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Riser Integrity Monitoring Techniques and Data Processing Methods

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ABSTRACT

Riser integrity monitoring provides critical performance data during day to day operation and in extreme events. In-situ integrity monitoring improves the understanding of the complex riser behavior leading to enhancement of design practices.

The paper discusses a range of methodologies for offshore riser monitoring. A review of existing and planned monitoring programs is provided with particular focus on the level of success achieved. Monitoring instrumentation and applications are discussed from the "fit for purpose" perspective, highlighting the monitoring objectives, reliability requirements and offshore operations.

The paper also describes data processing methods used for screening and evaluating the collected data. The differences amongst standalone, hardwired, and acoustic data processing and further analysis of the monitoring data are discussed. Hardwired methods are focused on providing information that are relevant for making operational decisions at offshore facilities during day to day activities. Additional onshore data processing is focusing on providing information that can be used in the continuous effort to better understand riser response.

In summary, the paper discusses the relative benefits and potential problems associated with hardwired, stand-alone and acoustic monitoring systems in adding value to the integrity management of deepwater risers.

KEY WORDS: Riser monitoring, structural monitoring, data processing methods.

NOMENCLATURE

ROV: Remotely Operated Vehicles
TDZ: Touch-down Zone
VIV: Vortex Induced Vibrations

INTRODUCTION

The offshore oil and gas industry has pushed aggressively into deeper and deeper water over the last 10 years. This is particularly true in the Gulf of Mexico, where developments are planned and sanctioned in water depths up to 9,000ft before the end of the decade. Compare this to 10 years ago, when developments planned in water depths of 5,000-7,000ft were groundbreaking and deepwater experience was limited to a few large operators and contractors. Today, many more operators are entering the deepwater arena as past deepwater developments prove successful despite the large upfront capital cost.

This presents significant challenges to equipment used to connect seabed to surface, such as risers and mooring systems. Deepwater risers for drilling, completion and production are subject to particularly harsh loading conditions from internal fluid pressures, the environment, and vessel motions and from internal and external corrosion. In addition, aggressive schedules to meet first oil and financial budgets commitments in times of ever increasing construction costs can lead to oversights in the design process as well as fabrication and installation errors. The risks to a dynamic riser system in service to such practices are great as the number of uncertainties that go into the design and build process are significant and include:

- As-built or installation anomalies
- Long-term and extreme environmental data at site
- Vessel motion response
- Under conservative hydrodynamic response predictions
- Material degradation with time
- Change of service or operating conditions

Riser integrity monitoring is one of the main indicators that provides critical performance data during day to day operation and in extreme events enabling effective riser management. Riser integrity monitoring also enhances the understanding of complex riser behavior leading to improvement in design practices, often referred to as "closing the loop" on design. Riser integrity response monitoring is a broad concept, and includes many disciplines. However, the focus of this paper is on monitoring of riser structural response.

RISER INTEGRITY MONITORING TECHNIQUES

Riser monitoring systems can vary tremendously in scope. The scope of this paper will be limited to monitoring systems for riser structural