

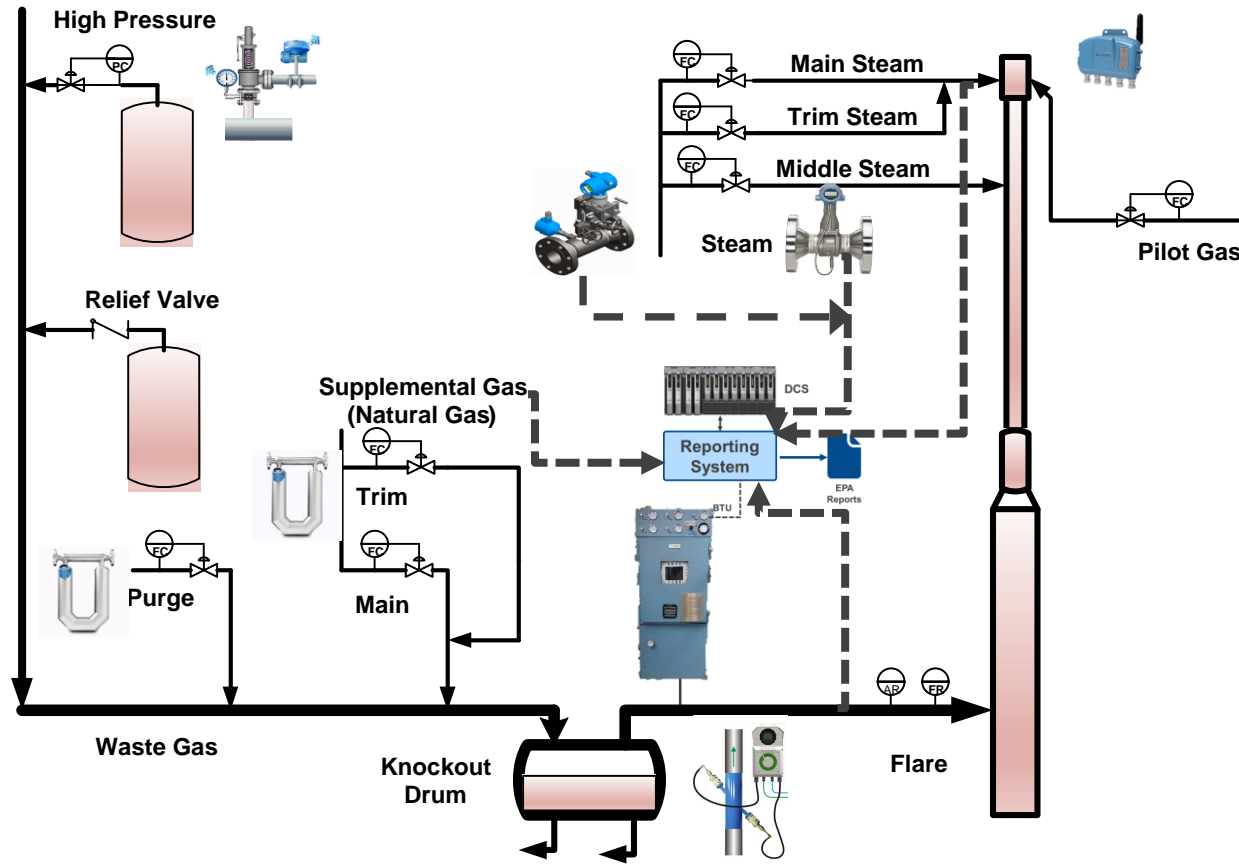
Measurement Technologies and Innovative Digital Solutions for RSR Compliance



Julie Valentine, Emerson
Director Refining Flow Solutions

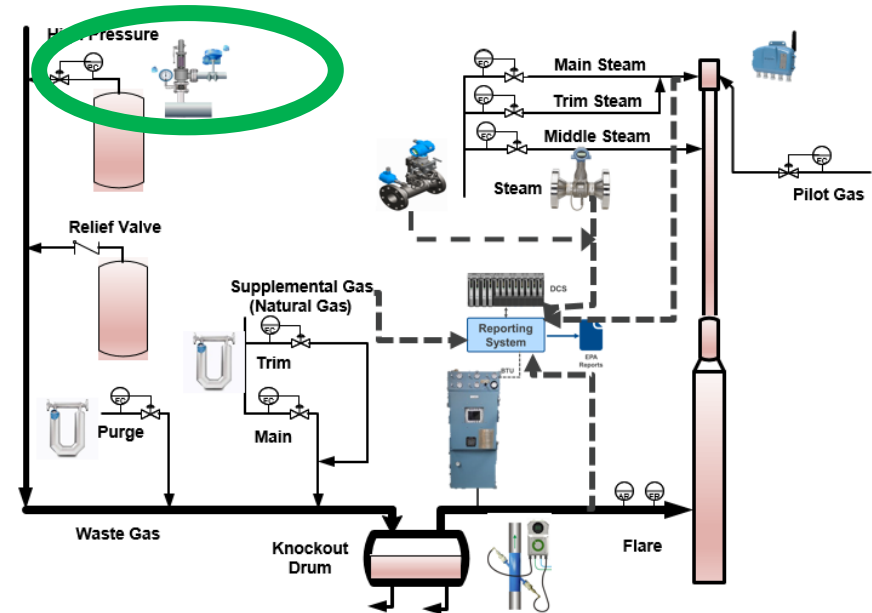
Marcelo Carugo, Emerson
Director Global Refining and Chemical
Industries

