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Offshore Routing of Large Diameter Pipelines through High Relief Outcrops

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Abstract

The pipelaying operation for the Gulf of Mexico's first floating production, storage and offloading system (FPSO) at the KuMaZa development in Mexican waters was a challenging one due to the extreme roughness of the seabed at the field and the combination of large diameter pipelines and routing requirements.

This project was faced with the challenge of ensuring that the pipelines, laid in curves on highly uneven ground, retained their integrity despite the high environmental loading. Working in close coordination with Global Industries' engineering department, DeepSea's approach was to identify an optimized routing of the pipelines and provide a satisfactory rock berm support layout over the rough terrain, while minimizing the quantity of rock used in the berms and maintaining the extremely tight schedule, given the huge quantities of rock placed on the seabed.

This paper discusses the 'live engineering' approach: using a combination of industry-standard tools and proprietary techniques to not only ensure acceptable rock berm configuration for pipe laying but also to optimize the quantities. It outlines the considerations that led to the modification of the installation design, and the factors that contributed to an extended engineering process leading to the ability to hydrotest the lines prior to completion of the final rock dumping for pipeline support and stability.

1. Introduction

Ku-G forms part of the Ku-Maloob-Zaap (Ku-G) development in Mexico's Bay of Campeche, northwest of Ciudad del Carmen. To link several platforms to the FPSO, five large-diameter (two 24 inch and three 30 inch) pipelines needed to be laid in 100m water depth across difficult and rocky terrain. Mexico's oil and gas company Pemex awarded the contract to install the pipelines to Global Industries at the beginning of 2006. The Gulf of Mexico's first FPSO started production in early 2007 and whilst FPSOs have been in use in other basins around the world since the mid-1970s, this installation constitutes a landmark project.

Typical project requirements call for the importance of early survey and engineering activities to ensure that a complete technical and economic solution to the project can be established and thus minimize the risk. However with the extremely fast track nature of this project for the pipeline installations from the tender phase to the required mechanical completion a different approach had to be taken in order to fulfill the schedule.

The Ku-G Package is one of the most challenging projects of its kind developed in Mexico, not only from an economic standpoint but also from the amount of new technology and resources needed in order to deliver a quality product on time to meet the Operator's expectations. The KuMaZa field is well known for the existence of vast reef outcrops and rocky areas that are practically impossible to dredge or bury once a pipeline has been laid on the seabed. Ensuring the pipelaying for the FPSO at the Ku-G development was performed to a tight schedule and on budget, with the required degree of accuracy – on a very rough seabed, and with significant wind and tide effects – was achieved through thorough pre-project planning, risk evaluation and preparation. The identified risks were mitigated by 'real-time' engineering performed during the offshore operations.