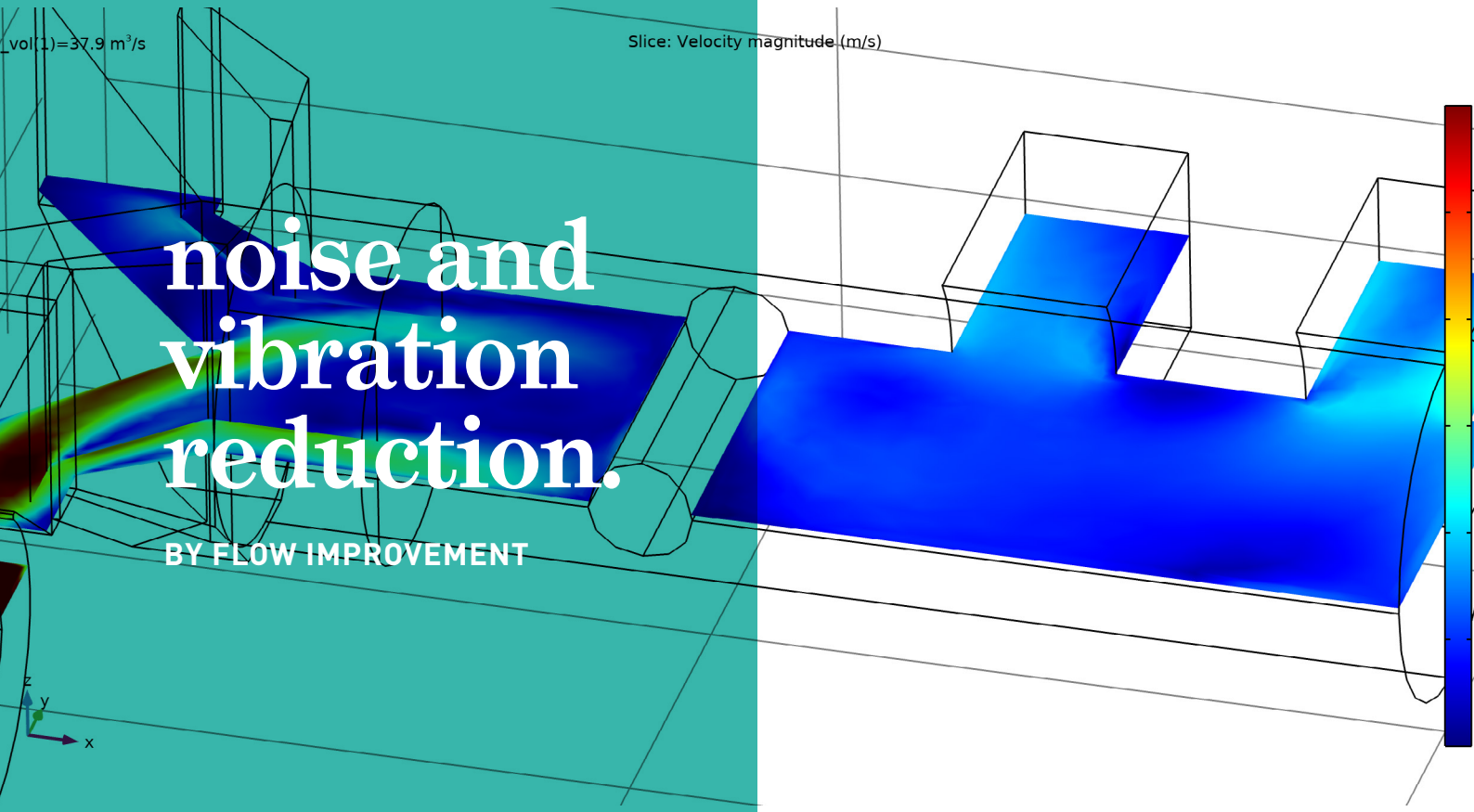

noise and vibration reduction.

BY FLOW IMPROVEMENT

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Goal

Our customer, Tupras Refineries in Turkey, operates several refineries. In one of the installations, strong vibrations occurred on the air ducting between the combustion air fan and the boiler. Demcon multiphysics performed a study with the goal to propose improvements in order to reduce these vibrations.

In the figure on the right, we indicate the areas where intense vibrations occur.

