Technical Publication

Natural Gas Fractionation Process Facilities Rely On Flow Switch For Relief Valve Leak Monitoring

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A company with multiple natural gas liquid (NGL) fractionation process facilities located in the Southeastern U.S became concerned about a series of missed events and nuisance alarms caused by the flow switches installed to monitor potential overpressure situations with its pressure relief valves. The company wanted a highly reliable flow instrument solution that would detect a real event and avoid the lost productivity of nuisance alarms.

NGL fractionation process facilities separate ethane, propane, butane and other heavier hydrocarbons from the mixed NGL streams (Figure 1). Multiple trains and columns are used in this fractional distillation process at each of the facilities, with relief valves installed as critical safety protection devices that release when needed to prevent pressure from building within the fractionation process.

A flow switch is typically installed after the pressure relief valve and alarms if there is flow. For the NGL fractionation process to work efficiently and safely, the operation requires early and reliable indication when a relief valve leaks or lifts during an overpressure situation.

Should the flow switch alarm due to gas being released through the relief valve, it indicates via a dry contact that there is an event in progress. The facility's staff then responds by taking the appropriate corrective action to resolve the event.

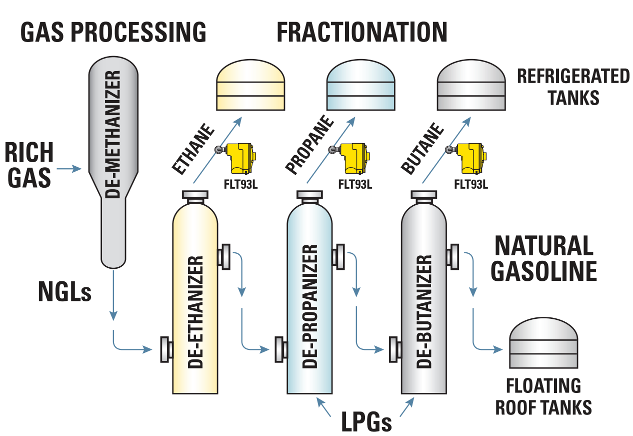

Figure 1. NGL Fractionation Processes

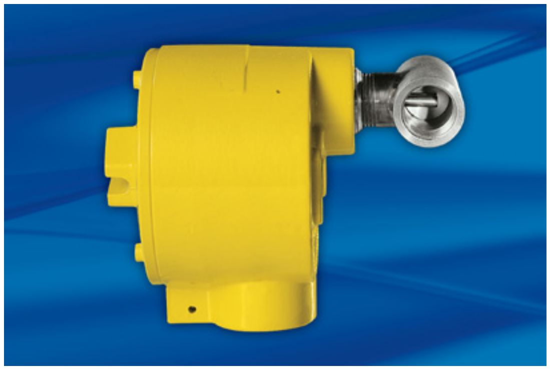

Figure 2. FCI FLT93L Flow Switch

The Problem

Two different types of flow switch technologies had been tried unsuccessfully in the relief valve monitoring application by the company. Each type of switch failed to alarm when expected to do so and also caused nuisance false alarms. Failing to find the right solution was time-consuming and expensive.

Not all gas flow sensing technologies are able to detect the required low velocity of leaking or seeping gas required in this application. Differential pressure (dP) and vane type technologies, for example, had been tried by the company with limited success.

Dp devices rely on pressure to indicate as to whether or not there is flow, and they are only "inferring" that flow is taking place. Mechanical devices, such as vanes, can stick or freeze, and they are typically not sensitive enough at very low flow rates. Similar problems have been experienced with these technologies by other companies at their NGL fractionation process facilities, and other similar low flow applications in the oil and gas industry.

The Solution

The company contacted the applications team at FCI and requested a review of its problems. An FCI representative visited the plant that had ongoing problems for a first-hand look at the fractionation process lines and discussions about the problems experienced during operations.

FCI then recommended the installation of the FLT93L Inline Flow Switch (Figure 2). The FLT93 Series is a heavy duty thermal dispersion flow/level/temperature switch that was designed based on FCI's more than 50 years of flow/level/temperature switch applications experience.

This switch is designed with an all-welded thermal sensing element and includes an advanced electronic control circuit, which is field configurable to satisfy any combination of application requirements. Unlike other flow switch technologies, the thermal sensor in this switch is suitable for both gases and hydrocarbon-based liquids.

FCI explained to the company that there were several advantages in using a thermal dispersion technology flow switch. It would provide highly reliable performance that would both alarm when there was flow present at their fractionation facilities and avoid any nuisance false alarms.

The company agreed with FCI's assessment and recommendations. Its engineers decided to install new FLT93L Switches at one plant for evaluation purposes prior to considering them for their other facilities. Each of their facilities would eventually need two or three flow switches depending on the scale of operations at each plan t.

The pilot installation of the flow switches at the first facility was completed relatively quickly because it was a standard flow switch product available off the shelf from FCI. Global agency approvals for Ex installations and a SIL 2 rating also are provided standard with this product.

The inline configuration FLT93L Flow Switch was placed on 0.5- and 1-inch (DN15 and DN 25) diameter pipes. The switches were installed by local plant technicians on the backside of the pressure relief valves, and they were integrated into the fractional process trains without any difficulties.

