Technical Session 1: Mature Fields

SPE/IADC 105509

Design, Construction and Optimization of Big-Bore Gas Wells in a Giant Offshore Field. B.M. Clancey, A.S.D. Khemakhem and T.F. Bene, RasGas; M.H. Schmidt, ExxonMobil.

An extensive big bore gas well drilling and completions program is in progress to develop the giant North Field offshore Qatar. This is the world's largest non-associated gas field and contains approximately 900 TCF of abnormally pressured natural gas producing from Khuff carbonate reservoirs at 8,500 to 10,000 ft TVD. Benefits of the big bore concept, compared with the prior 7-in. monobore design, include reduced development costs by requiring fewer wells and deferred installation of compression by providing higher flowing wellhead pressures.

This is the widest-known application of big bore wells in a single field and will involve up to 60 wells. More than 25 of these wells are drilled and completed and are believed to be among the world's most prolific gas producers. These wells are the first offshore wells to incorporate the big bore well design, combined with complex multi-zone completions and high-angle drilling into individual wells.

Challenges presented by the big bore wells include optimization of casing and tubing designs to provide the necessary flow conduit; development of large bore, high-pressure completion equipment not previously used in the industry; selection of materials suitable for the fluids environment and high flow rate; development of drilling practices to manage hydraulics and reduce casing wear for conventional and extended reach wells; implementation of equipment design reviews, performance testing, and quality programs to target design reliability on all components greater than 25 years. The adopted solution is a unique tapered tubing design known as the optimized big bore (OBB). This paper will discuss the challenges of planning and executing these OBB wells, incorporating state of the art enhancements to achieve outstanding results.

SPE 104522 PP

Evolutionary Well Construction Method that Challenges Convention. P.D. Howlett, M.T. Wardley and C. Black, Caledus; D. Reed, Senergy; G. Begg, Talisman.

This paper will describe the development, prototype testing, test well full system test and first field trial of an evolutionary well construction system. The system is a method of constructing oil and gas wells from close clearance flush jointed cased and cemented liners from top to bottom to form the entire well. IIn old wells through sidetracking or redrilling, the system can deliver a larger size of tubular across the zone of interest. In new or complete/full wells the system can significantly reduce the top hole sizes and with a bottoms up design and place the optimum size of pipe at TD but significantly reduce the diameter of the starting casings and reduce the telescoping effect in the well. The paper will describe the technical hurdles to overcome to make the system safe and practical to deploy, allowing drilling and completions engineers to plan the wells using accepted engineering methods.

SPE 105088 PP

A Systematic Approach to Drilling and Delivering Wells in Severely Depleted Sands at Ram Powell (GOM). D.R. Algu, E. van Oort, S. Landgrave and L. Grant, Shell; D. Hillburn, MI-Swaco.

SPE/IADC 104522: An evolutionary well construction system uses close clearance flush jointed cased and cemented liners from top to bottom to form the entire well.

Re-development drilling at Shell's Ram Powell prospect in the Gulf of Mexico targets profitable delivery of remaining hydrocarbons present in lower-volume reservoir pockets. Marginal economics drive a strong focus on efficient operations, which are complicated by the technical challenges posed by severely depleted reservoirs.

Specific challenges include high differential pressures and effective downhole pressures above minimum horizontal stress in depleted formations, thus raising the specter of catastrophic losses and complete loss of well(s); negotiating very narrow drilling margins with a mud weight strategy to satisfy borehole stability requirement posed by high deviation wells while preventing fracturing and losses; drilling the wells at optimum efficiency and favorable economics, but with a thorough appreciation for time-consuming measures such as good hole cleaning in deviated sections, minimizing the impact of temperature on lost circulation, leaving an existing stress cage around the wellbore intact through ECD and surge control, etc.

SPE 105782 PP

Beryl Alpha — Reaching Out to Recover: An Extended-Reach Drilling Upgrade Project on a 30-Year-Old Rig. R. Cutt, ExxonMobil.

