Panametrics
a Baker Hughes business

Application note

Operators' flare operations remain compliant and down-time avoided thanks to Panametrics' Computational Fluid Dynamics

Benefits:

- Easy upgradation process
- No process interruption
- Proven experience in CFD
- Put the flare measurement in ETS regulatory compliance
- Strong local support

Summary

A downstream operator installed a Panametrics GF868 ultrasonic flare gas meter some 25 years ago in a line where the pipework does not provide the 20D upstream and 10D downstream of straight pipe after a single disturbance.

The flare and flare meter were no longer in use, so it did not cause a compliance problem regarding the Environmental Trading Scheme (ETS) mandated for emissions monitoring and reporting.

Challenge

However, the flare in use required maintenance. To avoid down-time, the operator wanted to use the old flare. To do so and remain compliant, one of two solutions were considered:

Fig 1. A 30" horizontal pipe 12 meters (39'+) above ground level

1. Relocate the old meter to a new position in the flare line that complied with the requirements.
2. Carry out Computational Fluid Dynamics modeling of the existing installation and create corrections for the flow profile as measured by the meter.

The first option would be costly and would have consequences for the company in the form of a shutdown to relocate the meter. The second option, although technically challenging, was thought viable and worth exploring further.

Panametrics' technical experts were invited to discuss potential solutions. The customer supplied isometric drawings of the pipework and all the process cases that the meter would be required to measure. A variety of fluid compositions and flow calculations were carried out to ascertain flow velocities and Reynolds numbers for each case.

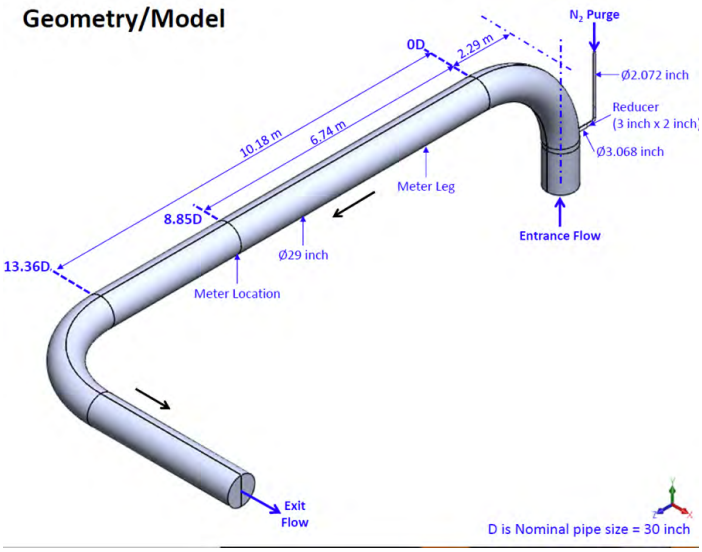

Fig 2. Layout of customer pipework

The solution

Panametrics' CFD team then used this information to model the flow in the above pipe to work out the velocity profile at the point where the meter is installed.

The flow profile is represented in several ways as shown below:

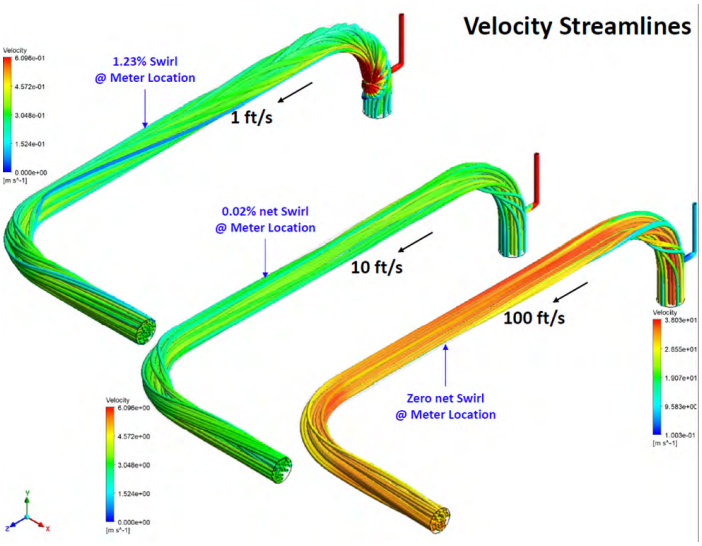

Fig 3. It appears that we are looking at tendons in the figure above but what is shown is the individual paths for small groups of gas molecules. Note the orientation of the lines change with velocity. The color indicates their velocity.

