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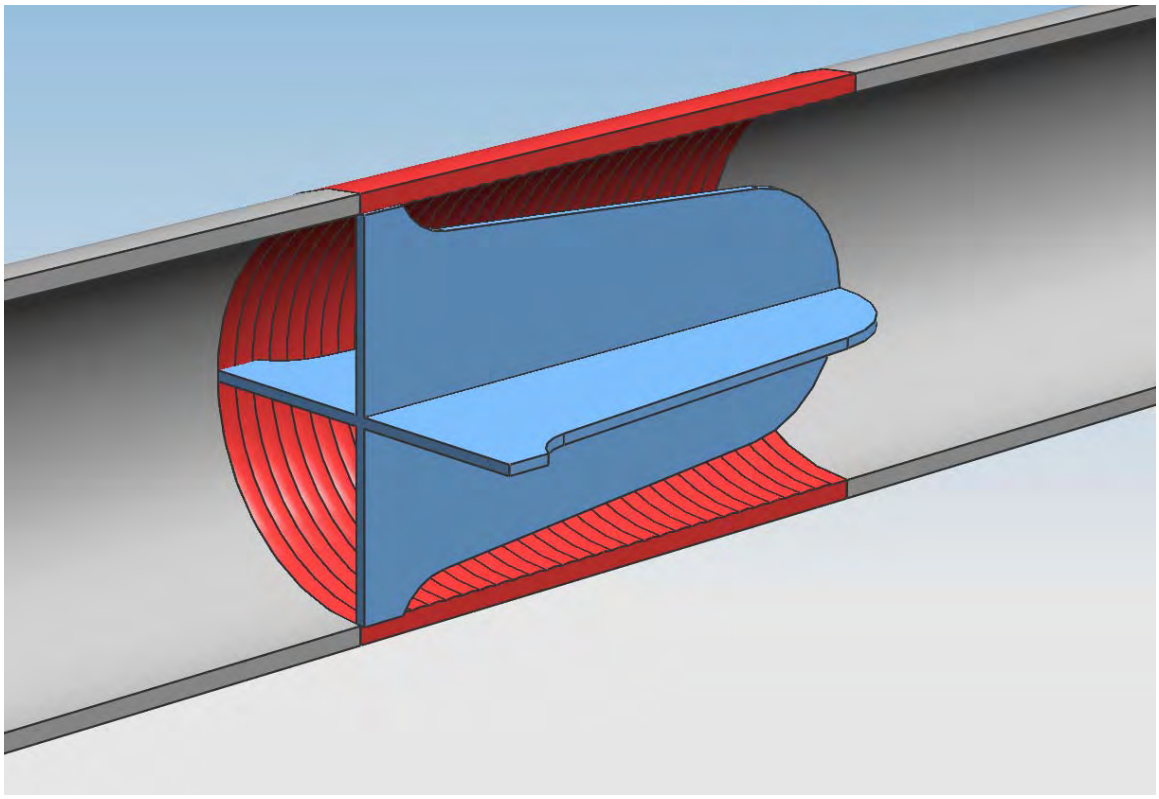

Metraflex VaneFlex Simulation

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Project Summary:

The Metraflex VaneFlex flow conditioner was analyzed to determine its effect in reducing turbulence and straightening flow exiting a pump discharge. The simulation was conducted using CFdesign version 9.0 from Blue Ridge Numerics, Inc.

Project Methodology:

The CFdesign analysis setup is shown below in Figure 1. Additional pipe lengths were modeled upstream and downstream of the device to ensure fully developed flow at the VaneFlex and at the constant pressure outlet.