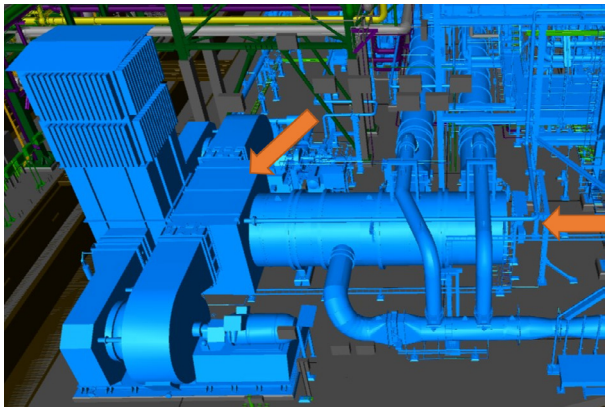

Figure 1 Areas with intense vibrations

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Approach & Results

Based on our experience in noise and vibration control, and our experience with similar types of installations, an initial assessment was made for possible causes of these vibrations. It proved that directly behind the air fans there was a region with poor flow conditions, which is likely to cause the low frequency noise and vibrations. Since this installation should be able to run either on an electric driven fan and on a steam turbine driven fan, a T-junction was used to guide the flow towards the boiler.

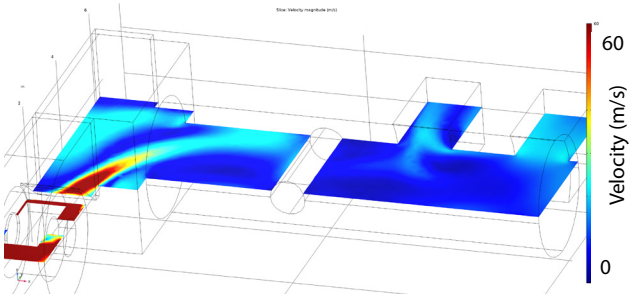
We analyzed the flow as a possible cause of the vibrations by CFD calculations. These calculations showed that in the T-junction and directly behind it, large vortices and turbulence occurs, which is likely the cause of the unwanted vibrations. See the top panels in figure 2 below.

The vortices can be reduced by changing the shape of the T-junction, and by the use of flow guiding vanes in the duct. The effect of such measures on the flow can also be calculated. See the bottom panels in the figure below.

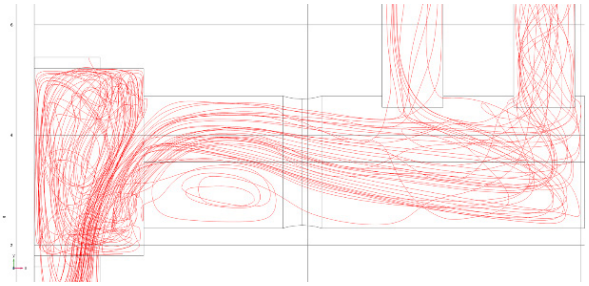
The strategy was to keep the changes as small as possible. This was challenging, since both electric fan operation and steam turbine fan operation should give a good flow result, with a sufficient decrease of vortices and turbulence. Since no quantitative criterion exists for such a flow, this was based on our experience and the proposal was made in cooperation with Tupras.

The analysis resulted in an improved design with which sufficient decrease of vibrations is expected.

Initial design

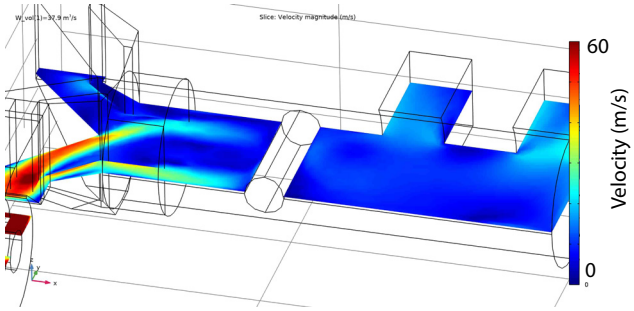


Flow velocities, indicating presence of large vortices

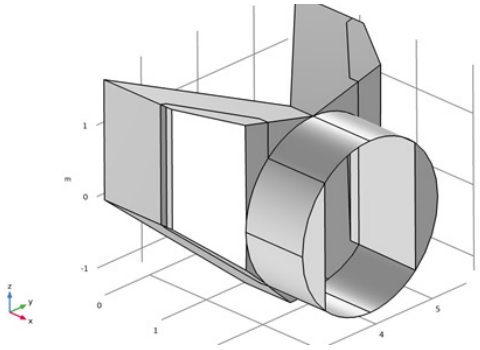


Streamlines showing large vortices (top view)

Proposed design



Flow velocities with proposed design change



Proposed design change to T-junction with adequate flow guidance

Figure 2 CFD analysis and proposed solution