Challenges in Determining Ice Action on Offshore Structure

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ABSTRACT

The paper is focused on the study of challenges in determining ice loads on the structure interacting with drifting ice in a scenario not covered by effective national and international regulatory documents, particularly, ISO 19906. The platform consisting of two supporting modules, each having inclined and vertical faces in ice interaction area is studied in the paper. This structure is a possible alternative of the supporting part of the ice-resistant platform for the development of the oil/gas field located in an ultimately shallow water area of the Northern Caspian Sea.

KEY WORDS: Ice-resistant platform; ice load; regulatory documents; ice model tests; shallow water.

INTRODUCTION

Current standards outline a restricted class of ice-resistant gravity and pile-gravity type structures for which theoretical methods of determining global ice loads have been developed. Those are structures with vertical (flat or cylindrical) or inclined (flat or conical) faces, and multi-leg structures. Rigorous ice conditions typical for certain areas, and some specific procedures of transporting structures to and installing on site, result in solutions non-standard in terms of the shape and type of structures being designed. Thus, a possible alternative of the supporting part of the ice-resistant platform for the development of the oil/gas field located in an ultimately shallow Northern Caspian water area is a structure consisting of two supporting modules, each having inclined and vertical faces in ice interaction area.

Model tests have been performed in the ice basin of Krylov Shipbuilding Research Institute to determine loads on those structures from drifting ice features. A complicated ice cover failure regime arisen from a combination of various failure modes such as bending along inclined faces, crushing against vertical faces, the formation of main cracks and fractures due to interaction between the supporting modules, was observed in testing. Design ice loads on the same structures were calculated based on provisions of effective regulatory documents. The model test results were then compared with the loads calculated as per the above provisions. The matters of poor agreement of results and possibility to apply effective regulatory documents for the estimation of global ice loads on the structure under consideration are dealt with in the paper.

THE DESIGN DESCRIPTION

Nowadays, oil/gas fields offshore Northern Caspian receive an intensive development effort. Korehagin field offshore structures have been operating since the end of 2009. Project designs for Filanovsky field, Khvalynsky field and Sarmatsky field are underway.

A structure involving two parts such as the supporting part to be built up from two independent supporting modules, and the topsides (Figs.1–2), has been designed specifically for the development of Filanovskoye field.

The design data were based on site-specific data for Filanovskoye field.

The main parameters of ice features are:

- Level ice, thickness, m 0.98.
- Rafterd ice, thickness, m 1.2.
- Ridge: thickness of consolidated layer, m 2.2.
- Keel depth, m 5.8.
- Sail elevation, m 2.1.

Some peculiarities of the represented supporting part of the platform and those of initial design data with respect to water depths and parameters of ice features are listed below:

- Non-traditional two-module type of the structure, each module