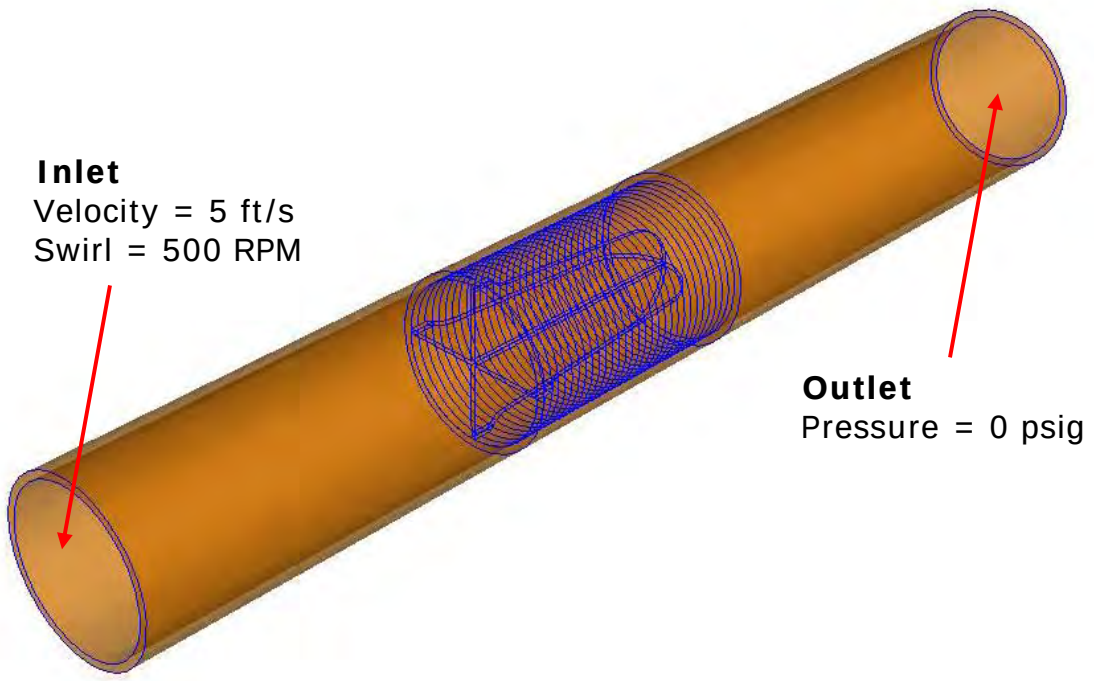

Figure 1. CFdesign analysis setup conditions.

Simulation Assumptions:

Various assumptions were made for the simulation of the elbow and are listed below:

- Steady-state conditions
- Incompressible flow
- Water modeled at standard temperature and pressure
- Constant water properties
- Thermal effects negligible

Results:

The VaneFlex flow conditioner was analyzed to determine its ability to straighten and stabilize an incoming water stream of 5 ft/s, initially swirling at 500 rpm. Figures 2 and 3 below show fluid particle traces as they travel through the VaneFlex. Note the vastly more streamlined flow downstream of the device.

