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Single-Diameter Technology Capable of Increasing Extended-Reach Drilling by 50%

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Abstract

The potential coupling of two leading-edge technologies has garnered much attention for its substantial business case regarding field development optimization. This specific application consists of marrying single-diameter technology and extended reach drilling (ERD). Using these two technologies as companion pieces in a drilling design can positively impact capital cost structure, resulting in economically superior alternative development scenarios.

Single-diameter technology, a natural derivative of the conventional solid expandable tubular system, provides the foundation for a significant increase in the lateral reach of many extended-reach wellbores. This extended lateral reach results in increased reservoir contact that can lead to increased production per well. Increased lateral reach and production per well can ultimately reduce the required field well counts and infrastructure, resulting in improved field development economics.

This paper will describe how combining these technologies mitigates critical factors that limit achievable reach including dogleg severity, casing openhole size vs. drillstring size, and ultimately torque and drag. Using solid expandable tubular single-diameter technology with significant friction reduction could extend the current ERD envelope 25 to 100%. More efficient reserves access, economic benefits and technical advantages will also be presented. In conclusion, this paper will discuss the technology's proven, simulated and engineered potential and how it can put more reserves within reach.

Introduction

Solid expandable tubulars have rapidly evolved over the last few years into a proven openhole drilling liner and cased-hole remedial liner alternative to conventional technology. These systems improve capital efficiency, reduce drilling trouble time, improve field development economics and extend lateral drilling reach, or perform extensive remedial work while preserving the required completion and/or completion size. The use of expandable technology has proven to be highly effective as a contingency and a planned well design application. The single-diameter system offers a truly enabling technology to complement the reliable and cost-effective solid expandable tubular applications.

As part of the front-end engineering and design for a major North Sea operator, a well design feasibility study was conducted over an existing and planned field development. This study was conducted to assess the relative merits of applying conventional drilling technology versus expandable tubular technology regarding lateral reach and the impact on capital efficiency and potential field development. This well-design modeling study indicated potential lateral reach increases of 25 to 100% with significantly reduced drilling trouble in both fields. Complementary drilling performance and cost studies have also indicated that existing operator well costs and times in the same two North Sea fields can be reduced by over $40MM, or 30 to 50% of the current drilling cost and time, with the application of solid expandable tubulars and/or single-diameter technology. These well design studies also indicated preservation of desired completion size, which led the operator to conclude that planned subsea templates and associated infrastructure and/or satellite tie-ins can be eliminated from their field developments with solid expandable tubulars and/or single-diameter technology.

Expandable ERD Well Design and Modeling

An existing North Sea oil development project and a near-term planned subsea gas development project were used to assess and quantify the lateral reach improvements possible with solid expandable technology. An in-house program was used for drillstring mechanics, stress analysis and fatigue analysis that incorporated actual operator-provided drilling and completion data, lithology, mud parameters, torque and drag and well designs, in conjunction with existing literature on ERD performance. Where data was not available, assumptions were based on reasonable engineering judgment and experience in ERD. The historical data provided a baseline for ERD in the subject fields and a context for estimation of trouble times and expected time to drill extended reach wells up to ~9.5 miles (15 km) in length. The current lateral reach record in the existing field, with significant drilling trouble, is approximately ~5 miles (8.2 km). Literature and actual field historical data were used as the basis for the selection of base case friction factor profiles in the mechanical analysis.

All implications of solid expandable tubulars and single-diameter liners were considered in the context of ERD beyond