

New experience, tools drive underbalanced drilling

CLOSED HOLE CIRCULATION

The drilling of a sour, high-pressure fractured reservoir in the Tengiz field of Kazakhstan displayed complex and hazardous well control situations. While drilling the carbonate reservoir termed Unit 1, multiple fractures would be encountered resulting in severe lost circulation followed by hydrocarbon influx into the wellbore.

A rotating control device (RCD) was employed to drill ahead blind by pumping a sacrificial fluid (water) down the drillpipe. Simultaneously, a pressurized mudcap on the annulus with weighted oil base mud controlled hydrocarbon influx.

Closed Hole Circulation Drilling: Case Study of Drilling a High Pressure Fractured Reservoir - Tengiz Field, Tengiz, Republic of Kazakhstan (SPE/IADC 79850) by J M Bailey, Tengizchevroil; M N Sweep, ChevronTexaco; C R Stone, Signa Engineering Corp.

UBO FROM TENDER RIG

Shell's first underbalanced drilled (UBD) well outside North America or Europe was successfully drilled with a fast track project plan by Sarawak Shell Berhad in a gas field in February 2002. This well was also the first UBD well in the world to be drilled with a tender assist rig.

Underbalanced Drilling From a Tender Assist Drilling Rig (SPE/IADC 79851) by J MacArthur, Sarawak Shell



In 2000 Shell recognized underbalanced drilling operations as one of four strategic technologies. The operator mobilized two UBO packages in Oman from different contractors to evaluate UBO conventional drilling.

Berhad; D A Elliott, Shell International Exploration and Production; M Williams, Halliburton; J Terwogt, Sarawak Shell; P Brand, Blade Energy Partners.

UBO MULTILATERAL WELL

This paper describes aspects related to planning and execution of six multilateral horizontal branches drilled underbalanced in Carmopolis field located in Sergipe/Alagoas basin, in Brazil's Northeast Region. The pre-planning to evaluate the conditions of the scenario, rock stability, PVT conditions of the reservoir and production mechanism were the base of the planning process which took months of discussions, meetings, presentations and drilling on paper training.

The First Underbalanced Multilateral Well Branches Drilled in Brazil, A

Field Case History (SPE/IADC 79852) by A C V M Lage, G P Sotomayor, P C da Silva, H D Lira, P D Filho, Petrobras; A C Vargas, Weatherford.

UBO IN OMAN

In 2000 Shell recognized UBD as one of its four key strategic technologies and put resources into its wider implementation. PDO (Petroleum Development Oman), supported by the Shell UBD Global Implementation Team, is currently conducting a UBD campaign to evaluate reservoirs that could benefit from this technology. The difficulty in assessing the performance of wells drilled underbalanced compared to conventional wells is compounded by reservoir heterogeneity, such that even two relatively close conventionally-drilled wells may deliver substantially different production. This paper will provide an overview of the two projects and an evaluation of the results after six months of the campaign.

Low Risk/High Reward Strategy Drives Underbalanced Drilling Implementation in PDO (SPE/IADC 79853) by P A Francis, S S Al-Harthi, PDO; I A Davidson, Shell Exploration & Production.

WELL CONTROL IN UBO

Approximately one-third of all known offshore resources of oil and gas are economically undrillable with conventional methods and equipment. The percentage increases with water depth.

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The equivalent circulating density management and wellbore pressure control benefits associated with using the specialized equipment and technology associated with underbalanced drilling is seen as one of the more important new offshore drilling technologies.

Well Control Considerations - Offshore Applications of Underbalanced Drilling Technology (SPE/IADC 79854) by **D Hannegan, Weatherford International.**

MULTILATERAL UBO

This paper reviews the planning, execution and results of a seven leg, semi-short radius multilateral well drilled underbalanced in a very mature field in Northeast Brazil. It explains such details as why short radius, underbalanced multilaterals were utilized in an effort to explain the many thought processes and considerations when designing and planning drilling operations in depleted reservoirs.

A New Look for an Old Field: Multilateral Underbalanced Semi-Short Radius Drilling (SPE/IADC 79857) by **P Grabirel, H Lira, P Filho, Petrobras; D C Lee, F J Brando, L Veneziani, Halliburton Energy Services.**

FOAM CUTTINGS TRANSPORT

Foams are of considerable interest for annular pressure management in many drilling applications. While foam rheology and hydraulics have been studied in the past, knowledge of cuttings transport with foam is very limited for vertical wells, and even less is known for horizontal and inclined well configurations. In this paper, cuttings transport with foam in horizontal and highly inclined wells is analyzed.

Cuttings Transport with Foam in Horizontal and Highly-Inclined Wellbores (SPE/IADC 79856 - Alternate) by **E M Ozbayaglu, Middle East Technical University; S Z Miska, T Reed, N Takach, University of Tulsa.**

OFFSHORE ACCEPTANCE OF UBO

Offshore underbalanced drilling (OUBD) was pioneered by Shell in the Southern North Sea with a successful project that commenced in 1997, and is ongoing today with two rigs. Recent developments are in the significantly lower cost, operating environment of Asia Pacific. OUBD is an effective solution for the highly depleted, fractured carbonate and basement reservoirs plus pressure depleted sandstone formations, which are frequently encountered in this area.

The paper will examine recent advances in technology that make OUBD less onerous in the amount of equipment necessary to safely perform UBD offshore, and to review existing and proposed developments in the region, quoting a number of recent case histories.

Offshore Acceptance of UBD Moves Outside the North Sea (SPE/IADC 79858 - Alternate) by **D Hannegan, B J Gedge, Weatherford International.** ■