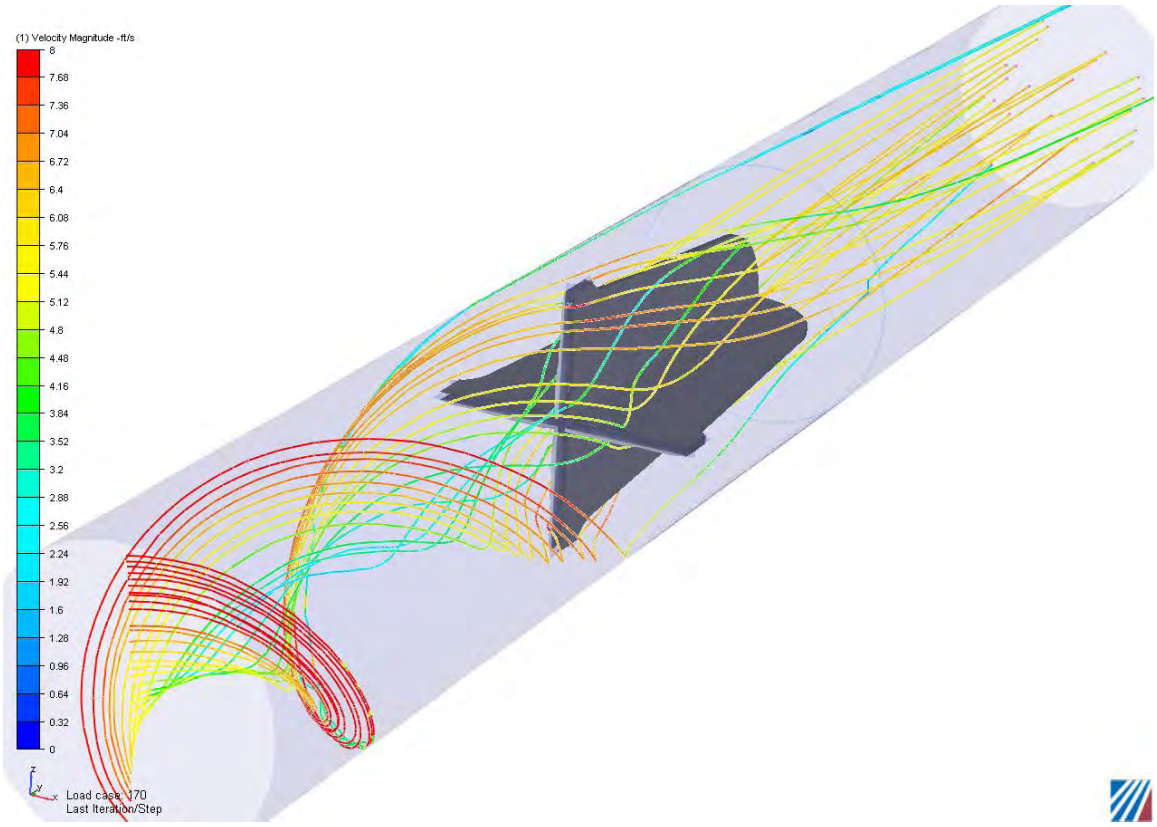

Figure 2. Particle traces released from the upstream inlet. Colors indicate particle velocity magnitude.

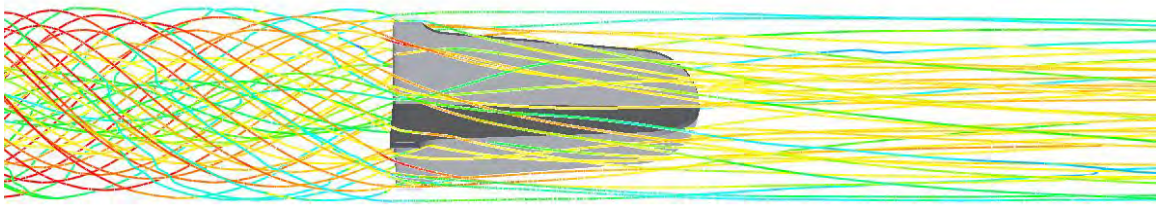

Figure 3. Side-view of incoming fluid particles colored by velocity.

Pressure data collected from the analysis is shown below in Figure 4. A large pressure drop is evident as the fluid enters the device due to flow restriction. As the flow exits the VaneFlex and the cross sectional area increases to its previous upstream value, the pressure rises initially before falling due to pipe losses. The pressure drop across the VaneFlex was found to be approximately 0.05 psig.

