Technical Publication

Importance of Flare Gas Measurement Grows To Meet Environmental Regulations

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In the oil and gas industry, regulations and requirements to measure, monitor and report flared gases continue to expand and extend. The USA EPA continues to focus on enhancing regulations aimed at reducing emissions of methane and volatile organic compounds (VOC's) into the environment.

The recently held multinational Paris Climate Conference (COP21) and its resulting agreement have even broader, global implications for still more attention on measuring flared gases. As environmental and climate change driven regulations in the USA., Canada, the European Union (EU) and elsewhere around the globe continue to become more stringent, companies in the oil and gas sector will be continuously challenged to invest in accurate and reliable flare gas measurement across their operations.

Typical Challenges

Flare gas flow meters provide a tool to signal abnormal process changes, early leak detection and provide a flow measurement that is used for environmental agency reporting. Flare gas applications present several challenges to plant, process and instrument engineers when selecting a flow meter solution, which can include any or all of the following challenges:

Low and High Flow
Low flow sensitivity is critical to identify and measure leaking valves and the normal low flow associated in day to day operations. The capability to measure very high flows is needed during system upset conditions requiring a meter that needs to accurately measure flow over an extremely wide turndown range.

Calibration
Flow meter calibration specifically for hydrocarbon composition gases and matched to actual process conditions are essential. Gas composition changes and wide turndown lead to relatively poor measurement accuracy in flare applications.

Large Pipe Sizes
As line sizes increase, the number of effective and suitable flow meter sensing technologies decrease and cost's increase.

Lack of Straight-Run
All velocity based flow meter technologies have straight-run requirements upstream and downstream from the meter in order to achieve repeatable flow measurement which are not always available.

Environmental Compliance
In nearly every application, the flow meter must meet performance and calibration requirements mandated within local regulations such as US EPA's 10 CFR 40; 40 CFR 98; EU Directives 2003/87/EC and 2007/589/EC; US MMR 30 CFR Part 250, Subpart K, Section 250 and others.

Limited Access
Pipe access and re-access for installation, maintenance or servicing is frequently difficult. For example, spool-piece flow meters can require prolonged process shut-down and extensive on-site labor costs to install and continuously maintain the system as opposed to insertion style meters that can be easily inserted or retracted into or out of the process through a ball valve.

Agency Approvals
For installation in hazardous (Ex) locations, the entire flow metering instrument should carry agency approval credentials for installation in environments with potential hazardous gases; enclosure only ratings are inadequate.

Offshore Platforms/FPSO and LNG vessels
Corrosive salt water environments such as those on offshore platforms, floating production vessels and LNG tankers can require the use of stainless steel on all exposed instrument materials including the enclosures.

Flare Gas Sensing Technologies

The three flow meter sensing technologies regularly considered in flare gas measurement are ultrasonic, optical and thermal. While all flow meter technologies have their advantages and disadvantages, some are generally better than others depending on the specific media (liquids [volume] and air/gas [mass]) and the application environment.

Ultrasonic flow sensing technology relies on ultrasound and the Doppler effect to measure volumetric flow rate. In ultrasonic flow meters, a transducer emits a beam of ultrasound to a receiving transducer. The transmitted frequency of the beam is altered linearly by particles or bubbles in the fluid stream. The shift in frequencies between the transmitter and receiver can be used to generate a signal proportional to the flow rate.

Optical flow metering relies on laser technology and photo detectors. This technology requires the presence of tiny droplets or particles of condensation, lubricants, dust and other particles in the gas stream. These particles scatter the light beam and the time it takes for these particles to travel from one laser beam to the other laser beam can be used to calculate the gas velocity and volumetric flow rate.

Figure 1: FCI ST100 Series Thermal Air/Gas Flow Meter

Thermal flow sensing provides direct mass flow measurement, which is ideal for measuring gas flow. Two platinum RTD temperature thermowells are used as the sensor. One RTD is heated while the other measures the process temperature. The temperature difference between these RTD's results in an analog output, which is proportional to the media cooling affect and compensates for changes in pressure and temperature to give a direct mass flow output without additional instrumentation.

Flare Gas Flow Meters

Whether the flare systems is a single flare line or a large header with a complex array of feeder lines, thermal flow meters provide the lowest installed cost and the lowest lifecycle cost solution. From detecting the smallest gas flows of 0.25 SFPS [0.08 NMPS] to 1000 SFPS [305 NMPS] to measure major upset conditions at high flows, thermal flow meters offer an accurate, dependable, low maintenance and long-life flaring solution.

