Technical Publication

Monitoring Flare Gas Accurately To Meet Environmental Regulations

Jim DeLee, Senior Technical Staff
Fluid Components International (FCI)

FLUID COMPONENTS INTERNATIONAL LLC

Visit FCI online at www.FluidComponents.com | FCI is ISO 9001 and AS 9100 Certifie

FCI World Headquarters
1755 La Costa Meadows Drive | San Marcos, California 92078 USA
Phone: 760-744-6950 **Toll Free (US):** 800-854-1993

FCI Europe
Persephonestraat 3-01 | 5047 TT Tilburg, The Netherlands | **Phone:** 31-13-5159989

FCI Measurement and Control Technology (Beijing) Co., LTD
Room 107, Xianfeng Building II, No.7 Kaituo Road, Shangdi IT Industry Base, Haidian District | Beijing 100085, P. R. China
Phone: 86-10-82782381

The European Union, the U.S. Environmental Protection Agency (EPA) and many other global groups are working to reduce the greenhouse gases (GHGs) that are the main cause of the global warming phenomenon. The oil and gas industry in response to new regulations and their requirements has increased its focus on accurately measuring, monitoring and reporting the flared GHG gases that result from production, refining, storage and distribution activities.

Flare gas measurement and monitoring is an instrumentation challenge that requires accurate gas flow sensing and metering in demanding rugged environments. Flare gas flow meters are an essential tool to signal abnormal process changes, early leak detection and provide the flow measurement data that are used for environmental agency reporting

Typical Issues

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 dilemmas:

Low and High Flows. Sensitivity to low flow conditions is required 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 measure flow accurately over an extremely wide turndown range.

Calibration. This application requires the calibration of flow meters specifically for hydrocarbon composition gases and matching to actual process conditions is essential. Gas composition changes and wide turndown can lead to relatively poor measurement accuracy in flare applications.

Large Line Sizes. As pipe sizes increase, the number of effective and suitable flow meter sensing technologies decreases and the costs increase too.

Lack of Straight-Run. All velocity based flow meter technologies have pipe straight-run requirements upstream and downstream from the meter in order to achieve repeatable flow measurement. These straight-run requirements are often difficult to achieve in crowded production sites and process plants.

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

Tight Access. Limited pipe access and re-access for installation, maintenance or servicing is frequently difficult. For example, spool-piece flow meters can require prolonged process shut-downs 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. When installing meters 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.

FPSO/Offshore Platforms and LNG Vessels. The ocean's corrosive salt water environmental effects such as those encountered by 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

There are three flow meter sensing technologies regularly considered in flare gas measurement applications: 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.

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 difference in temperature between these RTD's results in an analog output that is proportional to the media cooling effect and compensates for changes in pressure and temperature to give a direct mass flow output without additional instrumentation.

Thermal Flow Meters

Whether the flare system 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 0.08 NMPS [0,25 SFPS] to 305 NMPS [1000 SFPS] 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.

