FUGITIVE EMISSIONS SUMMIT AMERICAS

2022

Reducing Control Valve Fugitive Emissions in Industrial Plants and Facilities

SPONSORED BY: Bray EMERSON MRC Global TEADIT Sealing for a Safer and Greener Tomorrow ZWICK ARMATUREN GMBH

Richie Ritter - Emerson

FUGITIVE EMISSIONS SUMMIT AMERICAS

About the Presenter

2022

Richard (Richie) Ritter III, PMP, MBA
Program Manager, Digital Valve Services
Emerson Automation Solutions
Marshalltown, IA
Richard.Ritter@Emerson.com

Current Role: Responsible for coordinating Global Digital Valve Services implementations and ensuring that all steps of execution follow the best practices established by the global team's PMO (Project Management Office). This includes having a complete understanding of the project scope and requirements and having ownership for a timely and flawless delivery of services. As the number of contracts scales and new offerings are integrated, this role will be responsible for onboarding new project managers.

Experience: From 2000-2005 he served in the US Navy as a Nuclear Machinist's Mate and Midshipman earning various awards and accommodations. Richie began his career at Emerson as an intern with the Nuclear Power Team in 2005. He then took a position at Mechdyne, an engineering consulting firm, specializing in advanced interactive 3D visualization technologies. He returned to Emerson in 2010 when he took a role with our Ed Services department. He has a BS in Nuclear Engineering Technology from Excelsior College in Albany, NY and a Master's in Business Administration. Prior to joining Emerson (2009), he was a Certified Project Management Professional (PMP) working for Mechdyne and continues to be a PMP and contributes to this Global Group via the Project Management Institute.

Personal areas of interest: Church Elder, Johnathan's House Facility Coordinator CAR Africa, Husband & Father of 4 (Richard, Reagan, William & Wyatt), Scouts BSA Chartered Organization Officer & Den Leader, Team Rubicon Member, Long Term Disaster Recovery Committee Iowa, PMI Member, NRA (National Rifle Association) Instructor, Hunting & Fishing.

FUGITIVE EMISSIONS SUMMIT AMERICAS

3 Steps to Reduce Fugitive Emissions

2022

1) Engineer the correct solution to eliminate or reduce fugitive emissions.

Identify correct parameters.

Size/Select correctly.

Asset Management Tag (RFID).

2) Monitor the correct solution over the entire lifecycle.

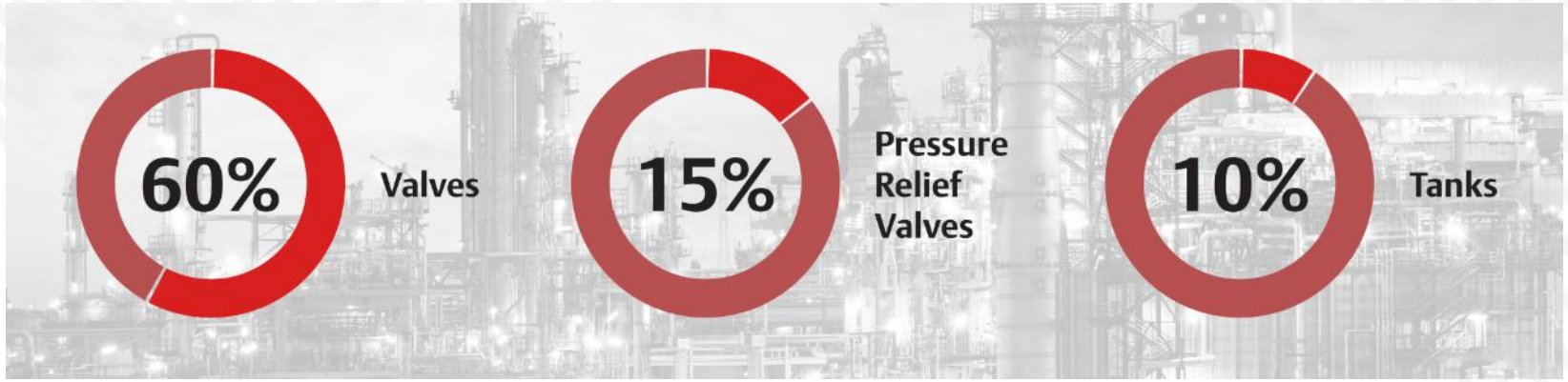
Utilize **Valve Condition Monitoring** to identify if there could be a future work order on critical assets.