Typical Flare System with Instruments, Analyzers and Reporting System



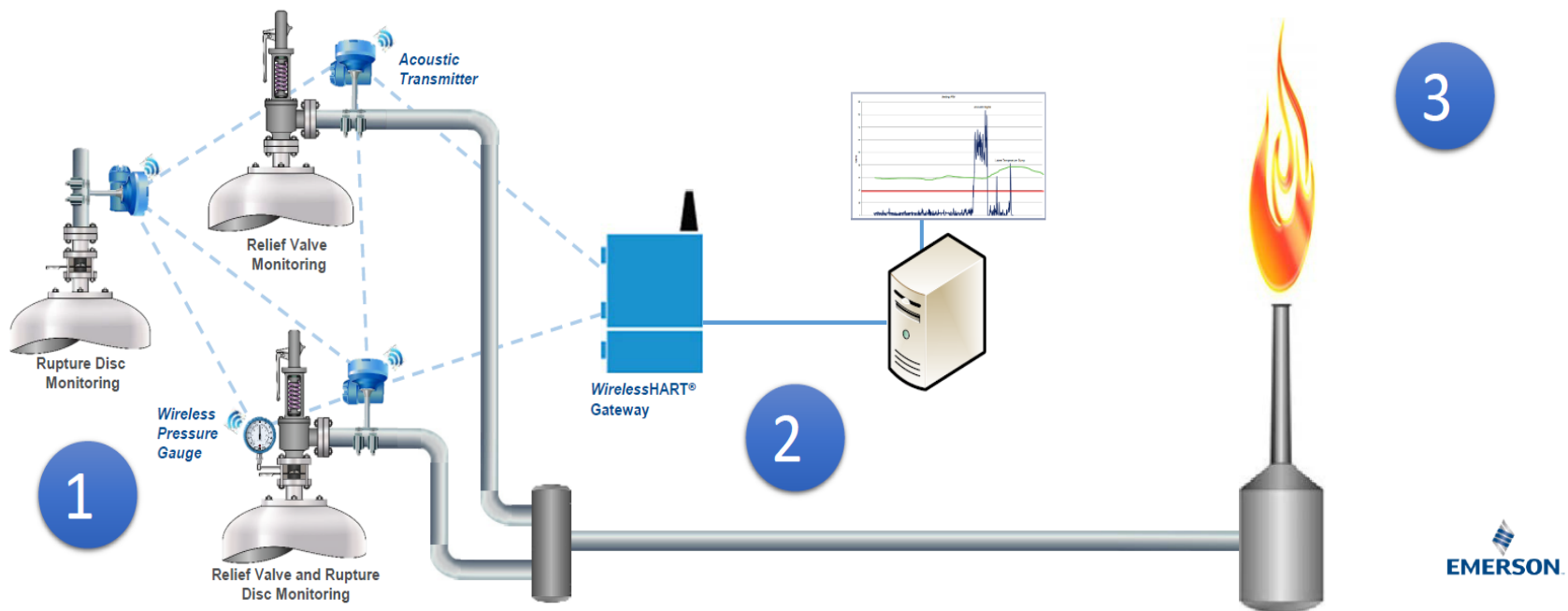
Refinery Sector Rule Solutions

- **PRV Monitoring**
- Pilot Flame monitoring
- Steam/Fuel Flow rate to Flare
 - Manufacturer's Recommendations for calibration/verification
- Composition Monitoring of the Flare Vent Gas
- Flare Vent Gas Measurement



PRD Monitoring Solution

1. Emerson's non-intrusive and wireless solution enables **lowest cost implementation**
2. Technology designed for **PRD** application delivers **the information you need for compliance** accessible through your existing host system or historian
3. **Quickly and easily identify the source of release** in your flare system





