Special drilling operations cover technical, management issues

IADC/SPE 59100

Adjustable Rate Drilling Contracts: Go With The Flow?

The paper reviews adjustable rate drilling contracts from several perspectives and discusses various means of structuring variable dayrate provisions. The author draws on over 20 years of industry experience in analysing various approaches to adjustable rate drilling contracts. The analysis considers selection of an appropriate index or other benchmark for rate adjustments, frequency of rate adjustments, use of a rate "floor" and "ceiling", and associated issues. The paper also discusses the attributes and drawbacks of adjustable rate drilling contracts.

—C Moomjian, Santa Fe International Corp

IADC/SPE 59178

Advanced Transient Simulator for Studying Shallow Gas Blowouts

2 wellbore hydraulics simulators (KICK and COMBOF) were modified to simulate high flow rate from overpressured high permeability formations in order to study the necessary reaction time to avoid a catastrophic event. This paper describes the computational approaches and results of calculations using these 2 different numerical wellbore hydraulic simulators.

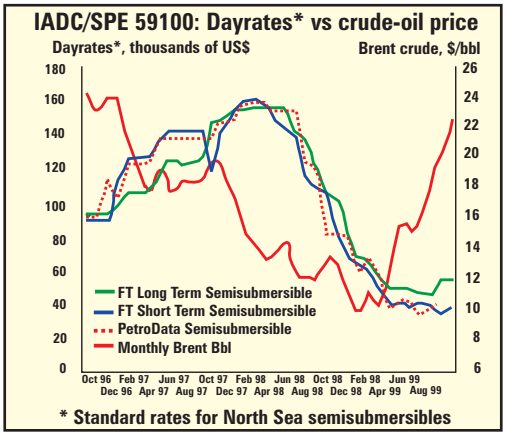
—J S Rath, Sandia National Laboratories
–A L Podio, University of Texas

IADC/SPE 59179

Casing Drilling Application Design Considerations

The implementation of casing drilling requires special considerations for the type of rig that will be used, bit cutting structures, casing connectors, hydraulics, and torque and drag. Casing drilling can be conducted with rigs that are designed specifically for casing drilling, hybrid rigs that are designed for both casing and conventional drilling, and conventional rigs that utilise a portable modification kit to facilitate casing, wireline, and BHA handling. Since the bit and BHA is retrieved through the "drill casing" and a hole large enough to accommodate the casing and cement sheath is needed, underreamers along with conventional pilot bits are typically used. Combinations of PDC and roller cone under-reamers and PDC and roller cone pilot bits have been used. The casing connectors must handle more torque than is normally required and is subject to fatigue from rotation. The reduced annular area from the relatively larger casing OD increases the annular velocity for improved hole cleaning, but also increases the ECD.

—T Warren and P G Angman, Tesco Drilling Technology



IADC/SPE 59100: This review of adjustable rate contracts discusses how to structure variable rates.

IADC/SPE 59180

"Frontier" Deep Water Exploration in the Norwegian Sea.

In 1999 **Saga Petroleum** drilled its "Gjallar" well in 1,352 m water depth, on the Vøring plateau in the Norwegian Sea. The well was drilled vertically to circa 3,900 m. The well's location was selected to avoid potential gas chimneys and to test reservoirs within the top Cretaceous sandstone enclosures. "Gjallar" was a rank wildcat, with the geology and pressure conditions unkown. Pressure evaluation was reviewed in planning and drilling as critical to well design, casing depth setting and meeting well objectives. The tertiary sequence presented unique uncertainty in that it was the first ever section of Diatomaceous Ooze to be drilled in Norwegian sectors. Special precautions were required to limit ECD exposure in this part of the well. The rig, **Saipem's** Scarabeo 5, had been employed on subsea completions for some time. A BOP upgrade, full functionality of this equipment and its personnel was necessary to meet the challenges presented.

This paper highlights the importance of organisational structure, assessing and designating necessary resources, applying risk management at every stage, providing detailed planning and operational guidelines with service company and drilling contractor involvement throughout.

—P Aird, Kingdom Drilling Services Ltd
–F Stene, Saga Petroleum A/S

IADC/SPE 59183

New Considerations for Handling Gas in a Deepwater Riser

In this paper, the author reviews the theory on the behavior of gas migration through drilling fluids and shows how this can affect operations in a deepwater well. Specifically considered are the operations as a result of gas getting above the BOP stack and into the riser during a well control incident. Computer model simulations are presented to define a range of conditions. Field test data is compared to simulator data to validate the predictions.

SPE/IADC 59181: BP Amoco details 20 years of drilling in Louisiana's Tuscaloosa formation. Wells are deep (22,000 ft), with pressures and temperatures of 16,000 psi and 380° F.

If the amount of gas that gets above the BOP stack is limited by successful detection, then the gas can be safely removed from the riser using controlled circulating procedures without the need for much specific equipment.