3) Other Options/Future to Monitor.

My Emerson – My Assets

Advanced Cameras and Walk Downs (Currently Evaluating)

Biggest Sources of Fugitive Emissions



FUGITIVE EMISSIONS SUMMIT AMERICAS

Engineer the correct solution to eliminate or reduce fugitive emissions

2022

Ensure proper process conditions including process fluid, fluid temperature, maximum valve inlet pressures, maximum valve pressure drops and valve design if known (ED, ET, etc.), size, pressure rating, valve stem diameter, bonnet type. Refer to “Product Bulletin 59.1:061” for Sliding Stem Valves and “Product Bulletin 59.3:041” for Rotary Valves.

ENVIRO-SEAL™ Control Valve Packing Systems

These packing systems keep fugitive emission concentrations below the 100 ppm (parts per million) requirement set by the federal Environmental Protection Agency (EPA).

ENVIRO-SEAL™ Bellows Seal Bonnets

Digital Valve Controller & Many Other Instruments

Ensure products are certified for low or no gas consumption and can help achieve the low fugitive emissions standards developed by regulatory agencies.

SPONSORED BY: Bray EMERSON MRC Global TEADIT ZWICK

FUGITIVE EMISSIONS SUMMIT AMERICAS

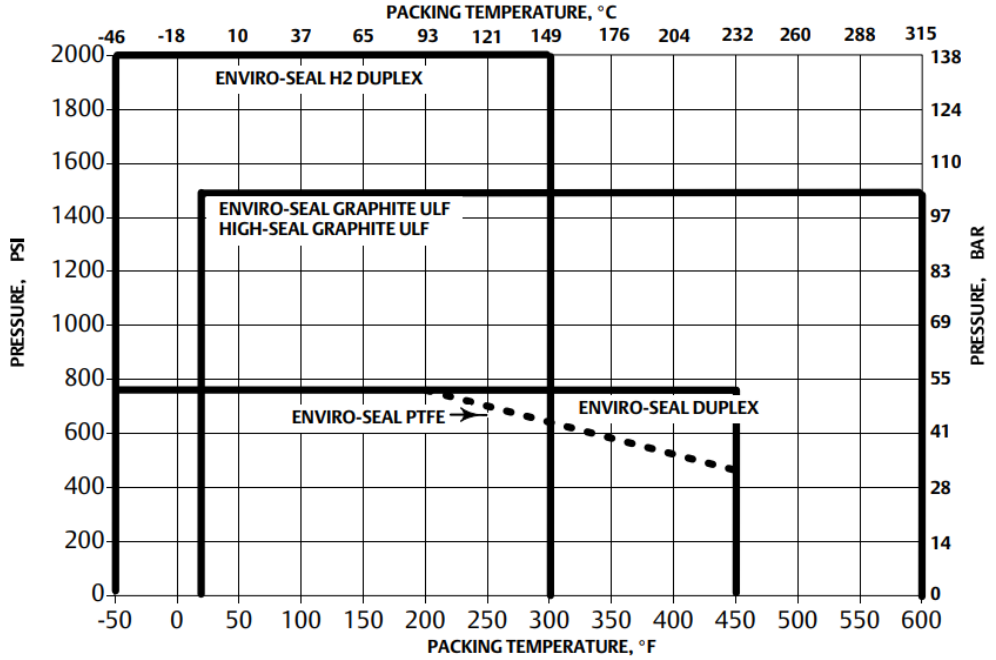
ENVIRO-SEAL™ Control Valve Packing Systems

2022

ENVIRO-SEAL™ Control Valve Packing Systems

These packing systems keep fugitive emission concentrations below the 100 ppm (parts per million) requirement set by the federal Environmental Protection Agency (EPA).

Figure 4. Applications Guidelines Chart for 100 PPM Service



PTFE

Graphite

Graphite & PTFE Combination

SPONSORED BY: Bray EMERSON MRC Global TEADIT ZWICK

FUGITIVE EMISSIONS SUMMIT AMERICAS

ENVIRO-SEAL™ Bellows Seal Bonnets

2022

Corrosion resistance is excellent--the bellows is available in either N06625 or N06022, and the bellows is protected against direct impingement by the flow stream.

