ABSTRACT

LNG liquefaction process and selection of equipment which is used in onshore is already quite mature, but deep sea and the harsh marine environment can cause FPSO hull and tank violent sloshing, which will lead to the obviously difference of LNG-FPSO liquefaction process and equipment selection in onshore. In this paper, the requirements of equipment and process during natural gas pre-treatment, liquefaction and storage process were analyzed while the typical pretreatment and liquefaction processes were compared and the processes adapted to the sea were chosen; At the same time, further analysis of effect of marine conditions on the equipment in the process.

KEY WORDS: LNG-FPSO; sloshing; liquefaction process; natural gas; equipment; sea state; adaptability.

INTRODUCTION

There are rich in natural gas resources in the sea and the intensity in exploiting marine gas has been increased throughout the world with the requirement of energy in recent years. However, for the small gas resources far from the land, the two traditional methods to exploit gas resources including building large marine fixed production platforms and transporting gas to the land by pipeline are not economical and suitable. Therefore, a new type of marine natural gas exploiting method named LNG-FPSO (LNG Floating Production Storage and Offloading unit) platform is emerged. LNG-FPSO mainly orients to offshore gas fields, and also can be used for exploiting and treating offshore oil-associated gas. It has the functions of LNG-FPSO include production, storage, and unloading while LNG-FPSO can be moved to another field to exploit gas resources after the completion of gas production, which can save great cost and makes LNG-FPSO so popular throughout the world (Wijingaarden and Meek, 2008).

The natural gas pre-treatment in the offshore production of LNG involves impurity of natural gas and is more extensive and more complex than the land-based LNG plant. Moreover, compared with the typical land-based facility (Wijingaarden and Meek, 2008), all kinds of low-temperature process equipment and piping system should be laid on the limited space. At present, there are still many unresolved technical issues on LNG-FPSO as a new type of offshore natural gas exploiting technology, such as the LNG liquefaction process, equipment design and selection, LNG unloading method and so on (Iversen and Hellekleiv, 2009; Ganielsen and Andreassen, 2009; Pastoor and Lund, 2009; Wang, 2009). In this paper, the requirements of equipment and process during natural gas pre-treatment, liquefaction and storage process were analyzed while the typical pretreatment and liquefaction processes were compared and the processes adapted to the sea were chosen; At the same time, further analysis of effect of marine conditions on the equipment in the process, such as compressor, expander, separators, pumps, and various towers were finished and the requirements of equipment on the platform in order to further improve operation efficiency and reduce the impact of sea conditions were proposed which provide basis and guidance for the LNG-FPSO process and equipment design options.

MOTION CHARACTERISTICS OF LNG-FPSO FLOATING PRODUCTION SYSTEMS

Different from the fixed platform, floating production platform in the marine environment would produce a certain degree of freedom of motion, as shown in Figure 1, the six movements in which are surge, sway, heave, roll, pitch and yaw. The first three are linear motion, and the last three are angle movements. These movements may have an impact on the performance of process equipment; Table 1 shows the influence that the above-mentioned six kinds of movements impact on production platforms.

Fig. 1 Motion forms of floating production systems