The use of advanced kick detection equipment is evaluated as a method of ensuring that the gas volumes above the stack would remain small.

—W L Lloyd, Transocean Sedco Forex

IADC/SPE 59181

20-Plus Years of Tuscaloosa Drilling: Continuously Optimizing Deep High-Temperature/High-Pressure Wells

Drilling the Tuscaloosa formation in Louisiana was as challenging as any area drillers worked 20 years ago. It was the most active area in the US. Problems that were new at the time, such as gas solubility in oil base mud,sulfide stress cracking of tubulars, pressure regressions and low margins between the fracture pressure and pore pressures resulted in numerous well control problems and high cost wells. Activity decreased in the mid-80s when the gas price did not encourage operators to challenge the drilling risks. **BP Amoco** is still successfully drilling to 22,000 ft into 16,000-psi, 380° F reservoirs that are now depleted over 10,000 psi.

This paper will address steps taken to optimise the drilling operation and continue making the wells economical. First, drilling problems such as stuck pipe, lost returns, drill string failures and well control had to be minimised. Next, successful cement jobs were required and have resulted in the highest rate completions in the history of the Trend. All objectives had to be achieved in a safe manner with little impact on the environment.

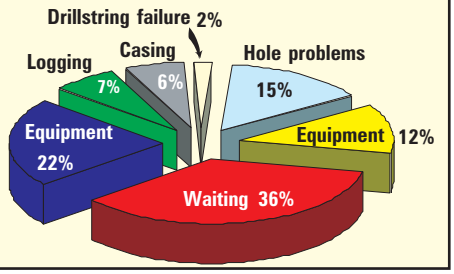
—J Shaughnessy and H A Locke, BP Amoco plc

IADC/SPE 59182 (ALTERNATE)

Overcoming Hard Rock Drilling Challenges

The paper initially describes a joint industry project aimed at developing and testing the most promising technology to drill through hard rock. The paper then presents the most promising technologies selected to be field tested in Brazil and Bolivia: fluid hammer, jet-assisted drilling, vibration reducers, and a new bit design. Some technologies derived from the mining industry and has been recently adapted to be used in the oil industry. However, some of them still lack durability. The field tests have been planned taking into consideration the risks associated to each technology, as well as the risk involved in the well itself. 3 sites were available—Amazon, South of Brazil, and Bolivia—and the best combination has been used to test the different technologies. Minimization of the risk was the key issue to successfully field test any technology still under development. The paper finally presents the most important results from the field tests, as well as the technical and economical analysis performed with each technology investigated.

IADC/SPE 59180: Gjallar operating loss breakdown



—H Santos, *et al*, Petrobras SA

IADC/SPE 59184 (ALTERNATE)

Record Performance Achieved on Gulf of Mexico Subsalt Well Drilled With Synthetic Fluid

Drilling subsalt wells has traditionally been problematic because of difficulties encountered in penetrating the salt formations. An operator recently used a synthetic invert-emulsion fluid with great success in a Gulf of Mexico subsalt well. Because the operator had previously drilled an adjacent well with a commonly used saturated salt fluid, improvements in drilling performance with the synthetic fluid were demonstrable. The first well (saturated salt fluid) was a straight hole; the second well (synthetic fluid) was deviated. Both wells penetrated the approximately 8,000-ft-thick salt formation to reach total depth below 21,000 ft.

In the first well, bounce and vibration precluded the use of polycrystalline diamond compact (PDC) bits and resulted in cracked collars and a cracked mud-motor housing. Penetration rates were slow and 17 bits were used. In the second well, penetration rates more than doubled and could have been increased further had controlled drilling not been necessary to maintain the proper course. Nevertheless, drilling time was faster than in other area wells at comparable depths. Only one bit was used, and fluid costs were less than the first well. The operator estimated that 80 days were saved using the synthetic fluid.

—M Young, Baroid Corp
–R A Meize, Anadarko Petroleum Corp

IADC/SPE 59185 (ALTERNATE)

PCD Technology Advances Sidetracking Capabilities

This paper discusses how PCD cutters, which are commonly used in drilling, were modified and applied to a casing-sidetracking mill. The mill design capitalizes on their ability to effectively and swiftly cut a window in casing and drill a rat hole in formations with compressive strengths of up to 40,000 psi.

The benefits of such a mill are: using the same cutting element for both steel and hard formations, substantial cost savings when constructing multiple laterals from the same mother bore, increased consistency in mill manufacture, reliable milling performance and improved efficiency in the sidetracking operation.

IADC/SPE 59185: PCD cutters were modified and applied to a casing-sidetracking mill. The mill could cut a window in casing and drill a rat hole in formations with compressive strengths up to 40,000 psi.

This paper details laboratory-milling tests that identify the best material for cutting steels and field test in Oklahoma, West Texas and Colombia on 7-in. and 9 5/8-in. casings.

—R Childers and G C Miller, Smith International Inc