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Development of an Expandable Liner Hanger with Increased Annular Flow Area

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Abstract

Several criteria are important for a cementing operation as it relates to effective zonal isolation. First of all, studies have shown that cementing operations can be improved by rotating and reciprocating the liner. In addition, it has been shown that increased flow rates (prior to cementing, during cementing, and during displacement) can improve zonal isolation. While currently available expandable liner hanger technology can achieve the required liner movement, rotation, and reciprocation to affect a good cement job, these capabilities alone have not been capable of always meeting cementing needs in every scenario.

When expandable liner hangers were introduced to the oilfield, they were immediately accepted. Experience has shown that increasing flow rates (prior to cementing, during cementing, and during displacement) can offer improved zonal isolation. A new liner hanger was designed to increase the annular flow area, subsequently reducing annular friction pressure to allow higher flow rates. The added bypass area would also provide reduced surge to the formation while running the liner. This would shorten liner installation times. In addition, by increasing the bypass area, the possibility of solids bridging at the liner hanger (which can cause loss of circulation during circulating and cementing) would also be reduced. When loss of circulation occurs, proper cement placement is jeopardized.

This paper highlights the development of the new smaller-outside-diameter (OD) expandable liner hanger. This project was commenced; the new liner hanger has a pre-expansion maximum outside diameter that is smaller than the outside diameter of conventional liner hanger's tie-back receptacles and integral top-set packers. The new smaller diameter expandable liner hanger maintains the desirable features of existing expandable liner hanger.

Computer modeling including Finite Element Modeling (FEA) will show the design analysis for the expandable liner hanger. Additionally, prototype testing will be performed to validate the new design.

The new expandable liner hanger design offers the capabilities to rotate and reciprocate during circulating/cementing and displacing; a simple, robust design for installation reliability; and gas-tight liner-top sealing.

Introduction

An operator in the North Sea had been experiencing issues with zonal isolation due to poor quality cement jobs. The wells had been drilled into depleted reservoirs where the fracture gradients were very close to the formation pressures.

One method sometimes used to increase the quality of the cement job is to increase the circulation rate during clean-up and cement placement. Because of the flow restrictions caused by the liner hangers in currently available designs, an increase in circulation rate would not be possible for this particular application without exceeding the fracture gradient in the well. To meet the needs of this project, the operator and service/engineering personnel felt that a new liner hanger that would allow increased circulation rates was needed. A review of the available liner hangers determined that the expandable liner hanger offered the cleanest flow path in its current design as well as it had the simplest design to modify.

This provided a starting point for development of an expandable liner hanger that would address the operator's issues in this field development. Since it was recognized that this need was global, the new liner hanger would have application well beyond the North Sea projects, and thus, the design project was initiated.

Liner hangers used to deploy and anchor the liner typically are larger in outside diameter (OD) than the liner being deployed. As such, they cause a restriction in the flow path during well circulation and cement placement. Analyses have shown that by decreasing the OD of the liner, even by a small amount, greater circulation rates, and thus, an improved cementing process can be achieved. However, there would be many issues from reducing the OD of the liner hanger that