Flare System - How to Simplify Three Projects' Execution
While Saving on Installation Cost and Improving Productivity

Marcio Donnangelo
Global Business Development Manager
Wireless Technologies
Agenda:

1. PRD Monitoring
2. Steam to Flare
3. Pilot Flame Monitoring
WirelessHART Industrial Network

**Basic Elements**

**Wireless Transmitters**
Field Sensors
Pressure, Temperature, Acoustic, Flow, Level, Corrosion, etc.

**Application**
One or more transmitters monitoring equipment
Safety Shower, PRVs, Pumps, Heat Exchangers, etc.

**Gateway**
An interface between Wireless Transmitters and Host System
WirelessHART Industrial Network

- Based on the same wired HART Standard that the instrumentation team is already familiar with
- Transmitters send field information to the Gateway (WirelessHART® protocol)
- Gateway is connected to the System (HART-IP, Modbus, TCP-IP, etc.)
WirelessHART® Gateway

- How can it expand to cover long distances in complex installations such as refineries?

Control Room, Security Room or 24/7 Location

WirelessHART Industrial Network

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WirelessHART Industrial Network

Control Room, Security Room or 24/7 Location

WirelessHART Gateway

- Pressure
- Acoustic
- Corrosion
- Temperature
- Discrete I/O
- Safety Shower
- Eye Wash Station

WirelessHART is NOT a star or point-to-point topology network
WirelessHART Industrial Network

- WirelessHART uses a Self-Organizing Mesh Network configuration
- Each transmitter is also a repeater!
- Reliable data transmission due to multiple path communication
- Easy to cover long distances
WirelessHART Industrial Network

Tech Notes Overview:
- Up to 100 devices per Gateway
- Update rates from 1 to 3600 seconds
- Up to 10 year power module life
- Standard range between devices is 200 meters
- 3+ kilometers with remote antenna
WirelessHART Industrial Network

- What happens if the communication path is lost?
WirelessHART Industrial Network

Advantages of Self-Organizing Mesh over Other Mesh

- **Self-Forming**
  - Adding Devices
  - Removing Devices

- **Self-Mitigates Obstacles**
  - Standard Instrument Locations
  - No RF Survey
  - No Manual Link Configuration
  - Native Redundancy

- **Self-Heals to Environment**
  - Weather
  - Infrastructure Changes
  - Device Location Changes
Wireless Technology is the Lower Total Cost Solution for Missing Measurements

- 51 Emerson Wireless Products Available Today
- 32,100+ Wireless Networks Operating Globally
- 10+ Billion Operating Hours
- 4100+ Emerson Wireless Experts
- 11 Proven Integration with All
- 146 Major Automation Suppliers Operating in Countries
- 7 Solutions for Plant Operations Including Mobility, Bridging, Tracking, Safety, Data Backhaul and Video
- 9 Emerson Has Won Wireless Infrastructure Category 2009-2017 (9 Consecutive Years). Control Readers' Choice Awards
Flare System - How to Simplify Three Projects' Execution

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40 CFR Parts 60 and 63
Petroleum Refinery Sector Risk and Technology Review and New Source Performance Standards

• Flare System Due Date: Jan, 30 – 2019
• Highlights for this presentation:
  • PRD Monitoring
  • Flare Monitoring
  • Steam to Flare

• Others Monitoring Request:
  • Coker - The output of the pressure monitoring system must be reviewed daily (§63.657(b)(5) - Delayed coking unit decoking operation standards.)
  • Pressure and Temperature Monitoring points on FCCU
  • Requiring daily checks of the air or water pressure to the spray nozzles
  • etc.

• Consent Decree: https://cfpub.epa.gov/enforcement/cases/index.cfm

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1) PRV Monitoring Overview

- Environmental regulations require critical PRDs to be electronically monitored.
- Implementing a real-time monitoring system ensures compliance while providing operational benefits and cost savings.
- Leading industries have implemented this technology and achieved immediate results.
Results from the 69 Monitored PRVs

- More than 200 lifts and reseating events over 15 months
- Inspection is required to fill out an RV Post Activation Report each time it lifts
- 20 Problems were identified and resolved

