

Strength Evaluation of Drill Pipe for Scientific Drilling in Nankai Trough with High Current

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ABSTRACT

Chikyu which is a scientific drilling vessel has been operated in a harsh environment especially high current area, the Nankai trough. The stage 1 expeditions will be done in areas with water depths up to 4060 m. The high current in the Nankai trough will increase the maximum stress on drill pipes which is combined with an axial static stress, an axial dynamic stress and a bending stress exerted during drilling operation. And it may lead to a crucially high stress.

In order to make the drilling operation in the Nankai trough a success, it is necessary to evaluate the strength of the drill pipes considering actually planned drill string configurations. It is also necessary to make slip-crushing consideration when the drill string is held by conventional handling tool slips. So, we conducted strength evaluation of the drill pipe using actual drill string configurations by analyzing the stresses mentioned above. Furthermore, we also performed slip-crushing consideration for power slips which will be used in Chikyu.

KEY WORDS: scientific drilling, drill pipe, current, Nankai trough

INTRODUCTION

Japan Agency Marine-Earth Science and Technology (JAMSTEC) constructed the scientific deep-sea drilling vessel Chikyu - Japanese word for Earth. Chikyu was designed to be capable of operating in water depths up to 2,500 m for riser drilling and 7,000 m for riserless drilling and also drilling down to 10,000 m total vertical depth for both riser and riserless drillings. Chikyu was also designed to enable continuous coring and recovering scientifically worthy core samples.

The first scientific drilling of Chikyu under the international organization IODP (Integrated Ocean Drilling Program) has commenced with riserless drilling at the Nankai trough located beneath the ocean off the southwest coast of Japan since September 2007. The main purpose of the expedition at the Nankai trough is to drill deep into the Earth to observe the earthquake mechanisms because there is one of the most active earthquake zones.

However, it has been recognized that the Nankai trough is a harsh environment area for drilling operation because the strong current due

to Kuroshio (Black Stream) always runs there. The current speed will be around 4 knots on surface or more at times. In riserless drilling the drill string deployed from the vessel will be directly exposed to such a harsh environment. So it is necessary to perform strength evaluation of drill pipes by analyzing an axial dynamic stress due to vessel heave as well as a static stress and also a bending stress due to the current for the drill string configurations which are scheduled to be used. For ocean mining, Aso et al (1992, 1994 and 1995), Chung and Cheng (1995 and 1996) and Cheng and Chung (1997) investigated the effects of dampers or absorbers fit in the pipe string to reduce the axial dynamic response. Also, Chung and Cheng (1996) and Cheng and Chung (1997) investigated the effects the joints fit in the pipe string to reduce the bending moment. These researches will offer a beneficial method to reduce the stress for offshore riserless drilling operations as well.

There is also a hoop stress exerted on the drill pipe located at the uppermost part of the drill string by conventional handling tool "slips". It becomes greater as increasing the weight of the drill string deployed and in extreme case will crush the drill pipe called slip-crushing. So it is also important to make slip-crush consideration.



Fig. 1 Scientific deep-sea drilling vessel Chikyu