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KNOWLEDGE

Using Coriolis Flowmeters to Improve Performance and Reliability in Compressor Fuel Gas Measurement

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Abstract

The Public Service of New Mexico (PNM) previously used turbine meters to measure gas flow at its Albuquerque four-unit natural gas compressor facility. The turbine meters were costly due to frequent maintenance and repair, and they were inaccurate over the required application range. The company carefully considered its options and found the best choice was to install Micro Motion® Coriolis flowmeters. After installation of the Coriolis flowmeters, the facility saved operational and maintenance costs. Additionally, it was able to accurately calculate emissions rates to improve EPA reporting and could more accurately account and bill for natural gas usage.

Background Information

PNM operates a four-unit natural gas compressor facility outside of Albuquerque, New Mexico. Each of the four compressors had a turbine meter installed on its fuel gas line to account for the amount of fuel consumed by the compressor. An accurate measurement of fuel used by the compressor is necessary for two main reasons:

- Consumed fuel must be accounted for and appropriately billed
- Fuel consumption is directly related to emissions, which are regulated and monitored by the New Mexico Environmental Department and the U.S. Environmental Protection Agency

Problems with Turbine Meters

Even though turbine meters are a common and accepted technology in compressor fuel applications, PNM experienced several disadvantages to using them:

- **Reliability:** Despite regular preventative maintenance on the meters, the meters frequently failed, requiring repair or replacement and causing unexpected compressor downtime leading to substantial financial loss.
- **Accuracy:** The accuracy of turbine meters is acceptable in ideal circumstances, but quickly worsens as circumstances change. They are sensitive to fluctuations in temperature and pressure, and lose accuracy over time as moving parts wear down. They can also be damaged by high flow rates and are susceptible to pulsation errors at resonant frequencies.
- **Application Range:** Compared to other flow meter options, turbine meters have a very limited application range. There was no single turbine meter capable of operating in the facility's full required operating range.
- **Installation Limitations:** Turbine meters must be installed carefully with substantial upstream and downstream runs to avoid measurement error from turbulence or damage to downstream devices, which can be contaminated by lubricants used on the turbines.

Evaluating Alternatives to Turbine Meters

It was clear to PNM that they needed to evaluate alternative flowmeter options to improve the accuracy and reliability of the system. It was an easy decision to eliminate turbine flowmeters because of the many difficulties they had experienced and expenses they had incurred using them. The decision came down to two options:

- **Orifice Plate Flowmeter:** A flowmeter that uses a restricting orifice and differential pressure measurements to calculate flow through a pipe.
- **Micro Motion Coriolis Flowmeter:** A flowmeter that measures the Coriolis effect caused by the mass of the material moving through a pipe (the mass-flow rate of the material).

Choosing the Coriolis Flowmeter

PNM chose the Micro Motion Coriolis flowmeter over the orifice plate flowmeter after weighing the strengths and weaknesses of each technology for the compressor fuel gas application.

Orifice Plate Strengths and Weaknesses

The main strengths of the orifice plate were a relatively low cost and wide acceptance in the industry (including conformance to Standard AGA 3). These strengths, by themselves, would make the orifice plate easy to select, but on closer examination, the orifice plate has some shortcomings:

- No health diagnostics
- Too high a differential
- Fair to moderate accuracy (1% to 3%)
- Poor turndown (typically 5:1)
- Can be damaged by high flow rates
- Requires upstream/downstream runs of pipe

The orifice plate would have been a better solution than the turbine meters, but it was not the best solution.

Coriolis Flowmeter Strengths and Weaknesses

The only real weakness of the Micro Motion Coriolis flowmeter is its higher initial cost. However, the strengths of the option more than made up for its weakness:

- High accuracy
- No wearing parts
- No damage from high flow
- Independent of the flow composition
- Low operating cost
- No pressure and temperature compensation required
- AGA 11 standard conformance
- No upstream or downstream runs required

Given the research, the Micro Motion Coriolis flowmeter was the best solution.

Results of the Changeover

The Micro Motion Coriolis flowmeter did not disappoint PNM. After installation of the new technology, the company received a return on their investment within 18 months through measurable cost savings. Overall, the company reaped the following benefits.

Operational and Maintenance Benefits

- Eliminated unscheduled shutdown and meter repairs
- Realized a one-device solution capable of operating in the entire gas flow rate range
- Acquired the ability to perform on-line engine efficiency measurements
- Reduced the need for calibration
- Took a step into PlantWeb Architecture, permitting present or future integration of other devices in the system

Environmental Benefits

- Improved compliance with acceptable EPA-calculated emissions rates (calculated exhaust volumetric flow)
- Improved reputation with emissions regulators due to high level of measurement accuracy

Availability and Throughput

- Improved accounting and billing of natural gas usage
- Eliminated unscheduled shutdown and meter repairs
- Eliminated threat of damage to downstream components

Summary

Using Micro Motion Coriolis flowmeters was the best choice for PNM's compressor fuel gas facility. Despite the higher initial cost compared to the turbine-meter status quo or replacement with orifice meter technology, the choice paid for itself within 18 months. The company was able to make the desired improvements in operational and maintenance savings, environmental benefits, and facility availability and throughput.

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