Parametric Sensitivity Studies for Floatover Installation Analyses of Liwan 3-1 Mega Topsides with a T-Shaped Launch Barge

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ABSTRACT
This paper details the rational floatover analysis method and its application in the successful floatover installation of the LW3-1 CPP Topsides. The main purpose of the floatover analyses is to determine the design loads and operability for each stage during docking, mating, and undocking operations. The findings of the parametric sensitivity studies ensure the integrity of the mega topsides and the preinstalled jacket, as well as the T-shaped barge, and therefore enable the challenging floatover installation as rapidly as possible coincident with safe practice in the deep water and harsh environment of South China Sea.

KEY WORDS: Numerical simulations; T-shaped barge; floatover installation; mega topsides, sensitivity study.

NOMENCLATURE
CPP = Central Processing Platform
COOEC = Offshore Oil Engineering Co., Ltd.
DSF = Deck Support Frame
DSU = Deck Support Unit
HYSY = Hai Yang Shi You
LMU = Leg Mating Unit
LW3-1 = Liwan 3-1
Te = Tonne, or Metric Ton

INTRODUCTION
The world’s second largest T-shaped barge HYSY229 was successfully employed by using a conventional high-deck scheme to floatover install the mega integrated topsides onto the preinstalled jacket standing at a water depth of 190 meters for the Liwan 3-1 Central Processing Platform in South China Sea. A rational analysis approach has been developed to simulate the three typical floatover stages including docking and undocking operations at two different entry and exit positions, as well as the continuous mating process. Parametric sensitivity studies have been performed on the effects of fender gaps, fender frictions, jacket leg stiffness, etc., thus ensuring the success of the challenging floatover installation of the LW3-1 mega topsides. Fig. 1 shows the portside-bow view of the T-Shaped floatover barge HYSY229 loaded with the LW3-1 CPP Topsides just before mating.

Fig. 1: Portside-Bow View of T-Shaped Floatover Barge HYSY229 Loaded with LW3-1 CPP Topsides Just Before Mating

This paper presents the rational approach developed for the time-domain simulations of the challenging floatover installation to analyze rubber material nonlinearity, fender geometric nonlinearity, and complex contact mechanics of docking, mating, undocking operations, as well as hydrodynamic effects of the T-shaped floatover barge. The SESAM family software SIMO is used for the time-domain nonlinear simulations to extract the impact loads and motion time series for the selected design sea states. Many various coupling elements have been used to simulate the nonlinear contact mechanics, including 16 coupling elements for 4 different sway fenders and jacket entry guides, 2 coupling elements for surge fenders, 8 coupling elements for 5 different types of leg mating units (LMUs), and 10 coupling elements for 5 different types of deck support units (DSUs). Another software model WADAM is used to analyze wave hydrodynamics for calculating the first-order motions, wave drift forces, as well as hydrodynamic characteristics of the T-shaped barge, thus generating...