Technical Publication

Greenhouse Gas Flow Monitoring

By Allen Kugi, Member Technical Staff
Fluid Components International (FCI)

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It is estimated that more than 10,000 facilities in the US meet the criteria for mandated reporting of greenhouse gases. A full description of the EPA mandate can be found on the EPA's web site at: www.epa.gov/climatechange/emissions/ghgrulemaking.html

The EPA's reporting mandate comes in response to the goal of reducing warming gases in the atmosphere to address the consequences of global warming.

The EPA says the present objective of the mandate is simple reporting and is not about regulating the reduction of GHG at this time, although bloggers and industry pundits speculate this is likely the next step. It's doesn't require a stretch of logic to anticipate the data collected will frame new regulations to curb the release of GHG in response to domestic and international pressure to slow the rate of global warming.

The EPA's initial mandate in October of 2009 required 31 industry sectors that collectively equal 85 percent of US GHG emissions, to track and report their emissions. In addition to these original 31 industries, the agency in March of this year proposed to collect emissions data from the petroleum and natural gas sector, as well as from industries that emit fluorinated gases and from facilities that inject and store carbon dioxide (CO_2) underground for the purposes of geologic sequestration for enhanced oil and gas recovery.

Methane is the primary GHG emitted from oil and natural gas systems and is more than 20 times as potent as CO_2 at warming the atmosphere, while fluorinated gases are even stronger and can stay in the atmosphere for thousands of years. The EPA says the data collected will allow businesses to track their own emissions, compare them to similar facilities, and identify cost effective ways to reduce their emissions in the future.

GHG Monitoring

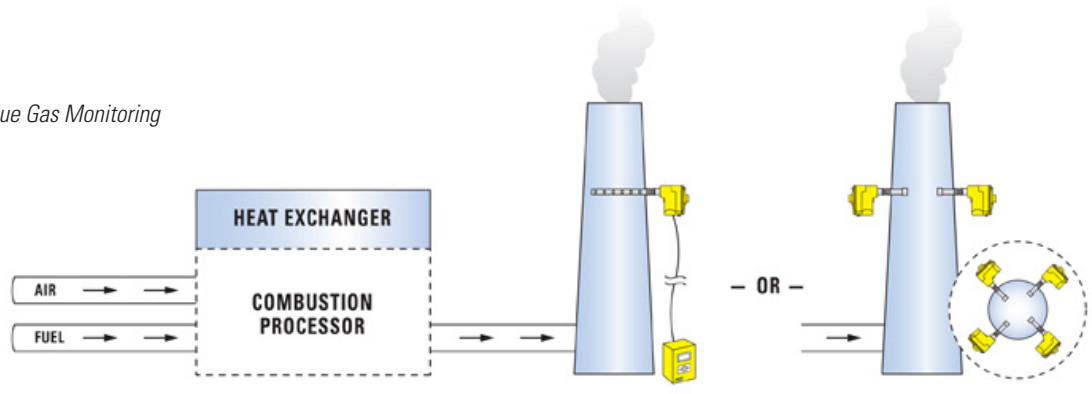
The EPA's current focus of GHG data collection is measurement, which requires flow monitoring and flow meters. For years, industrial process and manufacturing plants have been required to monitor flue or stack emissions by Federal, State and Local agencies in the fight against air pollution.

Flue gases are the general name given to the mixed composition hydrocarbon greenhouse gases that are the by-product of an industrial plant combustion process. A flue is typically a large pipe, duct, stack, chimney or other venting attached to a process or industrial manufacturing plant system such as a boiler, furnace, steam generator, oven, etc., through which waste gases are exhausted from the combustion process.

Flue gases are produced by many industries, including chemical and food processing, petroleum refining, pharmaceutical production, metals and advanced materials, paper plants, electric power generation plants and others. Depending on the type of plant, processes, fuel used and efficiency, flue gases include:

- Nitrogen
- Carbon Dioxide
- Oxygen and water vapor
- Sulfur Oxides
- Nitrogen Oxide
- Carbon Monoxide
- Particulates
- Ozone
- Methane

Figure 1: Flue Gas Monitoring



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These gases in our atmosphere absorb and emit radiation within the thermal infrared range, which has been identified as the primary cause of global warming.

Gas Measurement Problem

Measuring the flow of industrial process flue gas is a challenge (Fig 1). These gases are generally mixed hydrocarbons in terms of their composition. They are often wet, hot and dirty gases laden with particulates that can foul flow measurement devices with orifices or moving parts. In addition, the volume of gas that is emitted tends to vary based on the products in production, workload schedules and seasonal fluctuations in temperature and humidity

The flue itself is typically large and difficult to access in terms of installing and servicing instrumentation. The purpose for measurement is now becoming increasingly multipurpose: To comply with EPA regulations on the one hand, and to provide process gas data for scrubbers and flare systems. The combination of all these various factors results in the need for flow meters that operate accurately and reliably over a wide flow range in rugged environments challenged with distorted and swirling flow profiles.