To date, 81 wells have been drilled in the Alpha field. The field is faulted, generating numerous drilling opportunities with geological uncertainties. Extended reach wells are planned to develop resources beyond the reach of the current platform rig capabilities.

Costs of semisubmersibles have risen dramatically, and rig availability is an issue; the traditional concept of subsea satellite development is now problematic in terms of economic viability and control of schedule. The Beryl field has a number of satellite and in-field development opportunities beyond the platform's drilling reach. The concept of upgrading the Alpha drilling rigs to enable these resources to be developed by means of extended reach drilling (ERD) was conceived. The approach taken was to maximize ERD while remaining within the constraints of the existing derrick structures. This involved an innovative approach to retrofitting enhanced drilling capabilities on a 30-year-old rig extending horizontal displacement from 15,000 to 25,000 ft. This paper will address project planning from inception through the development of a rig upgrade execution plan and address the well design issues for the ERD program envisaged.

Technical Session 2: Drilling Fluid

SPE/IADC 105809

Further Development, Field Testing and Application of the Wellbore Strengthening Technique for Drilling Operations. G. Fuh, D. Beardmore, ConocoPhillips; N.Morita, Waseda U.

Based on theory and earlier test results, a significant increase in formation fracture resistance could be achieved due to fracture sealing or plugging mechanism induced by a particle "screen out" effect resulting from the drilling fluid loaded with an adequate amount of narrowly sized granular materials. We have shown in laboratory and field tests that such an increase in formation fracture resistance is particularly valuable in helping well operations do the following: drill through depleted zones without losing fluid even when a much higher mud weight is used; strengthen the weaker formations that usually require additional casing strings for protection; avoid lost circulation during cementing operations as the strengthening operation also improves the strength of the cement sheath; and drill high-angle well sections with high mud weights that would normally not be possible due to low formation fracture gradients, etc.

Several wellbore strengthening treatments were conducted using a special type of LCM material, in terms of particle size range and loading density, for increased formation fracture resistance (or increased apparent fracture gradient) during normal drilling operations. A wide variety of wellbore problems encountered have been addressed by this technique.

SPE/IADC 105449

Design of Well Barriers to Combat Circulation Losses. B.S. Aadnoy, M. Belayneh and M. Arriado, U of Stavanger; R. Flateboe, BP.

In a 10-year research program at the U of Stavanger, novel fracturing cells and mud cells were built to better understand the mechanisms that lead to circulation losses. The paper presents a new mechanistic model for fracturing called "the elastoplastic barrier model." It defines optimal barrier filtrate loss to place particles in the loss zone and the mechanical strength of the particles required to resist losses. It define new parameters that must be controlled to reduce circulation losses. Selected lab experiments will be presented demonstrating that borehole fracturing resistance can be significantly improved by changing the mud composition.

SPE/IADC 105567

Improved Method For Use of Chelation to Free Stuck Pipe and Enhance Treatment of Lost Returns. J.K. Montgomery, S.R. Keller, N. Krahel and M.V. Smith, ExxonMobil.

This paper will describe how intentionally increasing the permeability of a non-aqueous fluid (NAF) filter cake can enhance treatments to free differentially stuck pipe and recover from lost returns. NAFs are well known for their ability to deposit thin, low-permeability filter cakes that reduce the risk of differential sticking. Yet differential sticking still occurs, and techniques to free the pipe have largely been ineffective. ExxonMobil has developed an improved technique to increase the permeability of a NAF filter cake. It involves locally soaking the cake using a combination treatment that first conditions the cake, then removes a significant amount of the

weighting material. Laboratory experiments have shown that the technique can increase the cake's permeability by more than 50-fold.

SPE/IADC 105487

Field Result of Equivalent Circulating Density Reduction with a Low Rheology Fluid. N. Bolivar and J. Young, Hibernia Management and Development; S. Dear, ExxonMobil; J. Massam and T. Reid, MI-Swaco.

