ABSTRACT

This paper started with a briefly introduction to the development history of the ice-resistant platform located in Bohai Bay, a major production area for CNOOC. Based on the previous structural design experience of platform under ice environments, the ice loading calculation method and new types of platform are proposed. This paper had further discussed the technical measures for the ice-resistant platform design. Learning lessons from engineering and production practice, the outstanding issues and challenges faced by the structural engineers are summarized and discussed. This paper may provide helpful reference to the future platform design in ice regions.

KEY WORDS: Bohai Bay; Ice Loading; Fixed Platform; Structural Design.

INTRODUCTION

Bohai Bay is located at north east of China and CNOOC (China National Offshore Oil Corporation) started the offshore oil and gas development in this region last century. Nowadays, more than one hundred platforms are located in this area for offshore drilling, oil and gas treatment, storage and other functions related to oil industry. Compared with the other part of China offshore oil production area, the environmental conditions in Bohai Bay are quite complicated. Especially in the north part of this region, the offshore structures were seriously bothered by sea ice in the winter and resulted in the risking for platform safety and operational ability. Compared to the effect of wave and current loading, the effect of ice loading is predominant and often become the governing loading in structural design. During engineering of the platform in ice region, the distribution and characters of ice in the Bohai Bay must been investigated as basis of the design. From the lesson learning for previous project in this area, a lots of the study and optimization works have been done for the structural design of the platform in ice region. The analysis and field experience shows that the effects of ice loading on the platforms are significant to the design. Therefore, it is necessary to review the development history of the platform structural design and summarize the current design practices for the ice-resistant platform. It will be also important to summarize the challenges and outstanding problems need to be solved by the offshore structural engineers to ensure the safety and the operational ability of the platforms in Bohai Bay.

THE DEVELOPMENT HISTORY OF THE ICE-RESISTANT PLATFORM IN BOHAI BAY

China started offshore oil exploration and production in 1960’s in Bohai Bay and installed the first offshore platform at shallow water in this area. The platform was a jacket type structure supported by conventional pile foundation. At the early stage of the oil and gas production in this area, people even not realized the powerful damage potential from the sea ice and professional design standards were not available. Some onshore structural design standards were adopted for load calculation and structural analysis of the offshore platform.

In 1969, the “Old BOHAI No. 2” platform collapsed in the heavy icy season due to the huge overturning load from sea ice and cause serious losses to this young offshore oil industry. Taking the lesson from this incident, people get deeper understanding to the characters of sea ice in Bohai Bay. From that time on, the ice-load becoming the important consideration during the platform structural design. In 1982, China national offshore oil Corporation (CNOOC) was founded and the development of the offshore oil field was speeded up in Bohai Bay. At the same time, Company paid more attention to the sea ice issues in Bohai Bay. The great efforts had been made to the research and management for the sea ice, such as field measurement and monitoring, laboratory test and theory analysis. Based on various works, CNOOC issued two standards as guideline for the design of platforms in Bohai Bay. One of the standards is “Structural Design Specification for BOHAI Fixed Steel Platform”. And another is “Regulations for Offshore Ice Condition & Application in China Sea”. These standards summarized the long time research and operation experiences for ice effect structures and aimed to provide a set of applicable design method to the ice-resistant platform in BOHAI. At first time in China, the standards provide overall guidelines to select the design parameters for