ANALYSIS ON THE STINGER STRUCTURE RELIABILITY OF S-LAY BARGE IN OPERATIONAL CONDITION

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Abstract
Installation of pipes by way of the s-lay method is very often used for waters to a depth of 300 m. In this pipe installation stinger represents one of the primary components that determine the success of the operation. Therefore reliability analysis on the stinger in the operation is considered important to be performed, as reported in this final year project. A case study on the reliability has been performed on the stinger of a pipe lying barge Ombak Biru Satu, where the operational criteria addresses the capability of installation on the pipes sized 10 inches up to 36 inches at water depth of 50 m in the sea condition having significant wave height of 2.62 m. The first stage of evaluation is directed towards the motion responses of the barge. In this regard computational results show the highest significant motions for the surge mode is 0.44 m at the wave direction of 45°, for the sway mode is 0.87 m at the wave direction of 90°, for the heave mode is 1.38 m at the wave direction of 90°, for the roll mode is 4.4° at the wave direction of 90°, for the pitch mode is 1.6° at the wave direction of 135°, and for the yaw mode is 3.6° at the wave direction of 135°. All these intensities indicate the operation could be carried out safely, when it is viewed from the barge motion facet. The second stage is conducting the computation on the working stress for the stinger structure. In the installation of the 10-inch pipe axial stress is found to be 32.14 N/mm² and the bending stress of 90.33 N/mm², and further the maximum unity check of 0.70. In the case of the 36-inch pipe installation the axial stress is found to be 44.33 N/mm² and the bending stress of 117.10 N/mm², and further the maximum unity check of 0.93. The third stage is dedicated for the reliability analysis of the stinger by evaluating the deflection that would develop. In accordance with the criteria as contained in the API-WSD standard, the allowable maximum deflection is 2.6 cm. In this respect results of the computation for the 10-inch and 36-inch pipe installations give the maximum deflection in the order of, respectively, 1.95 cm and 2.44 cm, in the vertical or z-axis direction. On the basis of this failure mode indicator the Monte Carlo simulation was then carried out to obtain the reliability value of the structure. Simulation yields the reliability as much as 0.9998 for the 10-inch pipe, and therefore could be regarded as satisfactory to the criteria. Whereas in the installation of the 36-inch pipe the reliability is found to be 0.7029. This value of reliability does not met the criteria, and therefore a mitigation should be performed by strengthening and also increasing the thickness of the stinger. The mitigation preserves the improvement of the reliability value to 0.9985, hence the criteria is satisfied.

Keywords: S-lay Barge, Stinger pipelay, Reliability, Monte Carlo Simulation