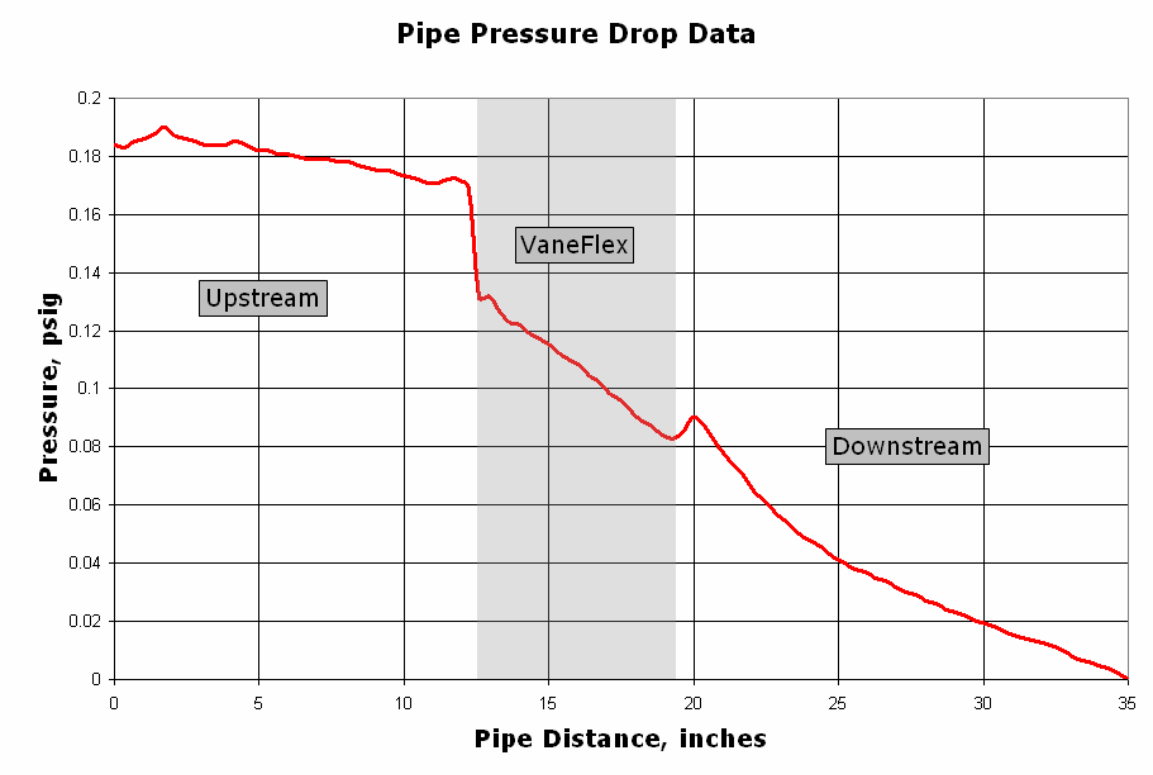

Figure 4. Pressure drop data through the through the VaneFlex device.

The VaneFlex wall corrugation appears to have a much smaller effect than the four conditioning vanes on the overall velocity and pressure profiles. While the corrugation does tend to cause wall flow separation through the device, the change in fluid pressure is much more related to the abrupt change in flow direction caused by the vanes. Figure 5 shows a close-up view of the corrugation and the corresponding wall flow separation.

