instances of BHA whirl and severe acceleration and deceleration caused by stick slip.

To enhance overall bit/BHA stability, a new style 8 1/2” PDC was implemented with innovative cut depth control (DOC) technology and enhanced stability features. The result was a significant reduction in stick slip, lateral vibration and BHA whirl.

SP/IA/DC 105906


Wells drilled in the Tuscaloosa Trend near Baton Rouge have long been recognized for the extreme nature of the HPHT operating environment and potential for well control problems. The current local point concerns drilling the highly abrasive formations contained within the intermediate and drilling liner sections to depths of about 20,000 ft. These sections are a major cause of bit, directional tool and drill string failures. The directional complexity of the well has increased exponentially in recent years; new drills are therefore primarily directional.

This paper focuses on the improvements which have been achieved over a 5 year period due to the implementation of Powered Rotary Steerable Systems (PRSS) coupled with Rotary Steerable Technology. The step change in performance has been evidenced by a 50% reduction from 90 to 55.

SP/IA/DC 105885


This paper will present laboratory-measured drilling performance of full-scale bits at 10,000 psi borehole pressure, cuttings volume estimates, apparent cuttings size distributions, mud properties and the influence of bit and mud design on drilling performance, cuttings and near borehole characteristics. Findings include:

1. Modulating up decreased PDC drilling efficiency and penetration rates in sandstone by 90% for both water- and oil-based systems with little sensitivity to ending mud weight or blade count.
2. TCI and impregnated bit penetration rates at these pressures were an additional 70-90% slower than PDC bits.
3. Cuttings from Carthage Marble and Mancos Shale appear to be compressed agglomerates of fine particles. Carthage Marble cuttings had low compressive strengths.
4. Test results indicated that opportunities for improvements in bit design and smart HPHT drilling fluids are possible.

SP/IA/DC 105522


PDC bit modeling and single cutter analysis have enabled a new generation of cutting structure based on the optimization of a specific interactive cutting mode that generates, by the only drilling action of the cutters, an axial force oriented in the drilling direction a negative weight on bit. This paper presents the application of this new PDC bit design and show that WOB can be strongly reduced in a large range of formations. This new bit technology has the potential to increase bit performance, specifically in operating conditions where power is available but WOB is limited due to friction, buckling or reduced vertical depth.

SP/IA/DC 105898


The drill bit is often assigned as the cause of downhole vibration/instability and frequently bears the scars of dynamic drilling problems. Historically bit manufacturers have used a combination of dull grades and surface data to speculate on cause and effect of downhole events with insufficient attention to what may be occurring in between. This paper discusses the implementation of a vibration logging tool and its flexibility for placement of multiple tools in various locations. Specific field cases will be presented, including validation of pre-run dynamics modeling software, up to 6 distributed measurements in one drillstring, rotary steerable tools, concentric and eccentric hole opening tools, and response of different BHA configurations.

Technical Session 8: Tubulars I

SP/IA/DC 105026


Drillstring failures caused by friction heating of BHA components and drillpipe have increased dramatically over the last several years. In one failure mode, the drillpipe is heated above a critical transformation temperature accompanied by a rapid decrease in tensile strength. Subsequently, the component fails under a tension loading, well below the rated strength of the drillstring.

This paper addresses the features of a downhole heating failure, including the material attributes that can be used to identify the phenomena. Guidelines and operating practices that can be employed to minimize the occurrence of these costly and potentially dangerous failures are discussed.

SP/IA/DC 105930


The design and development of steam injection fields is a mature subject. Since the strings in these wells invariably experience inelastic loading, issues such as the effects of temperature on the static and cyclic material properties become important. Due to the high temperatures involved, miscellaneous issues such wellhead loading gain prominence. Data on the cyclic thermal properties of OCTG steels is rare in oil field literature.

This paper presents a comprehensive mathematical model of casing strings subjected to thermal loads in steam injection wells. The model includes the effects of temperature on material properties and the effects of wellbore curvature and pressure-stress during the heating cycle. Several counter-intuitive aspects of the casing stress state during cooling/unloading are explained by an analytical model and finite element analyses. Test data and the mathematical models are used to determine the stresses in the casing at different points in the life of the well via a generic example design.

