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Development of Towing Techniques for Deep Water Flowlines and Risers

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Abstract

The interest of towing techniques for the installation of flowlines and risers has greatly increased in recent years, particularly for deep-water field developments. Surface tow presents particular interest although it is more delicate to engineer compared to other tow methods. This paper presents experimental data and feed back from surface towing trial operation performed by Acergy. Numerical models of tow operation can now be developed through dedicated software to allow engineers to better assess the behavior of the pipeline. During the Girassol project the limitations identified by engineering analysis were compared with data collected on field during operations to further improve the knowledge of the tow method and propose innovative and competitive alternatives to existing methods. A new surface towing technique adapted for long pipeline is presented which uses a wave configuration (patent pending). The paper also identifies the limits of application of the surface wave tow method in terms of pipe diameter, flowline length, environmental conditions, etc. The fabrication and overall costing aspects are addressed and compared with other pipe laying techniques.

Introduction

For the last three decades, the towing techniques have been used for large diameter carrier pipe denoted as bundles (including production lines, service lines, umbilicals etc.) on field development with constraining flow assurance requirements /1/2/3/4/. In recent years, the interest of towing techniques for the installation of flowline and risers has greatly increased, particularly for deep-water field development. Basically the reasons for selecting a tow method as opposed to a conventional laying ship or barge is due to:

- either fabrication requirements where the pipe cross section consists of the use of a bundle design,
- or economic reasons in the case the field development location is remote and the installation scope does not justify the mobilisation of a conventional laying spread /5/.

Deep water field development requires the utilisation of a dedicated installation spread designed to cope with the high tensions and the large amount of permanent work to be transported and installed. This represents a substantial investment for the contractor and the utilisation of such spreads also has to be shared between several regional markets. As a result projects developing deep-water fields in remote areas generally account for high mobilisation cost to bring appropriate installation spread in the region. Also there are increasing number of subsea fields with shorter flowlines (less than 20km) making the use of towed pipelines more attractive. Other positive issues include: the recent developments in engineering software and design codes allows better evaluation of pipe behavior and fatigue damage evaluation; recent deepwater operations allow to reduce and manage the risks successfully and effectively, and high performance DP tugs are available world wide. Therefore the deep water and ultra deep water market and associated constrains and recent technology development provide the motivation to revisit towing installation techniques which have a high local content as an alternative to more conventional installation techniques.

The development of the Girassol field (bundled riser and production flowlines) /1/ has proved that towing techniques were still technically and commercially competitive compared to conventional surface transportation and installation spread even in a deep water environment. The successful installation of the Hyperflow Riser Towers and production bundles at the Girassol field, combined with the results of experimental data from the early sixties, motivated the Acergy engineering team to further improve the knowledge of the tow method and propose innovative and competitive alternatives to existing methods. Acergy developed a new surface towing technique (patent pending), which uses a wave configuration and allows a better and more flexible control of the line during the tow. The fabrication and overall aspects are addressed and compared with other pipe laying techniques.

Surface tow through an experimental approach.

The behavior of the pipe when floating on surface of an ocean is difficult to model accurately without the assistance of sophisticated software operated from high performance computer. Those softwares did not exist in the sixties when the first surface towing operations were considered for pipeline installation. At the time engineers had to perform trials to

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