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Milling Through an Inoperable Ball Valve at Record Depth Provides for Successful Completion of an Ultradeep Well in the Gulf of Mexico

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Abstract

The Tahiti Field is located in the Green Canyon area of the Gulf of Mexico in water depths in excess of 4000ft. The discovery well was drilled in 2002 in Block 640 and, following appraisal drilling, was subsequently re-entered and successfully tested in 2004. Development of the field followed in 2006 with subsea completions from a drilling vessel but the combination of the water depth, the ultra deep producing zone and the high reservoir pressure presented some major hurdles to the field's exploitation.

Because of the weight of the completion fluid being used (14.8 ppg Zinc Bromide), fluid loss to the formation during completion was a major consideration. To prevent this, a ball-type fluid loss control valve was routinely set in the top frac packer assembly in the production liner, above the producing zone, prior to running the tubing. In January 2007 a well in Green Canyon block 596 was drilled and prepared for completion when the ball valve was damaged which prevented its mechanical actuation process from functioning and put the successful and economic completion of the well in jeopardy. After a review of the alternatives it was decided to perform a milling operation to mill as large a hole as possible through the ball valve and thereby provide access for production. A bottomhole assembly had been designed as a contingency, based on the use of suitable milling technology and a positive displacement motor (a first for this proposed operation), and it was mobilized to the rig, on an urgent basis, along with the required drill pipe work string. The milling job was successfully performed, to drill a 3.800in ID hole through the ball, in a time frame of 2 hours from reaching bottom with the mill, at a considerable savings when compared to other alternatives considered.

In this paper the authors will describe both the completion techniques used and the decision process that resulted in undertaking the milling job. They will go on to describe the procedures and equipment used to achieve its successful completion. Though such a milling job had been performed before, it had never been attempted at anywhere near the record depth of approximately 26,000' and bottomhole pressure in the order of 20,000psi at which the valve was set.

Introduction

The Tahiti Field underlies the Gulf of Mexico in the Green Canyon area (see Fig. 1), where water depths are routinely in excess of 4000ft, and is operated by Chevron USA and it partners Total and Statoil. The discovery well was drilled in 2002 in the Green Canyon block 640 approximately 190 miles southwest of New Orleans to a total depth in excess of 28,000ft using the drillship Discoverer Deep Seas. Initial evaluation indicated in the region of 400ft of net pay in the high quality reservoir sand that was encountered.

Subsequent appraisal drilling over the next two years resulted in confirmation of the size of the Tahiti Field and its' status as one of the most significant net pay accumulations in the history of the Gulf of Mexico. The discovery well was re-entered in 2004 and a well test carried out to verify deliverability, dynamic well data and reservoir properties. At the time, at a depth in excess of 25,800ft, it was the deepest successful well test and frac pack completion ever carried out in the Gulf of Mexico, a fact made more significant by the high pressure environment. The results obtained led to a formal announcement of the economic viability of the field, the formulation of development plans and their subsequent implementation commencing in 2006.

Well Completion

Based on the completion used on the discovery well test which required some enhancements to existing technology, a completion configuration was arrived at (see Fig. 2) with stacked gravel pack installations set in a 9-7/8" 62.8lbs/ft. Q-125 production liner and 13 Cr 5 Ni 2 Mo 110ksi tubing to surface. Because of the high reservoir pressure environment, a heavy weight Zinc Bromide completion fluid with a weight of 14.8 ppg was required and as a result a major concern was the possibility of considerable fluid loss to the formation during the completion process, with resultant damage to its