Technical Session 9: Geomechanics

SP/IA/DC 105405


The paper describes state-of-the-art approaches for assuring wellbore stability in high-angle extended-reach wells. While the step-out lengths of proposed ERD wells are becoming more challenging, wellbore stability assurance technologies are developing at an equal pace. Incremental step-out increases are no longer required, and it is now quite reasonable to plan 10 km ERD wells on the basis of a limited number of vertical or near vertical appraisal wells. The paper reviews the prior art of ERD wellbore stability, focusing on the Wyth Farm, Valhall and...
Niajak experiences of the 1990s. New developments in theoretical understanding and predictive capability of rock failure surrounding wells drilled at high-angle to bedding will be described.

SPE/IADC 105808

Wellbore Stress Indicators While Drilling: A Comparison of Induced Features from Wireline and LWD High-Resolution Electrical Images. G. Lindsay, S. Morris and J. Lovt, INTEQ; S. Ong, Baker Atlas.

Using recent examples from vertical and deviated wells, the differences between LWD and WL image logs for determining wellbore stress are explored. Wellbore stability analysis using wireline image data is well established. High resolution LWD images offer real time and time lapse image data until recently unavailable. Comparison of post drilling images with detailed wellbore images acquired at time of drilling shows that different features are observed. Extended reach, high pressure and geometrically complex well designs require increasingly sophisticated wellbore stability management. A method for incorporating the use of high resolution images in real time to supplement traditional analysis is discussed.

SPE/IADC 105193

Improving Formation Strength Tests and Their Interpretation. E. van Oort, Shell; R. Vargo, Halliburton.

Verifying pressure integrity of a casing string and the adjacent formation is an important requirement during drilling of a well. Crucial decisions on mud weight, kick tolerance, interval total depth and casing setting depth are based on the outcome of formation strength (FS) tests such as leak off tests (LOT) or formation integrity tests (FIT). Yet the majority of FS tests and their interpretation currently carried out in the field are inadequate. In this paper, we will highlight many of the problems underlying current FS tests and their interpretation, illustrating them with actual field examples. We will show how test artifacts can be overcome to correctly assess formation strength parameters.

SPE/IADC 105763


In 2002, Conoco drilled the Spa prospect, Walker Ridge 295 #1, in the Gulf of Mexico to a depth of 29,452 ft MD / 29,434 ft TVD, penetrating a nearly 10,000-ft salt section. While the potential for reduced fracture gradient below salt was recognized in well planning, pre-drill pore pressure and fracture gradient estimates were based on seismic velocities in the adjacent abyssal basin. The subsalt section was difficult to drill, and several formation integrity tests were performed. We developed basin scale finite element models to represent the geometry of the salt diapir and performed non-linear geomechanical simulations to analyze the stress changes in and around the diapir. The simulations predict stress perturbations that vary spatially in accord with the complex and irregular salt geometry.

The study provides validation of non-linear finite element stress modeling techniques that can be applied when drilling through salt diapirs. It also demonstrates the potential for stress distortions associated with topography along the top of salt.

SPE/IADC 104947


Wellbore instability during drilling is usually treated by casing and cementing the wellbore using several casing strings. If a formation is strengthened with fewer casing strings, it would save significant money and time. With wellbore strengthening, a wellbore can be stable under higher pressure without failing under tension. One way to strengthen a wellbore is to seal the fractures and/or microcracks penetrating the wellbore by adding sealing materials in drilling fluids. But without a fundamental understanding, selecting materials is a challenge. This paper will report results from a fundamental study aimed at revealing the basic physics that controls the success of treatments strengthening wellbores.

SPE/IADC 104606


The use of forward basin models in pore pressure prediction to enable real-time updates of pore pressure estimation ahead of the bit represent a significant improvement in modeling. The real-time application of pressure purposed basin modeling technology has been investigated in 10 wells in which this technique was applied. Overall, approximately 90% of these 10 wells were within 0.5ppg for the first 2,000 ft after update, 90% were within 1.0ppg.