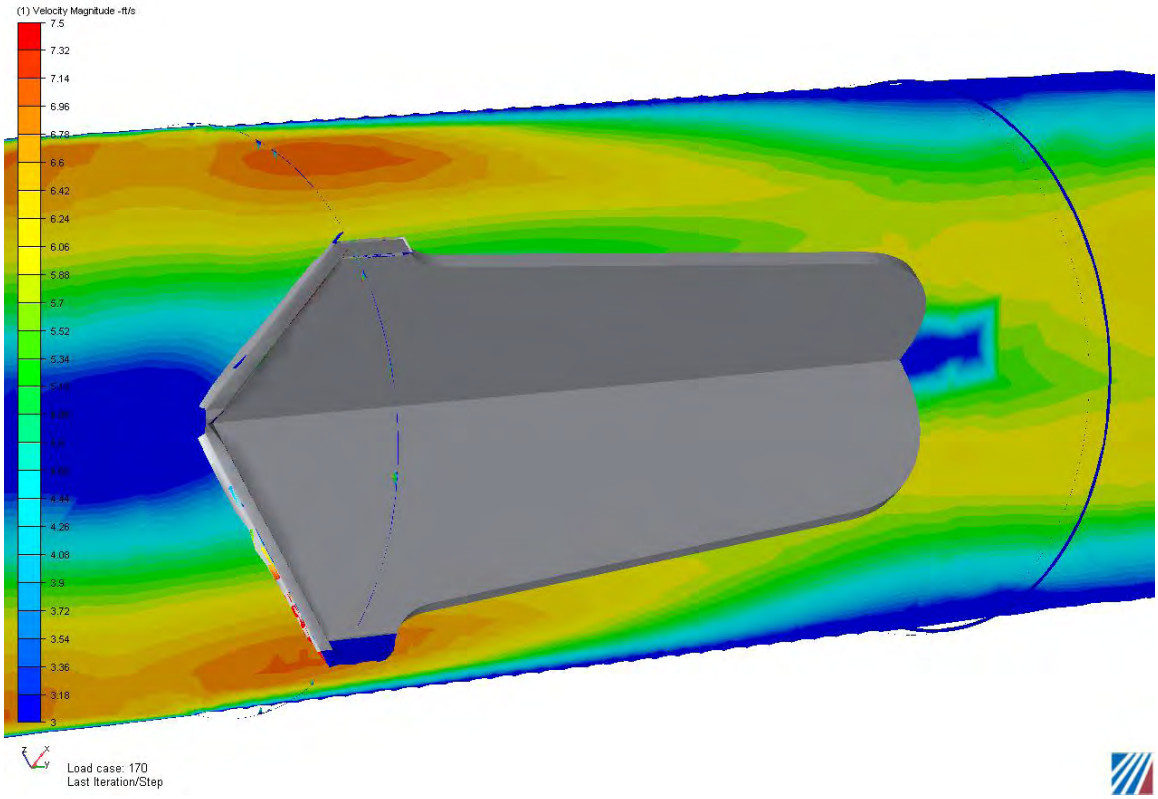

Figure 5. Flow separation caused by the VaneFlex pipe wall corrugation.

Pressure results on the solid surfaces of the device are shown in Figures 6 and 7 below. Each vane exhibits a high and low pressure side due to the incoming fluid swirl.

