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Safety Factors for Ultradeepwater SCR Handover Operations

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Abstract

This paper has been developed to provide some guidance/considerations in regard to design safety factors for installation aids required for deepwater Steel Catenary Risers (SCR) installations. In particular the paper focuses on SCR handover operations where an SCR is transferred from the installation vessel to the host floating facility.

Generally SCR transfer operations are prepared based on an empty SCR. However, should the SCR accidentally flood during this operation, the installation aids should be sized such as to preclude a catastrophic event.

The paper provides an approach for the design of installation equipment including rigging for ultradeepwater SCR installations. Emphasis is placed on presenting safety factors applicable to lift equipment and rigging design for SCR transfer operations. Also, included are installation aid and platform support structure load considerations.

Guidance on appropriate safety factors are presented for transfer operations associated with normal empty SCR transfers and accidental flooded riser conditions. Utilizing the same factors for both empty and flooded conditions may lead to an impractical design solution which may impede a safe installation process. This is especially true for deep and ultradeepwater conditions where just handling an empty SCR may already be pushing the limits of a conventional installation vessel and personnel capabilities. Instead of increasing the installation equipment size, this paper will focus on reducing the potential for accidental flooding of an SCR and the provision of adequate safety factors subsequent to the mitigation of the event.

Introduction

An SCR is viewed by the oil and gas industry as a cost effective and seemingly simple solution for connecting a deepwater host facility to a subsea pipeline system. SCRs have been utilized worldwide in all deepwater locations; Gulf of Mexico, Brazil, and West of Africa. To achieve such an elegant solution a significant engineering program is required both for design and installation. This paper focuses on installation issues surrounding rigging design requirements, with particular emphasis on an SCR transfer procedure from the pipelay vessel to the host facility. SCR design considerations are not covered in this paper.

SCRs are used for both in-field production and export systems. Whilst an SCR has been utilized for a floating facility in approximately 1,500 feet water depth Ref [1], they are most effective in deeper waters. Recent export SCR installations include Na Kika (6,400 ft), Red Hawk (5,300 ft), GC 518 (4,300 ft), Frontrunner (3,300 ft) and Thunder Horse export SCRs (6,000 ft). The Thunder Horse 24-inch export SCR system is now the largest and deepest SCR installed to date. New developments are looking to even deeper waters with ultradeepwater fields being considered in 10,000 feet water depths. Deepwater SCR installation poses a challenge for both installation vessel capabilities and rigging component sizes. Take for an example a development in 10,000 feet water depth, and a 16-inch outer diameter export SCR. A riser wall thickness of 1-inch will result in an empty static installation load of the order of 700 Kips. However, if the riser were to flood during installation, then this static installation load could potentially reach 2,000 Kips, not considering the weight of the installation equipment. There are less than a handful of installation vessels that could install this system even for an empty riser installation. This example illustrates the need to review whether the installation equipment size should be based on either the empty, accidental or adjusted accidental condition.

The proposed guidance and considerations summarized at the end of the paper have been based on a review of:

- A typical deepwater SCR installation methodology.
- Dynamic loading induced during installation.
- Design loads for an empty riser condition and associated target safety factors.