Chapter 3
Risk Due to Pipe Sticking

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ABSTRACT

A stuck pipe is a common worldwide drilling problem in terms of time and financial cost. It causes significant increases in non-productive time and losses of millions of dollars each year in the petroleum industry. There are many factors affecting stuck pipe occurrence such as improper mud design, poor hole cleaning, differential pressure, key seating, balling up of bit, accumulation of cuttings, poor bottom hole assembly configuration, etc. The causes of a stuck pipe can be divided into two categories: (a) differential sticking and (b) mechanical sticking. Differential-pressure pipe sticking occurs when a portion of the drill string becomes embedded in a filter cake that forms on the wall of a permeable formation during drilling. Mechanical sticking is connected with key seating, formation-related wellbore instability, wellbore geometry (deviation and ledges), inadequate hole cleaning, junk in hole, collapsed casing, and cement related problems. Stuck pipe risk could be minimized by using available methodologies for stuck pipe prediction and avoiding based on available drilling parameters.

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INTRODUCTION

Pipe sticking is, for most drilling organizations, the greatest drilling problem worldwide. It results in a significant amount of non-productive time and ends up as one of the major causes of increased well costs (Yarim et al., 2008; Reid et al., 2000; Pal et al., 2000). It may result in abandonment of the current hole and force a sidetrack. It is estimated that the cost of stuck pipe in deep oil and gas wells can be approximately 25% of the overall budget. In some areas, events related to differentially stuck pipe can be responsible for as much as 40% of the total well cost (Reid et al., 2000). The causes of stuck pipe can be divided into two categories (Isambourg, et al., 1999): (a) mechanical (key seating, formation-related wellbore instability, wellbore geometry (deviation and ledges), inadequate hole cleaning, junk in a hole or collapsed casing, cement related) and (b) differential pressure (wall sticking). Differential pressure sticking is usually indicated when the drill string cannot be rotated, raised or lowered, but full circulation at normal pressure can be established (Bushnell-Watson & Panesar, 1991). The force required to pull the pipe free can exceed the strength of the pipe. Usually, even if the stuck condition starts with the possibility of limited pipe rotation or vertical movement, it will degrade to the inability to move the pipe at all. Many oil and gas reservoirs are mature and are becoming increasingly depleted of hydrocarbons, which increases the risk involved with the stuck pipe. This is due to the fact that decreasing pore pressure increases the chance of stuck pipe. Therefore, the risk of differentially stuck pipe increases when drilling depleted reservoirs and avoids when drilling underbalanced. The increased use of deep, highly-deviated and tortuous wells has increased the risk of drill pipe and wireline logging tool strings getting stuck downhole, too. If this risk is not appropriately managed and effectively mitigated, significant financial exposure can result from the cost of the multi-day fishing operations (Prasad et al., 2012). The physical mechanisms of sticking wireline tools are similar to the mechanisms involved in drill-pipe sticking. The complexity of the wells has increased significantly in later years. Reach has been more than doubled, and high inclination and fully 3-D well paths are common. However, statistics shows that sidetracking the boreholes due to stuck pipe has also shown a significant increase, and is presently a high cost factor. The margins between success and failure are now much smaller (Aadnøy et al., 1999). Traditionally, stuck pipe problems are solved by using some standard methods and techniques after they occur, but the real key to savings and success is in the avoidance of the risks associated with the stuck pipe. Minimizing the risks of stuck pipe while drilling has been the goal of many operators recently.

Many researchers attempt to identify the parameters and their corresponding effects to minimize the risk of stuck pipe (Chamkalani et al., 2013; Jahanbakhshi et al., 2012; Al-Baiyat & Heinze, 2012; Meqeem et al., 2012; Shoraka et al., 2011; Meschi et al., 2010; Murillo et al., 2009; Miri et al., 2007; Aadnøy et al., 1999; Hopkins & Leicksenring, 1995; Howard & Glover, 1994; Hempkins et al., 1987; Courteille & Zurdo, 1985; Kingsborough et al., 1985). They proposed models or techniques to identify and diagnose the stuck pipe early and prevent its occurrence. The accuracy of the predictive model depends on the size of database and the variables selected for analysis. Even if different techniques and guidelines have been developed to reduce the probability of occurrence of stuck pipe and these have saved drilling industry millions of dollars, they suffer from exclusive prediction of this event. In some cases where the pipe is

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