SPE/IADC 105521

Implementation of ROP Management Process in Qatar North Field. S.M. Remmert and J.W. Witt, RasGas; F.E. Dupriest, ExxonMobil.

In March 2005, the ExxonMobil Fast Drill Process (FDP) was implemented in the Qatar North Field. Training material was adapted to the local operating environment, and a customized surveillance package was introduced to monitor energy efficiency and vibrations simultaneously. Energy surveillance led to changes to equipment and practices and significant learning about the drilling operating environment. This paper will focus on the learning cycle, changes in drilling procedures and associated results. While technical learnings specific to the Qatar North field will be presented, the information is considered applicable to many drilling activities.

SPE/IADC 104502

Maximizing Drilling Performance with State-of-the-Art BHA Program. D.C. Chen and M. Wu, Halliburton.

Bottomhole assembly modeling is an essential part of the directional drilling. A good BHA program enables many critical applications and can significantly improve drilling performance. Several methods have been developed to build BHA models. The most common approach is probably based on the finite element method. However, many of the finite element based BHA programs have been shown to be inaccurate for modeling steerable assemblies such as motor or rotary steerable systems. Thus, the semi-analytical methods are often required, but such methods are usually cumbersome to run and restricted in simple BHA configurations.

This paper will present a newly developed BHA program using a generic algorithm based on Lubinski's equations. The strengths of this new BHA program are the flexibility and accuracy compared with conventional BHA programs.

SPE/IADC 104623

Application of Novel Technology Improves Drilling Performance in Multilateral Field Development Offshore West India — Reducing Risk and Increasing Production. A. Jaggi, S. Gera and S. Upadhyay, BG Group; M. Gupta, A. Thorat and J. Ruszka, INTEQ; S. Tatake, Hughes Christensen.

The Panna Field offshore West India is a tight limestone drained using multilateral wells. There are significant drilling challenges. First, well trajectories are complex, and laterals are three-dimensional profiles requiring precise steering control to maintain position in the productive zones. Second, total fluid losses to the fractured limestone are frequently encountered. Third, high levels of vibration and high drilling torque threaten the integrity of the drillstring and ultimately limits the laterals' reach. The desire to improve gross drilling performance, reduce the risk to drillstring and extend the reach of the laterals prompted introduction of a new drilling system that was being tested in the North Sea. This new system integrates a high-performance drilling motor with high-speed rotary closed loop system to improving overall drilling performance in challenging areas, reduce stress on the drillstring and enable wells to extend past prior reach limits. On the first well, ROP increased by 46%, the distance drilled per BHA increased by over 300%, and the longest ever lateral in the field was successfully drilled.

SPE/IADC 105594

Effects of RPM and ROP on PDC Bit Steerability. S. Ernst, P. Pastusek and P. Lutes, Hughes Christensen.

Directional drilling is a critical necessity in many of today's wells, and accurate prediction and awareness of achievable build rates is vital in controlling costs. The science behind controlled wellbore deviation has advanced beyond prediction based solely on BHA geometry. Although BHA configuration is an important factor, interaction between each of the 4 primary components — bit, BHA, operating parameters and formation — must be evaluated thoroughly. Previous papers have described how changes in bit characteristics, BHA configuration and various formations influence build rates. With regards to operating parameters, weight on bit (WOB) is well known to be beneficial in increasing the desired build rate under certain drilling conditions and yet does not help in other situations.

SPE/IADC 105521: RPM has been neglected as a significant influence on steerability. A new study investigated the effects of RPM and ROP on build rate.

We propose that most of the WOB effects are actually due to its influence on ROP and bit tilt. However, the influence of operating parameters has not been fully investigated. RPM has been neglected as a significant influence on steerability. These properties have been measured and quantified with the use of a full-scale drilling laboratory and commercially available PDC bits. This paper investigates the effects of RPM and ROP on build rate and illustrates the importance of these parameters.

SPE/IADC 105578

Achieving Shoe-to-Shoe Drilling Performance in Hole-Opening Applications with Rotary Steerable Systems. G. Heisig, J. Hood, S. Okewunmi and E. Robnett, Baker Hughes INTEQ.

Deepwater drilling programs regularly include hole opening applications to provide room for intermediate casing strings. In directional wells drilled with rotary steerable systems, the borehole is typically opened with concentric reaming devices with hydraulically activated ribs. However, drilling with the additional rock cutting device in the bottomhole assembly (BHA) with the associated lack of stabilization in the BHA in the enlarged borehole significantly increases the risk of the operation. In particular, high lateral vibrations can result in failures of BHA components and subsequently in costly trips or fishing operations.

Detailed analysis of downhole weight on bit, torque, bending moment and vibration signals measured between bit and hole opener have provided clear insight into the dynamic response of hole opening BHAs in interbedded formations. Based on real-time information from an advanced downhole multi-sensor data acquisition and processing system, application specific drilling procedures have been developed to avoid or to identify and overcome critical dynamic situations downhole.

Applying these procedures, several hole sections in the GOM were drilled for the first time in one run. In the same field, all previous attempts had resulted in failures of the drilling equipment including several twist offs. For the first time, the paper will show the changes in downhole weight on bit versus weight on reamer when drilling interbedded formations.

