Technical Publication

Thermal Mass Flow Meter Helps Mud Logging Contractor Meet U.S. EPA Flare Gas Emissions Monitoring Requirements

By Steve Cox, Sr. Member, 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

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Figure 3: ST100 Series display close-up view

Upstream oil/gas production companies around the globe depend on mud logging service companies to analyze mud samples that help them maintain the correct direction for their drilling feld operations. In mud logging, samples of rock cuttings from bore holes are brought to the surface by recirculating drilling media (mud) for analysis by a mobile laboratory to determine the lithology and fuid content of the sample.

The surface logging process helps oil/gas engineers determine the correct drilling direction and depth when frst commissioning a new well. The drilling operation including mud logging and data analysis can take from three to four weeks. Drilling mud is pumped down the hole to help keep the bit from overheating and to bring rock cuttings to the surface for analysis.

Engineers from the logging service company and the production company generate the logged mud data. The careful analysis of this data helps the engineers confrm the presence of oil and gas to maintain drilling effciency.

Problem

As the mud is returned to the surface from down the hole, it also contains natural gas. This mud must be run through a gas buster to separate out the gas from the mud. The mud is then recycled back to the drilling (logging) system, and the natural gas is vented to a fare stack and burned off at low fow rates typically from 15 fps to 20 fps.

U.S. Environmental Protection Agency (EPA) Directive 40 CFR Part 98 requires measurement and reporting of these fare gas emissions from mud logging operations *(Figure 1)*. To provide the required fare gas data, mud logging service companies need an accurate, reliable gas fow meter able to measure gas fow at relatively low fow rates with the added beneft of low pressure drop.

In a north central U.S. oil/gas feld employing hydraulic fracturing technology, a major mud logging service company recently began looking for a fare gas fow measurement solution that supported these diffcult operational requirements and that would help it meet the environmental regulations. The company needed to measure fare gas accurately and reliably at the well head and then fnd a convenient way to gather the data for EPA compliance fare gas reporting. Environmental regulations normally require fare gas monitoring and reporting that stipulates fow meter accuracy of ±5% of reading throughout the entire measuring range.

Accurate surface logging fare gas measurement presents a challenging environment for any fow meter. It must be able to accurately measure the extremely low fow rates within the 5% of reading requirement. Changes in gas production can also result in a wide turndown requirement that makes it diffcult to achieve this accuracy level.

Solution

The mud logging service company engineers contacted Fluid Components International (FCI) for a possible solution. After analyzing the process requirements, the applications team at FCI recommended the company's ST100 Series thermal mass gas fow meter *(Figure 2)*, which provides acceptable accuracy at low fow rates combined with a turndown far in excess of 100:1. The meter also includes integral data logging, and the meter's insertion style probe offered low pressure drop.

Figure 2: ST100 Series thermal mass gas flow meter

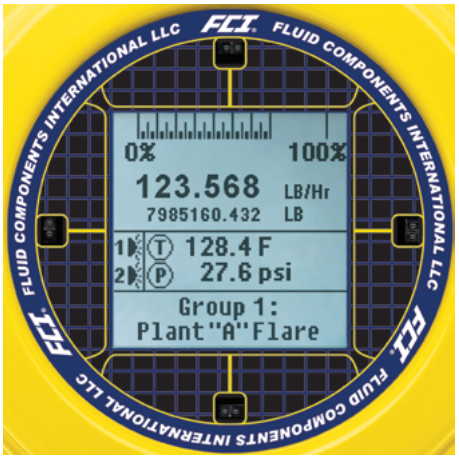

Figure 3: ST100 Series display close-up view

The ST100's unique hot-tap design allows the insertion type probe to be inserted directly into the surface logging gas monitoring system without the need to shut the process down. The ST100 meter includes a display totalizer *(Figure 3)* which can be read every 24 hours together with an internal data logger SD card to log fow data up to 90-days. This fow data is captured, stored, and easily exported to a Microsoft Excel® spreadsheet via USB cable connection or by removal of the SD card.

The fow meter process connection in this case is a 1-inch 300# fange. Pressure conditions at the well head can range from 10 psig to 250 psig (0.07 KPA(g) to 1.7 KPA(g)) at temperatures from 50 °F to 500 °F (10 °C to 260 °C). The gas fow rate was 23 SCFM to 1200 SCFM (0.65 NCMM to 34 NCMM), and the media was a seven component mixed gas. A remote transmitter was located over 50 feet away in a heated location because of extreme cold weather conditions, which allows the LCD display to show mass fow rate and totalized mass fow .

FCI's thermal dispersion constant power technology provides direct mass fow measurement without the need for additional pressure and temperature transmitters, which are required by volumetric type fow instruments such as differential pressure (dP) orifce plate meters, vortex shedding, ultrasonic and other meter technologies. The meter chosen by the mud logging company includes this built-in temperature compensation technology, which automatically compensates for changes in gas properties based on varying process temperatures.

FCI's advanced constant power design for thermal dispersion mass fow measurement allows the reference RTD temperature measurement to be used as an additional output *(Figure 4)*. This constant power technology has proven to be highly reliable and is preferred in moist gas applications where the naturally damped constant power design helps prevent the output "pegging" to 20 mA with the presence of moisture. The heated sensor provides a drying effect, which results in a stable and repeatable reading.

FCI's fow meters feature an advanced thermal mass sensing element comprised of two all-welded 316L stainless steel thermowells, with two precision matched platinum resistance temperature detectors (RTDs). This highly reliable no-moving parts design uses a heated RTD relative to the reference RTD, which creates a temperature differential relative to the gas fow rate.

The ST100 meter can be factory calibrated to measure virtually any process gas, including wet gas, mixed gases and dirty gases. The basic insertion style air/gas meter features a thermal fow sensing element that measures fow from 0.25 SFPS to 1000 SFPS (0.07 NMPS to 305 NMPS) with accuracy of ±0.75 percent of reading, ±0.5 percent of full scale.

This meter is agency approved for hazardous environments, including the entire instrument, the transmitter and the rugged, NEMA 4X/IP67 rated enclosure. Instrument approvals include ATEX, IECEx, FM and FMc.

Conclusion

The mud logging service company is pleased with the performance of the ST100 fow meter, which made it easier to meet the EPA's fare gas monitoring requirements. The benefts of this fow meter in this application included low fow sensitivity to 0.25 fps, multiple calibration groups, low pressure drop and easy, low cost installation. The company plans to expand use of this meter as it receives new contracts to commission additional oil/gas wells in the future. ■

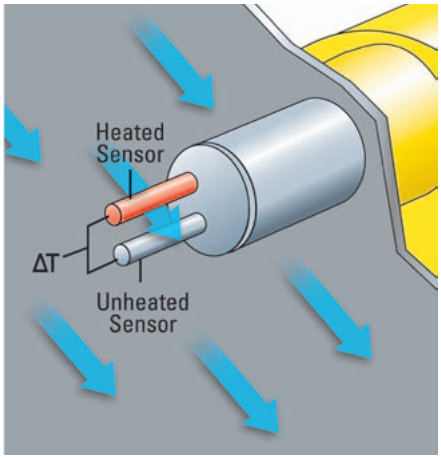

Figure 4: Thermal dispersion mass flow sensing theory of operation