including air drilling conditions.

Excessive downtime caused by drilling component failure can impact time/depth curves and well costs, removing potential underbalanced drilling benefits.

One company has developed, from scratch, a new electromagnetic telemetry system that can stand up to the harsher

downhole environments encountered during underbalanced operations while still provide mud pulse telemetry for balanced and overbalanced wells.

Weatherford's TrendSET electromagnetic MWD (EM/MWD) system is designed to handle the high shock and vibrations encountered during air drilling while still allowing the operator to use the same tool with mud pulse telemetry in different parts of a well.

What is unique about the system, according to the company, is that the same string of electronics can be used with electromagnetic or mud pulse transmission.

The system is vibration rated at 40g, twice the rating of any other system, according to the company. The system's

components have withstood more than 500 hours of testing without failure.

"Electromagnetic telemetry is required for underbalanced drilling because you are drilling through a compressible fluid and you don't receive signals as good as those transmitted through mud," said **Chip Swarr**, Weatherford's Global Product Line Manager for Directional Drilling and LWD Systems.

"You can also drill with straight air, for which the system is designed," he said. "It is really stepping out in terms of vibration tolerance."

WHY ANOTHER EM/MWD?

Weatherford designed and built its TrendSET EM/MWD system essentially to fill a void it perceived existed in the industry. The company's objective was to develop a fit-for-purpose system for underbalanced applications as opposed to other already existing systems that were developed initially as mud pulse systems.

Reliability was a primary focus as well. The system was developed in collaboration with six engineering consulting firms that aided in design of the system's individual components, according to Mr Swarr.

"We held them to a new plateau in vibration design criteria," he said.

The company says no MWD system addresses shock and vibration issues. Previous downhole systems failures have plagued drilling operations.

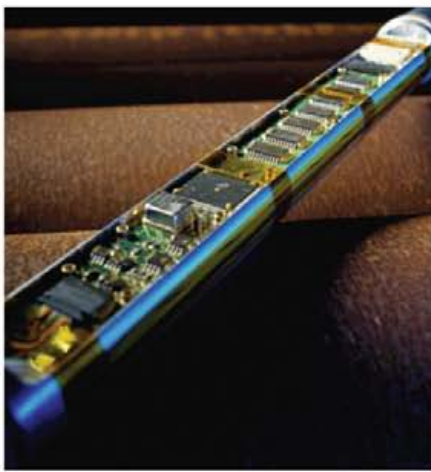
The company's system is designed to work reliably in harsh environments, setting new standards for shock and vibration resistant components.

Additionally, the various components can be configured in a plug and play mode to suit a particular application and includes pressure, directional, gamma and resistivity sensors. The company also says the system provides faster, more reliable up hole data rates for more accurate information.

The company spent two years developing the system and now has 11 systems deployed in the US and Canada. Commercial service presently includes the electromagnetic telemetry system capability plus directional, gamma and pressure services.



Weatherford's TrendSET electromagnetic MWD (EM/MWD) system can be used in both underbalanced and balanced drilling operations. The system is rated for high shock and vibration environments encountered in underbalanced operations such as air drilling.



The TrendSET EM/MWD system includes electromagnetic telemetry for underbalanced drilling operations, mud pulse telemetry for mud applications and is application configurable for directional and logging operations. Weatherford is beginning field tests on the dual space propagation resistivity (DSPR) tool for UBO, which also provides accurate resistivity for all fluids.

The company is beginning the field test stage for the dual space propagation resistivity (DSPR) tool.

The DSPR is designed specifically for underbalanced applications and also provides accurate resistivity in all fluids. It features a full diameter collar, eliminating through-collar wiring. The company also said it is the lowest cost MWD tool in the industry in terms of manufacturing and maintenance.

The company is also beginning field testing of its new DuraPulse positive pulser that will be used with the directional gamma service. It is expected to become commercial with the resistivity service around mid-2005.

APPLICATIONS

The system has two means of data transmission, E-WAVE electromagnetic data transmission and the company's DuraPulse mud pulse telemetry. E-WAVE is the wireless guidance for the underbalanced system.

When used in underbalanced operations with the electromagnetic telemetry, an insulating ring on top of the tool emits an electromagnetic charge into the tool's antenna, or gap sub. The company claims it's the strongest gap sub in the industry with gap ring material tougher than the mating steel.

This insulation point forces the electro-

magnetic signal from the drilling tool into the formation rather than traveling up the drillstring. The signal and data is then detected at the surface.

The company's surface system software is modular and expandable and can provide data from the remote site to a central communications location.

An electric lead is installed on the wellhead and a metal stake is driven into the ground about 100 yards away. The current is measured across that space, picking up the electromagnetic signal as it propagates up through the formation.

Historically, electromagnetic telemetry has had some limitations. For example, formations with high salt concentration absorb the electromagnetic signals, or the formations could repel the signal, depending upon the type of formation.

"These formations will impede the attenuation of the measurement through the formation, so there are certain areas where electromagnetic telemetry will not work," Mr Swarr explained.

CASE HISTORIES

During more than two dozen field tests and actual well applications with the system, the company has never experienced a downhole failure, including in directional wells and underbalanced wells drilled with straight air.

Depth limitation of the E-WAVE system showed transmission at 10,800 ft, deeper than any other EM/MWD, according to the company.

The TrendSET system was deployed in a vertical well in Routt County, Colorado. This was the system's first test with air drilling. The well was drilled underbalanced to a depth of 5,611 ft using water with air injected at 800-1,000 cubic ft per minute, creating equivalent circulating densities (ECD) between 4.9 and 8.6 ppg to minimize losses in high angle dipping beds.

The system accurately recorded and transmitted uninterrupted steering, internal, annular and differential pressure and gamma data, both in steering and rotating modes. Approximately 70% of drilling was in the sliding mode to control inclination.

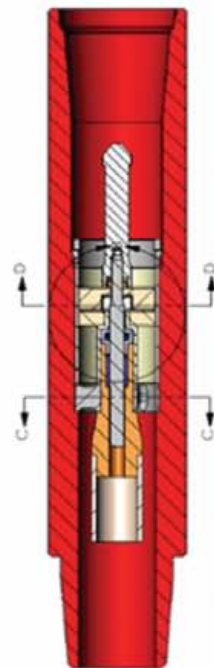
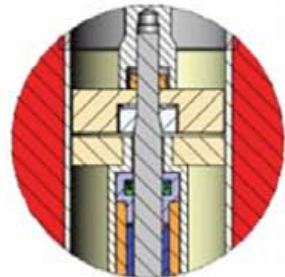
The company's first commercial well in southern Alberta, Canada, was drilled to validate the system in a directional well and to combine the tool with the company's motorhead assembly (MHA), Orien-

ter and RedHead positive displacement motor.

The EM/MWD tool was configured for high rate of penetration (ROP) and fast data rates required for shallow coiled tubing drilling projects. The EM/MWD was used to drill to 915 m measured depth with 620 m total vertical depth with a maximum inclination of 60°. The build rate was 10°/30 m, which was then held to TD.

The 6 1/4-in. hole was drilled at an average ROP of 156 m/hr, with no problems of tool failures and setting a record for a coiled tubing drilled directional well in the region.

The tool reached instantaneous ROP of 200 m/hr. Drilling a typical shallow overbalanced directional well with coiled tubing can take up to 18 hours, according to the company; this well was completed in 6 1/2 hours. ■



Weatherford is beginning testing on its new DuraPulse positive pulser that will be used with the TrendSET MWD gamma service.