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Study on Ship Motion Analysis of Turret-Moored LNG FSRU Compared with Experiment

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ABSTRACT

In this paper, the hydrodynamic performance of FSRU which is designed to operate in North America East Coast (Fig. 1) is assessed. In order to estimate the hydrodynamic performance, numerical analysis is carried out based on a time domain simulation program SESAM to solve the coupled dynamics for floater and mooring lines. The target operating area is East coast of North America and the model test was carried out based on the metaocean data of the area. The mooring analysis considered waves only without other environment conditions at this time. The results of the numerical analysis show the results are under-estimated the higher wave height condition.

KEY WORDS: Turret-Moored LNG FSRU; Ship Motion; DeepC; SESAM; Mooring Tension

INTRODUCTION

As an alternative solution of energy demand problem and NIMBY problem, a floater receives attention from engineering companies and shipbuilding companies. Because of the demands, the Floating Storage Re-gasification Unit (FSRU) is attractive solution instead of an onshore facility. Also, the price for building the onshore facility is normally higher than the Floating units and takes more time.

The FSRU is permanently moored offshore and exports gas to shore through a subsea pipe line directly to the final consumers. So safety based design should be consider and the abnormal environment condition can be a one of very important design criteria compare to the other floaters. Due to the risk of explosion and environmental pollution by LNG storage facility, the LNG terminal moves to an offshore area. For that reason the demand of the FSRU development is increasing.

To dominate the FSRU market in advance, the conceptual design of FSRU have been conducted by many companies such as SBM-IMODCO, BHP Billiton, Broadwater Energy and the operational methods have been established . And recently several FSRU's have been proposed, are being planned or under construction. An important thing during operation is safety in loading and offloading condition. LNG carriers should be operated in the proximity of the LNG FSRU and the effects of hydrodynamic interactions have to be carefully taken into consideration for safe operation.

Fig. 1 North America East Coast

The offloading systems adopted are the LNG loading arms with side by side mooring. In this study, the hydrodynamic interactions between FSRU and LNG carrier are not considered. Only single body operation was considered with single point mooring system.
To design the mooring system, 3 types of mooring systems (Conventional buoy mooring, SPM tower mooring, Submerged Turret Loading) were considered. Conventional buoy mooring is usually used in relatively calm water. This system is impossible to weathervaning to reduce its wave loading. Thus the Conventional buoy mooring is more applicable in temporary LNG terminal. SPM tower mooring is used in harsh weather condition and LNG carrier has to install manifold at bow. It can be applicable in LNG FSRU. But SPM tower mooring system has safety problem relating transportation line which has to be installed from storage tank to bow manifold and hard to maintain low temperature.