The FLT93L's voltage output allows the user to "see" into the process and accurately set the desired trip point. The delta range between the switch's two RTDs provides a span for setting the switch trip points. These flexible dual relays are settable by the plant technician for any combination of flow and/or temperature alarms.

With a standard flow accuracy of ±2% of the setpoint velocity over a ±50°F [±28°C] temperature range, the new switch met the needs of this application. Its repeatability of ±0.5% reading also was satisfactory for dependable, reliable operation.

Stainless steel enclosures were considered, yet a standard enclosure was chosen. It features a coated aluminum alloy and is rated for NEMA Type 4X (IP67) environments. The electronic control circuit can be integrally-mounted with the sensing element, or it can be remotely mounted up to 1000 feet away from the switch.

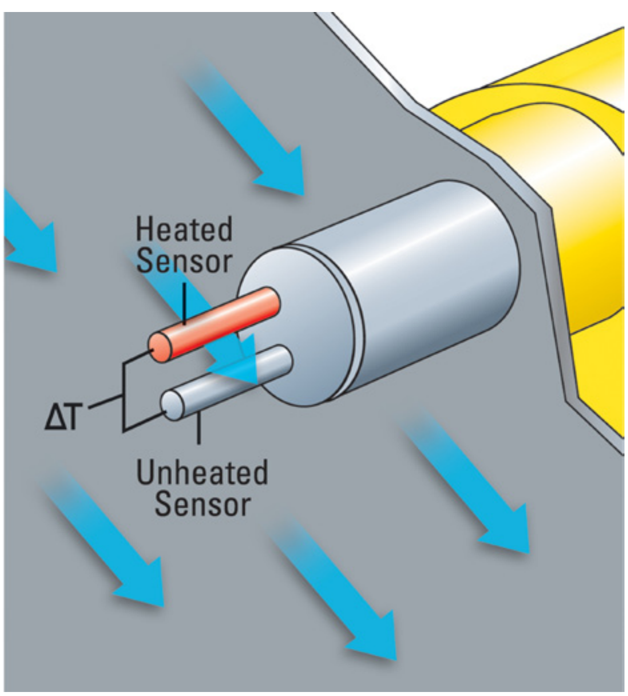

Figure 3. Thermal Dispersion Flow Sensing

Thermal Flow Switches

Thermal dispersion flow switches are ideal for monitoring liquid or gas flow. Two platinum RTD temperature thermowells are used as the sensor. One RTD is heated while the other RTD measures the process temperature (Figure 3), whereby thermal flow switches are monitoring the customer's direct variable of interest (flow) and can alarm based on the cooling of the heated RTD.

A high voltage output value indicates a low flow or no flow condition while a lower voltage value indicates that flow is increasing. Using this information, the user can "see" into the process and set a numerical switch trip point with a high degree of confidence.

Figure 4 illustrates how temperature compensated thermal flow switches will not experience signal drift during temperature changes. Whereas a non-temperature compensated flow switch experiences signal drift (as indicated by the red arrow) and causes alarm failure.

Thermal flow switches are exceptionally safe because there are no moving parts to break free. For this reason, instrument life also is long (190 years MTBF) with a low life-cycle cost over what can be many decades of service. The company considered both the low maintenance and long life qualities of the thermal switch solution to be critically important.

Integrated with this switch's thermal flow sensor is a fail-safe, dual alarm (SPDT) control circuit for field flexibility and user friendliness. This unique FlexSwitch control circuit offers a variety of field-selectable features for many different applications.

The control circuit's dual independent heavy duty 6A SPDT relays provide the multiple alarm combinations. They can be set for flow rate and temperature, high flow and low flow, point level and temperature, flow rate and low liquid level, three-phase interface or fail-safe flow, level or temperature.

Conclusions

In the first two months of operation at the initial pilot installation facility, the FLT93 Flow Switch correctly alarmed four times. The company verified the indicated relief valves were indeed leaking or seeping as designed to prevent over pressurization.

Since this original installation, the company has standardized on the FLT93 Flow Switch. It is now installed for this specific application and other similar applications at their other gas plants located throughout Texas, Louisiana, Oklahoma and Arkansas. ■

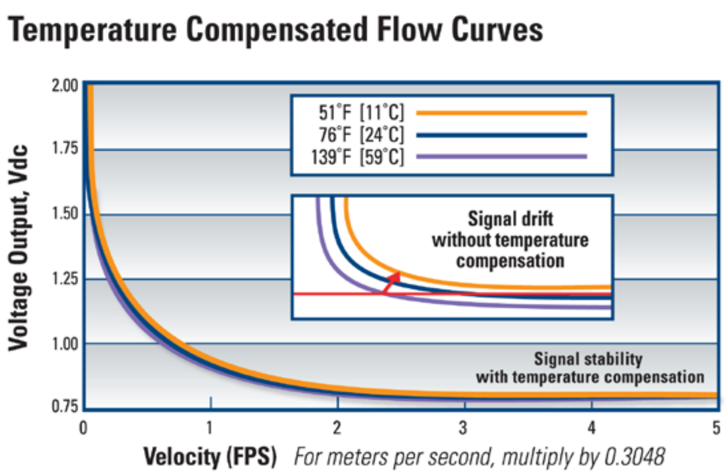

Figure 4. Temperature-Compensated Sensor