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Effect of Heave Plate on Semisubmersible Response

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ABSTRACT

This paper presents the findings from a study of heave plates on a deep draft semisubmersible. It reveals that the location or draft of heave plates has a significant impact on their effectiveness. When not located properly, heave plates could increase the heave response of a semisubmersible and would not be beneficial. Parametric study results on the heave responses of the semisubmersible with heave plates at different elevations are first presented. Recommendations are then made on how to effectively locate the heave plates based on these results. The motion responses of the deep draft semisubmersible presented in this paper are also compared with those of a conventional semisubmersible. The comparison results indicate that even without the heave plates on, the deep draft semisubmersible possesses superior heave motions and could be a viable dry-tree floating solution in harsh environments.

KEY WORDS: Semisubmersible; semi; deep draft semisubmersible; heave plate.

INTRODUCTION

As compared to Spars or TLPs, conventional semisubmersibles have been known to respond with higher heave responses in a harsh environment as in the Gulf of Mexico. With such high heave responses, conventional semisubmersibles are deemed less friendly to dry-tree risers. As a result, they are generally used as a short-term drilling vessel or a permanent wet-tree application production platform. As offshore development moves to deeper frontiers, a dry-tree floating solution has become increasingly attractive in term of drilling/workover capability and cost effectiveness. For semisubmersible to be considered as a viable dry-tree floating solution for deepwater developments, its heave response has to be reduced. One way to achieve this goal is to use a deep draft semisubmersible with longer columns and deeper pontoons. Furthermore, it is envisaged that the heave responses of the deep draft semisubmersible could be further reduced by adding flat plates as a heave inertia-driven damper, as has been evidenced in the Truss Spar concept in which multiple heave plates are used. Aubault, Cermelli, and Roddier (2006) discussed the design methodology for structural sizing of a three-column semisubmersible with large water-entrapment (heave) plates extending horizontally from the base of the columns. Halkyard et al. (2002) presented a deep draft semisubmersible with a retractable heave plate. However, heave plates in a semisubmersible have not been widely studied and their behavior and effectiveness were not well understood. The results presented in this paper would help gain a better insight of how the heave plate impacts the semisubmersible heave responses.

This paper first presents the hull configuration of a deep draft semisubmersible. Motion Response Amplitude Operators (RAOs) of the deep draft semisubmersible are compared with those of a conventional semisubmersible. A parametric study of heave responses of the deep draft semisubmersible with heave plates at various locations or drafts is described. Effect of heave plates with different sizes is also shown. The impact and the effectiveness of the heave plates are then discussed. Recommendations are then made on how to effectively locate the heave plates based on these results.

DEEP DRAFT SEMISUBMERSIBLE

Hull Configuration

The deep draft semisubmersible presented herein has better global motion characteristics and shares the load capacity, construction and installation advantages of conventional semisubmersibles. Figure 1 shows a rendering of the deep draft semisubmersible.

The deep draft semisubmersible consists of four interconnected pontoons forming a square center-well. The pontoons support four surface piercing columns which bear the topsides. Heave plates within the four columns may be utilized, if deemed necessary. Figure 2 highlights the typical configuration for a conventional semisubmersible and the deep draft semisubmersible. It can be seen that the deep draft semisubmersible is about twice as deep as a conventional semisubmersible.

The principal dimensions of the deep draft semisubmersible are shown in Table 1 and Figure 3. It has four square columns with a size of 53 ft x 53 ft. The column spacing is 235 ft. The length, width and height of the four pontoons are 235 ft, 62 ft, and 20 ft, respectively. The principal