Fugitive Emissions – Our Opportunity as a Community for Exponential Impact

Seth Harris Director of Sustainability – Americas Sales

EMERSO

Emerson Confidential

Agenda

Foundation - Hidden Cost of Valve Emissions

Our Opportunity as a Community – Emerson's Sustainability Framework "Greening Of, By & With"

5 Bray EMERSON MRC Global

Our Opportunity for Exponential Impact – Emissions Management - Where Do I Start

Key Takeaways

SPONSORED BY:

Foundation – Exponential Impact





The Hidden Costs of Valve Fugitive Emissions

Fugitive Emissions:

Unintentional and undesirable emission, leakage, or discharge of gases or vapors from pressure-containing equipment



Seth Harris, Emerson

Outdated and incorrectly specified valve designs put your plant personnel, the community and the environment at risk

> * Source: Monitoring and Containment of Fugitive Emissions from Valve Stems, University of British Columbia, Vancouver.



Your Selection of Valve Technology Matters



Minimize Safety Risks

Modern valve designs can minimize risk of harmful fugitive emissions to personnel and the environment.

Achieve Compliance

Advanced modern valves help you stay ahead of increasingly stringent and complex emissions regulation.

Improve Profitability

Improve the profitability of your operations with increased process efficiency and minimized product loss.

Targeted valve upgrades offer the opportunity to meaningfully advance your **sustainability goals** and **plant profitability**.



Decrease Operating Costs

Lower your maintenance labor and equipment costs related to identifying and repairing leaks.



Understanding Standards

Hierarchy of Regulation

AS

International Sets direction *Kyoto, Copenhagen, COP26*

> National Governments Pass laws Clean Air Act

> > Environmental Agencies Set limits & penalties EPA Procedure 21

> > > Industry Standards Ensure Compliance ISO 15848-1 & 2 API 608, 641, 622 Shell MESC 77- 300/312 TA Luft acc. to VDI 2440 FCI 91 - 1 EPA Process 22 Res

ISO 15848-1 / -2

Specifies testing procedures for evaluation of external leakage of valve stem seals (or shaft) and body joints of isolating valves / control valves intended for application in volatile air pollutants and hazardous fluids.



API 608

From July 1, 2020, the latest revision of API 608 – Metal Ball Valves mandates that compliant valves are certified to API 641 First Edition – 2016 – Type Testing of Quarter-turn Valves for Fugitive Emissions.









Enabling Decarbonization And The Clean Energy Transition

Our solutions enable the low-carbon transition of our customers in four strategic areas:

Energy Source

Decarbonization

Electrification &

System

Integration

Emissions

management

Energy Efficiency &

Optimization

Low-carbon Power Low-carbon Fuels Hydrogen & H2-based Fuels

End-use Electrification (Heat Pumps) Energy Supply Optimization Storage & Grid Management

Emissions Monitoring Carbon Capture & Storage Natural & Low GWP refrigerants

Advanced Controls & Analytics Simulation & Remote Monitoring Waste Management

GREENING WITCO22

Engaging our Governments and Policy Groups

Collaborating with Leading Research Institutions

Convening Leaders and Communities



BUSINESS 1.5°C



Clean Energy Buyers Association









by

We commit to reaching
Science-Based Aligned

Net Zero GHG Emissions

across all Scopes (1, 2 & 3)

from 202

To get us on the right pathway by



we commit to achieving...



in our offices and facilities

5 Bray EMERSON MRC Global

25% Absolute Reduction

Scope 3 GHG Emissions

Reduce 25% our Energy



our Energy Intensity



Beyond our four walls, we have a huge opportunity to influence change in our value chain

FUGITIVE EMISSIONS

SUMMIT

AMERICAS



WHERE DO THE REST OF OUR EMISSIONS COME FROM?



From the materials, components & capital goods that we purchase

2,049,500 mTCO₂e



From the transportation & distribution of our products

803,000 mTCO₂e



From the daily commute of Emerson employees

155,000 mTCO₂e



From the disposal or recycling of our products

150,000 mTCO₂e

FUGITIVE EMISSIONS

Reinforcing our commitment to becoming an ESG leader with strong governance

2021 ENVIRONMENTAL, SOCIAL AND GOVERNANCE REPORT

В

BBB

E-4 | S-2

Medium Risk

Ø

*

ICFD

.114

SASB

EMERSON



ENVIRONMENT REPORTS



ENERGY SOURCE DECARBONIZATION



Low-carbon Power (Solar, Wind, Nuclear, Hydro)



Low-carbon Fuels (Biofuels, LNG)



Hydrogen & Hydrogen-based Fuels





<u>(B</u>)

SPONSUR

(@)

EMISSIONS MANAGEMENT





Carbon Capture Utilization & Storage

Emissions

Monitoring

& Control



Natural & Low GWP Refrigerants



Controls &

& Remote

BONNEY FORCE

ELECTRIFICATION &

SYSTEM INTEGRATION

End-use

Electrification

(Heat Pumps)

