Examination of Hull Forms for an Offshore Nuclear Plant

by

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Abstract

The Nuclear Science and Engineering Department at MIT has a concept design for an Offshore Nuclear Plant (ONP). This project highlights the advantages of the offshore location by reducing the risk of natural disasters and cost of terrestrial nuclear power facilities. The original ONP conceptual design consists of a large cylindrical floating platform similar to existing platforms in the offshore oil and natural gas industries.

This study investigates the advantages and disadvantages of different hull forms that the ONP may use in an effort to identify an optimal balance between hull configuration and stability. Multiple platform designs were modeled to compare the differences in seakeeping and stability. These variants explored the characteristics and combinations of flat hull plating to replace the original cylinder shape, lengthening the platform to minimize overall depth and draft. The different hulls were modeled and then analyzed using a three dimensional radiation-diffraction panel method to simulate each platform's response in a given sea state. The variants were compared utilizing the JONSWAP spectrum for a 100-year storm in North Sea and evaluating the response in six degrees of freedom. While seakeeping performance is the primary characteristic evaluated, other effects of the design changes such as mooring complexity, ease of construction, and arrangeable area were also compared.

The key trade off is the seakeeping performance prediction versus the estimated economic benefits of the alternate hull form arrangement. This consideration has to be made with respect to the actual meteorological and ocean conditions for the operational location. This is particularly true with respect to ocean depth, as the deep draft of the vertically arranged hulls can allow for greater non-linear effects on the motions. For the environment specified in this study and the economic benefits perceived by the design, the laterally arranged "stretched" design is worthy of more attention.

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