

An Investigation of Amine Pipe High Vibration Problem, 2009

The high vibration problem of pipe for Train 1 & 2 is investigated.

The flow generates random excitations. Hence, there was no issue of resonance. Subsequently the case is treated as stiffness controlled problem. However, the random excitation helps to reveal the first two modes of vibration. These findings are useful in ascertaining that the FEA model generated is good by comparing the modes between FEA and FRF ODS. Once a good FEA model is achieved, further analyses such as Computational Fluid Dynamics (CFD) and Fluid Structural Interfacing (FSI) are performed. From CFD analysis, the forces due to the velocity pressure are at the 4 bends in X, Y and Z directions. This verified that the vibration problem was due to flow induced vibration. The flow generates total head (pressure) pattern which are input as loading to structure in FSI analysis. FSI analysis gave the static deformation of the pipe. The total deformation shall be the superimposition of static deformation and dynamic deformation obtained from the ODS analysis. Combining all the analyses, it revealed that the pipe is statically weak or classified as stiffness controlled situation.

In modification approach, the forces due to the velocity pressure were at the 4 bends. Since this was a stiffness controlled problem, forces along X- direction generated deflection close to the shape of the 1st bending mode in the X-direction. Similarly, forces along Y-direction generated deflection close to the 1st bending mode in the Y-direction. The final deformation was the combination of the two modes of deflections. Countering these forces at the sources would be a good strategy.

The recommendations proposed are to counter the X and Y deflection which generated by the flow. Introducing 2 additional supports in FEA have managed to reduce at least 80% of vibration level. Although high stress concentration occurred at the new upper support and lower support for all 4 recommendations, but they were still under the Ultimate Tension and Yield Tension limit which are 400MPa and 248MPa.