Energy Supply

Enabling the decarbonization and clean energy transition of a broad range of critical industries

MERSON MRC Global

MANUFACTURING INDUSTRIES

20 GtCO₂e

2022



Sealing for a Safer and Greener Tomorr



Enabling the decarbonization and clean energy transition of a broad range of critical industries

IERSON MRC Global

MANUFACTURING **INDUSTRIES** 2022

ENERGY SOURCE DECARBONIZATION







EMISSIONS

 $\langle \cdot \rangle$

CO2

MANAGEMENT

Emissions

& Control

Utilization

& Storage

Monitoring

Carbon Capture

Natural & Low

GWP Refrigerants



Hydrogen & Hydrogen-based





Energy Supply Optimization

Energy Storage & **Grid Management**

ENERGY EFFICIENCY & OPTIMIZATION

& Remote



Sealing for a Safer and Greener Tomo

SOR

-(~ 0



Our Opportunity for Exponential Impact – **Emissions Management - Where Do I Start?**



Increasing Environmental Regulation – Regulators enforcing tighter emissions standards



Gaps in Expertise – Don't have in-house expertise to address complex standards



Limited Capital for Upgrade Projects - Sharp focus on efficiency of allocated capital



Outdated Technology – Inferior valve technology can introduce risk to personnel



Cost of Intervention – Replacing emitting valves requires process shutdown



Sustainable Operations Becoming a Barrier to Entry – Must have strong emissions credentials **TATER SON MRC Global**

2

Example: New Environmental Regulations Requiring PRV Monitoring - Emissions Will Be Visible and Reported!

Example: New EPA Regulation for Basic Chemical Manufacturing – August 12, 2023

40 CFR Part 63 - Subpart FFFF – Miscellaneous Organic Chemicals (MON) (§ 63.2480(e)(3)(i)) (3) Pressure release management. ...

(i) You must equip each affected <u>pressure relief device</u> with a device(s) or use a <u>monitoring</u> system that is capable of:

(A) Identifying the pressure release;

(B) Recording the time and duration of each pressure release; and...

40 CFR § 63.2520 – "What reports must I submit and when?"...

(iii) If any affected <u>pressure relief device</u> releases to atmosphere as a result of a <u>pressure release</u> event, You must also calculate the quantity of <u>organic HAP</u> released during <u>each pressure release</u> event and report this quantity ...

40 CFR § 63.2445 – "When do I have to comply with this subpart?"

(g) All affected sources that <u>commenced construction</u> or <u>reconstruction</u> on or before December 17, 2019, must be in <u>compliance</u> with the <u>requirements</u> listed in paragraphs (g)(1) through (7) of this section upon <u>initial startup</u> or on August 12, 2023, ...

Proper PRV Selection Reduces Releases, and Volume of Each Release



Limited Capital for Upgrades

Outdated Technology



Valves with rising stems, such as gate valves and rising stem ball valves, **extrude emissions** up through gland box when cycling, while also **wearing the packing faster**. Packing materials have also advanced, leaving **legacy compounds** far behind.

High Frequency Cycling



Valves in frequent cycling applications experience repeated wear and side load impact on the packing materials that are designed to contain fugitive emissions as the stem rotates or rises through the stem seal system.

Temperature Cycling



Individual components of a valve experience thermal expansion and contraction at different rates depending on their material properties. This asymmetrical movement creates leak paths for fugitive emissions.

Challenging Media



Valves used in challenging process media such as those in **corrosive or lethal services** should be given special attention when considering fugitive emission prevention to **protect personnel and** the community.

Accessibility & Downtime Risk



Consider valves on services that are **critical to plant throughput** with limited bypass or redundancy options. Or even valves in **challenging locations** that require equipment hire, additional labor and/or time to repair.

Identify and upgrade your highest risk values to maximize returns on sustainability investments

5 Bray EMERSON MRC Global

SPONSORED BY:

What Does a Superior Low Emission Valve Look Like?



Quarter Turn Action

Rotary stems eliminate the challenge of rising stems to draw particulate up through the packing when cycling to create or reactivate leak paths.

Precision Machining

Smooth surfaces enable smaller tolerances between moving internal components to ensure tighter sealing without overcompression.

Engineered Sealing Materials

For enduring performance, materials must be optimized for cycle frequency, temperature range and process media permeability.



Live-Loaded Stem Seal System

The system dynamically self-adjusts to provide optimal packing compression over the lifecycle to ensure compliance without maintenance.



Certified Compliance

Ensure manufacturers are able to demonstrate proven testing performance to the specified standard to mitigate your compliance risk.

Side Load Protection

Support of the valve ball or disc eliminates sideways movement during cycling to prevent premature packing wear and deformation.

High Integrity Joints

Joints are the 2nd leading source of emissions in valves so ensure components used have similar thermal expansion & contraction rates.

No-Bleed Automation

Venting of gas-powered devices can be a major source of emissions. Electric and emissions controlled actuators solve this challenge.

