SPECIAL FEATURE

Flaring excess gases

A consideration in oil and gas investments

There are certain industrial processes that have an inherently high risk of producing unwanted off-gases. Heavy industry recognises the potential impact of these off-gases on the environment, and continually invests countless hours and funds into mitigating the associated risks involved with manufacturing processes.

Excess gases occur in a multitude of industrial and municipal processes. These excess gases occur because the amount of gas exceeds the needs of the system, as part of a safety strategy to remove pressure build-up, or when the process creates unusable waste gas. One of the most critical requirements is the safe elimination of pressure build-up in reaction and process lines associated with the manufacture and processing of hydrocarbons, and other flammable and explosive materials.

In chemical, petrochemical, and other production processes, volatile organic compound (VOC) off-gases are created that cannot be stored, reused, or compressed; or gases are diverted during maintenance procedures and emergencies. The most common solution is to provide a controlled venting process that supports both the necessary system safety and a process that reduces or eliminates any harmful gases or particulates before anything is vented into the environment. The venting process that works most effectively in avoiding the release of hazardous excess gases into the environment are flares, combustors, and vents. These venting and oxidising processes are most commonly structured with off-gas routing valves, piping, and an open burn flaring system.

A vent simply releases the gases into the atmosphere. Flares and combustors are typically vertical pipe structures situated away from the process facility. Each also has a pilot flame (much like a water heater) that is always lit to ensure quick ignition. Flares are typically tall structures with an open flame, while combustors have a lower profile with a hidden flame. Pipes carry excess gases away from the process facility to the flare or combustor via a safety device (such as a liquid seal) that prevents ignited gases from returning through the pipe. Once at the flare or combustor, the excess gases are mixed with natural gas to ensure full and complete combustion.

There are three major flow concerns in monitoring the off-gases to flare and combustors: the need to indicate and quantify any event; a means that accurately indicates all valves involved in the event have fully reseated; and any purge gas flow through the flare/combustor line is sufficient to preclude back flash into the off-gases line. It is often found that only the sensitivity of a rapid response thermal flow meter can identify a valve leak that occurs through a line after an event cessation. A continuous leak adds up to tens of thousands of lost product dollars.

Any indication showing that safety valves have not fully reseated represents potentially faulty valves. This risks the safety of employees, a larger scale equipment failure, and potential system downtime. If a faulty valve is identified by a regulatory agent, significant legal and financial impacts can result for the system operator.

Regardless of the application, it is vitally important to accurately monitor the gases coming out of the flare or combustor. If the gases are dry, a standard thermal flow meter provides highly accurate and repeatable measurements. Thermal flow meters have a large turndown ratio; that is, they stay accurate from extremely low flow rates (such as when a flare is idle) to very high flow rates (such as during extreme over-production).

Increasing environmental concerns

Increasing regulations continue to push industrial and municipal sites to find solutions for reducing carbon dioxide (CO_2) emissions. In order to track CO_2 emissions, sites must monitor and report flare activities to various environmental regulators. There is the potential for significant penalties when companies are found to not be in compliance with related policies (such as the Air Quality Framework Directive in Europe), so it is important to be proactive in seeking solutions.

For tracking CO_2 emissions, a thermal flow meter supports the ability for providing real-time data to regulatory boards to avoid under and over-reporting emissions that can lead to increased fines and penalties.

However, monitoring flare gas flows containing various amounts of liquid vapour have always been the domain of differential pressure (DP) and ultrasonic technologies. Unfortunately, neither one supports large turndown ratios requirements, and they either have up-front or maintenance cost issues. Advancements in thermal mass flow meters provide a new alternative to DP and ultrasonic meters. The meter sensors are virtually unaffected by moisture in the flow stream, and the meters require almost no maintenance. Thermal flow meters designed specifically for wet gas environments provide reliable and repeatable capabilities in wet flare gas applications, as well as in other condensing gas applications within petroleum and gas applications.

For example, there is substantial moisture in the excess gases coming from the wellhead that require a flow meter designed specifically for the condensing gas environment. The gas retrieved from porous shale formations is laden with moisture from the water and chemical slurry that is injected to release the trapped methane and hydrocarbons. The mixture must be separated upon extraction, but this still leaves significant moisture in the gases sent from the storage tanks to the flare or combustor.

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Further, natural gas is the predominant associated gas found in oil wells. The gas exists separately from the oil as free gas, but is also found dissolved within the oil. While flaring is the cheapest method for separating associated natural gas from the crude oil, it releases more CO_2. To produce consumable natural gas, the hydrocarbons and fluids (such as water vapour) must by cleaned and dried to create purified natural gas.

There are already several areas in the flow stream containing vapour. Additionally, to help control the volatility of the excess gases sent to a flare, the gases go through a liquid seal (such as a flashback or knockout drum). The liquid seal prevents an explosive air mixture from forming upstream and keeps the upstream air flow pressurised (reducing the chance for ignition). Depending on the size of the drum, a substantial amount of liquid vapour can enter the exhaust flow stream.

As an indication of process inefficiency, flaring represents lost revenue and unused production resources. In most cases, the gases being flared can be converted and used as energy for the facility or captured and become part of the commercial revenue stream. The World Bank's Global Gas Flaring Reduction (GGFR) Initiative recognises that billions of dollars' worth of gases is wasted in flaring, and is encouraging cooperative relationships that will reduce flaring while developing strategic partnerships and investment incentives as part of the infrastructure and regulatory framework.

Investing in the additional vapour recovery equipment needed to purify the gas can be viewed as a costly alternative, especially on platforms facing space limitations. However, the ability to sell the captured natural gas and natural gas liquids, the elimination of increasing fines related to flaring, and the ability to promote a reduction in greenhouse gas contaminants convert the upfront cost into a capital investment and improved corporate image.

Accurately monitoring dry and wet flare gas provides information that can be used in conjunction with other data to identify potential problems and support solutions. A fast response time at the flare can indicate an obstruction in the line, impending over-pressure, or failing high-pressure connection. Thermal flow meters provide a cost-effective alternative to other flow technologies and should be considered as part of the investment in any flaring, emissions, or condensing gas application. gw

ABOUT THE AUTHOR

Dario DiMaggio is Director of European and Middle Eastern Sales and Robert Morpeth is Senior Staff Writer at Kurz Instruments, Inc. Kurz Instruments designs and manufactures thermal mass flow transmitters for industrial gas flow measurement. Its products are used in a wide variety of industrial applications including combustion air, aeration air flow, digester gas, nuclear power plants, flare stack monitoring, and compressed air.