FATIGUE ANALYSIS DUE TO INFLUENCE VORTEX INDUCED VIBRATION ON RISER OF TENSION LEG PLATFORM

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Abstract

Fatigue analysis due to VIV is performed to derive the level of responses occur on the riser, stress on the riser as well as the riser fatigue life. VIV in a pertinent condition where the vortex shedding frequency resonate to the natural frequency of the structure would significantly affect rapid development of fatigue damage. In this particular analysis the riser data of the West Seno TLP-A operated in Makassar Strait has been used. Analysis is carried out making used of full spectral method and concurrently closed form fatigue equation as well as the software, in three stages. In the first stage the riser is divided into 10 segments, with each length of 91.18 m. In the second stage the riser is divided into 25 segments, with each length of 36.75 m. In the third stage the riser is divided into 50 segments, with each length of 18.38 m. Results of the full spectral analysis shows the VIV occurs at the riser’s natural frequency of 1.42 Hz. The vortex flow develops in the vicinity of the riser is somewhat irregular due to the Reynolds number range of $5.11 \times 10^4$ ~ $9.17 \times 10^4$. The reduced velocity value $V_r$ ranges between 0.14-5.7, this affect the occurrence of in-line and cross-flow responses. In-line responses take place at the values of $1.0 < V_r < 3.7$, whereas cross-flow responses at $3.7 < V_r < 5.7$. The riser amplitudes due to the in-line responses are 0.03 m and 0.07 m, whilst the cross-flow responses are 0.34 m and 0.41 m. An S-N curve of class B1 joint is used. Result of analysis using software show that vortex force is largest at riser A1, hence the fatigue life analysis has been focused on this particular riser. By applying the closed form fatigue equation the fatigue lives of riser A1 is found to be 2531 years, 3656 years and 3673 years, respectively, for segment I, II and III. This fact assure the riser would be safe when operated during the period as defined as the design life of the TLP-A.

Key words: vortex induced vibration, in-line response, cross-flow response, fatigue