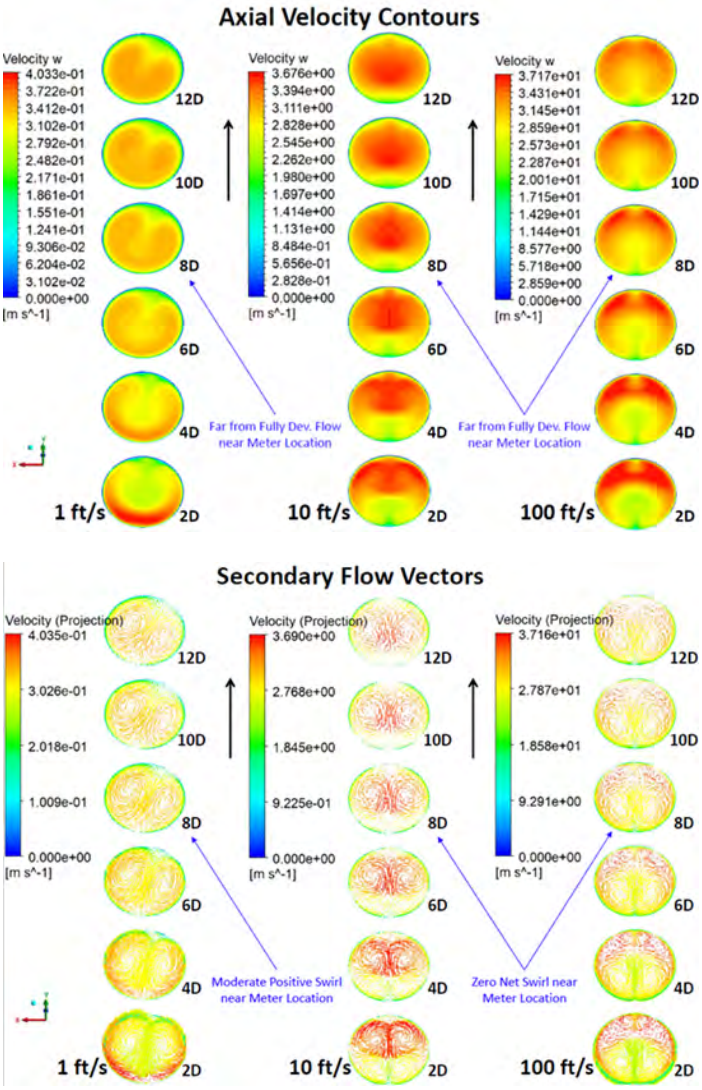

Fig 4 and 5. Axial velocity contours and secondary flow vectors

Although every CFD is unique, Panametrics applies the same approach for each of them. The team uses flow, temperature, pressure, gas composition, and pipe isometric dimensional data to generate the flow profile at various positions down the line. In this specific case, only the performance at 8.85D where the meter is located was required. Generally, distortions fade out traveling further downstream.

The CFD helped understand the flow behavior at different velocities and provided the recommended correction factors for the non-fully developed flow profile under several flowing conditions. In addition, it confirmed the total meter uncertainty stayed within 3% of the measured value under these non-ideal conditions which was perfectly acceptable to the customer.

This 3% uncertainty may seem high in comparison to the typical value to that for a standard 2 path solution. Panametrics would normally claim an accuracy in the range of 1.5% for a non-calibrated application. One of the outcomes of the CFD is the calculation of the additional uncertainty coming from a disturbed flow profile which is both velocity and molar weight dependent. The second outcome is to provide a set of k-factors to be entered into the meter to offset the additional measurement bias from the specific non-ideal flowing conditions.

A Panametrics service engineer implemented these correction factors in the GF868 electronics.

The outcome

The customer was pleased that Panametrics technology enabled the upgrade of its existing flare meter to the latest regulatory requirements, keeping the company compliant with the ETS for monitoring and reporting emissions. This saved significant cost and resource avoiding, for example, the interruption of operations, erecting scaffolding, contracting welders and the burden of complex and lengthy change management processes that would have been required otherwise.

Panametrics, a Baker Hughes business, provides solutions in the toughest applications and environments for moisture, oxygen, liquid and gas flow measurement.

Experts in flare management, Panametrics technology also reduces flare emissions and optimizes performance.

With a reach that extends across the globe, Panametrics' critical measurement solutions and flare emissions management are enabling customers to drive efficiency and achieve carbon reduction targets across critical industries including: Oil & Gas; Energy; Healthcare; Water and Wastewater; Chemical Processing; Food & Beverage and many others.

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