DP FPSO – A Fully Dynamically Positioned FPSO for Ultra Deep Waters

Joaquin Lopez-Cortijo
IZAR FENE, Ferrol, Spain.
Arun S. Duggal
FMC SOFEC Floating Systems, Houston, USA
Radboud R.T. van Dijk
Maritime Research Institute Netherlands, Wageningen, Netherlands
Sergio Matos
Det Norske Veritas Inc., Houston, USA.

ABSTRACT

In the coming years, there will be a growing demand for Floating Production and Storage Units (FPSOs) for ultra deep waters (greater than 2,000 meters) worldwide. One of the issues in the design of FPSOs for these water depths will be the selection of the most cost-efficient station keeping system for the specified operational requirements. Standard solutions based on internal turret mooring systems are already being offered by the industry. However, beyond certain water depths, the technical and economical constraints associated with the use of mooring systems may favor other concepts potentially more attractive and cost-efficient, such as a fully dynamically positioned FPSO. This paper presents the preliminary results from a design study being undertaken by the authors and their respective organizations to develop such a system. The paper provides a description of the FPSO hull and station keeping system and the disconnectable turret-riser system developed specifically for this application. Finally the paper compares results obtained from a comprehensive large-scale model test program of the system with numerical simulations.

KEY WORDS: FPSO; Dynamic Positioning; Ultra Deep Water; Model Tests; Global Analysis

INTRODUCTION

There is a growing demand for cost-effective and reliable floating production system concepts for ultra-deep water depths (greater than 2,000 meters). Floating, Production, Storage and Offloading (FPSO) systems are a mature floating production technology that is readily adaptable to deep water and is one of the floating production system of choice offshore Brazil and West Africa. Though there are currently no FPSOs in the deepwater Gulf of Mexico (GOM), the technical and economical limitations inherent to other type of concepts, the lack of pipeline infrastructure in ultra deep water, and the wide acceptance of the FPSO concept by Shelf Authorities should result in these systems being considered to be deployed in the near future.

One of the critical issues in the design of FPSOs for ultra deep waters is the design of the most cost-efficient station keeping system for the specified operational requirements. The capital cost of the station-keeping system including its installation can increase dramatically with an increase in water depth. In addition, seafloor congestion, poor geotechnical conditions, or short field life may result in the traditional mooring system not being an optimum solution. Thus beyond certain water depths and for certain other conditions and applications, the technical and economical constraints associated with mooring systems may favor other concepts more attractive and cost-efficient, such as a fully dynamically positioned FPSO (DP FPSO). This concept combines state-of-the-art FPSO technology and latest generation drill ship technology for dynamic positioning and operation in ultra deep waters. This system can either be utilized as an early production system or as a full-fledged field development solution. The areas most suited for this application are the Gulf of Mexico, Brazil, West Africa and Eastern Canada.

An early comprehensive study of dynamic positioning of large ships in ultra deepwater was conducted for a large ocean mining vessel in 6,000 meters of water (Brink and Chung, 1981). The development of the DP FPSO builds from this and the experience obtained with the BP Seillian FPSO, and the latest generation of dynamically positioned drillships specifically designed for water depths up to 3,000 meters. The BP Seillian operated in the North Sea for 8 years as a dynamically positioned production platform and was recently re-deployed in deep water offshore Brazil as an early production system for the Roncador field in 1,853 meter water depth. In Brazil the Seillian has remained on station while offloading to standard and DP shuttle tankers without incident (Henriques, 2000; and Gardner, 1999). The latest generation deepwater drillships have been in operation almost 5 years in many deepwater regions worldwide and are designed to remain on station in seastates up to the 10-Year hurricane environment in the Gulf of Mexico. In addition many thruster-assisted turret-moored FPSOs are in operation in the North Sea and have been studied for the Gulf of Mexico (Wichers and van Dijk, 1999).

The paper describes a joint study undertaken by the various companies represented by the authors to develop a design for a fully dynamically positioned FPSO for ultra deep waters. The paper will address the technical issues associated with such a system by presenting the preliminary results from a rigorous engineering analysis, and the design effort undertaken by the partners for a DP FPSO on a hypothetical deepwater field in the Gulf of Mexico. The paper will focus on the...