PLANTWEB

insight



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Dashboard

Asset Summary Settings



System Settings



Number of Events



of Releases
Last 30 Days
■ 4 Releases

Duration of Events



Total Release Duration
Last 30 Days
■ 5d:15h:00m

Emissions



xxx
Metric Ton / 30 days
Lost Product Cost: \$XXX

Graph Log

Asset	Event Type	Event Start Time	Event End Time	Duration	Acknowledge
PRD101	Release	October 1, 2017 2:15:00AM	Ongoing	04h:15m:00s	
PRD204	No Data/Error	October 1, 2017 5:15:00AM	Ongoing	01h:15m:00s	
PRD167	Release	October 1, 2017 3:15:00AM	October 1, 2017 5:15:00AM	02h:00m:00s	<input type="checkbox"/>
PRD123	Release	October 1, 2017 4:15:00AM	October 1, 2017 5:15:00AM	01h:00m:00s	<input type="checkbox"/>
PRD223	Release	October 1, 2017 4:00:00AM	October 1, 2017 4:30:00AM	00h:30m:00s	<input type="checkbox"/>

Show All
Unacknowledged

Show All

Home

Dashboard

Asset Summary Settings



System Settings

3h 24 1w 1m 1y

Number of Events



of Releases
Last 30 Days
■ 4 Releases

Duration of Events

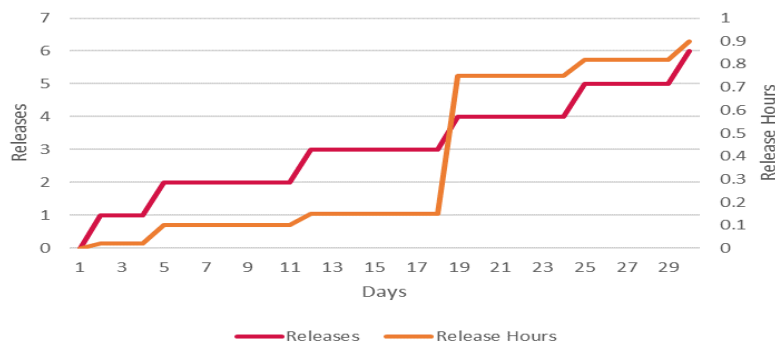


Total Release Duration
Last 30 Days
■ 5d:15h:00m

Emissions



xxx
Metric Ton / 30 days
Lost Product Cost: \$XXX

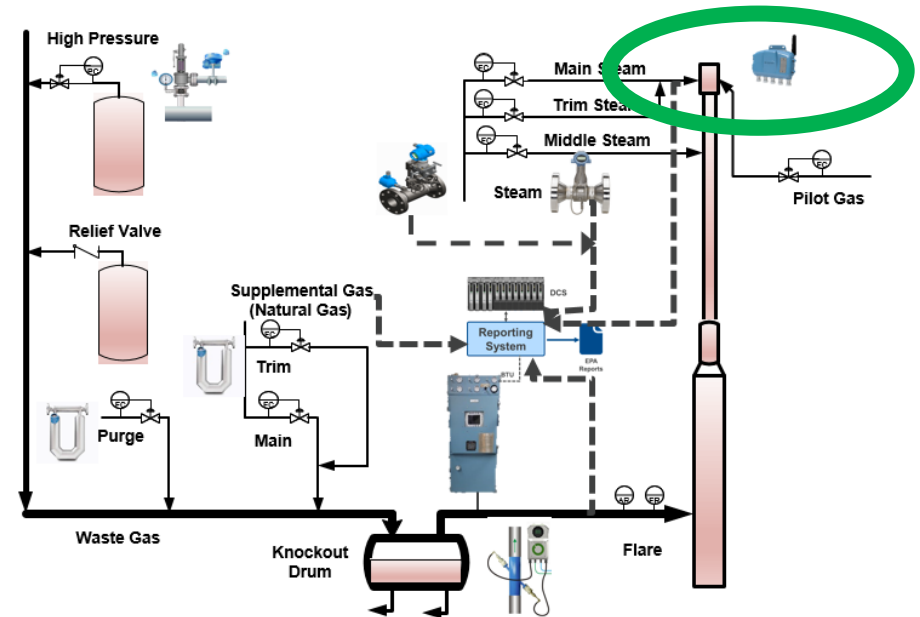


Graph

Log

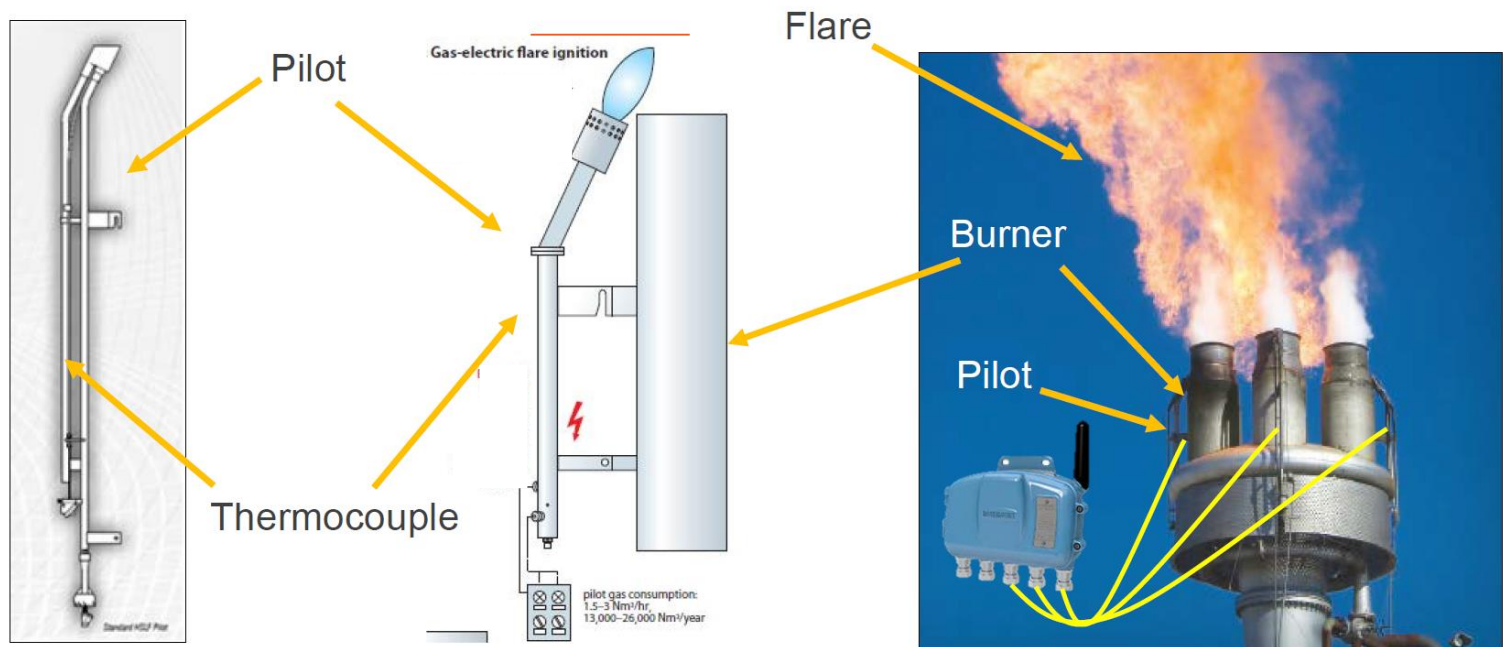
Refinery Sector Rule Solutions

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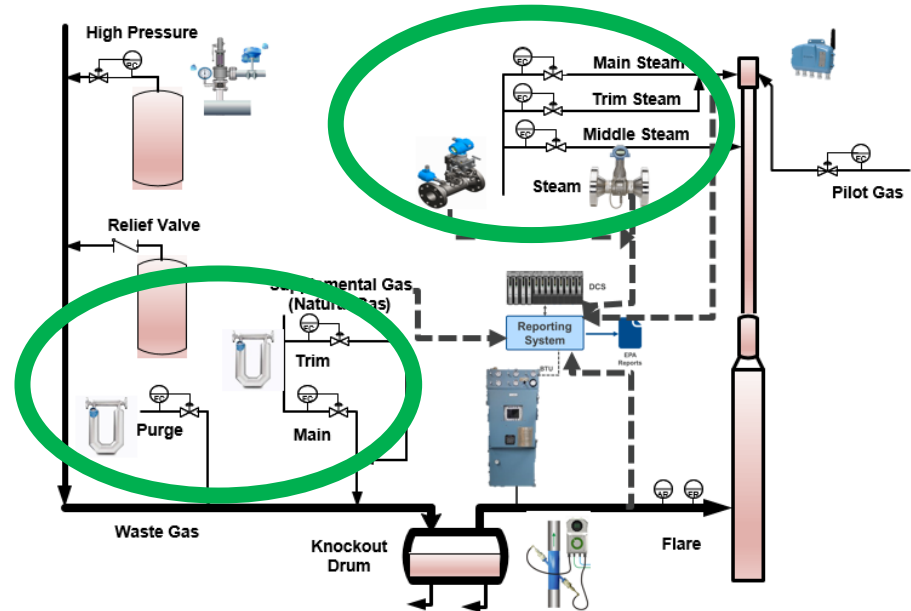
Pilot Flame Application

- (g) **Pilot flame monitoring.** The owner or operator shall **continuously monitor the presence of the pilot flame(s)** using a device (including, but not limited to, a **thermocouple**, ultraviolet beam sensor, or infrared sensor) capable of detecting that the pilot flame(s) is present.