<table>
<thead>
<tr>
<th>Problems by Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bypasses found open</td>
<td>3</td>
</tr>
<tr>
<td>Leaking RVs that were replaced</td>
<td>6</td>
</tr>
<tr>
<td>Leaking RVs that were rebuilt</td>
<td>6</td>
</tr>
<tr>
<td>RV did not reseat, blocked in, depressured, RV resealed</td>
<td>5</td>
</tr>
</tbody>
</table>
PRD Monitoring - Key Facts from Regulations

- Operators would **install electronic monitors** on PRDs that vent to atmosphere to **identify and record the time and duration** of each pressure release (§ 63.648 Equipment leak standards)

- **Identify the source of release** on the flare systems for root cause analyses (§63.670, paragraphs (o)(3))

- Implement at least 3 of the **redundant prevention** measures for each pressure relief valve that can **discharge to the flare** (§63.670, paragraphs (o)(1)(ii)(B) and (o)(1)(vi))

- **Reporting emissions** during startup and shutdown (§63.670, paragraphs (o)(3)(g)(vii))

- **H₂S exemption claim** if the exceeding emission was due to leakage and it has been repaired (§ 60.105 Monitoring of emissions and operations)

Real-time monitoring systems can also be used to detect leaks in shutoff and bypass valves.
Challenges With Compliance

• Manual monitoring: *Inefficient, unsafe and doesn’t meet the requirement*

• Traditional electronic monitoring technology is expensive due to **complex installation and commissioning requirements**

• Identifying time and duration of releases using process information requires **extensive data interpretation, time and expertise**

• Locating the source of release in your flare system requires even more complex analysis and can result in **increased emissions or production slowdown**
Desired Features for Real-Time PRD Monitoring Solution

- Non-intrusive and wireless solution enables lowest cost implementation
- Technology designed for PRD application delivers the information you need for compliance accessible through your existing host system or historian
- Quickly and easily identify the source of release in your flare system
Desired Features for Real-Time PRD Monitoring Solution

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Non-Intrusive Design

Acoustic Transmitter Features

- Strap-on Installation on PRV Downstream
- WirelessHART® Data Communication
  - Acoustic
  - Temperature - for pipe surface
  - Operating Temperature - electronic board
  - Battery Charge
- Long Battery Life – 1 to 60 Second Updates
  - 5.8 year @ 8 Second
  - 10 year @ 32 Second

The non-intrusive sensor clamps directly onto the PRD vent pipe surface. It’s that simple!!! Install in just minutes.

Probe with Acoustic and Temperature Sensors
Downstream Acoustic Monitoring Benefits

• Observe upstream pressure peaks and valleys around the pressure limit
• Challenges of monitoring with process pressure
• Peaks and valleys make it difficult to determine when the PRD is actually opened or closed
Downstream Acoustic Monitoring Benefits

- Eliminate Process Pressure Information Interpretation
- Eliminate False Positives
- Easy to Identify Release Duration
- Stuck Open
- Leak Detection
- Simmering
Meet ASME Requirements for Rupture Discs

Wireless Pressure Gauge

- *WirelessHART®* Data Communication

Detect and react to Rupture Disc failure before it becomes critical

Under normal conditions, pressure is atmospheric behind the rupture disc

When corrosion or pinhole leak occurs, pressure build-up goes undetected

ASME *(Section VIII – Div. 1)* requires the space between the Rupture Disc and a PRV shall be provided with pressure monitoring
Identifying the Source of Release in Your Flare System

Challenges

• Not all releases are audible to human detection even when the PRD is releasing to the atmosphere

• Using process information to identify where the release is coming from requires hours to days of expert data analysis and exposure to what may be a hazardous area

Every minute spent identifying which PRD is releasing leads to increasing emissions, regulatory fines and lost production
Identifying the Source of Release in Your Flare System

Solution

- Comprehensive PRD monitoring for closed recovery and flare systems enables immediate identification and response

Eliminate the need to slow down production and ensure minimal emissions with clear visibility to your full system
Fast Detection of Releases and Leakages

- Undetected PRD leakages happen quite often
- Even a small leak (0.1% from PRV flow area) can cause tens of thousands of dollars per year of material losses

Leakages caused by PRD malfunctions can waste large amounts of valuable product, along with the energy required to produce these products.
PRD Leaking detection example

Counts (Acoustic)

Skin Pipe Temperature
Customer Experience

Major U.S. Refinery

**CHALLENGE**
Detecting PRV releases and leaks, current work process on average detected the source within 48-72 hrs. up to weeks. Environmental fines are levied on H₂S releases to flare.

