Development of a New Installation System for Deepwater Riser and Subsea Structure

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ABSTRACT

During the riser installation operation of S-lay vessels, such problems exist: tension conversion problem, complicated underwater operations, requiring a number of auxiliary vessels and so on. In order to solve these problems, taking S-lay vessel: Hai Yang Shi You 201(HYSY201) as target vessel and Liwan 3-1(LW 3-1) as target project, a new installation system is developed. It is used for the installation of deepwater riser and subsea structure. This paper presents the design considerations and analysis methods of the new installation system. The ultimate strength analysis is performed and the results show that this system meets design requirements. Corresponding experimental verification is accomplished and results show the feasibility of the application.

KEY WORDS: Riser installation; Subsea structures installation; SCR; S-lay

INTRODUCTION

The South China Sea is rich in oil and gas resources. In order to meet development requirements of oil and gas resources, China built its first 3,000 meters water depth S-lay pipelay vessel: HYSY201. With the continuous progress of the South China Sea deepwater oil and gas field development, more and more problems appear, including how to realize the S-lay pipelay vessel for riser and subsea structures installation.

The installation of risers and subsea structures is a complicated but essential operation in the development of deepwater oil and gas field. The vertical operation during J-lay is more suitable for deepwater installation, compared with the level operation during S-lay. It was originally planned to install J-lay tower on HYSY201 in the basic design, but ultimately did not come to integrate that. For the sake of economic/fast/effective installation of riser and subsea structures, HYSY201 needs to be partially modified and add some ancillary equipment. So a new installation system is developed.

This system is suitable for 1500m ~ 3000m depth of SCR installation or some subsea structures installation. It realizes directly riser lifting or subsea structures installing after completing pipeline laying, without the help of other large vessels. It avoids the mobilization and demobilization of large ships, and reduces the use of auxiliary vessels. And it also provides an important early knowledge accumulation for the future pipeline maintenance, and the integration of J-lay and so on.

DEEPWATER RISER AND INSTALLATION PROCESS

Deepwater riser

A riser system is used to connect the upper floating/platform and subsea facilities. Based on the configurations, the riser can be separated into steel catenary riser (SCR), top tensioned riser (TTR), flexible riser and hybrid riser (a mixture of flexible riser and rigid riser).

The main advantage of the SCR is that steel pipe costs significantly less than flexible pipe, and is “flexible” in a long length. Flexibility of SCR increases with the increase of the depth of the water. It can adapt to the motion of platform, and suitable for high temperature and high pressure working environment. But the cost of manufacture and installation is greatly reduced than flexible riser(Antani, 2008).

It is generally believed that the choice of SCR will be very economic in deepwater. In fact, the SCR application depth has more than 3000 meters. This paper mainly focuses on the SCR.

SCR installation

Various installation methods including J-lay, S-lay and Reel-lay have been applied for SCR installation (Weustink. 2003). However, the majority currently prefers J-lay process. And generally should be avoided to additional vessel mobilization costs as far as possible.

THE DEVELOPMENT OF NEW INSTALLATION SYSTEM

Design basis

The target ship "HYSY201", as shown in Fig 1, is the first one in China at the same time with the 3000 meters deepwater pipeline laying ability, 4000T heavy lifting capacity and DP3 full electric propulsion dynamic positioning, and has self-navigation ability of deepwater S-lay crane work ship. The main parameters of "HYSY201" are shown in Table1.