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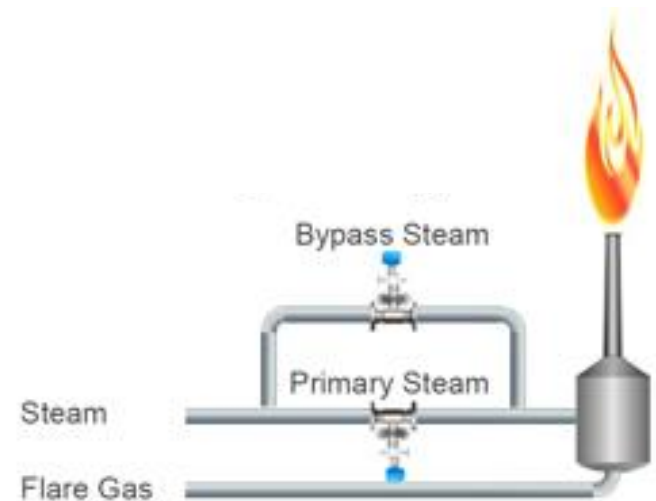
MultiVariable™ (MTA) Vortex Design for Steam or Fuel

- **Excellent choice for steam flow measurement**
- **Online Temp and Flow Sensor Replacement**
- **Accuracy 2% of Mass Flow Rate**
- **High turndown, can often meet high turndown requirements with advanced filtering**
- **Accuracy of measurement not as sensitive to shedder bar wear as other technologies are to the primary element**
- **No gaskets, leak points other than pipe connection flanges**
- **Meter verification used to check sensor and transmitter health, inspection of the shedder bar recommended at turnarounds.**



Using dP

- Ultra for Flow allows for wider turndown and extended transmitter calibration due to superior stability
- Most solutions require multiple meters in parallel lines to achieve desired flow range and accuracy requirement
- Documented solution involving parallel meter to achieve a turndown of 100:1
- Documents to support extended calibration period to up to 10 yrs including primary elements
 - Report on orifice bore wear and effect on accuracy
 - Long term annubar performance report
 - Manufacturer's Recommended Calibration Practices for Transmitters



Using Coriolis

- High turndown to meet most requirements for pilot, supplemental or purge gas
- Calibration requirements very simple with Smart Meter Verification (SMV)
 - Manufacturer's recommended calibration letter
 - Document verifying the validity of SMV



VERIFICATION OF CORIOLIS FLOW METER CALIBRATION: THEORY AND PRACTICE, INCLUDING LAB AND FIELD RESULTS
 Paper # 2015-0164 Catlin 2015

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 Boulder, CO 80301 USA

INTRODUCTION

Coriolis flowmeters precisely measure mass flow rate. Separately and independently from the measurement, Coriolis meters also measure density. Coriolis mass flowmeters use measurements to calculate volumetric flow rate of their inherent accuracy, minimum, and absence of moving parts. Coriolis flowmeters have become widespread in a wide range of applications. This paper will verify techniques, in conjunction heret robustness, can be used to do flow calibration.

Many flow measurement applications require the flowmeter be proven or verified. This can be proven like any other type using fixed or portable provers [1, 2]. This can be costly and difficult in some cases because of this, several techniques to measure the Coriolis meter have been developed. This paper will give a brief subset of meter verification techniques.

Alberta Energy Regulator's Directive 14.9 provides a framework for verification techniques to be used to extend service in some applications [3, 4]. As that the inherent reliability of Coriolis meters and their long history of maintenance free development of advanced verification by vendors provide measurement coriolis verification is also recognized by MPMS Ch 14.9. This recognition can ownership of Coriolis technology.

To give users a framework to make it more around meter verification, stable testing will be discussed. Hypothesis 2 x 2 matrix to present the four aspects relating meter condition and verification.

Flow and verification data from third-party manufacturer's meters will be presented. Hypothesis testing with actual field data shows the validity of using meter confirm meter accuracy.

Presented at Canadian School of Hydrocarbon Measurement with permission

Verification of Coriolis Flowmeter Calibration

Expressed algebraically, mass flow rate through a sensor \dot{m} , is given by

$$\dot{m} = FCF \cdot \frac{d}{dt} \quad (1)$$

The FCF, the mass flow calibration factor, is defined in units of mass flow rate/time delay. Typical units for the FCF is (gm/sec)/usec.

This is shown dimensionally using fundamental physical units as

$$FCF = \frac{\text{Mass}}{\text{Time}} \cdot \frac{\text{Time}}{\text{Time}} \quad (3)$$

(The $\frac{\text{Time}}{\text{Time}}$ can be read as "has units of") In a consistent system of units, mass can be represented by force/acceleration, taking advantage of Newton's Second Law. Substituting this into Equation (3) shows that the flow calibration factor has units of stiffness (Force/Length).

$$FCF = \frac{\text{Mass}}{\text{Time}} \cdot \frac{\text{Force / acceleration}}{\text{Time}} = \frac{\text{Force}}{\text{Length}} \cdot \frac{\text{Length}}{\text{Time}^2} = \frac{\text{Force}}{\text{Length}} \quad (4)$$

So the FCF, which relates it to the mass flow rate, is simply a scalar multiple of the stiffness. Mass flow rate is the fundamental measurement made by Coriolis flowmeters.

