Proactive Prediction Methods of Punch-through Analysis on Jack-up Rigs

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ABSTRACT

Jack-up rigs are major offshore oil development equipments. Platform punch-through impacts seriously on its operational safety, and has caused major incidents such as equipment damages and personnel injuries. This paper summarizes the punch-through accidents of jack-up rigs, analyzes the existing prediction methods on platform punch-through. Taking the Bohai 12 # jack-up rig at a certain site in Bohai bay as an example, the possibility of the platform punch-through has been studied, and the methods of preventing punch-through on jack-up rigs have been presented in the end.

KEY WORDS: Jack-up rig; punch-through accident; prediction method; prevention of punch-through.

INTRODUCTION

Jack-up rig has played an important role in the development of offshore oil and marginal oil fields, and has been widely used in drilling, workover, well testing, producing test and other operations. Because of its better stability, mobility, flexibility and lower rents per day compared to the semi-submersible drilling platform and the drilling vessel, jack-up rig has been widely used in the development of offshore oil.

As the geological condition in offshore is comparatively complicated, there are ancient river channels, uneven terrain and other geological conditions. Especially when there are stiff strata above the soft formations in the operational area, the platform has the possibility of punch-through, which will seriously threat the operational safety of the platform.

Osborne and Paisley (2002) made a definition about the punch-through of jack-up rig, based on analyzing a large number of accidents on jack-up rigs. They stated that punch-through is an incident in which the foundation happens unanticipated rapid subsidence and results in serious loss during the operation of a jack-up rig. Also, they divided punch-through into two categories in terms of the extent of loss caused by the accident: “punch-through failure”, which is defined as that the rig or its operability is subjected to catastrophic loss; “uncontrolled penetration” is defined as that the rig has no significant loss. Most punch-through accidents occurred during the jacking up, preloading operations or a major storm.

The type statistics of the accidents that jack-up rigs occurred are shown in Fig.1. It can be seen from the figure that punch-through accidents account for 53% of all the accidents on jack-up rigs. The statistics of the punch-through accidents that the jack-up rigs have taken place over the years is listed in Table 1. Most of the actual causes of the punch-through are not completely known as they were not disclosed. As...