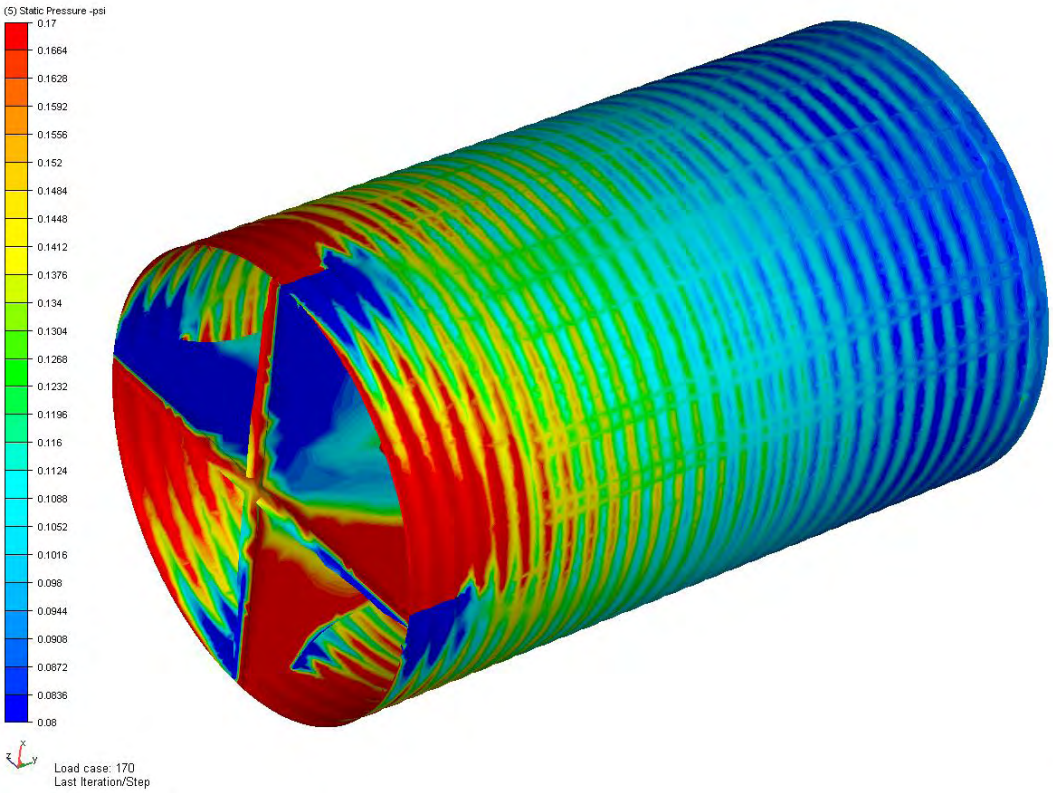

Figure 6. Solid pressure results shown on the VaneFlex.

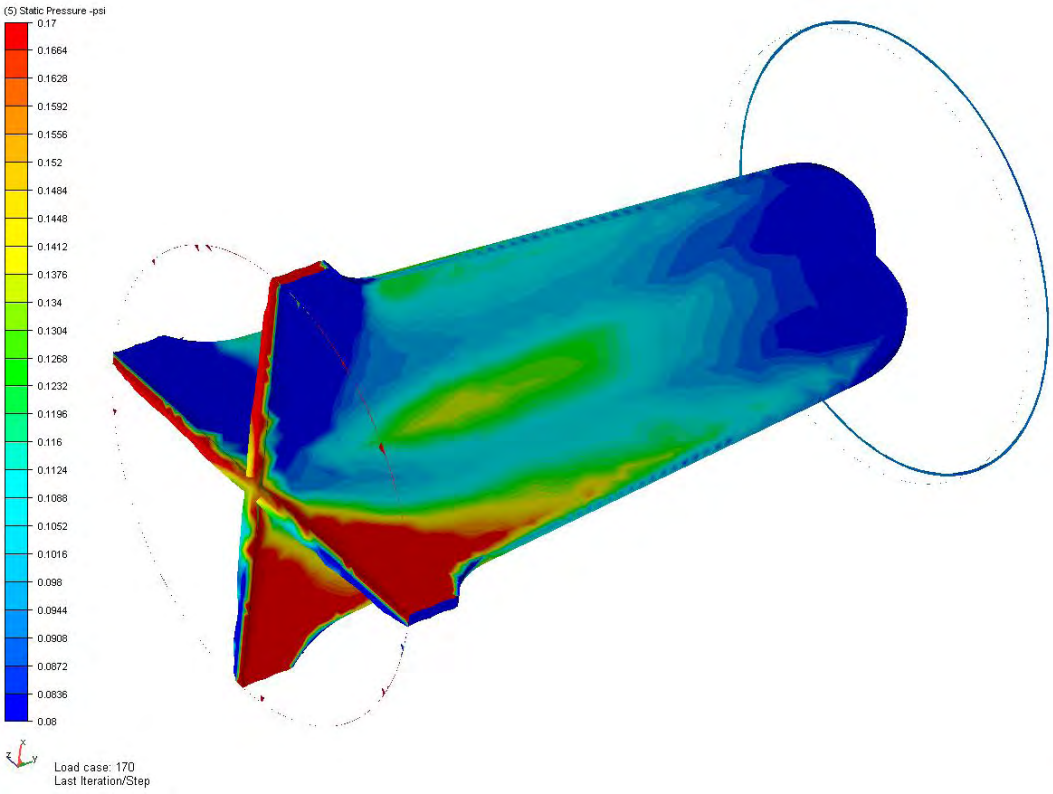

Figure 6. Solid pressure results shown on the VaneFlex. (Corrugation hidden).

Conclusions:

After reviewing the simulation results, it is clear that the VaneFlex device is very effective at stabilizing incoming swirling flow from a pump discharge. At the expense of a slight increase in back-pressure, the device was shown to remove nearly all of the rotational velocity in the incoming fluid stream.