# Mature fields can still contain deeper reserves

## SLIM WELL TECHNOLOGY

The plans for re-developing the mature Forcados-Yokri field in the shallow offshore area of the Niger Delta was conceptualized as an integrated project with a fixed and delegated budget for well delivery. However, with the upbeat in global drilling activities resulting from increased oil prices, rig rates for the jackup rig in use was increased by 100% and was set to jeopardize the project economics for the campaign. Several innovations aimed at improving drilling performance such as cluster and batch drilling and conductor driving optimization etc were implemented in the face of a flattening learning curve as the drilling campaign progressed, with the most significant being the adoption of slim well technology.

**The Northstar development drilling program off Alaska's North Slope covered an 8,400 acre field from a 3.7 acre artificial island half the size of an American football field.**

The paper includes highlights from the execution phase – problems encountered, learning points and recommendations - and the resultant cost impact in the drilling campaign.

*Reducing Development Cost in Forcados-Yokri Field with Application of Slim Well Technology* (SPE/IADC 79860) by **O E Erivwo**, **H D Okwa**, **M A Ideh**, **D C Woodland**, **Shell Petroleum Development Co**.

## ACCESSING DEEP RESERVOIRS

Producing a prospect's reservoirs "from the bottom up" may not always be feasible. Economics often dictate that higher STOIIP or better-quality reservoirs must be produced first before deeper-lying horizons can be accessed. In mature prospects operators now face the challenge of having to drill through severely depleted zones in order to unlock these deeper reservoirs. This is the case at the deepwater prospect Ursa in the Gulf of Mexico.

*Accessing Deep Reservors by Drilling Through Severely Depleted Formations* (SPE/IADC 79861) by **E van Oart**, **J Gradishar**, **G Ugueta**, **Shell E&P**.

## CASING DRILLING

Conoco has had a sustained, multi-rig development program in the Lobo field of South Texas since the mid-1990's. Drilling efficiency using conventional techniques has been improved to the point where additional gains are difficult to achieve. Each hole section is drilled with a single PDC bit run and downhole trouble time has been reduced to less than 10% of the overall drilling time. Even with the high ROP's and minimized trouble time, further cost reductions are dictated by the need to develop smaller and smaller reservoirs.

Tesco's Casing Drilling system was selected for a five well pilot program to evaluate the technology. Sufficient progress was demonstrated in the pilot program so that Casing Drilling continued through the end of 2001 and the rig was contracted for continued operation in 2002. After drilling sixteen wells, the Casing Drilling process has proven to significantly reduce the in-hole trouble time below the low value that was already obtained.

*Casing Drilling Activity Expands in South Texas* (SPE/IADC 79862) by **K Fontenot**, **J Highnote**, **ConocoPhillips**; **T Warren**, **B Houtchens**, **Tesco Corp**.

## THROUGH TUBING TECHNOLOGY

Many companies operate on a global basis. Often a new idea or technology can make a step change in the economics, or performance, in a particular province or field. That leaves the company with the enviable problem of understanding how and where it could impact its operations in other areas of the world. One area where BP has had such success is in the North Slope of Alaska, where through tubing drilling (TTD) has had a dramatic impact on their infill-drilling program. This paper discusses how the potential gains from transferring the technology from Alaska to the North Sea were analyzed.

*The Transfer of Through Tubing Drilling (TTD) Technology Between Provinces* (SPE/IADC 79863) by **J W Morrison, BP.**

## P&A OF BLOWN OUT PLATFORM

This paper describes the plugging and abandonment of gas producing wells following a blowout on a six-slot platform located in western offshore India. The paper highlights the complications and severe tubular damages that occurred due to the blowout and the technology that was adopted to abandon such wells. The extensive use of through tubing tools with coil tubing was the key to the success of the project.

*Plugging and Abandonment of a Blown Out Platform* (SPE/IADC 79864) by **A Rai**, **ONGC**; **D G Strickland**, **Cudd Pressure Control**; **A Ferguson**, **Thru Tubing Solutions**.

## ACCESSING TRAPPED RESERVES

As fields enter the later stages of their producing lives, accumulations of hydrocarbons may become trapped below them. While the overlying field is produced down to a very low pressure, these smaller accumulations often remain untouched at virgin pressures or are only slightly depleted. Drilling problems arise when attempts are made to drill through the overlying field into these lower reserves with mud weights required to either prevent lower reservoir influx or shale collapse. This mud weight is often much higher than the remaining formation strength of the overlying field and severe losses and fracturing can occur.

The authors will detail the theoretical and practical aspects of the project identifying field and technology selection criteria, risk management aspects, and how all these were combined to deliver a successful well.

*A Novel Approach to Access Trapped Reserves Below Highly Depleted Reservoirs* (SPE/IADC 79865) by **A Chesters**, **S Donaldson**, **T Vandeweyer**, **Nederlandse Aardolie Maatschappij**.

## 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