SPE/IADC 105566

Detailed Post-Event Analysis of Drilling Problems Significantly Alters the Root Cause Reality for Technical Sidetracks. M. Blaasmo, A.V. Singelstad and K. Bekkeheien, Statoil.

A major Norwegian operator has drilled an average of 30 technical sidetracks every year since 2000, and a significant portion of the total drilling and well technology costs is related to these operations. A project was initiated to investigate the causes for the technical sidetracks. A total of 24 detailed analyses have been concluded with a direct cause and a corresponding root cause. The three major findings from these analyses were: (1) Little consistency between reasons for sidetrack reported in daily drilling reports compared with root causes found from the detailed analyses; (2) Major reduction in formation related root causes; (3) Operational practice accounts for about 44% of the technical sidetrack root causes. The paper presents why this knowledge is of great value during both planning and operations phase and how it may be implemented most efficiently and successfully in both phases.

SPE/IADC 105565

Aggressive Drilling Parameters Capitalize on Cutter Technology and PDC Frame Advancement in Mature Field. P. Langille, Marathon Oil; J. Hildebrand and K. Massie, Hughes Christensen.

In many fields, the mere introduction of standard PDC technology can result in monumental performance improvements. However, in southwest Washita County, Oklahom, the conversion to a PDC-dominated drilling program has proven difficult utilizing standard PDC technology and operating procedures due to the shallow showing (5,000-6,000 ft TVD) of the highly abrasive weathered granite conglomerate. Recently, however, the combination of new bit technology and operational practices has resulted in performance improvements, allowing for a 41% reduction in drilling time.

In much of the surrounding Anadarko Basin, the interval to 11,000 ft (where the Granite Wash is typically encountered) is dominated almost exclusively by PDC bits. However, as recently as 9 months, all operators in the southwest Canute area were forced to use a drilling program comprised solely of roller cones due to the shallow arrival of the Granite Wash and the inability of standard PDC technology and operating parameters to drill this formation. This paper will document how a major operator in the area utilized the concept of aggressive high WOB/low RPM drilling parameters, typically reserved for roller cone bits, coupled with innovative PDC bit frames to replace the typical 6-8 roller cones required to drill to 10,700 ft with just 2 PDCs.

Technical Session 5: Well Planning & ERD

SPE/IADC 105839 PP

Floatation of 10 ¾-in. Liner — A Method Used to Reach Beyond 10 km. J. Eck-Olsen, R. Haugom, G. Løklingholm and H. Sletten, Statoil.

To drill longer wells to reach reserves on the boundaries of the Gullfaks Field required new techniques. The planning of well A-32 C, more than 10 km long, was a challenge where the floating technology where used. The 4,660 m-long, 10 ¾-in. liner was successfully floated to section TD at 7,721 m on 9 May 2006.

The well is the longest well planned and drilled from an offshore installation with a planned TD at 10 km-plus. The simulation in the planning phase indicated it would be very difficult or impossible to run the 5 km, 10 ¾-in. liner to TD with conventional methods. The floatation method was selected for the 10 ¾-in. liner. Simulation showed using floatation and running the liner fully evacuated with air, gave substantial reduction in torque and drag. Using this solution required development of new equipment such as special floats to withstand more than 360 bar differential pressure. Snubbing slips was used to secure liner during running. It took more than a year to plan and prepare this well. The paper describes the planning and obstacles to achieve this challenging goal.

SPE/IADC 105123

The Effect of Hydraulic Vibrations on Initiation of Buckling and Axial Force Transfer for Helically Buckled Pipes at Simulated Horizontal Wellbore Conditions. E.R. Barakat, Chevron; S. Miska and M. Yu, N. Takach, U of Tulsa.

Frictional losses due to contact forces between pipes and wellbore are a primary limitation in extending the reach of many long and high-angle wells. This study investigates a novel technique to reduce the drag forces using hydraulic vibrations induced inside the pipes. Due to pipe dynamics, the contact force will be altered, and therefore the drag friction force will be reduced. The mechanism of drag reduction and the quantitative influence of frequency and amplitude of pulses are not well understood in the drilling industry. Therefore, an experimental study of the effect of hydraulic vibrations on the initiation of buckling and the axial force transfer for helically buckled pipes at simulated horizontal wellbore conditions has been conducted. Results are presented in terms of simple and useful correlations that can be effectively utilized for practical design applications.

SPE/IADC 105068

How Good is the Torque Drag Model? R.F. Mitchell and R. Samuel, Halliburton.

Perhaps the only "standard" drill string model in use today is the torque drag model originally developed by Johancsik in 1984 and put in a standard form by Sheppard in 1987. Because of the simplicity and general availability of this model, it has been used extensively. Why does this model work well in some circumstances yet not so well in other cases? Part of the problem may lie in the description of the wellbore trajectory and the wellbore tortuosity. However, this study concentrates on the actual model formulation. Several example problems with different inclinations and wellbore curvatures are studied to show how these criteria can be used to validate torque drag models.