DENSITY MEASUREMENT

Coriolis flowmeters also independently measure the density of liquid process fluids by very accurately measuring the resonant frequency of the drive mode. The resonant frequency is a function of the stiffness of the flow tubes and the mass of the flow tubes which includes the mass of the steel of the flow tubes plus the mass of the fluid within the tubes.

$$Freq = \sqrt{\frac{\text{Stiffness}}{\text{mass}_{\text{tube}} + \text{mass}_{\text{fluid}}}} \quad (5)$$

The stiffness of the flow tubes and the mass of the steel in the flow tubes is constant, so the resonant frequency depends on the mass of the fluid in the tubes. Since the tubes contain a fixed volume of fluid, the resonant frequency is dependent on the density of the fluid within the flow tubes (density=mass/volume).

While Coriolis meter can measure density of liquids very accurately, the density signal is not adequate for accurate gas density measurement. Other vibrating element technologies are optimized for gas density measurement.

CORIOLIS METERS & VOLUMETRIC FLOW RATE

Coriolis flowmeters can calculate volumetric flow rate from the independently measured mass flow rate and density using Equation (6),

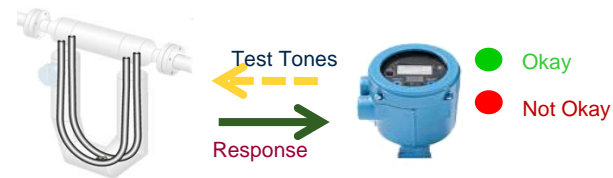
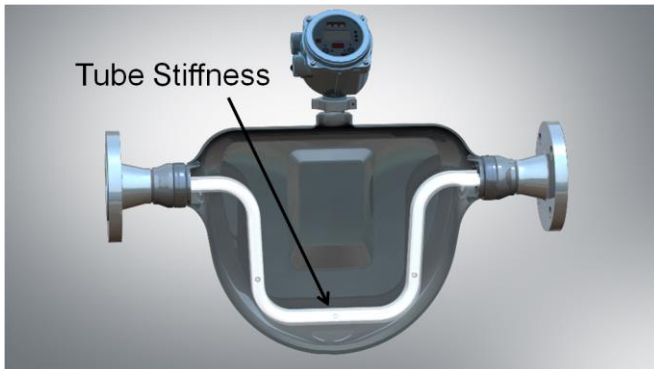
$$Q = \dot{m} / \rho \quad (6)$$

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Smart Meter Verification Diagnostic Tool

- In-situ testing of meter integrity
 - Tube stiffness
 - Sensor components
 - Transmitter electronics
- On demand or scheduled
- No measurement interruption
- Historical data available
- Third party independent testing validates SMV as an effective diagnostic tool

“Exhaustive testing determined that when SMV returned a passing value, the meter was meeting its’ mass flow specifications” NMi



