STACKED MULTILATERAL SYSTEM

In response to the need to drain more of the M-Sand reservoir within the Troll field, especially where production levels are low, the existing dual lateral technology was advanced to include two lateral legs in addition to the mainbore by creating a stacked or trilateral system.

Stacked Multilateral System for the Troll West Field: Development and Case History (SPE/IADC 79866 - Alternate) by **A J Cuthbert**, **Halliburton**; **J M Hegreberg**, **E Skoglund**, **Norsk Hydro**.

COILED TUBING DRILLING

A prototype drilling system has completed a three-well Dynamically Over Balanced Coil Tubing Drilling project. The system successfully drilled horizontal sidetracks through 3 1/2-in tubing into overpressured/underpressured fault blocks of the Kuparuk River Formation on Alaska's North Slope.

After a moderately successful start of this intermittent program in 1998, attempts to expand to more lucrative targets, albeit more technically challenging, have met with minimal success largely due to shale instability. Through careful study of the problems encountered in 2000 and 2001, modifications to procedures, fluids, and specifically equipment were introduced to provide optimum opportunities for success.

Prototype Drilling System Improves Coil Tubing Drilling Performance in Kuparuk Field in Alaska (SPE/IADC 79867 - Alternate) by **M G Rixse**, **Baker Hughes INTEQ**; **D Venhaus**, **Phillips Alaska**.

NORTHSTAR DRILLING

Size, location and access are the three most obvious aspects of the Northstar development project. Drilling an 8,400-acre oilfield from a 3.7-acre man made island 6 miles out in the Beaufort Sea has presented some distinctive challenges. Many of these challenges were anticipated and addressed, while many others were not.

This paper explores the Northstar field in detail, along with the logistical details of supplying for an accelerated drilling program during seasonal restrictions in a lay-down area equivalent to 50% of a football field.

Northstar Drilling - A Progressive Arctic Endevor (SPE/IADC 79868 - Alternate) by **G N Kidd**, **B Holt**, **BP**. ■

Tubular technology means more efficient operations

TWIST AND SHEAR OF PIPE

The effect of torque on buckling was first recognized in the design of hollow propeller shafts for ships. If buckling could be caused by torque, could torque be induced by helical buckling of drillpipe and tubing? The answer is yes, but the assumption has always been that the effect was too small to be of concern. The author has re-examined this problem and has found an exact large-displacement solution to the helically buckled pipe that predicts induced torque. As a part of this calculation, the lateral shear in the pipe was also determined and found to be unexpectedly large.

The Twist and Shear of Helically Buckled Pipe (SPE/IADC 79869) by **R F Mitchell**, **Landmark Graphics**.

INSULATED TUBING

Of the several options for controlling temperature in a well, vacuum insulated tubing (VIT) has proved useful in a number of applications. Use of VIT, however, requires a number of unique design considerations, from both a thermal and mechanical perspective.

This paper describes the application of VIT for a particular purpose: to minimize temperature change and ensuing annular fluid expansion pressures in a deepwater well design.

Thermal and Mechanical Considerations for Design of Insulated Tubing (SPE/IADC 79870) by **P D Patillo**, **S W Gosch**, **BP**; **J E Bellarby**, **Tracs International**; **G R Ross**, **Stress Engineering Services**; **G D McLaren**, **Landmark Graphics**.

NON-UNIFORM LOADING

In various locations worldwide, casing designers are confronted with non-uniform cross-sectional loading due to contact with a mobile formation. The formation movement may be due to rock constitution (salt, swelling shale) or it may be tectonic in origin.

This paper documents the results of theoretical and numerical studies to determine the effect of non-uniform loading on the conventional collapse resistance of casing. The current work focuses on casing exposed to external fluid pressure and extreme point loading, as might be the case in a poorly cemented wellbore.

Effect of Non-Uniform Loading on Conventional Casing Collapse Resistance (SPE/IADC 79871) by **P D Patillo**, **N C Last**, **BP**; **W T Asbill**, **Stress Engineering Services**.

PERFORMANCE DRIVEN TUBULARS

New developments in drilling tubulars are rapidly evolving and represent enabling technologies for the industry's continued advancement of drilling deeper, longer reach and more cost-effective

wells. Intermediate sized 5 7/8-in. drill pipe has rewritten previously perceived limitations in ERD and deepwater projects. The drill pipe has been successfully used to drill ERD, deepwater and ultra deep HPHT wells in the South China Sea, Gulf of Mexico, Caspian Sea, offshore Trinidad, onshore Wyoming and onshore Columbia. The 5 7/8-in. drill pipe has improved penetration rates and significantly shortened drilling curves. Its performance on many of these projects will be presented in the paper.

