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K2 Topsides Facilities—Design Challenges

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Abstract

Overall, the tieback of the K2 Field to the Marco Polo TLP was a success, albeit not without some significant challenges. Some of the challenges include Simultaneous Operations (SIMOPS), minimizing production downtime from existing wells, and Personnel Onboard (POB) limitations imposed by the ABS/USCG.

The two biggest design challenges associated with the K2 Topsides Facilities were associated with space/weight considerations and the high inlet temperature of the incoming K2 production streams. Most hub type TLP's have unique design requirements that are generally established and implemented well before the details of a specific tie-back are known. The Marco Polo TLP initial design criteria did not anticipate some of the unique requirements associated with the K2 production. The Marco Polo TLP is a Modec International "Moses" mini type structure designed to receive and process 120,000 BOPD, 50,000 BWPD, and 300 MMSCFD. The design of the facility anticipated that several tie-backs would be utilized to achieve these maximum production rates. Space as well as weight was allocated in the initial TLP design to accommodate these additional production facilities. However, since no detail design information for future tiebacks was available, the allocated platform space was based on engineering judgment and industry practice. The future space reserved on the cellar deck resulted in very limited space to accommodate the K2 facilities. In addition, the initial facilities design did not anticipate that incoming crude production streams with temperatures on the order of 180° F would be processed. This paper addresses these design issues and the solutions implemented to rectify them. Also, several other design issues such as pigging pump criteria and high pressure mechanical design issues are reviewed.

In addition to the design issues noted above, the K2 production facilities had to be installed on an operating platform. This necessitated detailed construction planning consistent with the ongoing Marco Polo production operations. SIMOPS (Simultaneous Operations) and the related safety issues were major factors in conducting all of the offshore construction activities

Introduction

The K2 development, operated by Eni Petroleum on behalf of its partners Anadarko, Conoco Phillips and Chevron, selected the Marco Polo TLP as its host processing platform in deference to building a stand alone facility.

The Marco Polo TLP was designed to be a hub type facility to support the Marco Polo dry tree production as well as other potential tie backs in the Green Canyon Area of the Gulf of Mexico. It is a "Moses" type TLP designed by Modec International LLC. The structure was installed in January, 2004 with first oil production from the dry tree Marco Polo wells in July 2004. The TLP is owned by Deepwater Gateway, LLC (50/50 joint venture between Enterprise Field Services, LLC and Cal Dive International, Inc.), and is operated by Anadarko Petroleum who owns the GC-608 Lease (Marco Polo Field).

From a Steel Cantenary Riser (SCR) standpoint, the TLP was configured to accommodate six sets of dual subsea pipelines from potential tiebacks in the area. In addition, space and weight were allocated in the original design to accommodate additional production facilities for the subsea tiebacks.

An agreement to tieback the K2 production to the Marco Polo TLP was reached with Enterprise Field Services in late 2003. This agreement was reached essentially at the same time as Anadarko's agreement to tieback the GC-518 Field (also referred to as K2 North) and was also consummated with Enterprise Field Services.

Marco Polo and K2 Detail Design Basis

Tables 1 and 2 below outline the detail design basis for the Marco Polo TLP and the K2 production system. The design basis for the GC-518 Facilities is very similar to the K2 basis from a flow, subsea pipeline arrangement and physical properties basis.