Calibration
Data assurance
Maintenance

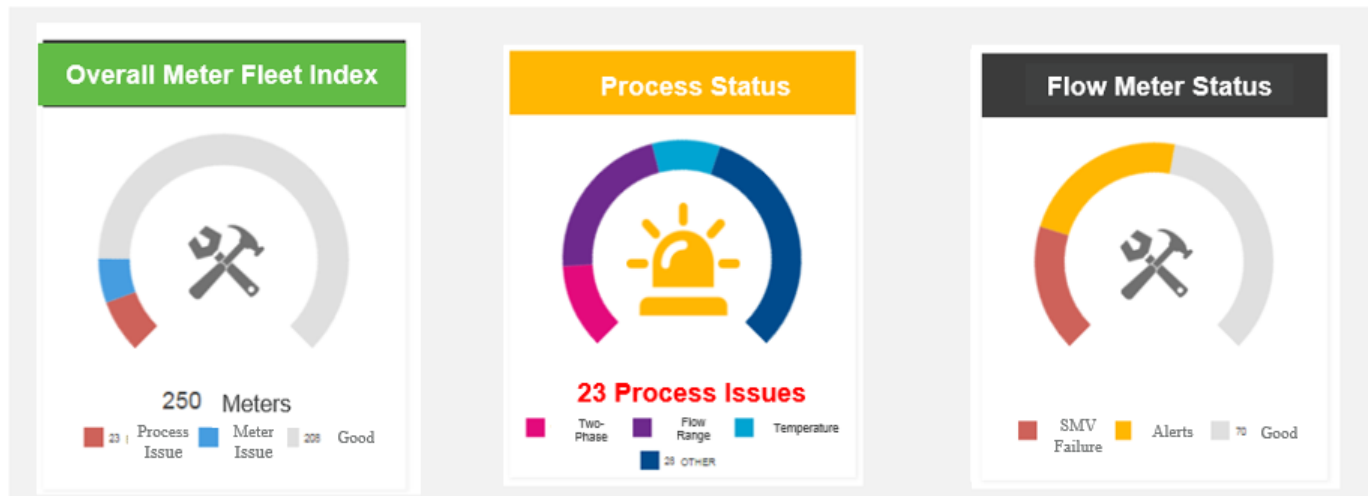
Changing Workforce



Additional Needs

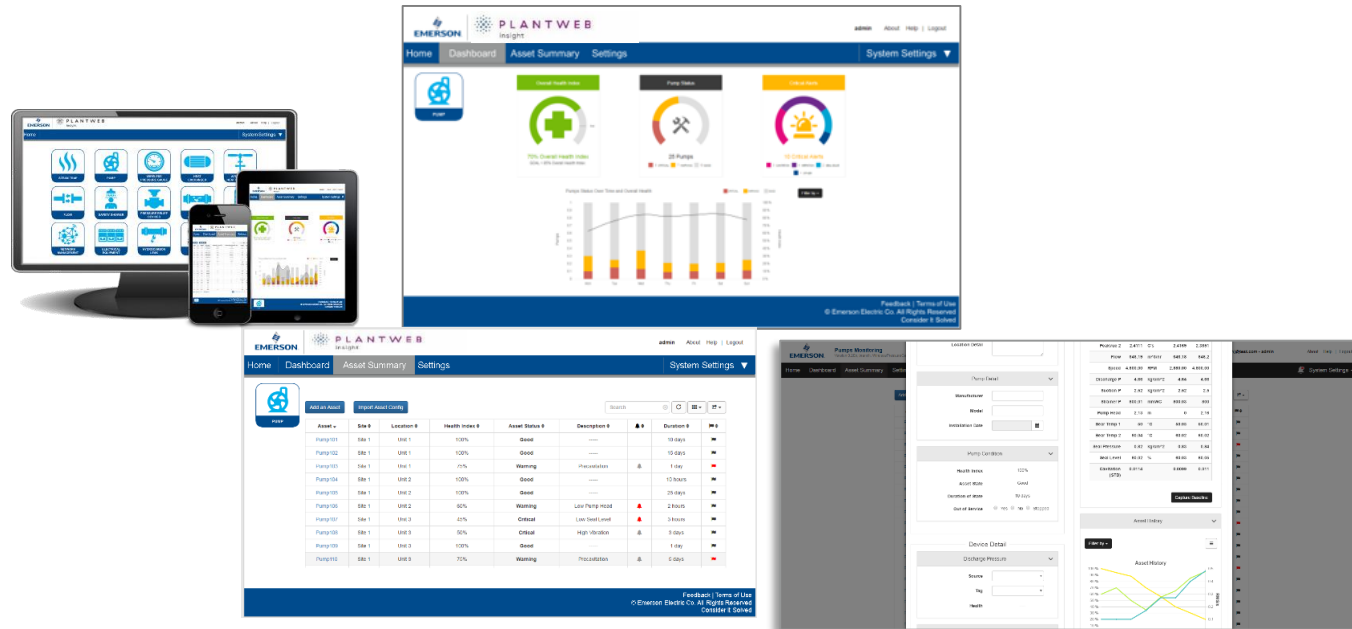
- **Overview** of Diagnostics **About your Process**
- **Direction** where to Focus Action (“Know before you go”)

Smart Meter Fleet



Aggregation of Flow Meter Fleet Process Information and Direction for Action

Plantweb Insight has Pre-Built Analytics, Minimal Configuration, Intuitive Design, and Consistent User Interface



IIoT Platform that serves key emerging Customer Needs:

1. **Remote access** to information, **aggregates** multiple sources
2. Visualization and Analytics – **Provides Information, not Data**
3. Serves **Different Personas** (those without access to control system)
4. Provides **easier deployment and updates** of software **without risk to control** instrument firmware

Intelligent Systems Enables Our Lifecycle Services to Keep Your System Running and Profitable

