A Novel Design of Retrofit Hang-off Structure for Steel Catenary Risers

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ABSTRACT

A novel design of retrofit hang-off structure that was used to tie-back Steel Catenary Risers (SCRs) to a jacket platform is presented. The structure includes baskets, tubular support members, hang-off clamp and stop clamp. The structure possesses two novel features: dual clamp redundancy and tubular members to support baskets. Though the clamp is designed as a friction clamp to withstand all operational and extreme loading from the SCRs, a Stop Clamp is provided below it for dual redundancy in case an unlikely loss of friction occurred at the SCR Clamp. The Stop Clamp is supported by the jacket bracing members through saddle supports. The Stop Clamp is designed to assist in the proper orientation of the SCR clamp during installation. Different from the conventional I-shaped bracing members, tubular bracing members are used to support the baskets. This approach reduces the welding requirements and steel material usage significantly.

A variety of analyses were performed to ensure that the design of the structure is adequate to perform the targeted service.

KEY WORDS: Fixed platform; Retrofit clamp; Stop clamp; Hang-off receptacle; Steel Catenary Riser; Dual redundancy; Tubular supporting members.

INTRODUCTION

It is not unusual that existing hang-off structures such as I/J-tubes on offshore platforms are all occupied by risers. This poses a setback when the host is being considered for future riser tie-backs. In such instances, retrofit hang-off structures such as the SCR Clamp described in this paper can be used to accommodate the future risers.

The field in the current study consisted of a gas well with the subsea tree located 6 miles south-east of the platform. The well was expected to produce a maximum of 40 Million Standard Cubic Feet per Day (MMSCFD) of gas with an initial completion shut-in tubing pressure of approximately 8260 psi (570 bars) and an arrival temperature at the platform of 50 °F (10 °C). Minimal amounts of condensates and water were expected initially. Flowline size was 6-inch nominal. A 6-inch riser and 3-inch umbilical were designed to complete the tie-back of the well. The only available J-tube on the platform was to be used for the 3-inch umbilical. Due to the unavailability of additional I/J-tubes and/or hang-off porches, a retrofit hang-off structure had to be designed to support the 6-inch riser. In addition, it was decided that provisions were required on the hang-off structure for two future 10-inch risers. The 6-inch riser was divided in two main sections. The upper section was in the form of a number of pipe spools bolted together using flanges. The lower section was supported by the SCR Clamp at EL. (-) 323 ft (98.5 m) (elevations are defined relative to the MWL positive upward). The upper pipe spools were supported by a number of smaller friction clamps fastened to the jacket at various elevations. Since the SCR Clamp had the highest self-weight and supported the operational and extreme loads induced by the SCRs, this paper focuses on the SCR Clamp. The SCR Clamp and all Jacket Clamps were successfully designed and installed on the platform, and are currently in service.

SCR CLAMP DESIGN

General Arrangement

At an elevation of (-) 323 ft (98.5 m), the north-western jacket leg has an outer diameter of 102-inch (2.6 m) and was determined to have the required strength to withstand the loads imparted by the risers. A 102-inch SCR Clamp was designed for this elevation to safely transfer the SCR loads to the jacket structure. The clamp was designed to be able to transfer all the expected riser loads as a standalone friction clamp. In order to satisfy the dual redundancy requirement by the client, a 102-inch Stop Clamp was designed to provide support to the SCR Clamp in case an unlikely loss of friction occurred at the SCR Clamp.

The 102-inch Stop Clamp was comprised of two semi-cylindrical shells connected through a hinged joint. Two rows of 8 pre-tensioned 1.25-inch stud bolts were used to provide the required clamping force. Two alignment keys, provided on top of the Stop Clamp were designed to mate with alignment slots provided on the SCR Clamp in order to prevent in-service rotation of the SCR Clamp under unlikely loss of friction.