Installation of Rigid Pipeline on Extremely Challenging Seabed

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ABSTRACT

The oil & gas offshore exploitation fields in Brazil are mainly characterized by deepwater areas. One of the big challenges associated with the development of these fields is the installation of subsea pipelines which allow the flow of gas/oil from the deep water areas up to facilities close to shore, providing interface between live productions fields and auxiliary units such as manifolds. The continental shelf break and slope are the critical sections of this interface as it is characterized by extremely uneven seabed and high values of seabed inclination.

Part of the development in this area is the Camarupim 12-in pipeline, which Petrobras contracted Subsea7 to perform the detail design and to install this rigid pipeline. The work scope consisted of a 5.9km length gas export pipeline with 3mm LPE coating. The line was initiated with a PLET and there was a ball valve and PLR on a skid at the lay down end. The initiation was done with a suction anchor. Although the scope was conventional, the Camarupim route represented various challenges. The pipeline was initiated at 712m of water depth on a clayey seabed at about 5.5 degrees lateral inclination. This area was identified as marginal with respect to lateral stability during installation. The pipeline route then approached the live Golfinho 12-in gas export line previously installed. Here the Camarupim line was laid very close to the Golfinho line going up a steep hill. Towards the top this hill had an inclination of approximately 40 degrees. In the same area there were large lateral inclinations and also extremely uneven seabed giving a number of large and small free spans. The only feasible corridor for installing the pipeline in this area was between 1 to 7m away from the live Golfinho line. These conditions required good knowledge of the seabed, the expected behavior of the catenary and the capabilities of the vessel. Also, various types of installation aids had previously been installed.

The end of this dramatic part of the route was at KP 4.1 at a water depth of 120m of water depth. About 500m further along, a friction clamp was installed and connected up to a pre installed anchor system. This was deemed necessary in order to guarantee the axial stability of the pipeline during installation and operation. About 1km further along the pipeline was laid down in 65m of water depth.

The purpose of this paper is to describe the main engineering challenges during the planning phase, all the detailed analyses that were performed to evaluate and guarantee pipeline stability during installation / operation and cover all aspects of the offshore campaign.

KEY WORDS: rigid pipelay; seabed slope; pipelay stability.

INTRODUCTION

Offshore oil and gas industry in Brazil is mainly concentrated in deep water fields. The link between shore sites and exploitation fields commonly located far from the coast has been a big challenge due to distance from the floating production units to the shore processing and distribution facilities. In addition to the several restraints associated with the location of the fields, the Brazilian coast is also characterized by extreme seabed slopes in some cases which represent a challenge for pipeline operation and installation stability over the continental slope.

Part of the new strategy for gas exportation in Espírito Santos Basin, located 140km north of the main area for Brazilian oil industry activities, Campos basin, is the operation of onshore facilities connected to subsea equipment in water depths greater than 700m through subsea pipelines installed across the extremities of the continental shelf characterized by high longitudinal and lateral slopes.

Camarupim Project is part of this strategy and the installation of approximately 5.9km of 12-in pipeline was part of an EPIC project, comprising the engineering, procurement, installation and commissioning of the rigid pipeline in water depths varying from 65m up to 712m, connecting FPSO Espirito Santo to a 24-in rigid pipeline on the shallow end, as illustrated in Figure 1.

Figure 1 – Schematic Drawing of the Camarupim Layout