An Experimental Study of Iceberg Hydrodynamic Interactions with a Generic Floater on the Grand Banks NL
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ABSTRACT
Disconnection criteria for iceberg sizes and environmental conditions have been studied regarding specific ice design for different floaters, but there are chances that a floater cannot disconnect or have to stay in position to withstand the impact. It is important to improve the current methodology of ice design with the consideration of hydrodynamic effects if marginal fields and fields in more severe ice environments are to be developed in the future. The ice impact rates and loads may be reduced as a result of hydrodynamic effects. This paper describes the observations from an experimental study on the influence of hydrodynamic effects on potential iceberg impacts with floaters. A probabilistic analysis was first carried out to determine likely scenarios contributing to design iceberg loads, considering the population of icebergs and environmental conditions on the Grand Banks and a typical FPSO. Three iceberg sizes and the associated environmental and test conditions were identified for the study. First set of 45 tests were conducted at the National Research Center (NRC) – Towing Tank in St. John’s NL with one iceberg model. The experiments show that the hydrodynamic effect will result in reduced probability of impact for icebergs of small size relative to the platform. Further experiments are proposed to look at the influence of hydrodynamics for larger icebergs.

KEY WORDS: Iceberg Impact; FPSO; Hydrodynamic; Experiment; Iceberg deviation; Iceberg speed reduction;

INTRODUCTION
Offshore Newfoundland and Labrador (NL) has significant oil and gas resources, but there are challenges to extract resources safely given the harsh environment including the presence of icebergs. After many decades of oil and gas development on the Grand Banks, two Gravity Based Structures (GBS) and two Floating, Production, Storage, and Offloading (FPSO) vessels have been designed and deployed for oil and gas operations. The effects of hydrodynamics between a moored floater and icebergs have not been well studied for risk analysis previously since floaters are required to disconnect for all icebergs. There might be ignorable hydrodynamic effects for a large iceberg, compared with the floater beam width, but noticeable hydrodynamic effects for similar or smaller icebergs are reported in multiple studies. A good understanding of hydrodynamic effects for critical iceberg sizes might reduce the requirement for disconnection and increase production ultimately.

The effects of hydrodynamics between a moored floater and an iceberg can be studied through experimental tests in a laboratory or Computational Fluid Dynamics (CFD) simulations. It is essential to have a set of experiment tests handy to act as bench marks for CFD simulations. With the availability of National Research Council’s (NRC) towing tank, a series of tank tests were performed in the 200 m x 7 m x 12 m towing tank (Fig. 1) to represent a moored FPSO approached by an iceberg in few different heading directions, currents, and wave conditions.

The experiment tests were performed using a generic FPSO with a generic iceberg shape for this study. The experiment utilizes available instruments and a cost-effective steel cylinder to represent the generic iceberg shape. The experiment is focusing on finding preliminary understanding of iceberg hydrodynamic interactions with a generic floater on the Grand Bank, NL.