Mooring arrangement for a floating LNG bunkering terminal at East Sea of South Korea

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ABSTRACT

The initial design of mooring arrangement for a floating LNG bunkering terminal (henceforth FLBT) is presented. The design procedure consists of three major steps. First, minimum number of mooring line is selected. Then optimum orientation of mooring line arrangement to we line tension or offset is determined. Lastly, the relation between each design parameter and maximum line tension/offset is established through a case study for the line diameter, line length and line angle. The final mooring line design, which satisfies minimum weight condition and MBL/offset criteria, is selected based on the case study results.

KEY WORDS: LNG bunkering; mooring; turret; catenary; tension; offset.

INTRODUCTION

The number of LNG fueled ships has increased globally due to reinforcement of IMO environmental regulation, and also demands for LNG bunkering infrastructure have been raised steadily. Until now, the onshore type such as LNG truck, LNG station and converted LNG terminal is generally being used for LNG bunkering, but considering the restriction of land area and the cost of construction, it is expected that the interest in floating type will increase in the near future. Fig. 1 shows the operation concept of a floating type LNG bunkering terminal which has been developed through an R&D project mainly funded by Korean government.

As shown in Fig. 1, an FLBT is installed in an offshore area, which is in the neighborhood of an existing port and supplies LNG fuel to a LNG fueled vessel through an LNG bunkering shuttle. Unlike onshore type, in case of floating type, the robust design for mooring arrangement is very important to operate stably in the harsh environmental condition and also economical design is significant to be competitive compared with the onshore type in the initial market stage of LNG bunkering.

Various researches related to mooring arrangement design have been performed until now. Lim (2015) developed the risk assessment method which could be applied in initial mooring design stage based on the frequency domain analysis. Park (2015) studied limitation of the frequency domain analysis by comparing with time domain coupled analysis result. Wichers (2001) performed the coupled mooring analysis including mooring line and riser. Jo (2015) studied the major design parameter’s effect on the mooring system performance such as the line tension, platform motion, etc. Lim (2014) suggested the optimum mooring design procedure to decrease the mooring line weight based on the frequency domain analysis. Ryu (2009) performed the optimized study for the mooring arrangement design by using the harmony searching method. Song (2013) applied the lumped mass on the seabed to improve the performance of mooring lines.

In this study, the design procedure of initial mooring arrangement for an FLBT, is suggested, which satisfies economic feasibility as well as safety. The design procedure consists of three steps. First, minimum number of mooring line is selected. Then optimum mooring orientation, which minimizes the line tension or offset, is...