Risk Analysis of Subsea Gas Pipelines in the Jakarta Bay due to Soil liquefaction

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Abstract
This thesis discusses the risk of failure analysis of piping systems due to the possibility of soil liquefaction. The piping system owned by PT. Perusahaan Gas Negara (Persero) Tbk (PGN) was selected for analysis. Piping system being simulated is a path gas pipeline transportation of gas flow Maringgai Labuan- Muara Bekasi. Soil liquefaction is a natural phenomenon in which the soil changes their properties due to increasing pore water pressure and reducing shear stress. As a result, the soil will behave like a liquid (liquefy). This phenomenon possibly leads to land subsidence in the area of piping system. Risk analysis was conducted using Monte Carlo methods. This method aims to find the probability of failure (frequency) for the system concerned. The calculation of consequences obtained from the stresses analysis of the system, include: hoop stress, axial stress, longitudinal stress and combined stress. Then the risk matrix can be determined by incorporated the values of event frequency and consequence of occurrence into the matrix. This effort aims to determine the level of hazard.

An analysis has been done, soil liquefaction will not occur in the pipeline that affected minimum peak ground acceleration ($\alpha_{\text{min}}$) = 0.1202g and it with average peak ground acceleration ($\alpha_{\text{avg}}$) = 0.5538g on all variations of earthquake magnitude (Mw). But for pipeline that affected maximum peak ground acceleration ($\alpha_{\text{max}}$) = 0.9983g, soil liquefaction will be occurred in the magnitude 6, 6.5 and 7. At earthquake magnitude 7.5 and 8 on the maximum peak ground acceleration, pipe does not occur soil liquefaction. For the result of this study shows that the risk in the piping system is still in a state acceptable or in a state of ALARP (As Low As Reasonably Practicable).

Key words: Risk Analysis, Soil liquefaction, CRR (Cyclic Resistance Ratio), CSR (Cyclic Stress Ratio), Monte Carlo method.