Real time applications are downhole eyes and ears

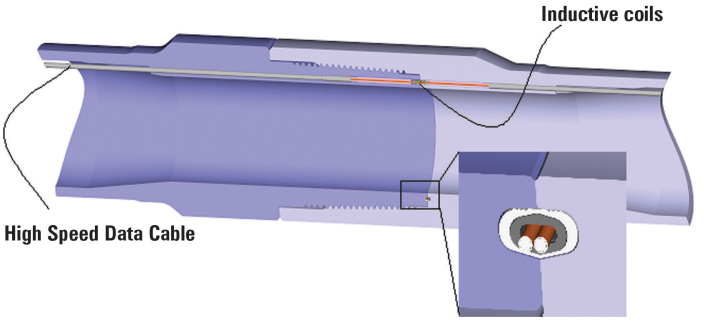
INTELLIGENT DRILLSTRING

Drill string components capable of transmitting data at rates up to 2 megabaud have been developed and successfully tested in commercial drilling applications. The authors detail the lessons learned during separate intelligent drill string field trials in wells ranging from 10,000 to 14,000 feet in depth, with focus on the overall network performance during drilling operations, physical handling ease and integration of existing down-hole measurement tools into the network.

This is the first publication of information from such field trials, and the first discussion of down-hole tool data transmission through the intelligent drill string network.

The authors include insight from operators involved in the field trials regarding the potential impact of intelligent drill string technology on the drilling and completion process.

This new technology can improve well productivity, reduce drilling time and enhance well control safety. The authors also address these issues and provides a forward-looking statement regarding large-scale introduction of the system and the anticipated time-line for commercial availability.



Drillstring components capable of transmitting data at rates up to 2 megabaud have been developed and successfully tested in commercial drilling applications. The new technology can improve well productivity and reduce drilling time. SPE/IADC 92477.

Intelligent Drill String Field Trials Demonstrate Technology Value (SPE/IADC 92477) **M E Reeves**, **M J Jellison**, **Grant Prideco**; **M L Payne**, **BP**; **A W Iyoho**, **Anadarko Petroleum**; **A Adeleye**, **Anadarko Canada**.

ECD MANAGEMENT

Economically marginal wells, sometimes critical in their own right, can require tight ECD control like their expensive HTHP, deepwater and extended-reach counterparts. Limited budgets can preclude use of pressure-while-drilling technology (PWD). The authors present a case history where the ability to manage ECDs from a remote real-time operating center (RTOC) was tested on a low-budget land well in the western United States.

A contrasting case history is also included where the same innovative approach was taken on an HTHP shelf well in the Gulf of Mexico. Field results demonstrate that it is now possible to obtain quality ECD information without running PWD tools.

The authors will critically compare and review the case histories to help assess the spectrum of opportunities for ECD management from remote RTOCs. Field results, operational issues, planning requirements, training needs, hardware/software technologies, and technical and business drivers are among the topics that will be presented and discussed. Lessons learned and recommendations for future efforts will also be included.

Case History: ECD Management on High and Low-Budget Wells using a Real-Time Operating Center (SPE/IADC 92605) **M Zamora**, **M-I SWACO**; **B J Toups**, **M-I Drilling Fluids**.

SEISMIC WHILE DRILLING

The authors describe field testing of a downhole tool capable of generating a broadband seismic signal at the bit while drilling. The tool was developed to improve pore pressure prediction while drilling.

The authors will discuss existing practices for predicting pore pressure including pre-drill seismic interpretation, wireline vertical seismic profiling (VSP), drill-bit seismic-while-drilling and drillstring seismic.

The tool consists of a mud-actuated poppet valve, located in a stabilizer housing directly above the bit. Operating principles, seismic processing techniques and results of a field demonstration of seismic profiling while drilling in a shallow well will be described. Performance characteristics of the tool will be compared with industry requirements for pore pressure prediction in deep offshore wells.