Prior to being considered for use on a world record ERD well, a field trial well was selected to demonstrate the technical benefits of using a uniquely designed low rheology, synthetic-based drilling fluid. The 8 ½-in. production hole section was 1,755 ft (535 m) long and drilled to 20,472 ft (6,240 m). Prior to drilling this section, a low rheology drilling fluid was selected. Selection analysis was based on assessment of key drilling parameters as compared with wells drilled previously using a conventional API barite weighted synthetic fluid. A unique characteristic of the low rheology drilling fluid is its use of specially treated micronized barite weight material. This paper presents the background work performed leading up to the field trial.

SPE/IADC 105730

Lubricants Enabled Completion of ERD Well. J. Holand, S.A. Kvamme, T.H. Omland, A. Saasen and K. Taugbøl, Statoil; J. Jamth, Intertek West Lab.

Lubricants are sometimes added to drilling or completion fluids to obtain well objectives. The paper shows how the addition of a lubricant to an oil-based drilling fluid affected the lubricity significantly in 2 comparable track runs, resulting in historically low coefficients of friction. The paper discusses significant drag reduction when adding lubricant to the brine in the completion phase and compares drag obtained with the use of rollers.

SPE/IADC 105733

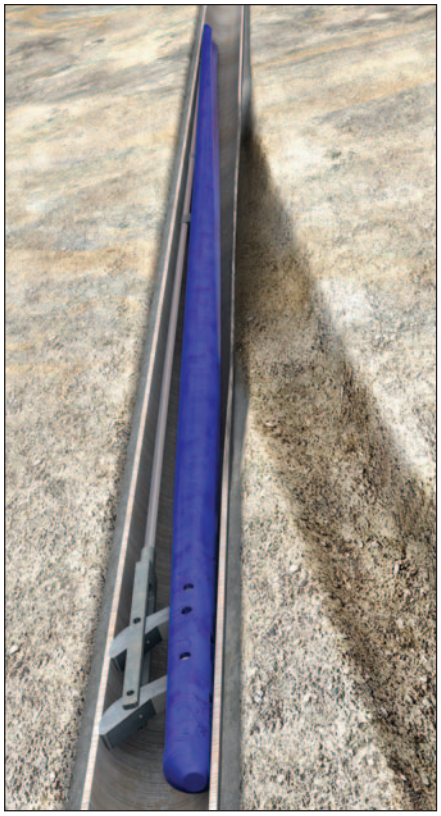
Drilling and Completing High-Angle HPHT Wells in High-DensityCesium Formate Brine: The Kvitebjørn Experience, 2004-2006. P.C. Berg, E.S. Pedersen, A. Lauritsen, N. Behjat and S. Hagerup-Jenssen, Statoil; S. Howard, G. Olsvik, J.D. Downs, M. Harris and J. Turner, Cabot Specialty Fluids.

Cesium formate brine is a high-performance drilling and completion fluid for HPHT wells. Its benefits as a reservoir drilling fluid for high-angle offshore HPHT wells were first demonstrated by Statoil in their Huldra field development. Statoil found low solids drilling fluids based on cesium formate brine reduced risk and improved well economics by providing extremely good well control, lowering ECDs, increasing trip speed, avoiding surge and swab, reducing time for flow checks, and improving hole cleaning. Cesium formate brine was also found to make an excellent completion fluid for standalone sand face completions, creating 6 highly productive wells with low skins. The use of cesium formate brine as a combined drill-in and completion fluid simplified operations, reduced waste and avoided introducing fluid compatibility issues. This paper describes how cesium formate brine has now been taken to the next level as an HPHT drill-in and completion fluid.

Technical Session 3: Downhole Drilling Technology

SPE/IADC 105853

Coiled Tubing Re-Entry Whipstocks: The Next Evolutionary Step in Drilling Practices for Mature Field Development. G. Garfield and G. Mackenzie, Baker Oil Tools.



SPE/IADC 105853: A whipstock system uses the conveyance method of coiled tubing to create a casing/liner window.