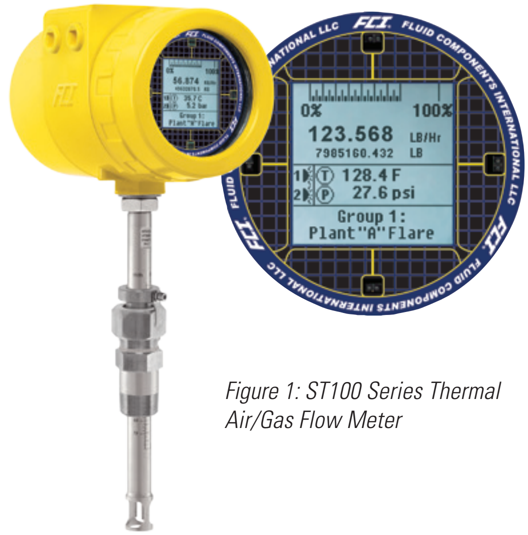
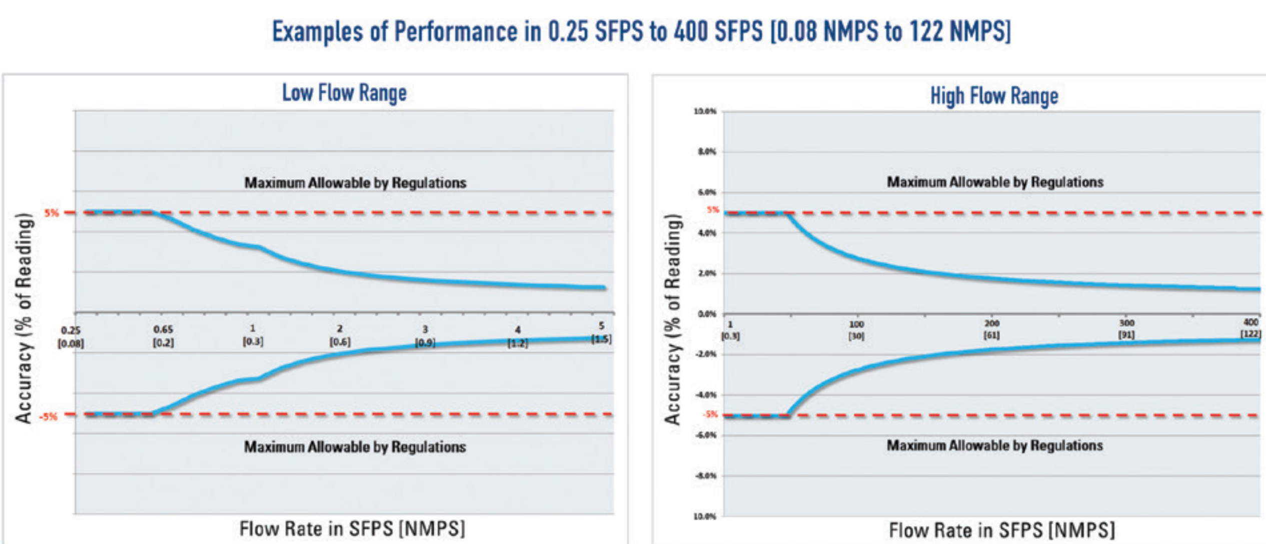


Figure 1: ST100 Series Thermal Air/Gas Flow Meter

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

Figure 2: Typical Flowing Flare Gas Low Vs High Flow Ranges



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 406 mm [16 inches] a dual-probe averaging flow sensor system can provide improved accuracy compared to a single probe system (Figure 3). Dual probe sensors are connected via a single flow transmitter to provide an averaged output.

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

As the importance of reducing carbon emissions grows, the installation of accurate and dependable flare gas flow meters also becomes an essential must-do plant or site 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 solution. ■

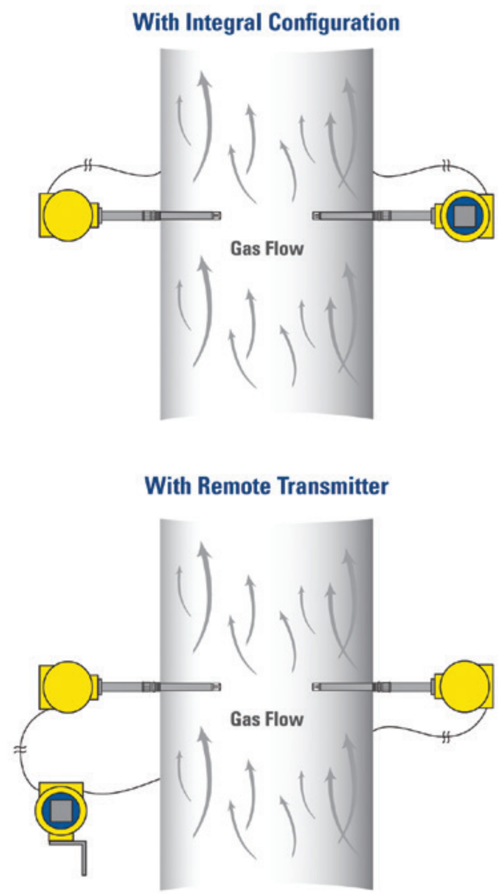


Figure 3: Dual Element ST102 Flow Meter