This paper will present drilling tubular technologies that represent enabling technologies for drilling tomorrow's deeper, longer reach wells more cost effectively.

Performance Driven Drilling Tubular Technologies (SPE/IADC 79872) by **R B Chandler**, **M J Jellison**, **Grant Prideco**; **M L Payne**, **BP**; **J S Shepard**, **GlobalSantaFe**.

ALUMINUM ALLOY DRILLSTRING

Aluminum technology for drilling still can be considered as new to most of the operators that do not yet have this capacity. The experiences of many years in Russia were successfully transferred in offshore applications during the past decade and have been used to study super-long boreholes drilling opportunities today. The latter is the subject of the paper.

Drillstring with Aluminum Alloy Pipes Design and Practices (SPE/IADC 79873) by **M Y Gelfgat**, **V S Basovich**, **V S Tikhnonov**, **Aquatic Company**; **F M Sharifulin**, **Slavneft**.

GOODMAN DIAGRAM

There are many drilling programs in the industry that stretch the limits of existing drill pipe. A drill pipe failure in these holes can be expensive in lost time and in some cases lost equipment. The primary failure mode of the drill pipe is fatigue. As with the drill pipe tube, the tool joints are also subject to fatigue failure and are, in many cases, the weak link in a drillstring.

This paper presents considerations and recommendations to improve the fatigue life of rotary shouldered connections on drill pipe and other drilling tools. These recommendations are based on the stresses induced in the connection at make-up and the additional stresses resulting from the service loads.

The Goodman Diagram as an Analytical Tool to Optimize Fatigue Life of Rotary Shouldered Connections (SPE /IADC 79874) by **J E Smith**, **Weatherford**; **E I Bailey**, **Stress Engineering Services**.

Lightweight drillstrings can cut drilling costs by using smaller, less expensive rigs. For extended reach drilling, aluminum alloy drillstrings could allow wells of 15,000m or longer.

PRESSURE BUILD-UP

Trapped fluid in the annulus of subsea wells can cause failure of casing strings. This condition occurs when casing annuli attain a closed volume circumstance when a well is cased, cemented and head seals set. Upon production, the trapped fluid increases in pressure due to the heat transfer of the produced fluids to the casing strings.

This paper contains a simple laboratory procedure and resulting data to determine the resulting trapped-volume pressure. Data from eight different fluid combinations are presented.

Control of Contained-Annulus Fluid Pressure Build-Up (SPE Alternate 79875) by **R N Williamson**, **W Sanders**, **ConocoPhillips**; **J E Griffith**, **J Jakabosky**, **Halliburton**.

INTEGRATED MULTISTRING CASING

This paper is the third in a series about new approaches on multistring casing design. The wellhead growth index, introduced in the first publication by the authors, includes annular fluid expansion and wellhead growth and provides a simple, practical way to view not only casing movement but also fluid expansion in the annulus during drilling and production events.

The system work-done concept was introduced in the second document, and includes the casing design process the response of the whole casing system to high annular pressure build-up by quantifying the amount of work done during worst pressure-temperature loading events.

This paper integrates both concepts in a practical manner to select mechanical and cost effective casing design solutions that includes in the calculations wellhead growth constraints as well as optimization of the amount of work done by the system.

Integrated Multistring Casing Design for HPHT Wells (SPE/IADC 79876 - Alternate) by **A C Gonzales**, **R Samuel**, **Landmark Graphics**.

CASING PERFORATING

Three wells have been successfully drilled, cemented and fracture stimulated in the Kenai Gas Field utilizing an industry unique Casing-Conveyed-Completion Systsm (CCPS). This revolutionary system consists of perforating guns external to the casing and integral valves in the casing for zonal isolation.

During completion operations all equipment is remotely actuated without wellbore intervention. In addition, downhole sensors were run on all three wells providing monitoring of bottomhole pressures and temperatures during cement operations, as the cement cures, during stimulation operations and ultimately over the productive life of the well.

Casing-Conveyed Perforating System Presents a Unique Set of Drilling and Cementing Challenges; A Case History Study - Kenai Gas Field, Alaska (SPE/IADC 79877 - Alternate) by **J J Garner**, **BJ Services**; **J G Eller**, **W J Tank**, **Marathon**.