**MECHANICAL ENGINEERING: CASE STUDY**

**ROOT CAUSE ANALYSIS OF FLOW INSTABILITIES IN HEADERS**

This example shows how Computational Fluid Dynamics (CFD) can be used to identify the root cause of flow instabilities in an inlet header. One of the four outlets of the inlet header under consideration was experiencing significant vibrations, which was causing the unit to trip more often. E²G | The Equity Engineering Group, Inc. was asked to identify the root cause of the vibrations and provide recommendations to minimize vibrations and thus the frequency of unit trips. Single and multiphase CFD models were utilized to predict flow abnormalities in different outlets of the header. It was determined that the presence of solid particles larger than a certain size can cause the imbalance in the mass flow rates, which can cause one of the outlets to vibrate more than the others. Particle size adjustments were recommended to balance the flows and avoid instabilities.

**INLET HEADER UNDER CONSIDERATION**

![Diagram of Inlet and Outlet Headers]
CFD MODEL PREDICTING IMBALANCE OF PARTICLE FLOW RATES

Each line in the figure represents a path of a particle.

<table>
<thead>
<tr>
<th>PARTICLE MASS FLOW RATE</th>
<th>PARTICLE DENSITY</th>
<th>PARTICLE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>5% of the liquid phase mass flow rate at the inlet</td>
<td>2.0 Specific Gravity</td>
<td>0.01 inch</td>
</tr>
</tbody>
</table>

CFD MODEL PREDICTS PARTICLE SETTLEMENT OF LARGE PARTICLES

PARTICLE DIAMETER

0.015625 inch

PARTICLE DENSITY

1.2 Specific Gravity

VOLUME FRACTION OF PARTICLES AT THE INLET

0.015625 inch