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Casing Drilling Package Reduces Overall Drilling Time: Critical Analysis of an Operation in Papua New Guinea

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Abstract

The lowlands area of Papua New Guinea is composed of claystone overlying a limestone formation. The upper claystone formation is primarily sticky, dispersive, and soft to very soft. Historically, drilling operations have used 12 1/4-in. steel tooth roller cone bits to drill this formation**.** However, one major problem with drilling this formation conventionally is the open hole time. The formation has a tendency to swell and break out, hence increasing the risk of not being able to run casing to bottom. This risk was overcome by employing casing-while-drilling (CwD).

A casing drilling package comprising casing with a polycrystalline diamond compact (PDC) casing bit was used to drill the 12 1/4-in. 287-m section in the claystone formation. The casing drilling package reached section total depth (TD) with an average rate of penetration (ROP) of 15 m/hr. The casing bit drillout was then achieved with a specific 8 1/2-in. PDC drillout bit, which then continued to section TD. By eliminating bit trips, this one-run capability of the drillout bit resulted in significant overall time savings compared with any other offset.

Removal of metal cuttings while drilling out the casing bit with a PDC bit is one of the primary challenges with CwD. Rotary system drillout times with PDC bits historically have been difficult to predict, with times varying from 40 minutes to five hr. Alternatively, using a dedicated junk run with a roller cone bit can add time to the overall drilling process. In this application, a mud motor was used allowing the reactive bit torque to be monitored very closely, so that WOB adjustments could be made immediately. This resulted in an efficient drillout time of 65 minutes. Vibration damage to the specific drillout PDC bit was minimized allowing the bit to continue drilling 950 m to section TD at an average ROP of 23 m/hr, surpassing offset ROP by 44%.

This paper describes the application and its challenges, and the analyses conducted to design the CwD operation. The drilling performance achieved in both the CwD and the subsequent 8 1/2-in. hole section is described and compared with that seen in conventionally drilled offset wells.

Introduction

Korobosea-1 was planned as a vertical exploration well in the Petroleum Prospecting Licence-240 area of Papua New Guinea (PNG). This is near the town of Mendi in the forelands area of the Papuan Basin in PNG. Typically, offset wells in this area consist of soft to very soft claystone formations to surface, overlying a thick calcareous limestone formation, which can be up to 1500 m thick. The claystone formation near surface has historically caused problems running casing to bottom. The open hole time between drilling the section and then rigging up in preparation to run casing has been planned to be as short as possible. For Korobosea-1, CwD was chosen to ensure the 9 5/8-in. surface casing was run effectively through the claystone Era beds. The vertical well was planned in three sections. The 12 1/4-in. section was to be drilled into the top of the Darai formation to approximately 300 m TVD. The 8 1/2-in. section was planned to be drilled through the Darai limestone formation until a formation change was indicated at the Upper Ieru formation at approximately 1250 m TVD. Finally, a 6-in. section was to be drilled to TD at approximately 2200 m TVD. Proposed setting depth of the PDC casing bit was 270 m.

Objectives

As a result of difficulties experienced on offset wells (the most recent and valid offset well being Kapul-1), the operator intended to improve the planned well performance by focusing on the following objectives:

- Eliminating the need for a 17 1/2-in. top hole section
- Successfully running 9 5/8-in. surface casing using the 12 1/4-in. casing drill bit on the casing running tool (CRT) to the required TD, and setting casing in the competent limestone formation