For example, the ST100 Series Thermal Flow Meter (Figure 1) from Fluid Components International (FCI) consists of an easy to install insertion flow element with a rugged and powerful electronics/transmitter. With specific calibrations for mixed gas compositions, if needed, the split-range/dual calibration feature with (3)4-20 mA analog outputs or digital bus communications (HART, Foundation™ Fieldbus, PROFIBUS or Modbus) make it ideal for flare applications

Split-Range Calibrations

Many oil/ gas operators, refineries and chemical plants have flare applications uniquely challenged with two diverse operating flow conditions: (1) very low flow under normal conditions and (2) very high flow during an upset/blowdown condition (Figure 2). Site or plant operators are then further challenged to comply with environmental and emissions regulations that stipulate meter accuracy of ± 5% of reading over the entire measuring range. This meter's split-range/dual calibration feature supports both requirements.

Dual-Element Systems

In pipe sizes larger than 16 inches [406 mm] a dual-probe averaging flow sensor system can provide improved accuracy compared to a single probe system. Dual probe sensors are connected via a single flow transmitter to provide an averaged output.

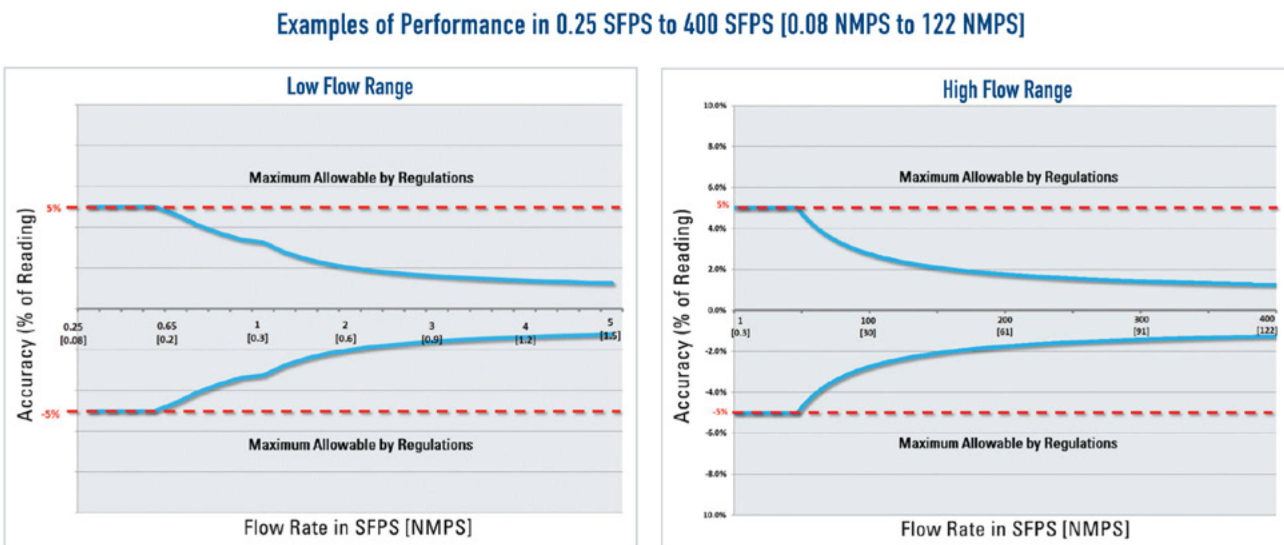

Figure 2: Typical flowing flare gas low versus high flow ranges

Calibration Verification

With the newest environmental regulations requiring routine flow meter calibration verification, a simple-to-use tool to validate the meter's calibration is an option. VeriCal is a 'wet' verification where gas is pressure controlled through a sonic nozzle on to the sensor. Flow versus pressure is used to verify the performance of the flow meter. This can be done without removing the flow meter from the process.

Conclusions

With the growing importance of reducing carbon emissions and monitoring waste gas in the petrochemical industry, an accurate, dependable and low maintenance flare gas flow meter is a must-do site or plant requirement. There are multiple flare gas flow meter technologies available on the market, but thermal flow meters provide direct gas mass flow measurement without the addition of pressure or temperature sensors. They feature a no-moving parts design with low pressure drop, which is virtually maintenance free for a low installed cost and a long life-cycle. ■