**SOLUTION**
Non-intrusive wireless solution utilizing acoustic / temperature transmitters to detect the PRV release in real-time.

**RESULTS**
Detected at least 200 incidents. Identified 20 “bad actors” and the problems were resolved within an hour.
Increased throughput and revenue of the units.

ROI: 270%

“*The increased throughput and revenue was an unexpected bonus*”
Results from the 69 Acoustic Monitors

- The ability to pinpoint broken or stuck-open PRVs saves weeks and even months of high flow releases.
- The ability to detect “undetectable” slow or intermittent releases.

“Over time, all these actions combined have a significant impact on reducing the total $H_2S$ and hydrocarbon flow to the flare.”

“The acoustic data shows when we are operating outside of operation limits, and now we have more confidence to increase throughput of the units.”
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2) Steam to Flare

Key Facts from Regulation

- Refining Sector Rule, Section § 63.670(i)(2)
- Refinery compliance deadline January 30, 2019
- Chemical currently reviewing flare application
- **Mass flow monitors** used for determining volumetric flow rate of assist air or assist steam. (Temperature and Static Pressure compensation)
  - Flow sensor calibration **check at least biennially**. (every other year)
  - ±5 percent over the normal range measured for mass flow.
Why/When do Refineries Use Steam Assist?

• Steam injection creates turbulence as it is injected into the vent gas
  • Improve combustion through mixing
  • Reduce smoking
  • Reduce metal temperature
• Complete combustion
  • Eliminates VOC (volatile organic compounds)
  • Eliminates toxic gas emissions into the atmosphere
• In general, 0.4 lb. of steam per 1 lb. of flare gas is the amount needed for complete combustion efficiency
  • Over-steaming reduces combustion efficiency
  • VOCs and toxic gases being emitted to the atmosphere
Application Challenges

Fact: The amount of hydrocarbon flowing to the flare can vary widely

• A stack gas flow range-ability of 100:1 is not uncommon
  • To comply with the regulation, the steam assist flow-metering must achieve the same flow range
  • To achieve this very wide range-ability with the required ±5% of mass flow accuracy, the user requires two parallel steam flow lines
    • A large line (probably existing) with a “High Steam” flowmeter for 0-100% of flow
    • A small line (probably new) with a “Low Steam” flowmeter meter for ~0-10% of flow

• Verification every 2 years
Application Challenges

• Vortex with P&T compensation  →  Still need 2x meters for turndown

• Ultrasonic with density compensation  →  Verification requires too long, and incurs cost.

• dP-Flow with separate dP, P, T and DCS calculation
  • Variety of different primary elements
  • DCS calculation may be simplified or “complete”

Expensive, complex (or inaccurate).
Integrated DP-Flow for Steam to Flare Monitoring Solutions

- Integrated P&T
- Mass flow equation with gas expansion
- Pre-engineered, leak-tested, drop-in
- Easy verification – by user or by vendor

\[
Q_{\text{flow}} = NC_eX_eD^2 \sqrt{\frac{\text{DP}(\rho)}{\text{P}}} \]

Accurate Flow Measurement Requires Dynamic Compensation

4C HSE CONFERENCE
San Antonio, TX | April 3-5, 2018
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3) Pilot Flame Requirements

Section § 63.670 Requirements for flare control devices.

- (b) **Pilot flame presence.** The owner or operator shall operate each flare with a pilot flame *present at all times* when regulated material is routed to the flare. The pilot system must be equipped with an automated device to relight the pilot if extinguished. The owner or operator shall **monitor for the presence of a pilot flame** as specified in paragraph (g) of this section.

- (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.
Pilot Flame Monitoring

- Thermocouples - most common method
- Ionization – Indicated for enclosed environment but susceptible to wet, dirt, rust, shorts and uses high tension ignition
- UV – Potential false positive due to sunlight
- IR - Remote mount, Potential false positive due to fog; difficult to see individual pilots requiring multiple devices
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PRV
PRV and RD

Rupture Disc

Flare Gas
Steam

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Where To Get More Information

Visit Emerson Booth 629

- PRV Monitoring in action (Hands-On)

- Non Intrusive Corrosion Monitoring

- New Wireless Gas Monitoring

- Visit also Emerson Wireless pages:

  http://www.emersonprocess.com/PRDWirelessMonitoring
Thank You for Attending!
Enjoy the rest of the conference

Marcio Donnangelo
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Wireless Technologies