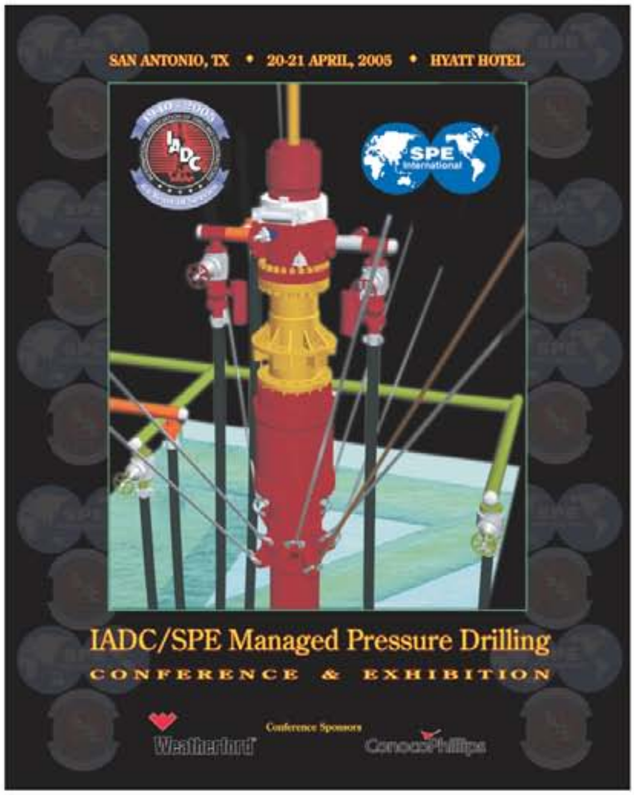
IADC, SPE unite for Managed Pressure conference

THE 2005 IADC/SPE Managed Pressure Drilling Conference & Exhibition will present the latest developments and drivers MPD technology offers, from MPD's fundamentals, drilling opportunities and applications, MPD equipment, challenges to its implementation, and the future direction of the technology. The conference, sponsored by **Weatherford** and **ConocoPhillips**, is scheduled for 20-21 April at the Hyatt Regency Hotel in San Antonio.



Rick Stone, Signa Engineering, will open the conference by outlining three challenging well scenarios that present their own barriers to achieving drilling or geological objectives, or both. The scenarios represent onshore, surface stack and subsea stack drilling.

At the end of the two-day conference, a panel will present likely solutions to these challenging wells. Panelists will include representatives from an operator, an offshore drilling contractor, a service company and an engineering firm, all of which are heavily involved in MPD technology, its challenges and its ability to provide solutions to difficult drilling problems. This interactive session is also the audience's opportunity to pose questions or solutions of their own to the panelists and audience.

MPD OPPORTUNITIES

As drilling costs increase drillers are realizing MPD's potential to meet the industry's toughest and most expensive downhole challenges. Many drilling prospects that are shifted to the bottom of the priority list may move up when MPD techniques are considered. Proper implementation of MPD can overcome drilling obstacles such as low penetration rates, lost circulation and differential sticking. Key drivers include reduction of non-productive drilling time and elimination of one or more casing strings. A panel will discuss how "walking the line" of downhole pressure gradient to precisely control the annular hydraulic pressure profile can succeed where conventional techniques have not.

MPD APPLICATIONS

MPD techniques have been used in onshore drilling for two decades, although the technique was not often known as such. MPD techniques that have common and almost status quo acceptance onshore will be discussed as will the categories and variations of MPD currently being practiced offshore.

In dual gradient drilling, a type of MPD, annular pressure at the seafloor is reduced to approximate seawater hydrostatic pressure, causing an imbalance in hydrostatic columns in the annulus and drillstring. As a result, the mud level will drop in the drillstring and rise in the mud tank when circulation is stopped in a phenomenon known as u-tubing. Use of a drillstring valve (DSV) has been suggested to arrest u-tubing but no studies have been published. However, the results of a study that was performed to analyze this phenomenon and a method to model the DSV during drilling and well control will be presented during the conference.

In a discussion of MPD's values, a three-well trial conducted to investigate and quantify the reduction in rate of penetration (ROP) as a result of mud weight increases to overcome formation overpressures and associated nuisance gas will be examined. The trial results address many of the issues and provide forward-looking views regarding large-scale introduction of MPD to other fields.

Multiphase flow modeling is necessary to provide an optimum pre-job design of wellbore hydraulics as well as for managing wellbore pressure during operations. Concepts related to multiphase flow modeling will be clarified during the conference and the effects of operating parameters on the wellbore pressure profile will be discussed.

A wellbore strengthening application utilizing drilling fluids will be described as an effective extension of a generally accepted lost circulation strategy. Using this approach, the "stress cage" concept (Aston 2004) was successfully implemented to drill through depleted zones with minimal to zero downhole losses. Case histories will detail drilling parameters, formation pressures, field and laboratory fluids testing and operational challenges.

Heavy annular mud cap drilling was conducted as a solution to drilling underpressured highly fractured carbonate. A two-well MPD program was drilled for a major operator offshore Angola into a target zone with a massively fractured carbonate reservoir containing up to 1% H_2S with a history of lost circulation leading to well control events. Drilling was conventional until losses became unsustainable, at which time mud cap drilling commenced. The well was drilled to TD on time and within budget while meeting the project's HSE objectives.

Case studies from the North Sea and Gulf of Mexico will be presented to illustrate how different wellbore instability mechanisms can be detected early during drilling and how an appropriate annular pressure management strategy can be selected.