Every bellows seal is tested before leaving the factory. Each bellows is mass spectrometer tested to 1 X 10-6 cubic centimeters per second of helium.

Long Cycle Life—Cycle lives in excess of those shown in tables 1, 2, 3, and 4 can be achieved with proper use and maintenance.

Purging/Monitoring Connections are Standard—Two connections above the bellows allow for purging or monitoring of bellows integrity

Table 1. Estimated Cycle Life for N06625 Bellows(1) at 10.3 Bar (150 Psig) and 38°C (100°F)

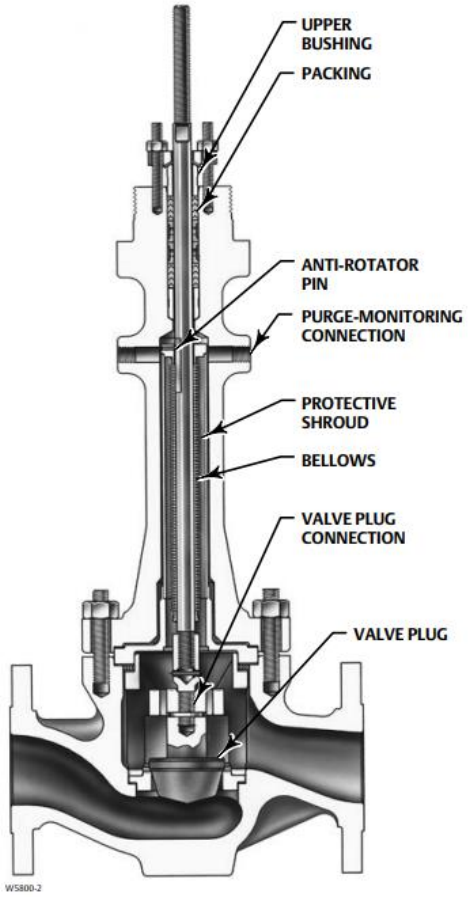
VALVE SIZE, NPS		BELLOWS SEAL TRAVEL											
1/2, 3/4, 1, & 1-1/2		mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch
		3.6	0.14	4.6	0.19	6.4	0.28	9.7	0.38	14.2	0.56	19.1	0.75
	1 Ply	8,000,000		4,000,000		1,400,000		550,000		150,000		50,000	
	2 Ply	10,000,000		10,000,000		2,300,000		800,000		160,000		50,000	
2		mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch
		5.3	0.21	7.1	0.28	10.7	0.42	14.2	0.56	22.2	0.88	28.6	1.12
	1 Ply	8,000,000		4,000,000		1,400,000		550,000		150,000		50,000	
	2 Ply	10,000,000		10,000,000		2,300,000		800,000		160,000		50,000	
3		mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch
		6.4	0.28	9.5	0.38	26.0	0.56	19.1	0.75	28.6	1.12	38.1	1.50
	1 Ply	1,000,000		1,000,000		700,000		450,000		300,000		100,000	
	2 Ply	10,000,000		10,000,000		5,000,000		2,500,000		1,000,000		350,000	
4		mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch
		9.5	0.38	12.7	0.5	19.1	0.75	28.6	1.12	38.1	1.50	50.8	2.00
	1 Ply	1,000,000		700,000		450,000		300,000		100,000		50,000	
	2 Ply	10,000,000		5,000,000		2,500,000		1,000,000		350,000		150,000	

1. See the Cycle Life section in this bulletin for more information on bellows travel.

Table 2. Estimated Cycle Life for N06625 Bellows(1) at Maximum Pressure and 316°C (600°F)

VALVE SIZE, NPS		BELLOWS SEAL TRAVEL											
1/2, 3/4, 1, & 1-1/2		mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch
		3.6	0.14	4.6	0.19	6.4	0.28	9.7	0.38	14.2	0.56	19.1	0.75
	1 Ply	100,000		80,000		50,000		30,000		12,000		7,000	
	2 Ply	100,000		90,000		50,000		30,000		12,000		7,000	
2		mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch
		5.3	0.21	7.1	0.28	10.7	0.42	14.2	0.56	22.2	0.88	28.6	1.12
	1 Ply	100,000		80,000		50,000		30,000		12,000		7,000	
	2 Ply	100,000		90,000		50,000		30,000		12,000		7,000	
3		mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch
		6.4	0.28	9.5	0.38	26.0	0.56	19.1	0.75	28.6	1.12	38.1	1.50
	1 Ply	45,000		45,000		34,000		24,000		18,000		12,000	
	2 Ply	50,000		50,000		41,000		34,000		24,000		12,000	
4		mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch
		9.5	0.38	12.7	0.5	19.1	0.75	28.6	1.12	38.1	1.50	50.8	2.00
	1 Ply	45,000		34,000		24,000		18,000		12,000		7,000	
	2 Ply	50,000		41,000		34,000		24,000		12,000		7,000	

