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Downhole Tool Design Challenges for Deepwater Highly Deviated Wells

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Abstract

The evolution of the offshore oil and gas industry has resulted in operators drilling multiple wells from single platforms targeting more challenging reserves in deeper waters. This progression has introduced many new technical challenges for the downhole tools used in conventional processes. These challenges must be addressed to maximize operational efficiency in these extreme service environments. This paper specifically discusses some of the shortcomings that have been identified in downhole tools currently used in offshore operations and presents a few recently released technologies specifically designed to address some of the challenges posed by the new offshore environment. Case studies including the impact of the new technologies on operational efficiency are presented.

Introduction

As the offshore environment evolves into large, multiple-well platforms targeting more challenging reserves in deeper waters, the processes and equipment being used to drill and complete these wells must also evolve. With the progression into the deepwater environment where rig costs can reach \$800,000 per day, an important issue brought to the forefront in terms of the equipment used, is the capability and functionality of the downhole tools being used to perform services on these more complex wells. Some of the technical challenges encountered with this progression include high pressures and temperatures, high string weights, and highly deviated or horizontal wellbores. Using downhole tools not designed to function in these challenging environments can result in costly delays that can directly affect the profit margin for both the operators and service companies that employ the tools. To maintain the utmost in reliability and operational efficiency, these technical challenges must be identified and addressed in the development of new downhole tools for the offshore environment.

The remainder of this paper will discuss some of the challenges and shortcomings that have been identified in downhole tools being used currently. The paper also discusses two newly released technologies: (1) a high-strength subsurface control valve system used for blowout preventer (BOP) change-outs and/or temporary abandonment situations, and (2) a retrievable packer designed to operate in high-pressure, high-temperature, extended-reach wellbores that are highly deviated. These technologies were developed to address some of the early industry challenges associated with downhole tools in the new working environment. The paper will also include specific case studies for the two new technologies and discuss the impact their introduction has made on the industry.

Early Challenges

As mentioned previously, several technical challenges for downhole tools have been identified with the offshore environment's progression into deeper waters. Higher pressures and temperatures are continuing to push the limits of the downhole tools being used today. For example, 10 years ago, 10,000 psi at 300°F was considered an extreme working environment for service tool exposure. In today's offshore environment, requests have been made for packers and plugs that can withstand 15,000- to 20,000-psi differential pressures at temperatures ranging up to 500°F. At these elevated pressures and temperatures, standard elastomer packages on service tools will not survive. The temperature effects alone on standard steels will downgrade their strengths such that they could not withstand the burst and collapse pressures for which they are currently rated. To address these issues, materials of higher strength must be developed so that tool components can withstand the loads that will be applied. Tool designers must also be creative with the design of sealing elements and their supporting components while holding extreme pressures.