Overcoming Challenges to Deliver West Africa’s First DP Floatover Topsides Installation

Dong Lin,*, Ding Zhang¹, Chungun Cho¹, Andy Wang¹, Alex Ruskin², Xiaohong Qiu³
¹. Oil & Gas Technology Centre, DNV GL, Singapore; ². DNV GL, Perth, Australia; ³. COSCO Shipping Co., Ltd, Guangzhou, China; * Correspondence Author

ABSTRACT

This paper outlines the methodology taken for the Meren Gas Gathering Compression Platform (GGCP) dynamic positioning (DP) assisted float-over. The feasibility assessment, DP time domain analysis, swell model used for DP float-over analysis and operational aspects for motion optimization have been outlined to demonstrate the innovative concept leading to the first safe and reliable DP float-over installation in West Africa. In addition, recommendations for further improvements on the present DP float-over state-of-the-art are made to account for the challenging environmental conditions of West Africa or other areas with swell-dominated seas.

KEY WORDS: Float-over; floatover; dynamic positioning; West Africa; swells; hydraulic jacks

NOMENCLATURE

COSCO = COSCO Shipping Co. Ltd.
DP = Dynamic Positioning
DSF = Deck Support Frame
DSU = Deck Support Unit
LMU = Leg Mating Unit
GGCP = Gas Gathering Compression Platform

INTRODUCTION

Over the past 15 years, about twelve DP float-over topsides installations have been executed in various offshore locations in the world including the Middle East, Southeast Asia and South China Sea. The principal advantage of using DP is that less marine spread is needed, meaning a shorter required weather window and hence higher workability. As a result, DP floatovers can be more cost effective than a moored methodology, which is often the driving decision-making factor.

Prior to the installation of the Meren Gas Gathering Compression Platform (GGCP) topsides (approximately 7, 400MT) in the Meren and Sonam fields offshore Nigeria in December 2014, no attempt had been made at performing a DP-assisted float-over in West Africa. Conversely, there have been several successful moored float-overs in the West African region. This can be linked primarily to challenging operational environments, with prevailing long-period swells that may cause significant motion. COSCO’s Tai An Kou, a 20,000 MT DP heavy lift vessel was used for the GGCP topsides floatover installation. Technical and operational considerations and design optimizations were tailored to cope with the station-keeping and motion challenges posed by the West African environment.

This paper presents an overview of the methodology that was applied for the GGCP topsides DP-assisted float-over installation. The engineering methodology is presented, both for typical float-over elements and for the specific jacking system applied to achieve rapid load transfer of the topside weight to the jacket. In addition, the optimization methodology and results for more efficient and reliable workability assessment, DP capacity analysis and swell model analyses is presented. Finally, design choices surrounding equipment layouts for a safer mating operation are discussed, including an overview of the float-over operation key stages, and items that were included to cope with a swell-dominated environment.

ENGINEERING OPTIMIZATION

Traditionally, engineering design for a floatover installation includes:

- Floatover vessel/barge evaluation and selection;
- Workability study;
- Load transfer system design (ballasting analysis);
- Positioning capacity analysis (mooring system or DP capacity);
- Hydrodynamic analysis (motion and mating analysis);
- Structural design (for load bearing elements – typically grillages, deck/load-out support frame (DSF/LSF) and sea-fastening, etc.);
- Equipment design (installation aids/guides, leg mating units (LMU), deck support units (DSU), fender system, tether lines);
- Motion, position and environmental measurement systems.

Further considerations were applied for the DP floatover in West Africa, as follows:

- Use of a hydraulic jack system to achieve rapid load transfer;
- Performing a waiting time probability analysis based on workability;
- Time domain DP capacity analysis (instead of quasi-static);
- Selection of a realistic swell model