1. See the Cycle Life section in this bulletin for more information on bellows travel.



ENVIRO-SEAL Bellows Detail
(Mounted on easy-e VALVE)

FUGITIVE EMISSIONS SUMMIT AMERICAS

Getting Ready for Valve Condition Monitoring 2022

Site Requirement

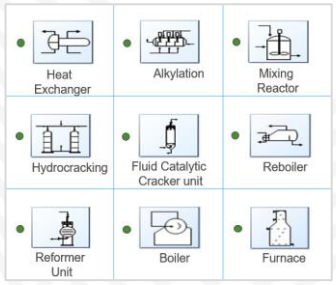
Approach to Site

Ready for First Report

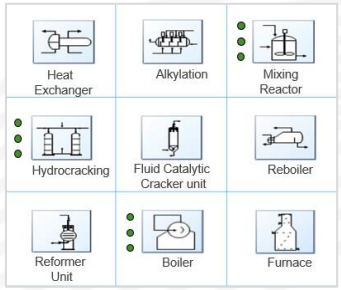
Digital Valve Controller

ValveLink

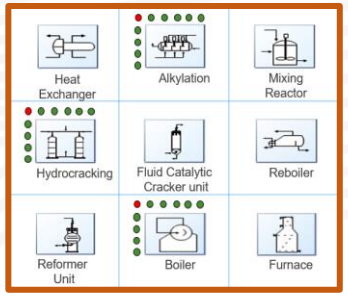
Problematic Valve



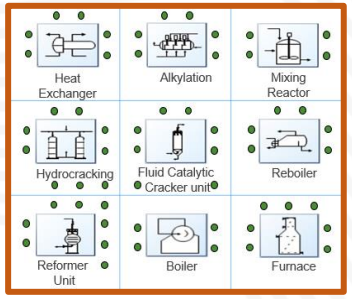
Critical Valve



Valves in Critical Operation Unit



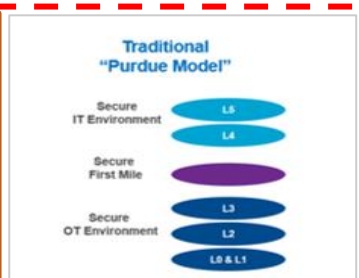
Valves in Advanced Process Control



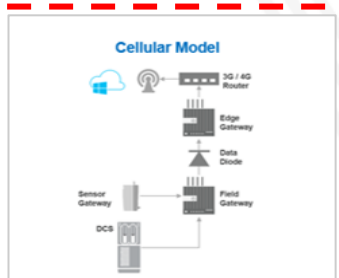
Site Implementation

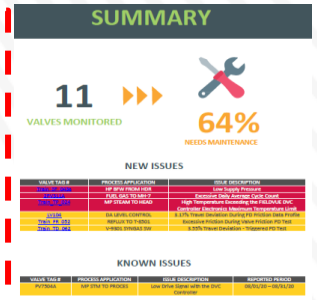
Secure Offline Data Transfer

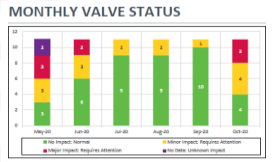
Traditional "Purdue Model"

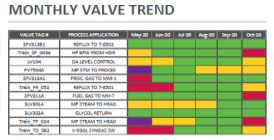


Cellular Model









Choose a method on how the data to be transferred

SPONSORED BY:

FUGITIVE EMISSIONS SUMMIT AMERICAS

The Value of Digital Valve Controllers

2022

Most production facilities do not have the **focus** or **expertise** to **sustainably** analyze valve diagnostics

