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Design, Fabrication and Installation of the First Ever Reeled Pipe-In-Pipe System in Offshore Brazil

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Abstract

The domestic demand of gas is increasing in Brazil. Petrobras is responding to this challenge by bringing several gas fields on stream offshore Brazil. Among them is the Canapu field, located east of the State of Espirito Santo, about 75 km off the coast, in a water depth of 1608 m. The produced gas is transported using a 20 km long pipe-in-pipe (PIP) system to the Cidade de Vitoria floating, production, storage and offloading system (FPSO) located in the Golfinho field to be processed and then exported onshore through an existing gas pipeline.

Technip was awarded an engineering, procurement, construction and installation (EPCI) contract and was responsible for the detailed design and installation of the first ever reeled PIP system offshore Brazil. The project was awarded on a fast-track basis, which required design, qualification, fabrication and installation of the PIP system in less than 18 months. The scope also included two pipeline end terminations (PLET) with seven gate valves, free span rectification, the crossing of three flexible flowlines, and, pre-commissioning activities (flooding, cleaning, gauging and hydrotesting). The PIP system was also prone to lateral buckling, which required definition of a robust mitigation strategy.

The design requirements for the Canapu PIP system involved the design and qualification of several technically advanced components and novelties in PIP design including the application of the first ever reelable mechanically clamped waterstop system and the use of buoyancy modules for lateral buckling management on a PIP system.

This paper presents the overview of the design, fabrication and installation of Canapu PIP system as well as a summary of the qualification test program performed for the different PIP system components.

Introduction

The offshore activities of Petrobras in Espirito Santo state, located in the southeast of Brazil, take place in the Espirito Santo basin and the north portion of the Campos basin. These dates back to 1968 when the first Brazilian offshore well (shallow water) was brought onstream. In deepwater, the Golfinho prospect was discovered in 2003, which contained two oil and one non-associated gas reservoirs. Two FPSOs (Capixaba and Cidade de Vitoria) were employed to exploit the reservoir. The produced gas is transported through a 66 km pipeline to the Cacimbas gas treatment facility [1, 2].

The Canapu field, located approximately 20 km east of Golfinho, is designed to produce gas using a PIP system, which is linked to the wellhead through flexible jumper and to the Cidade de Vitoria FPSO using flexible riser system. The flexible riser system is anchored at the catenary touch down point (TDP) using a torpedo pile in order to avoid any riser residual bottom tension to be transferred to the PLET, which could damage the goose-neck or cause pipeline walking. The produced gas is then transported to the Cacimbas gas treatment facility via an existing pipeline (see Figure 1). The PIP system was required due to the properties of the production fluid, the necessity to avoid hydrate formation and restrictions on injection and storage of hydrate inhibitors in the FPSO. This was the first use of a PIP system in waters offshore Brazil.

The detailed design, fabrication and installation contract was awarded at the beginning of 2007, requiring the flow of gas before December 2008. This challenging schedule was met by utilization of Technip's assets worldwide resulting in completion of the project safely and ahead of schedule. Project and engineering centers in Brazil, UK and USA were involved.