Project Title

Predicting wall pressure fluctuation in process piping systems due to high velocity fluid streams.

Background

Gas producing Caribbean territories such as Trinidad and Tobago have numerous processing plants in the upstream and downstream sectors. Process plants may seek to increase the overall production at certain points in time either to meet contractual or domestic demand. This often directly translates to increasing the flow rates in the process piping system. An increase in flowrate results in an increase in flow induced turbulence which may render piping systems susceptible to vibration induced fatigue failure. In many cases the output of a process plant is limited by the vibration experienced by the piping system. Vibration levels are often measured whilst a plant is being ramped up; at the point where it is determined that the levels are approaching excessive the flowrate is not increased further. This approach is plagued with uncertainty and analysts often take to the side of caution by making conservative estimates. The proposed project aims to address this problem and will include analytical, numerical and experimental analysis to accurately model and predict the source of excitation in process piping systems due to increased flow rates. This information can then be harnessed to determine with greater certainty the threshold flowrate a process plant can withstand and also identify the modifications which can be incorporated to achieve the desired production rates.

Problem Statement

The main challenges which several upstream and downstream oil and gas companies face are:

1. Uncertainty as to the maximum flowrates their plant can safely accommodate. This may result in a plant not realizing its full production capability.
2. A lack of understanding of the structural and piping modifications that can be incorporated to increase plant production.

Proposed Solution(s)

The engineering approaches being proposed for project are:

Analytically model the pressure fluctuations and resulting forces caused by turbulence in a complex piping system using computational fluid dynamics.

Experimentally determine the pressure fluctuations at several locations in a generic piping system for different flow regimes.

Compare the results from the analytical model developed with the experimental results for the piping system considered.

Students Needed: Mechanical Engineering MEng