On their own, facilities do not fully utilize all the diagnostic features available – most advanced facilities use **less than half** of diagnostic capabilities

60% time managing DATA

Valve Condition Monitoring helps you achieve your vision of **lower variability and increased uptime**

SPONSORED BY: Bonney Forge, Bray, EMERSON, MRC Global, TEADIT Sealing for a Safer and Greener Tomorrow, ZWICK ARMATUREN GMBH

FUGITIVE EMISSIONS SUMMIT AMERICAS

How It Works

2022

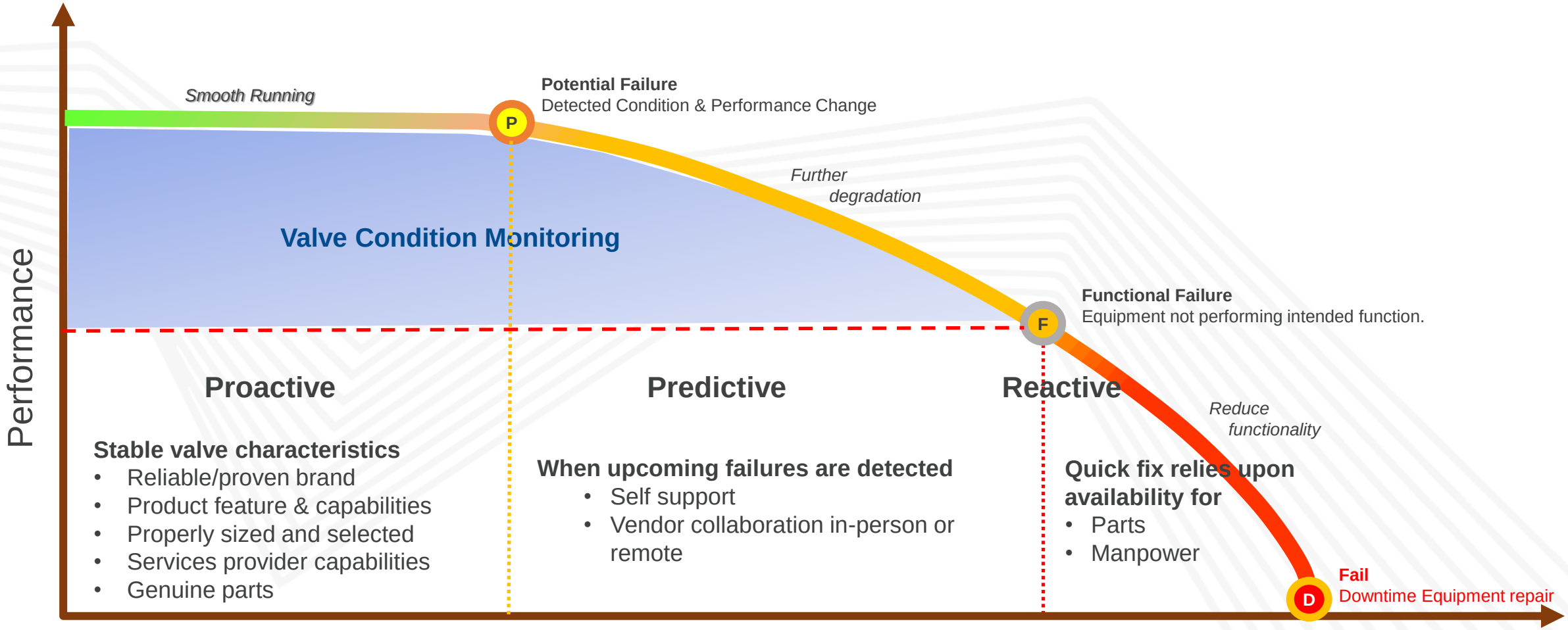
- Diagnostic data collected via online ValveLink system
- Data securely sent to expert technicians for analysis
- Experts compile a monthly/quarterly report complete with issue identification and actionable recommendations to work toward resolution
- End-Users (or Accredited Service Providers) complete emergency maintenance or add to shutdown work scope
- Technicians available via Remote Assistance for additional support

SPONSORED BY: Bonney Forge, Bray, Emerson, MRC Global, TEADIT Sealing for a Safer and Greener Tomorrow, ZWICK Armaturen GmbH