Choosing A Flow Meter For GHG Monitoring

In selecting a flow meter for greenhouse gas monitoring or any process gas application, the first step is choosing the appropriate flow technology. There are multiple flow sensing technologies available, and the major ones now include:

- Differential Pressure
- Positive Displacement
- Turbine
- Electro Magnetic
- Ultrasonic
- Vortex Shedding
- Thermal (Mass)
- Coriolis (Mass)

All these technologies have their advantages and disadvantages depending on the type of process fluid, limited straight run challenges, dirt and particulates, mechanical installation considerations, high temperatures and moisture entrained in the flow stream in addition to cost/benefit considerations in meeting accuracy requirements, maintenance and life expectancy of the equipment. By looking at these factors as well as the plant's layout, environmental conditions, maintenance schedules, energy cost and ROI, it will soon be easy to narrow the field to one or two best choices.

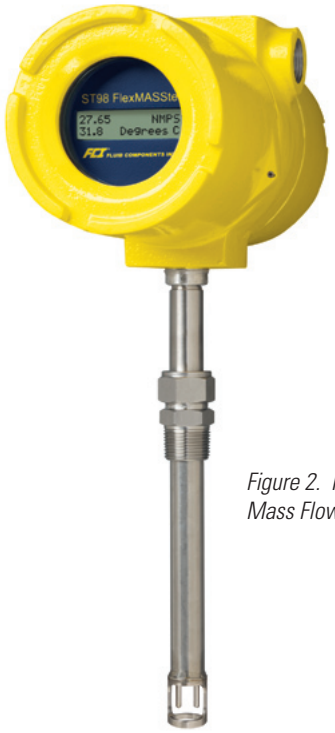

Figure 2. FCI ST98 Mass Flow Meter

Accuracy and Repeatability

It is essential to know the accuracy, repeatability and flow range of the flow meter under consideration and to question instrumentation suppliers regarding their calibration lab facilities and certification processes. For example a thermal dispersion gas flow meter such as FCI's insertion-style ST98 Series (Fig. 2), operates over a flow range from 0.75 to 600 SFPS (0.21 to 172 NMPS) with an accuracy of +1% of reading, +0.5% of full scale, with a repeatability of +0.5% of reading with a certified calibration in a NIST traceable flow lab using master flow meter equipment in compliance with ASME MFC specifications.

Thermal dispersion provides a gas flow measurement solution that is easy to install and virtually maintenance free. It has no moving parts to foul in dirty applications and the calibration parameters are digitally stored in electronic memory. Thermal dispersion technology places two thermowell protected platinum RTD temperature sensors in the process stream (Fig 3).

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One RTD is heated while the other senses the actual process temperature. The difference in temperature between the two sensors is measured and is directly proportional to the mass flow rate of the fluid.

Be sure that the instrument chosen meets the accuracy, repeatability and flow range requirements of the plant's process measurement requirements and the EPA's monitoring regulations under installed conditions. .

Installation Requirements

Some flow meters are more straightforward than others when it comes to installation. Be sure to ask if the flow device can be inserted directly into the process pipe or if it requires an inline configuration that will require the pipe be cut and spliced in multiple places. The more penetrations required into the pipeline or duct-work the greater the risk of pressure drop, complexity and overall cost of the installation. Some flow measurement devices feature minimally invasive or non-intrusive sensing technology, which makes them much faster and easier to install and that helps to reduce the cost of labor. Don't forget, the easier it is to install, the easier it is to maintain over the long run.

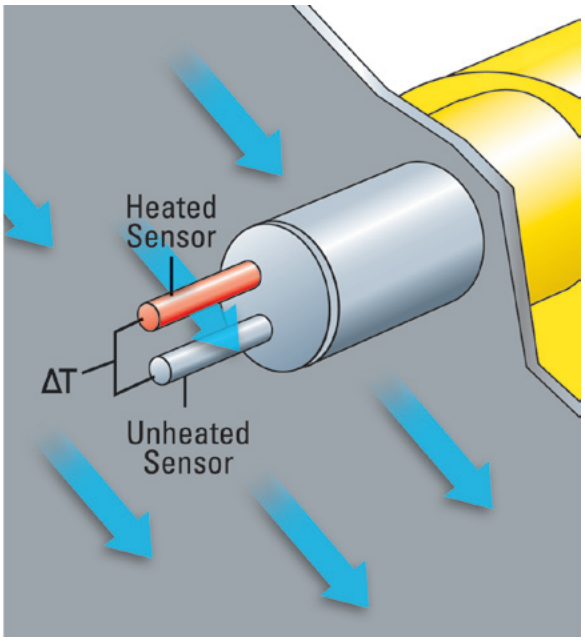

Figure 3. Thermal Dispersion Mass Flow Measurement Theory of Operation

Maintenance & Life

The frequency of maintenance and the expected life of a flow meter are essential criteria to evaluate before selecting a flow meter. In general on one side of the spectrum, some flow meters are relatively inexpensive and designed for a short life expectancy even when used in benign environments with routine maintenance

At the other end of the spectrum there are more expensive flow meters designed with rugged materials for harsh environments with lower maintenance requirements and a longer life. The important thing to recognize is the cost of installing and maintaining an instrument over a long period of time. The initial cost of a flow meter is only part of the story. An apparent bargain on first purchase can end up being a cash drain over time and cause on-site technicians a lot of frustration. Make sure whatever flow meter is chosen for the application is backed up by a strong manufacturer's customer service department.

Conclusions

While GHG certified flow meters have been in the news, the government is not certifying specific flow meter technologies or manufacturing companies that supply them. The important thing is to focus on is the specific process flue gas monitoring requirements while simultaneously meeting EPA's regulations and maintaining company budget goals over the life cycle of the flow meter. ■