Tubulars session examines pipe fatigue and failure

HELICALLY BUCKED TUBING

IN THE ORIGINAL publication by Lubinski, Althouse and Logan (1962) it was assumed that no torsion can be developed in buckled tubular string if there is no casing-to-tubing friction and tubing remains in elastic range of bending. The recent theoretical paper by R.F. Mitchell (2003) presented the large displacement analysis of helically buckled slender beam and determined that shear force and twisting moment are induced by helical buckling of pipe. In other words, without externally applied torque, there is an induced left-hand torsion in right-hand buckled tubing that is surprisingly large and in some cases may approach or exceed the make-up torque values for connections.

Measurement and Analysis of Induced Torsion in Helically Buckled Tubing (SPE/IADC 92274) **A A Zdvizhkov**, **S Z Miska**, **University of Tulsa**; **R F Mitchell**, **Landmark Graphics**.

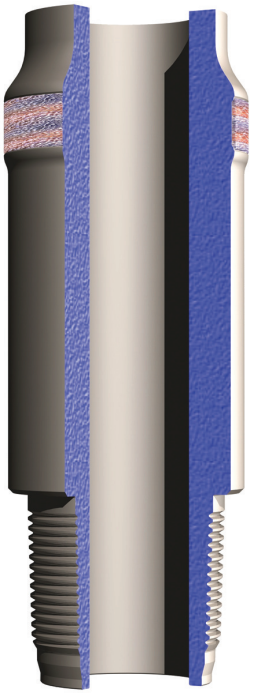
HIGH PRESSURE COMPLETIONS

ChevronTexaco's Tahiti prospect is one of the most significant oil discoveries in the history of the deepwater Gulf. Tahiti well depths are in excess of 28,000 ft creating challenging conditions for high pressure, subsea completion operations. A major challenge was the design, testing and manufacture of a subsea completion string that would provide efficient hydraulics during the fracturing operations while insuring mechanical and pressure integrity to absolute pressures up to 29,000 psi during screen out. The authors will present the results of a two-year comprehensive effort to design, test, manufacture and implement a high-pressure completion tubular.

Project-Specific High-Pressure Completion Tubular for ChevronTexaco's Tahiti Project (SPE/IADC 92497) **R B Chandler**, **A Muradov**, **M J Jellison**, **Grant Prideco**; **M E Gonzalez**, **J R Hensley**, **ChevronTexaco**.

DRILLPIPE FATIGUE

This paper addresses the nature and assessment of drillpipe fatigue. Through a detailed examination and statistical analyses of the three published sources of drillpipe S-N curve data, and by applying the principles of machine design, the authors provide a consistent basis to determine S-N curves for drillpipe of arbitrary size and grade.



Through a detailed examination and statistical analyses of the three published sources of drillpipe S-N curve data, a consistent basis to determine S-N curves for drillpipe of arbitrary size and grade can be determined. SPE/IADC 92591.

Advanced Assessment of Drillpipe Fatigue and Application to Critical Well Engineering (SPE/IADC 92591) **U B Sathuvalli**, **Blade Energy Partners**; **P D Pattillo**, **BP America**; **R B Livesay**, **Hecate Software**; **M L Payne**, **BP**.

DRILLPIPE TENSILE FAILURES

The amount of tensile pull that can be applied to free a stuck drill string is usually restricted by the drill string's minimum margin of overpull (MOP). To free a stuck string, the drill string is often rotated and pulled simultaneously. When this is done, the maximum permitted pull is reduced, depending on the amount of torque applied.

Application of pull, either based on MOP or the decreased tensile rating given the applied torque, has resulted in several instances of overload failures of drill pipe. These failures have occurred at loads significantly lower than the drill strings rated capacity. In each of these failures, the formation had packed off around the string and circulation was lost.

The author will present case studies and lessons learned from the analysis of drill pipe failures. The paper is based on field data collected and metallurgical test results obtained during the analyses. The author discusses the factors that contribute to these failures and provides testing data to support the findings. The limitations of currently available methods used to determine the maximum allowable loads that may be applied when packed off with no circulation are also discussed.

Rotating While Packed off May Cause Unexpected Heat-Induced Drill Pipe Tensile Failures (SPE/IADC 92429) **S E Ellis**, **T H Hill Associates**.

INCREASED MAKE-UP TORQUE

Torque is one of the constraints imposed by modern drilling applications on drill pipe with standard tool joints. In order to prevent uncontrolled downhole make-up in severe drilling environment, standard rotary-shouldered connections are, in some cases, made-up above recommended torque values. The authors discuss the effect of the increased make-up torque on the fatigue performance of rotary-shouldered connections.

The Effect of Increased Make-up Torque on Performance of Rotary Shouldered Connections (SPE/IADC 92575) **A Muradov**, **J W Breihan**, **Grant Prideco**.

HELICALLY BUCKLED PIPE

The most fundamental question about helically buckled pipe is "What is the pitch?" The original development by Lubinski and Woods used the method of virtual work to determine a specific constant pitch.

Since the buckling differential equation is non-linear, it is not surprising that no other solution has been discovered. Recently, however, new buckling solutions have been found for the vertical well problem.

Two possible end conditions are considered in this study: a cantilever boundary condition to model a packer, and a

"pinned" boundary condition to model a centralizer. For the first time, analytic solutions were found for both problems, and interestingly, both solutions converged rapidly to the Lubinski constant pitch solution a short distance from the boundary. The solutions are simple and suitable for spreadsheet calculations. Many of the original Lubinski calculations remain essentially correct, such as length change and contact forces.

The Pitch of Helically Buckled Pipe SPE/IADC 92212-Alternate) **R F Mitchell**, **Landmark Graphics**.

DOPE FREE CONNECTIONS

Experiences of dope-free OCTG connections were limited to carbon or low alloy steel threads. However, the higher galling tendencies inherent in stainless steel threads create a different challenge to their successful dope-free running.

The author describes the criteria required to be fulfilled to realize the successful design of a dope-free system for CRA connections with respect to connection design and the operational constraints of field installation.

Laboratory development and testing of the dope free system included an initial process of galling resistance testing and composition mapping to identify and set process limitations for the anti galling treatment. Corrosion and laboratory trials on full scale connections preceded actual field rig trials that ultimately provided final confidence of the system's integrity, culminating in successful field installation.

Running of 13% CRA OCTG with Dope-free Premium Threaded Connections (SPE/IADC 92739-Alternate) **A Roberts**, **Hunting Oilfield Services**.

BURST CASING

N-80 grade casing is the preferred grade for production casing strings. Most often N-80 casing is ordered to API 5CT without specifying the appropriate supplementary requirements. These strings that meet the minimum strength requirements of API 5CT have experienced sudden failures during work over and well stimulation operations.

The author presents case studies and lessons learned from the analysis of such casing failures based on field data collected and on the results of metallurgical analyses performed during the investigation.

The author details the standard manufacturing operations and heat treatment processes performed for N-80 casing ordered to API 5CT, and the result of these operations on the casing's final material properties.

By re-heat treating the failed casing with published supplementary requirements in mind, the casing material properties were improved substantially. If the casing initially had the properties of the re-heat treated steel, the failures may have been avoided.

The author presents the factors that contributed to the N-80 casing failures, and discusses the importance of specifying supplementary tests for verification of fracture toughness.

API 5CT N-80 Grade Casing May Burst or Part Unexpectedly If Supplementary Metallurgical Requirements are not Specified (SPE/IADC 92431-Alternate) **S E Ellis**, **T H Hill Associates**.