FUGITIVE EMISSIONS SUMMIT AMERICAS

Condition Monitoring : Maximize Valve Performance

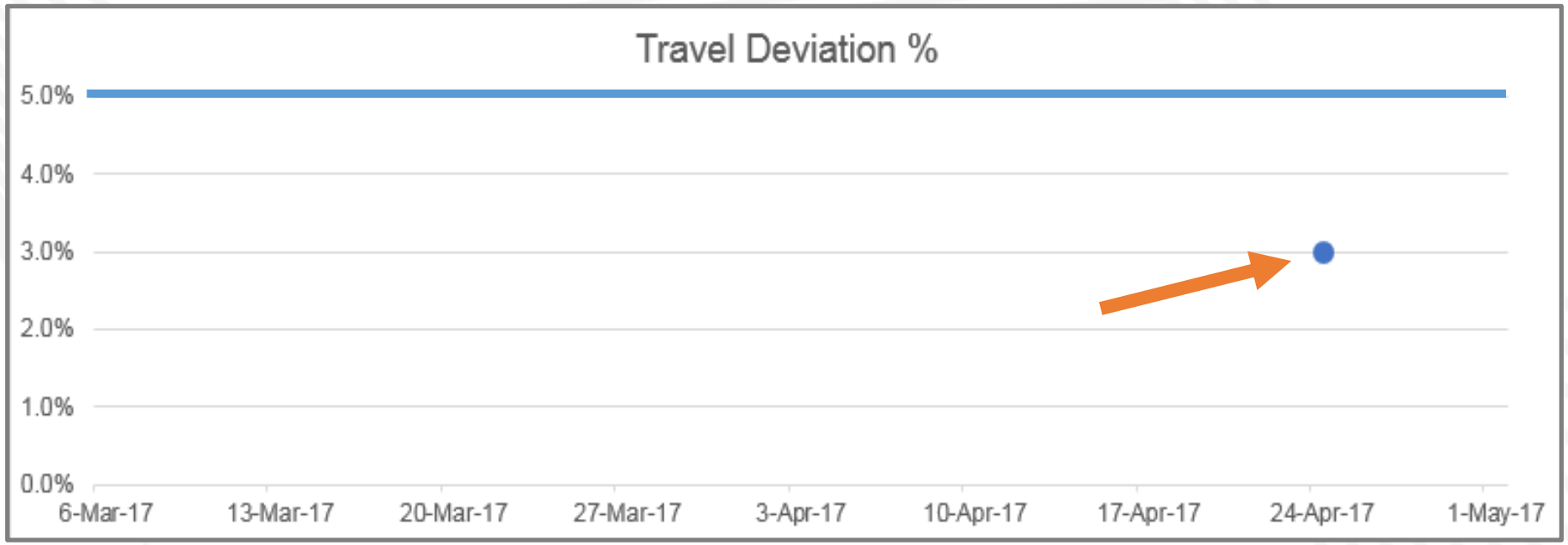
2022



SPONSORED BY: BONNEY FORGE, Bray, EMERSON, MRC Global, TEADIT Sealing for a Safer and Greener Tomorrow, ZWICK ARMATUREN GMBH

Importance of Time Series Analysis

Using traditional logic, most valve experts would look at a travel deviation of 3% and view this as a good number, because it is not above the 5% alert threshold.