Creating a sidetrack out of the main wellbore has become a more common oilfield drilling practice. In the past, re-entry applications have used a sidetrack philosophy governed by threaded tubular drilling conveyance; however, from the standpoint of a coiled tubing methodology, the practice of sidetracking a well may still be seen by some as being in its infancy. It was a natural desire to be able to exploit the inherent advantages of coiled tubing and marry it to the practice of being able to perform a sidetrack.

The paper will discuss utilizing a whipstock system with the conveyance method of coiled tubing to create a casing/liner window. The overview will also discuss general practices and tool selection criteria and provide case history demonstration of each.

SPE/IADC 105021

Field Test Results of An Acoustic Telemetry MWD System. J.M. Neff, XACT Downhole Telemetry; P.L. Camwell, Extreme Engineering.

Acoustic telemetry (AT) MWD systems are finally coming of age as a commercially viable alternative to mud pulse and electro magnetic propagation systems. A high data rate, acoustic telemetry system has been developed for drilling assemblies. In this paper we describe the field test program used to evaluate its performance and to demonstrate practical and commercial applications.

The field test program was limited to shallow, vertical and directional land wells (<2,500 m) drilled with jointed pipe using both kelly and top drive systems. The AT tool was placed in a number of different locations in both rotary and steerable BHAs. A variety of operational modes and configurations were tested. The system performance was evaluated for various carrier frequencies and baud rates while signal, battery, decoding and reliability data were recorded and evaluated.

SPE/IADC 105000

New Assembly Drills Without Reactive Torque. R. Southard, Southard Drilling Technologies.

A new type of drilling assembly has been designed, built and tested that drills and produces no reactive torque to the drill string. It uses a simple set of planetary gears to drive a center bit in the conventional clockwise direction and an outer, concentric bit in the counter-clockwise direction. The 2 bits offset each other's torque, resulting in a new zero reactive torque into the drillstring.

This new type of drilling assembly will make directional drilling more efficient by allowing all drilling to be done in the desired direction, instead of moving constantly as reactive torque changes. Less time will be spent waiting for toolface orientation, resetting toolface after motor stallout, making a connection, etc..

SPE/IADC 105400

Drilling Tests of an Active Vibration Damper. M.E. Cobern, C.A. Perry, J.A. Barbely, D.E. Burgess, APS Technology; M.E. Wassell, APS Oilfield Services.

Drillstring vibration is a serious problem, particularly in deep and hard rock drilling; it can reduce ROP, shorten bit life and damage expensive downhole components. Testing of an active drilling vibration damper (AVD) system under conditions designed to induce vibration demonstrated that the use of the AVD reduced vibration, maintained more consistent weight on bit (WOB) and increased ROP.

The AVD has a structure similar to that of a shock sub with the shock absorber filled with magneto-rheological fluid (MRF) rather than hydraulic oil. Under the influence of a magnetic field, MRF instantaneously increases its viscosity. Using a series of coils to induce intense electromagnetic fields across the fluid gap, the damping coefficient can be changed in milliseconds by a factor of 7 to 10. A linear motion detector provides feedback to control the AVD in response to bit motion.

Technical Session 4: Drilling Optimisation

SPE/IADC 105201

Deployment of an SeROP Predictor Tool for Real-Time Bit Optimization. C.A. Guerrero and B.J. Kull, Chevron.

Since 1965, Specific Energy principles have been used to predict bit performance and analyze ROP and bit efficiency. Factors that create drilling inefficiency include bit dull, bit balling, bottomhole balling/cleaning issues, torque and drag and drillstring vibrations. These are often evident with high specific energy values. Based on these principles, Chevron has established proprietary relationships for bit-specific coefficient of sliding friction and mechanical efficiency as a function of the rock's confined compressive strength (CCS). CVX then uses these relationships to predict reasonable and achievable ROPs with associated bit torque for several bit types. The effect of mud weight, blade count and cutter size to the coefficient of sliding friction and efficiency are considered in the ROP predictions. The relationships have proven to be of high value. This paper will present a number of global case histories showcasing CVX's rapid deployment of the SeROP tool maximizing its value and reducing drilling costs.