Looking deeper for deepwater solutions

IMPROVING SLURRY DESIGN

OVER THE COURSE of a four-year period, during which approximately 42 wells were constructed by this operator, processes were developed to improve cement slurry design and reduce non-productive time (NPT) during cementing operations on deepwater wells. Cementing best practices have been well documented for many years. However, not all of these practices are applicable to deepwater operations, especially for the riser-less sections.

A systems approach to cover all cement design needs, from conductor to plugging, should be considered. Both conventional and foamed cement slurries can be used when properly designed and placed. Placement design should include a thorough understanding of the static gel development behavior of the drilling fluid.

It is generally accepted that conventional circulating temperature estimates are not appropriate for use in deepwater, yet alternatives are not always used. This operator realized better cement slurry performance and lower slurry costs via the correct use of wellbore thermal simulators. Applying the correct data to computer simulations resulted in lower slurry costs and achieved improved shoe integrity.

Real-time monitoring and detailed pressure analysis were used to manage cementing operations and the correct application of SSR plugs. Feedback of these processes through operators and service tool personnel resulted in reduced NPT and overall costs.

Improved Deepwater Cementing Practices Help Reduce Nonproductive Time (IADC/SPE 99141) RF Vargo, JF Heathman, Halliburton; DS Kellingray, JM Lummus, MD Ward, BP.

INNOVATIVE BOP SYSTEM

API 16 D mandates that minimum acceptable blowout preventer (BOP) control system response times be 60 seconds or less for an annular preventer and 45 seconds or less for a ram type preventer. In deepwater, conventional BOP actuation technologies based on full or partial hydraulics are unable to meet this standard because of the long hydraulic fluid communication path between an offshore platform and a BOP stack on the sea floor.

This paper presents an innovative subsea blowout preventer (BOP) using shape memory alloy. The goal is to develop fast-response BOPs using only nickel titanium (Nitinol) shape memory alloy (SMA) as the actuator.

Nitinol SMA has a long fatigue life and high corrosion resistance. As a solid state actuator, it is capable of up to 5 percent strain recovery or 72,500 psi restoration stress with many cycles. It can be actuated by electrical heating, replacing hydraulic actuation and hydraulic lines with electric cable. With significantly fewer components, the SMA system will reduce cost and increase operation reliability. The new device could be retrofitted to existing conventional subsea control system. The all-electric BOP also will provide much faster response than its hydraulic counterpart.

A prototype of a BOP with SMA actuation has been tested at the University of Houston. The BOP actuator uses strands of SMA wires to achieve large force and large displacement in a small space. Experimental results demonstrate that the BOP can be activated and fully closed in less than 15 seconds.

An Innovative Ultradeepwater Subsea Blowout Preventer (BOP) Control System Using Shape Memory Alloy Actuators (IADC/SPE 99041) CA Ehlig-Economides, Texas A&M University; G Song, Z Hu, University of Houston; K Sun, Well Dynamics Inc; N Ma, MJ Economides, University of Houston; R Samuel, Halliburton.

INTEGRATING RISER JOINTS

A new technology developed by IFP is presented for integrating riser joints, which allows reductions by up to 30 percent the weight of the system and to significantly lower the proper period. It consists of joining together all the pipes constituting the riser in such a manner as to share the axial tension between all of them. This hyperstatic working mode may be used conjointly with hybrid (steel/composite) kill and choke lines previously developed.

To obtain information on the capacity of the technology to work properly in the operational context of a drilling rig and to maintain in the time the hyperstatic working mode of the riser joint, a field test was carried out.

The Pride Angola drillship was chosen for the test. In the preparation phase, mechanical changes were designed: adding two hybrid auxiliary lines, fixing the lines at both ends and integrating limited instrumentation. In the qualification phase, relevant equipment were laboratory-tested. The operating phase is now engaged, and data is being recorded during drilling operations to check the working conditions of the riser joint.

The paper presents the basis of the technology and describes the three phases of the field test.

First Hyperstatic Riser Joint Field Tested for Deep Offshore Drilling (IADC/SPE 99005) Y Poirette, Inst Francais du Petrole; DC Dupuis, Pride Forasol.

CUTTING SUBSEA COSTS

Deepwater interventions using a MODU can average $8 million per job and take more than two weeks for simple interventions such as logging or acidizing.

The Subsea Intervention Module (SIM) concept aims to substantially reduce the cost of subsea interventions, accelerate production and improve ultimate resource recoveries from subsea wells. SIM is a riser-less, subsea coiled tubing intervention system capable of conducting through tubing interventions in a fraction of the time and cost of conventional MODU interventions in 2,000 ft to 6,500 ft water depths.

This paper will introduce the SIM concept as well as discussing the operator/developers incentives for progressing the technology.

Subsea Intervention Module: An Innovative Approach to Subsea Interventions (IADC/SPE 99151) JH Moss, GM Browning, ExxonMobil.

DRILLPIPE/SLIP MECHANICS

Current models of drillpipe slip crushing behavior treat the rotary slip as an axisymmetric wedge that generates an axisymmetric radial load on the drillpipe lateral surface. However, recent tests on strain gauged drillpipe specimens suggest that this model does not adequately capture the mechanical response of the drillpipe.

When the design basis for a recent deepwater development required the drillstring to support ~750 klbf, a program to investigate drillpipe/slip interaction was undertaken.

A series of tests in which custom-built joints of drillpipe were strain gauged and loaded to failure in different slip configurations was performed.

This paper presents test details and results of data analyses from the program. The results are compared with both theoretical and finite element analyses of the drillpipe and the slip. The analyses indicate that the most highly stressed regions in the drillpipe correspond to gaps between slip segments.

A Re-examination of Drillpipe/Slip Mechanics (IADC/SPE 99074) UB Sathuvalli, Blade Energy Partners; PD Pattillo, BP; PR Paslay, Techaid Corp; ML Payne, PM Driscoll, BP.

SMART DOWNHOLE SYSTEM

One of the most frustrating and costly aspects of any well bore intervention operation, regardless of whether it is fishing, milling, cutting or a casing exit job, is when little or no progress is made during a trip in the well and tools are returned to surface showing no visible signs of performing work.

Equally frustrating is when a downhole tool becomes worn or damaged beyond its usable life and the operator continues to try to make progress based on readings from traditional surface-based indicators. These situations are becoming more common as wells become more complex and technically challenging.

To address these problems, a new smart downhole system has been developed that provides a new level of process control to the operator while the work is being carried out. The system incorporates a short modular sensor sub that is integrated into the bottom hole assembly (BHA). Measurements such as weight on bit, torque, RPM, bending moment, vibration, annular and bore pressures are gathered downhole to provide a clearer picture of what is occurring at and around the downhole tools.

Information is then transmitted to surface using mud pulse telemetry and viewed on a rig floor monitor. This allows the operator to take immediate action to optimize the intervention.

The paper provides details of the initial system integration and field testing, benchmarking and analysis. The results of early field case histories from a variety of intervention applications performed to date and the lessons learned are discussed as well. In essence, the tests have demonstrated the potential of this innovative systems approach of providing true economic benefits through significantly improved efficiency, reduced uncertainty, better reliability and less wear and damage to down hole tools and equipment.

Innovative Systems Approach Enables Smart Intervention Solutions (IADC/SPE 99121) T Ellzey, Shell; G Heisig, Baker Hughes INTEQ; JP DeGeare, M McGurk, J McNicol, Baker Oil Tools.