Emerson Monitoring



VPN or SSL
Data Transfer

Customer
Engagement

Customer Site

Customer Site

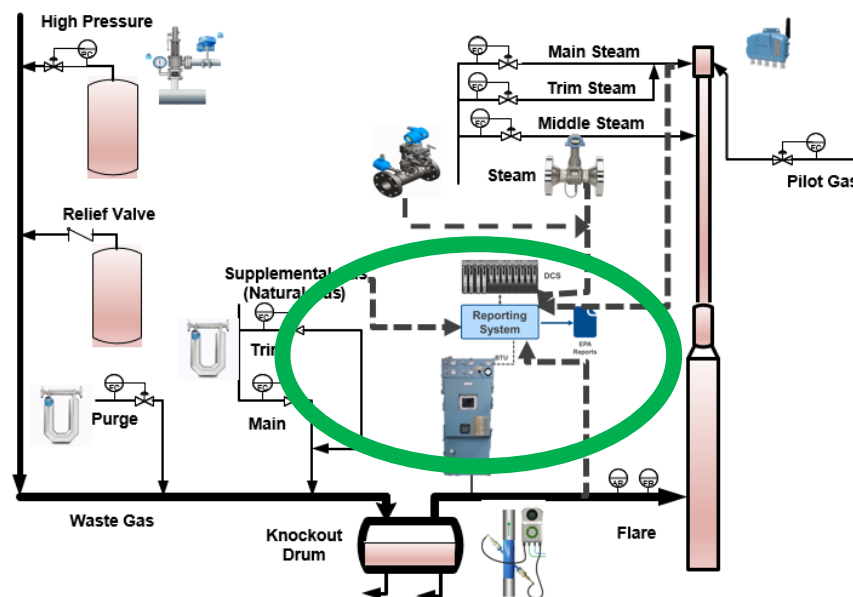


Issue Detected at Site



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New 1500 XA Gas Chromatograph



3-Sided shelter and Cabinet Options Enable Complete Solution

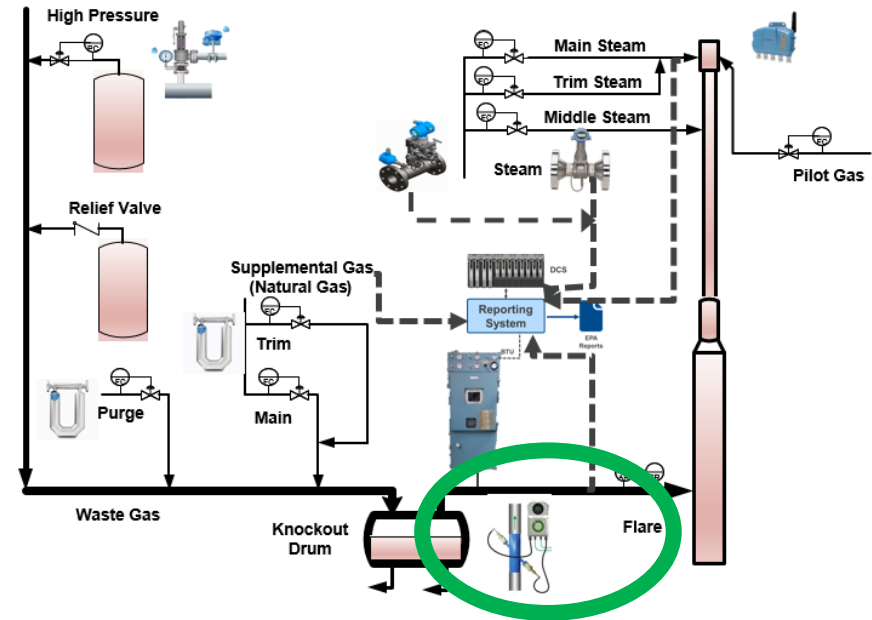
Emerson Solution

1500XA Gas Chromatograph with 4 Thermal Conductivity Detectors

8 Minute Cycle Time

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Accurate Flare Flow Measurement Critical to Reduce Losses



Challenges

- Large gas flow velocity range (0.03-120m/s)
- Low pressure
- Variable gas composition
- Accuracy without pressure
- Requirement of 5% over most of the flow range



- An ultrasonic time-of-flight flowmeter measures the difference between upstream and downstream signal transit times which are directly affected by gas flow rate.
- The difference in transit times is used to calculate velocity of the gas flow.

Other Ultrasonic – Intrusive Measurement

Disadvantages of Some Ultrasonic Meters

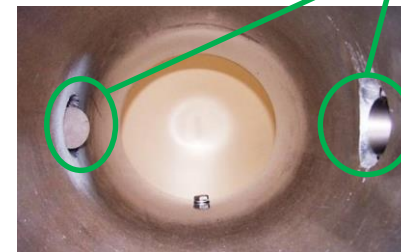
- Intrusive Sensors, high velocity can damage the sensors during a flaring event
- Requires Multiple Sets of Sensors to cover full flow range
- High Maintenance Costs

Advantages of Fluenta Technology

- Utilizes a single set of non-intrusive sensors
- Uses broadband (multi-frequency), un-dampened transducers to measure the range 0.03 – 120 m/s
- Low maintenance costs



Fluenta probes are wetted but non-intrusive!



Robust velocity measurements up to 120 m/sec

Questions?

