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Tahiti Spar as a Wet Tree Concept

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Abstract

This paper will address the advantages and challenges involved in designing a truss spar for wet tree application. The spar has traditionally been used as a dry tree concept with top tensioned production risers. Chevron's Tahiti project in the Gulf of Mexico will be the first wet tree truss spar. For Tahiti, the favorable motions characteristics of the spar enabled successful fatigue design of the sour service HPHT steel catenary risers without use of corrosion resistance alloys. Use of polyester mooring significantly improved hull vortex induced motions response to loop currents relative to traditional chain-wire-chain mooring and enabled SCR departure angles to be reduced. HPHT production riser were hung off using pull tubes, which simplified riser installation and eliminated uncertainties related to performance of flex joints under HPHT conditions. Challenges for a wet tree truss spar design include increased hull density and float-off requirements due to smaller moonpool dimensions than traditional spars with top tensioned risers. In addition, the large number of pull tubes created challenging VIV fatigue designs and as a result, stringent welding and NDE requirements were imposed for the pull tubes in the shipyard.

Introduction

The Tahiti project commenced with a discovery well in 2002 followed by the formation of a facilities engineering team and an appraisal drilling program. Early Tahiti facilities concepts took the form of a semisubmersible floating production facility tied into two subsea production centers with wet trees. More thorough concept selection studies revealed a range of possible facility options including differing hull forms (spar, TLP, semisubmersible), wet and dry trees with SCRs and dry tree vertical risers, and options for drilling from the facility vs. drilling by MODU. Early concept decisions were made to use wet trees and conduct drilling activities from two drill centers away from the floating production facility. Eventually a spar concept was selected for the floating production facility and SCRs were confirmed as the most attractive riser option. The spar offered more favorable motions characteristics for the design of the sour service HPHT SCRs and large diameter export SCRs.

This paper addresses the key advantages and challenges associated with designing a spar for an all wet tree application. Spars have traditionally been used for dry tree developments, with vertical production risers directly over a production drill center. The Tahiti project is the first all wet tree truss spar. This deviation from the traditional spar design offered a range of challenges and opportunities for the project team. These included topics ranging from the selection of polyester mooring for improved VIM performance directly impacting the risers to the trade-offs in the selection of the riser hang-off options. There were also challenges with the hull design due to the higher hull density of the wet tree truss spar configuration and the large number of pull tubes with complex fabrication requirements due to their critical fatigue loading.

Concept Selection

Tahiti concept selection was performed using a comprehensive decision analysis process. B Varnado provides an extensive discussion on the concept selection process in OTC-19856 [Ref 1]. Economic models were constructed to compare the relative performance of the range of facilities options. A wide range of technical studies were performed to provide input to the decision analysis process. One key area for these technical studies was the impact of hull form and floating structure motions on the riser system options. Technical studies were conducted on two riser types and three hull forms to provide concept feasibility and relative performance of the various options. These studies included the calculation of hull response for all of the hull forms and resulting riser performance for each scenario.

The riser types considered in the concept selection process were Steel Catenary Risers (SCRs) and Subsea Vertical Import Risers (SVIRs). SCRs, a conventional riser technology typical for deepwater developments such as Tahiti, were evaluated for TLPs, Semis, and Spars. SVIR's are a hybrid technology application conceived by the project team as an alternative to