Technical Consideration for Pipe Unit Support of FPSO in the Harsh Environmental Conditions

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ABSTRACT

In general, pipe lines are arranged quite complicatedly on the cargo deck in FPSO (Floating Production Storage Offloading unit), and the arrangement should be made in the limited space to avoid any clash with structural members and other outfitting members, such as MSS (Module Support Stool), cable rack supports, pipe rack supports, crane pedestal and outfitting supports. Moreover, FPSO is occasionally installed in the harsh environmental condition. Considering these conditions, pipe unit supports, which support the pipe lines, should be designed to have sufficient strength.

However, these conditions, limited space for the arrangement and harsh environmental loading condition, cause serious matters; (1) Ongoing design changes due to difficulties to settle the pipe line arrangement on the cargo deck, (2) Difficulties to determine the pipe unit support design concept with sufficient strength at the early stage against the severe loading condition.

With regard to the matter, the background of the study is introduced firstly. Next, the harsh environmental loading condition is presented. The referred metocean data is based on the FPSO project ordered by INPEX Browse, LTD. The maximum design requirement of the environment loads is corresponding to 10,000 years return period wave. Finally, strength evaluation on the pipe unit support is carried out for the following loading conditions that dominantly affect the structural responses: hull girder bending moment, wind, inertia, pipe reaction load and green water.

With this study, it would help structure engineers to have better understanding and set the strong design of pipe unit supports at the early design stage. Also, it could save much man-hour to the support design by frequent design changes from the pipe lines arrangement.

KEY WORDS: Pipe arrangement changes; harsh environment; hull girder bending moment; inertia; wind; green water; 10,000 years return period.

INTRODUCTION

Pipe unit supports are laid on the cargo deck, and both pipe unit supports and the reinforcement members should have sufficient strength. In the study, it focuses on the technical considerations of pipe unit supports in the harsh environmental condition.

The background of the study is the strength assessment of pipe unit support of INPEX FPSO project. The evaluation standards are Class rules, CPY (Owner of the project) Specification, and AISC.

The structural model is modeled as two types; (1) 1D beam model by SACS, (2) connection structure by FEM. In order to verify the strength of supporting beam itself, software “SCAS” is used, which can perform the AISC standard code check. However, the connection structures consist of H-beam and brackets, so they are hard to be idealized and evaluated by 1D model, therefore, their strength is verified by FEM as shown in Fig. 1.

During the project design progress, pipe line arrangement had changed by the late stage. Clash with other structures and short time to reflect the proper reinforcement plan were big issues, so, inevitably, there happened that a part of brackets has to be cut or unattached in the construction yard as seen in Fig. 2. Even though the built structures were not in line with the design, the structures should still satisfy the