



OTC 19336

The Roncador P-52 Oil Export System - Hybrid Riser at a 1800m Water Depth

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This paper was prepared for presentation at the 2008 Offshore Technology Conference held in Houston, Texas, U.S.A., 5–8 May 2008.

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Abstract

The PDET (Oil Flow Master Plan) project consists of the P-52 oil export system, an 18in oil export pipeline and a Free Standing Hybrid Riser (FSHR) connecting the P-52 floating production unit to the fixed platform PRA-1, both located in the Campos Basin, offshore Brazil. The base case for the export system comprises a vertical riser and an export pipeline. The FSHR consists of a vertical steel pipe tensioned by a near surface Buoyancy Can with a flexible jumper connecting the top of the riser and the FPU. The foundation is a drilled and grouted pile. The oil export pipeline is 56km long, going from 1800m water depth at the P-52 location to 100m water depth at PRA-1. The installation was finalized on October 2007.

This paper describes the studies carried out to confirm the concept feasibility for such application and explains the main features of the design that takes best advantage of local practices and Petrobras capabilities. Initially a MODU was considered for the deployment of the FSHR system. However, as an outcome of the bid process, a pipelay and construction vessel would be utilized instead, for installing the system. Moreover, the subsea equipment and derivations would be designed considering a new engineering conception of independent and retrievable modules connected at the base, named In Line Structures, therefore precluding the need of a certain number of PLETs and rigid jumper installations, thus optimizing the operation.

Some of the engineering analyses performed for the design development, for both installation and in-place conditions, are described in this text. The fatigue damage due to Vortex Induced Vibration proved to be an important driver for the Hybrid Riser design. Vortex Induced Motions of the Buoyancy Can were also a significant source of fatigue damage to the system. The rigid base jumper, connecting the riser base to the pipeline is another special component of the system, and a brief explanation of the design issues is provided. Key issues such as crossing design and thermo-mechanical analysis are addressed as well as the development of mitigation solutions to overcome the thermal effects on the pipeline.

Introduction

The PDET project consists of the P-52 semi-submersible oil export system, an 18in oil export pipeline and a FSHR connecting the P-52 floating production unit at 1800 m water depth to the jacket PRA-1 at approximately 100m water depth. The system configuration is shown in Figure 1. The FSHR was developed through a FEED (Front End Engineering Design) contracted to 2H Offshore Engineering, according to technical specifications and functional requirements provided by Petrobras. Flow assurance studies required 50mm thickness thermal insulation material for both pipeline and the vertical portion of the riser.

During the FEED development a MODU was considered for deployment of the FSHR system, to take best advantage of local practices and Petrobras capabilities. The bid requirements allowed some changes to the design and installation procedure developed during the FEED phase, in order to better suit the contractor's capabilities. As a result, only a pipelay and construction vessel for installation of both riser and pipeline were considered. The contract was awarded to Technip, with exception of the flexible jumper, which was awarded to Wellstream and the foundation, which was provided by Petrobras.

The high expected production rates of the P-52 platform require an 18in oil export pipeline. The instrumented pigging requirements dictate the export riser to have the same diameter. This large bore specification combined with the deep water site put this application outside the present feasibility range of solutions such as flexible pipes and steel catenary risers (SCRs). Both these solutions present high top tension loads for installation and operation. The lateral buckling failure mode in flexible