Specify these features when upgrading emitting valves

Bray EMERSON MRC Global

SPONSORED BY:

Technology Options to Reduce Emissions from Actuated Valves

Natural Gas Powered Valves

- Methane released as normal course of operation
- Upstream/Midstream applications



- Pneumatic Controllers
- Control Valve Operation
- On/Off Isolation Valves
- ESD Valves

*New

SPONSORED BY:

<u> </u>		
	ESD	 SY / RP / RV Direct Gas Gas over Oil
Technology	CapEx	\$

	Emissions Impact					
	Current	Good 💋	Better 💋 💋	Best* 🔊 🔊 🌶		
ower	Natural Gas	Natural Gas N2 B	ank Air Compressor	Utility Solar		
ontrol	High BleedController	 Low Bleed Controller 	 High or Low Bleed Controller 	• Electric		
		Valve Packing Monitoring				
n / Off	 SY / RP / RV Direct Gas Gas over Oil 	 SY / RP / RV Direct Gas Gas over Oil 	 SY / RP / RV Direct Gas Gas over Oil 	 E-CAT Electric EHO 		
5D	 SY / RP / RV Direct Gas Gas over Oil 	 Self-Contained SY / RP / RV Direct Gas Gas over Oil 	 Self-Contained SY / RP / RV Direct Gas Gas over Oil 	 E-CAT Electric EHO 		
арЕх	\$	\$\$	\$\$\$	\$\$ - \$\$\$		
pEx	\$\$	\$\$	\$\$\$	\$		

Correlating Real Time PRV Releases with Process Data & Maintenance Records

Detect and report all PRV releases (near miss events)



Enhance Safety, Reliability, Operation and **Meet Environmental Compliance**



Monitor active relief events, keeping employees safe

Recording release events for process safety root cause failure analysis



Analytics to increase availability optimizing overhaul scheduling



Adjust operating pressures to improve plant performance

Immediate notification of events to reduce severity of releases

Example: Putting It All Together Undetected and Unreported Relief Events Often Occur

Many Potential Causes for Releases



Monitored PRV Case Example



Overpressure PRV Releases: Vented Emissions

PRV Leakages: Fugitive Emissions

ð Bray EMERSON MRC Global

SPONSORED BY:

Lifecycle Services

Next Steps

Ready to take action to reduce valve fugitive emissions in your facility? Here is your path to implementation:



Identify and prioritise high risk valves for upgrade. Schedule a **Digital Walkdown & Installed Base Assessment** to get started.



3

Map out like-for-like superior valve technology alternatives. Emerson's valve application experts can help to identify.

Make a repair vs. upgrade cost analysis including downtime and fugitive emission reduction savings.

Leverage data from the **Digital Walkdown** to prioritize and integrate valve maintenance actions for your STO.

5

Get proactive with your fugitive emission reduction strategy using Emerson's **Valve Condition Monitoring** to identify risks.



Digital Walkdown & Installed Base Assessment



Acquire, analyze, and organize your process and equipment data more efficiently & accurately when you partner with Emerson.

LEARN MORE »

Valve Condition Monitoring

MRC Global 【



Regardless of your maintenance strategy, implementing Valve Condition Monitoring can help you uncover issues before they impact your plant's compliance or reliability.

LEARN MORE »

Results Are What Count

Large APAC Refinery



- Saved \$500,000 /year in lost hydrogen from leaking vent valves and PRVs
- Saved \$200,000 / year in lost hydrocarbons from leaking flare valves
- Improved health and safety by eliminating manual readings

U.S. Refinery 1



- Detected more then 200 lifts and reseating events over 15 months (69 valves)
- 20 Problems were identified and resolved within an hour
- Reduction in loss of hydrocarbon to the Flare System

U.S. Refinery 2



- The ability to pinpoint malfunctioning or stuckopen PRVs saves weeks and even months of high flow releases.
- "Every hazardous material relief valve event detection results in approximately \$2,500-\$50,000 in savings from un-wanted fines, potential process downtime and manpower

E.U. Power Plant



 "Some of these valves are located 25 meters high on top of the boilers and are difficult to check visually by operators. Remote monitoring significantly improved operator safety"

"The increased throughput and revenue was an unexpected bonus." – U.S. Refinery



Key Takeaways – Fugitive Emissions

Hidden Costs of Emissions

Targeted valve upgrades offer the opportunity to meaningfully advance your sustainability goals and plant profitability.

Emerson's Participation in the Community



Establish Best Practices for Exponential Impact

- Partnerships that are founded on deep technical expertise
- Inventory analysis of critical valves and/or known emitters
- Develop guidelines for prioritization and quantification of environmental impact
- Implement design specifications with emissions reduction or avoidance as a priority
- Establish remote monitoring program to minimize future risk

SPONSORED BY:

Improve

Profitability

Decrease

Operating Costs

EMERSON MRC Global

Achieve

Compliance

Minimize

Safety Risks

Fugitive Emissions – Our Opportunity as a Community for Exponential Impact

Seth Harris Director of Sustainability – Americas Sales Seth Harris @ Emerson.com 720-635-5149

EMERSO

Emerson Confidential