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DYNAMIC RESPONSE ANALYSIS OF DDMS PLATFORM SUBJECTED TO ACTIONS OF WAVE GROUPS AND CURRENT FOURCES*

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Abstract: Coupled dynamic analysis of the Deep Draft Multi-Spar (DDMS) platform and the mooring system under the action of waves and current is carried out in the time domain. Using a geometrically nonlinear finite element method, the mooring-line dynamics is simulated based on the total Lagrangian formulation. Wave groups are obtained by the JONSWAP spectrum and an empirical wave envelope spectrum involving two envelope-based factors Group Height Factor (GFH) and Group Length Factor (GLF). The results show that the wave groups have a significant effect on the motion responses of the platform and the mooring line tensions.

Key words: Deep Draft Multi Spar (DDMS) platform, dynamic response, wave groups, current fources

Introduction

In deep or ultra-deep water, the mass and the damping of the mooring lines would become important and have appreciable effects on the surface platform motions, to make a coupled dynamic analysis of floating platforms with the mooring lines critical in their designs. Kim et al.[1] showed that an uncoupled analysis of Spars may give inaccurate results for cases in deepwater. Chen et al.[2] compared the computed and measured results, and showed that the numerical model can effectively simulate the motion responses of the tunnel element and the cable tensions when the motions of the tunnel element are within some limit. Yang and Kim[3] performed a numerical study of the transient effect of the tendon disconnection on the global performance of an Extended Tension Leg Platform (ETLP) under harsh environmental conditions of Gulf Of Mexico (GOM). Liapis et al.[4] made some global motion predictions of the Perdido Spar using Shell's in-house COSMOS/WAMIT suite of programs, with extensive comparisons between the numerical predictions and the experimental results. In all cases, the comparisons saw very good agreements. Liu et al.[5] developed a Time-domain Higher-Order Boundary Element Method (THOBEM) for simulating wave-current interactions with 3-D floating bodies. Shi et al.[6] employed the method of bimodal spectrum to simulate the mixed waves that swell and wind wave appearing at the same time, performed the experiments for a LNG ship moored to an island berth. Low and Grime[7] analyzed the extreme response of floating structures using the coupled frequency domain method. Wang et al.[8] analysised a moored Spar platform in irregular waves in deepwater.

Ocean waves often appear in sequences of high wave elevations, known as wave groups. They occur in both deep and shallow water, and meanwhile, can cause severe loading on floating structures, especially at or near the natural motion frequencies. Hence, their influence is an important issue in the design of the ocean structures. Johnson et al.[9] studied the effects of wave grouping on breakwater stability and the two wave trains of a wave spectrum. It was shown that the one with higher extent of grouping was more dangerous. Lin and Huang[10] used the linear wave theory

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