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Contemporary Challenges and Solutions for Post-Katrina Gulf of Mexico Spar Design

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Abstract

Deepwater field developments in the Gulf of Mexico typically consider Spar, Tension Leg Platform and Semisubmersible hull forms as potential candidates for floating facilities. Since 2005, field development studies for floating systems have had to consider more severe environmental conditions, including increased wind and wave criteria released in API Bulletin 2INT-MET in 2007, increased or more prevalent loop/eddy current events and longer wave periods. These changes have quantifiable impacts to Spar hull and mooring design that are evaluated in this paper. In addition to the design challenges presented by the environment, operator functional requirements (e.g. hull-supported top-tensioned risers), robustness requirements (e.g. minimum air gap in survival conditions) and execution plan considerations (e.g. hull dry transport constraints) also have a quantitative impact on the Spar configuration.

This paper presents a summary of the recent design challenges affecting Gulf of Mexico Spar design and uses global performance analysis to evaluate different options to update the Spar configuration to effectively satisfy the design challenges. Design solutions that produce acceptable global performance results are further evaluated to quantify the potential benefit to delivery cost and schedule based on overall hull weight. Based on the analysis results, recommendations are made regarding the best solution to meet the identified post-Katrina design challenges. Results indicate that the optimum number of heave plates depends on the top-tensioned riser support system. The effect of overall hull length (a typical execution plan constraint) on overall weight (and therefore cost) for a given payload is identified. The technical solutions and recommendations are applicable to all future field developments that are considering a Spar hull concept to support floating facilities.

The offshore oil industry is characterized by more challenging developments, increasing costs, and ever-increasing focus on safety and survivability. The technical conclusions and recommendations from the work discussed in this paper will assist operators that choose the Spar concept in developing more cost effective designs that retain the required robustness and survivability for safe, reliable operations.

Introduction

Deepwater production of oil and gas in the Gulf of Mexico utilizes floating and subsea systems. Spar, Tension Leg Platform and Semisubmersible hull forms have been used for existing floating production systems and are typically considered for new developments. All of these hull concepts have unique features to meet the demanding functional and environmental requirements of offshore oil and gas production. As experience is gained in deepwater production, functional and environmental requirements are updated and the hull concepts must be evaluated in consideration of the updated requirements to ensure that each implementation provides a good balance of cost, function, reliability and safety.

This paper specifically considers the Truss Spar concept and evaluates unique aspects of the concept against updated constraints and requirements, including:

- Updated metocean criteria
- Updated air gap criteria
- Constraints on overall hull length due to the preference for single-piece transport
- Requirements for top-tensioned riser support in deep water