Seismic-While-Drilling Using a Swept Impulse Source (SPE/IADC 92114) **J J Kolle**, **Tempress Technologies**; **K Theimer**.

3D WELLBORE VISUALIZATION

Visualization has evolved into an important G&G tool to view and interpret

seismic data, 3D logs, geocellular models, grids, horizons, and well placements.

Directional drillers also benefit from visualizing complex placements in 3D. However, this is one of very few drilling applications that currently exist for this technology. The authors will introduce software that for the first time permits 3D visualization of the inside of the wellbore.

In this initial version, downhole drilling hydraulics and related conditions can be critically examined while navigating the well from surface to TD using a PC and joystick. The new software system has application for evaluating large data sets, mitigating drilling problems, training, and encouraging collaboration among multi-disciplinary teams.

3D perspective rendering interactively shows internal and side projections of the well tortuosity, formations (texture, rugosity, and breakout), drill string (including eccentricity), cuttings beds (height and position), annular velocity profiles, downhole engineering parameters (temperature, ESDs, etc.), and downhole tools, among others. Simulated data are provided by an advanced hydraulics program.

A real-time version is planned that also will include other key drilling and wellbore parameters.

The authors will discuss the development and application of this wellbore

visualization software with special emphasis on the quality and uncertainty of models and methods used to drive the 3D graphics. The design, development, and implementation of the fit-for-purpose graphics platform will also be discussed.

Development and Application of a 3D Wellbore Visualization System for Hydraulics Analyses (SPE/IADC 92338) **M Zamora**, **M-I SWACO**.

4D SEISMIC

The Gullfaks Main Field is one of the largest oil field in the Norwegian sector of the North Sea. Production started in 1986 and reached a peak in 1994. Today the field is becoming more mature as approximately 90 % of the base reserves have been produced. Locating the remaining oil reserves is a challenging and important task for the future of Gullfaks.

The reservoirs are comprised of middle and early Jurassic sandstones, possessing overall excellent reservoir properties. The structural setting of the field is complex, and represents one of the main factors of uncertainty concerning the drainage of the field.

The authors describe how multiple time-lapse seismic (4D/4C) has proven very accurate in identifying undrained oil pockets in the Brent Group. The importance of 4D/4C in the wells drilled is estimated to represent a reserve volume of approximately 4 MM Sm3 during 2004.

Through Tubing Drilling and Completion has also been crucial on the Gullfaks main field to reach smaller oil pockets, being a more flexible and less expensive technology.

The potential offered by these technologies has been optimized having multidisciplinary teamwork on Gullfaks, creating synergy and flexibility. These three key elements have contributed to reverse the oil production decline and establish a new plateau, reducing costs and increasing profit.

4D Seismic and Through Tubing Drilling & Completion Wells Extend Life on the Gullfaks Field (SPE/IADC 92551) **A C Todnem**, **Statoil**.

WELLBORE STABILITY

Knowledge of a well constrained geomechanical model provides valuable information for the efficient design and drilling of wellbores. Incorporating real-time wellbore stability monitoring during drilling can reduce the associated risks, especially for deepwater extended reach wells. The authors will discuss the preparation, delivery, and outcome of the field trial for a real-time wellbore stability monitoring service delivered at a major operator's Real Time Operations Centre (RTOC).

The operator and service company agreed on three key objectives for the field trial: develop a seamless integration of the real-time wellbore stability service into the current RTOC monitoring provision; provide frequent updates of the wellbore stability model using techniques independent of the operators own methods; and monitor and verify the geomechanical model while drilling based upon the drilling experience and real-time data.

Application of Predictive Real-Time Wellbore StabilityM on a Deepwater ERD Well (SPE/IADC 92588-Alternate) **J A Greenwood**, **Halliburton Sperry Sun**; **E Van Oort**, **Y E Volokitin**, **D R Algu**, **Shell**, **A Brehm**, **GeoMechanics International**.■