Challenges in Shallow Water Riser Design for FPSOs Installed in Campos Basin

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ABSTRACT

The selection of flexible riser configurations for production systems consisting of a turret moored Floating Production Storage and Offloading (FPSO) vessel for shallow waters can be as challenging as for deep waters. OGX is currently developing the Waimea and the Waikiki fields in shallow waters in the Campos Basin, offshore Brazil, using the turret moored FPSO’s OSX-2 and OSX-3, respectively. Both fields are identical in relation to the quantity of flexible lines: up to 26 lines, including umbilicals and flexible risers, with outer diameters ranging from 4inch to 9inch. This paper describes the steps followed to determine feasible riser configurations. The main challenges are discussed while different configurations are compared and evaluated.

KEY WORDS: Flexible risers, shallow waters, FPSO, Campos Basin.

INTRODUCTION

OGX is a private Brazilian operator currently exploring hydrocarbons in shallow waters in the Campos basin, offshore Brazil. FPSO’s have been employed in all its field developments so far.

The most recent field developments are located in the Waimea and Waikiki fields, whose FPSO’s are named OSX-2 and OSX-3 respectively and are located in water depths of 105m and 135m. Both platforms are VLCC’s (Very Large Crude Carrier) and are kept in position by a single point mooring system (Turret). OSX-2 makes use of an internal turret, while OSX-3 adopts an external turret solution, Figure 1. At the time of writing, they are both under construction and are planned to be installed in 2013. Each FPSO will gather the oil and gas production from four subsea satellites wells and from nearby wells through dry completion Wellhead Platforms (WHP). Water injection systems to increase the oil production at a later stage are also planned to be installed from the WHP. Both OSX-2 and 3 are similar in many aspects including the flexible pipe properties adopted for the flowline and riser systems.

This paper describes the challenge of finding feasible riser configurations for the field developments of OSX-2 and OSX-3. The extensive study includes analysis of three different types of riser arrangements: free hanging catenary, pliant-wave and lazy-S. The intricacy of this work was complicated by the quantity of flexible lines each field is designed for: up to 26 lines, including umbilicals and flexible risers and flowlines with outer diameters ranging from 4inch to 9inch. Significant interference issues followed the whole process of the study. The relatively light weight of the flexible lines, geometrical limitations due to the shallow water depth and the highly dynamic vessel response added to the complexity of the task and made the riser system selected for the OSX-2 and OSX-3 vessels unique in the world.

Figure 1 – OSX-3 FPSO External Turret