An Integrated Ice Management Alert System

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ABSTRACT

Ice management in support of offshore operations can be separated into two distinct sets of activities: near-field and far-field ice management. The first set encompasses ice breaking activities upstream of the vessel, whereas the second covers ice floe monitoring and forecasting. Near-field ice management has received increased attention recently, but not far-field ice management. In this paper, we present a framework for far-field ice management, recast near-field ice management in a consistent manner, and recommend an integrated alert system for both to provide a rational basis for risk-based decisions for safe offshore operations.

KEY WORDS: Alert system; drilling; icebreaker; ice management; offloading; T-time; watch circle.

INTRODUCTION

There was never a shortage of challenges to the offshore industry in deep-water or Arctic frontiers. Nowadays, however, the challenge is particularly daunting with the merger of the two frontiers in new Arctic deep-water leases such as those in the Beaufort Sea (Fig. 1a), Chukchi Sea, Kara Sea and elsewhere. The main challenge can be succinctly summarized in two words: station keeping.

Take for example the concrete island drilling structure (CIDS, Fig. 1b). This shallow-water mobile offshore drilling unit was designed by Global Marine to withstand about 59,000 tonnes of ice load in around 17m of water depth (Wetmore, 1984). As water depth increases, ice loads do not increase much, but overturning moment does prohibit the use of fixed-base structures beyond a limiting depth of about 100m. In fact, this depth typically delineates the boundary between shallow and deep zones in Arctic waters. This shifts the focus for the developers of those leases to floating platforms and drillships.

The next boundary that faces the industry is that of mooring system capacity. Floating systems such as Hoover-Diana (Fig. 1c) are held in place by mooring systems with capacity in the range of 1,000-2,000 tonnes (API RP2SK, 2005). This capacity pales in comparison with ice load magnitude (Fig. 1b), not to mention iceberg loads (Fig. 1d). Therefore, while subsea developments may end up being the viable concept for Arctic deep-water development, some operations still need to be conducted at the surface such as a drillship drilling a subsea well or a tanker loading crude.

Offshore operations would have to consider the open water season. In the higher Arctic, the open water season is short and varies over the years. At the Ajurak block in the Canadian Beaufort Sea, for example, the season lasts between 0 and 24 weeks, with a median of about 9 (Fig. 1e). The open water season may simply not be sufficient and ice management, therefore, will play a significant role in extending the operational season beyond the period of open water, and even in protecting operations against ice floe intrusions during the open water season.

With the heightened importance of ice management in the higher Arctic, we introduce here a risk-based approach for establishing an alert system to improve the current practice of using secure and hazard times (Wright 2000), which is mostly deterministic in nature. This provides then a rational basis for risk-based decisions during Arctic operations.

Figure 1 Arctic and Deepwater Challenge