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Recovery and Re-Hookup of Liu Hua 11-1 FPSO Mooring System

Alan Wang, Rong Pingsheng, and Zhu Shaohua, Offshore Oil Engineering Co. Ltd.

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Abstract

The internal turret mooring system of the FPSO Nanhai Shengli was damaged by the 100-year return period Typhoon Chanchu in the mid May of 2006. Lack of qualified multi-purpose installation vessel and the harsh environment in South China Sea present challenging combinations for recovery and re-hookup of the FPSO mooring system.

The mooring system of dual toroidal swivel internal turret consists of ten composite mooring legs. The Typhoon damaged all the ten mooring legs where four of ten legs remained to be connected whilst other six legs, as well as all the three flexible risers, completely broke away from the FPSO mooring turret.

The DP2 multi-purpose vessel HYSY709 was selected and upgraded with stern A-frame and mooring recovery winch. Due to various scenarios of damaged moorings, different recovery methods were developed for the mooring components including six buoys floating at the surface, three buoys submerged approximately 20m below the surface, and one mooring leg fully descended to the seabed. The realignment of four mooring legs was required since their position and orientation of DIP chains and ground wires were misaligned due to damaged mooring system.

Prior to re-hookup of the FPSO, the mooring components were reconnected with replacement of new upper and riser wires, as well as improved tri-plates, and then redeployed in a specified pre-laid condition equipped with a locating buoy and ROV friendly recovery slings. Re-hookup of the FPSO shall be conducted in a pre-determined order of the mooring connection with correct identification of each mooring leg.

The purpose of this paper is to present the successful recovery and re-hookup methodology of the LH11-1 FPSO from the unique perspectives: recovery, realignment, reconnection, replacement and redeployment of the mooring leg system, as well as the re-hookup of the FPSO. The details of the operation procedures are outlined herein to enable the FPSO to be re-instated to operation with safe practice and to ensure the subsequent upgrading of the riser system as necessary to provide for additional 15 years operation lifetime.

Introduction

The FPSO “Nanhai Shengli” is moored at the Liu Hua oilfield, Block 11-1, the largest offshore oil deposit in the South China Sea, located approximately 130 miles southeast of Hong Kong in water depth of 300m. The offshore production system developed by Amoco and CNOOC in 1995 consists of three major components, including a Floating Production, Storage and Offloading (FPSO) system for processing and storing the crude oil, a Floating Production System (FPS) for drilling and producing well support, an innovative subsea manifold system using electric submersible pumps to service 25 horizontal wells. There are two 13.5” production flowlines and one 6” test flowline connecting the FPSO and FPS facilities. Fig. 1 illustrates the computer-generated schematic general field layout of the LH11-1 FPSO and FPS while Fig. 2 shows the marine spread layout during the LH11-1 FPSO re-hookup upon recovery and redeployment of the damaged mooring system.

A semi-submersible drilling vessel purchased in September 1993 and converted into the FPS “Nanhai Tiaozhan” was moved onto location in June 1995 while a 140,000DWT crude tanker purchased in October 1993 and converted into the FPSO was moored at the location in March 1996, which are approximately 3km apart. The FPSO is a modified crude oil carrying tanker of 280m overall length, 44m moulded breadth, 23m moulded depth and 17m design draft, which processes crude oil, stores processed oil, flares associated gas and processes produced water. The FPSO supports the processing equipment necessary to