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ABSTRACT

The new Deep-draft Cylindrical Offshore Nuclear Power Platform (DCOP), which combines some characteristics of Classical Spar Platform (SPAR) and Cylindrical Drilling Platform (CDP), is an excellent carrier for future offshore nuclear power plants. In this paper, the hydrodynamic performance of DCOP is calculated comprehensively, which includes time-domain and frequency-domain analysis of motion and mooring tension response, proving that it has excellent hydrodynamic performance in the target sea area of the South China Sea. Through the comparative analysis of related parameters of SPAR and CDP with the same displacement, it is proved that DCOP combines the advantages of the other two platforms and has the best comprehensive performance.

KEY WORDS: Deep-draft Cylindrical Offshore Nuclear Power Platform; hydrodynamic characteristics; numerical calculation; comparative analysis.

INTRODUCTION

In recent years, with the progress of ship and ocean engineering technology, island city construction, seabed oil and gas exploitation and seabed mineral exploitation have become the focus of Marine development of major countries in the world, and various infrastructure projects and Marine equipment are under research or practice. Providing strong and stable power for these construction projects and Marine equipment is another focus of the ocean development process.

Floating nuclear power plant (Zou et al., 2019), which is the construction of nuclear power plants on ships or offshore platforms can provide strong and stable power resources for far-offshore areas. Scholars from various countries have explored and proposed a variety of typical offshore nuclear power platform concepts (Lee et al., 2015), including ship type, concrete gravity based structure (GBS), sinking type and cylinder type platforms. One ship type platform mainly Russia's “The Academician Lomonosov” (Kostin et al., 2007), subsided Flexblue Marine nuclear power plants (Haratyk et al., 2014) by the French state-owned ship manufacturing companies are developing the design, South Korea design concept of concrete gravity based structure (GBS) (Lee et al., 2013) type floating nuclear power plants can reduce the marine environmental load on the platform, the Massachusetts Institute of Technology (MIT) proposed the concept of offshore cylindrical floating nuclear power platform by referring to the design of cylindrical FPSO (Buongiorno et al., 2016).

Among them, cylindrical platform has simple structure, good environmental adaptability (Zhao, 2022), and relatively high space utilization rate of the whole platform (Huacheng et al., 2015), which has great research and development prospects. Scholars have also conducted a lot of studies on cylindrical platform carrier. Zhao Zhimin (2020) designed catch-line mooring system for cylindrical FPSO. Huang Jia (2017) carried out a series of hydrodynamic performance model tests on cylindrical FWPSO (FPSO with workover function). Siow (2015) introduced a method to simulate the motion response of cylindrical FPSOs by using the diffraction potential theory. Yao Yuxin (2015) put forward a new type of hourglass FDPSO (floating drilling production storage systems), through the test verified the rationality of the design of the platform.

Based on the above research results, a new Deep-draft Cylindrical Offshore Nuclear Energy Platform (DCOP) is proposed as a power support facility for island cities, Marine industries and Marine equipment in the construction of islands and reefs. The platform combines some of the advantages of the Classic Spar Platform (SPAR) and the Classic Cylindrical Drilling Platform (CDP) with absolute stability and wide interior space. In addition, the platform can be installed and transferred in an upright position, allowing pre-assembly of nuclear power facilities and flexibility to provide strong and stable power to the target area. In addition to being the carrier of floating nuclear power plants, such platforms can also be used as the carrier of other plants such as seawater desalination, hydrogen preparation and power transformation hubs. In short, the deep-draft cylinder type floating nuclear energy platform can not only ensure safe production, but also not occupy valuable island land.