SPE/IADC 104478

Backing Off a Free Drillstring — Planning and Execution on a World-Class ERD Well. J. Eck-Olsen, Statoil; B.M. Foster, K&M Technology Group.

Since the inception of horizontal and extended reach wells, operators have been faced with the complications that arise when dealing with stuck pipe and pipe recovery options. Drillstring washouts in particular create a tricky situation in ERD operation, as extensive time circulating and rotating at high rates are necessary to sufficiently clean a high-angle wellbore of cuttings to a level that allows a safe and trouble-free trip. When a washout occurs prior to the completion of the cleanup process, the operator is faced with a difficult choice: continue to circulate until the hole is clean, running the risk of enlarging the washout and potentially creating a twistoff, or attempt to pull out of a dirty hole, which may result in tight hole and/or stuck pipe.

SPE/IADC 105493: A rotary steerable system and ring gauge pivot stabilizer was systematically tested to enable direct comparisons of the directional response, hole quality and drillstring vibration.

A case history is presented where a drillstring washout occurred on a long extended reach well prior to the completion of hole cleanup. Attempts to trip the string quickly proved futile, and it became apparent that the string would either become stuck during attempts to pull. An unconventional application of the backoff technique was safely used to separate the pipe below the washout without the drillstring being physically stuck. The entire string was subsequently recovered, saving more than US$2 million in lost time and equipment.

SPE/IADC 105558

High-Integrity Wellbore Surveys: Methods for Eliminating Gross Errors. R. Ekseth, K. Kovalenko and J. Weston, Gyrodata; T. Torkildsen, E. Nyrnes, Statoil; A. Brooks, H. Wilson, Baker Hughes INTEQ.

SPE 103734 pointed out the costs of unreliable directional survey data and described how a significant degree of reliability can be achieved with the application of quality control checks internal to the directional data. It also identified the fact that such checks fall short of providing comprehensive reliability assurance.

This paper will document weaknesses in conventional directional survey QC procedures through theoretical considerations, statistical analyses of real survey data, and real examples of failed surveys that have made it through conventional QC procedures without detection. The paper will define principles for survey programme design and implementation to eliminate these weaknesses and propose a new set of minimum requirements for survey validation.

SPE/IADC 104609

Step Changes Needed to Modernise T&D Software. C.J. Mason, BP; D.C.Chen, Halliburton .

Over the past 20 years, while software interfaces have improved significantly, only incremental improvements have been made to the underlying torque and drag (TD)models. The prevalent T&D mathematical model is based on soft string assumptions pipe stiffness and borehole clearance effects are negligible. Although soft string model is considered appropriate for drill strings, there is uncertainty around its applicabilitys to stiff, heavy casing strings. Several stiff string models have been developed, but their verification is limited.

The first half of this paper will assess limitations of the various stiff string TD models. The second half will define future requirements for what is considered to be the next generation of TD models.

SPE/IADC 105493

Unique Pivot Stabilizer Geometry Advances Directional Efficiency and Borehole Quality with a Specific Rotary Steerable System. S. Barton, A. Clarke and D.G. Perez, ReedHycalog; S. Peach, Weatherford.

The geometry of a stabilizer, when used as a near bit pivot within specific point-the-bit rotary steerable BHAs, is critical to stability and deflection to provide optimal directional response. This paper describes the extensive and systematic testing of a rotary steerable system and ring gauge pivot stabilizer that has enabled a direct comparison of the directional response, hole quality and drillstring vibration to be made for the various combinations tested. The testing also evaluated interaction between the gauge design of the bit and the pivot stabilizer.

Technical Session 6: Deepwater Drilling I

SPE/IADC 105792

More Ultra-Deepwater Drilling Problems. J. Shaughnessy and W. Daugherty, BP; R. Graff, Chevron; T. Durkee, Anardarko.

The industry has pushed the water depth record of ultra-deepwater drilling beyond 10,000 ft and drilling depths below 32,000 ft. A number of new problems have occurred that have been caused by mechanical failures (equipment stressed to its limits) or human error. In the Gulf of Mexico, recent drilling has encountered problems drilling salt. Four operators active in deepwater have collaborated on this paper to document problems under the assumption that understanding what can go wrong is the best way to avoid problems.

SPE/IADC 105914

Deepwater Blowout — A Case History: Shallow Gas Hazards Hide in the Weeds. W. Flores Jr., J.B. Garner and C. Scarborough, Boots & Coots.

This paper will detail the sequence of events involving the blowout of a deepwater development well adjacent to the discovery well, while loop currents prevented running of the BOP stack and riser following the cementing of surface casing. Water depth was 2,400 ft. The cause of the blowout was gas flow after cementing.

The operator designed the exploration well to incorporate the pump and dump process, and successfully drilled riserless through a shallow gas hazard. Surface casing was run and cemented and the #1 well drilled to the objective depth and completed. The #2 well was spud less than 200 ft from the #1 well and duplicated the process.

After circulating lead cement to the mud line and observation of cement returns at the wellhead, a cement slurry was circulated into the well. The drill string was withdrawn and preparations made to run the subsurface stack and riser. However, loop cur-