EQUIPMENT

The Continuous Circulation System (CCS) is a new and enabling technology whose potential benefits are elimination of pressure surges when stopping and starting circulation, continuous movement of cuttings in the annulus, improved drilling fluid management, elimination of kicks while making connections, improved ECD control, improved hole conditions, and elimination of ballooning effects. The CCS was developed through a joint industry project (JIP) supported by the UK Industry Technology Facilitator (ITF) and sponsored by six major oil companies.

Shell International Exploration and Production BV began intensive research into MPD concepts in 1998, identifying a variety of methods. A common drilling choke to maintain backpressure was selected, providing solution that was readily available and familiar to the industry as a result of its use in well control. A full-scale automated choke manifold was developed to test this MPD concept. Since then, there have been additional field trials and improvements to the original prototype.

An ECD reduction tool is designed to counter increased fluid pressure in the annulus due to friction loss and cuttings loading. The tool is expected to have a broad range of drilling applications including in narrow pore/fracture pressure margins, deepwater, wellbores that are prone to instability, pressure depleted reservoirs and extended reach wells. It is expected that the tool will be ready for additional field trials in 2005.

A comparison and evaluation of two different control strategies for maintaining a suggested annulus pressure gradient in a well will be presented. The first method uses a model reference control where a simple dynamic flow model is used. The second method uses a nonlinear model predictive control where a detailed numerical implementation of a transient drift-flux formulation is used. Both methods are useful for controlling the annulus pressure gradient, but the non-linear model predictive control methodology gives a wider operating range at various drilling fluid compositions and flow regimes.

A pneumatic fluids drilling model is used to demonstrate how the annular bottom hole pressure is manipulated by diverting a portion of the pneumatic fluid traveling down the drillstring into the wellbore annulus before it reaches the bottomhole assembly and bit. By diverting this fluid, energy normally lost to friction and potentially detrimental to drilling efficiency can be used beneficially to improve penetration rates, hole cleaning, bit life and hole erosion. The presentation describes the mechanical means by which this diversion is precisely and dynamically accomplished without sacrificing borehole stability or robbing energy needed at the bit, especially when utilizing a percussion hammer.

A new downhole pump system generating a reduction of the annulus pressure while circulating is a promising technology option to address limitations posed by the narrow pressure window. By redefining the ECD limitations and improving hole cleaning, the technology can also help extend the lateral reach in ERD wells. The first results of a technical feasibility study of such a pump system jointly performed by a service company and an operator will be examined.

An innovative new drilling technique has been developed to provide an additional level of well control beyond that provided with conventional drilling technology. The patented process involves implementation of one or more annular fluid injection options to compliment the standpipe injection through the jointed pipe drill string or through a coil pipe injection in a coiled tubing drilling (CTD) process. The method has been designed in conjunction with flow modeling to provide a higher standard of well control, and has been successfully field tested and proven.

IMPLEMENTATION

Despite the enabling nature of MPD technology, its implementation can face cultural, commercial, risk tolerance and regulatory hurdles, as well as unknown challenges. A panel comprised of operators, drilling contractors, academia, and government agencies with responsibility for safety and regulations will discuss potential pitfalls in MPD implementation.

FUTURE DIRECTIONS

The application of dynamic annulus pressure controlled (DAPC) coiled tubing drilling to access target reserves from the Gannet Alpha platform in the North Sea will be examined. How the technique was selected, planning stages and operational and post-operational phases will be discussed as well as describing how DAPC affects the drilling operation. The presentation will discuss the equipment and techniques used to provide adequate zonal isolation while minimizing risk.

Shell E&P has constructed a staircase for technology deployment to meet the challenge of sidetracking existing tension-leg platform wells through small-diameter production casing and severely depleted sands. The technologies include two MPD approaches: continuous circulation and dynamic annular pressure control, the latter of which is a Shell proprietary technology. The aim is to combine these techniques with Casing While Drilling, with the goal of a two trip sidetrack, one trip to set a whipstock and mill the window, and a second trip to drill in the 5-in. or 5 ½-in. production liner using MPD and CWD techniques.

Dynamic density control (DDC) is a highly adaptive, real-time, process-control extension of MPD with unlimited scalability to any rig, large or small, on land or water. DDC simultaneously quantifies and utilizes combined static and dynamic stresses and displacements at strategic locations within and around both sides of the wellbore u-tube and its several constituent elements as the well is being drilled. Effective implementation of DDC not only allows the operator/service company team to "Walk-the-Line", but in certain specific operational scenarios to actually "Move-The-Line".

The development of a closed-loop drilling system based on the micro-flux control (MFC) method for the management of downhole pressures is examined. It uses a combination of real time simulation techniques connected to a process control loop that facilitates full back-pressure control over the well. The challenges and development hurdles overcome to commence field testing will be reviewed.

PROGRAM COMMITTEE

Special thanks go to the MPD conference's Program Committee that included **Ken Armagost, BP; Don Duttinger, Petroleum Technology Transfer Council; Ken Smith, ConocoPhillips; Hugh Elkins, Varco; Ken Gray, University of Texas; Don Hannegan, Weatherford; John Kozicz, Transocean Inc**; and **Eric Maidla, Slider LLC; Ken Malloy, Stress Engineering; Alan Orr, Helmerich & Payne IDC; Moe Plaisance, Diamond Offshore; Don Reitsma, Shell; Helio Santos, Impact Engineering; Jerome Schubert, Texas A&M University; Bruce Selby, Shell; Rick Stone, Signa Engineering; Morten Perlander, Petroleum Safety Authority Norway; Ken Fischer** and **Mike Killalea, IADC**; and **Paul Thone, SPE.** ■