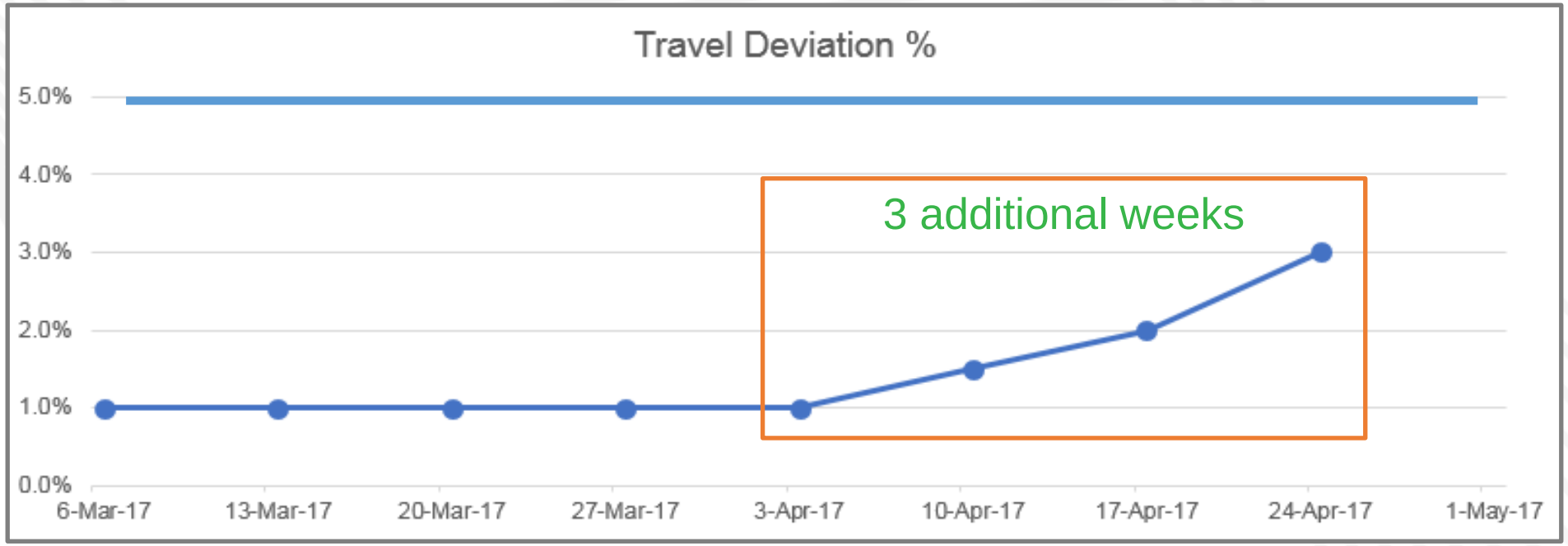


FUGITIVE EMISSIONS SUMMIT AMERICAS

Importance of Time Series Analysis

2022

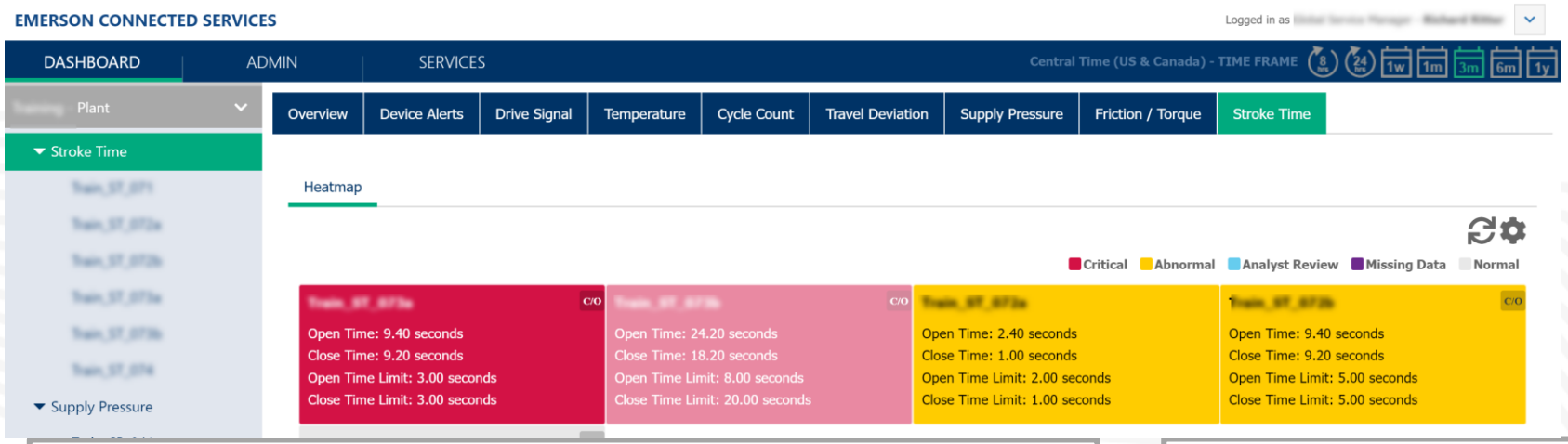
Valve Condition Monitoring analysis tools for time series analysis allow to see the rapid increase of travel deviation. **This provides more time to analyze conditions that can cause travel deviation.**



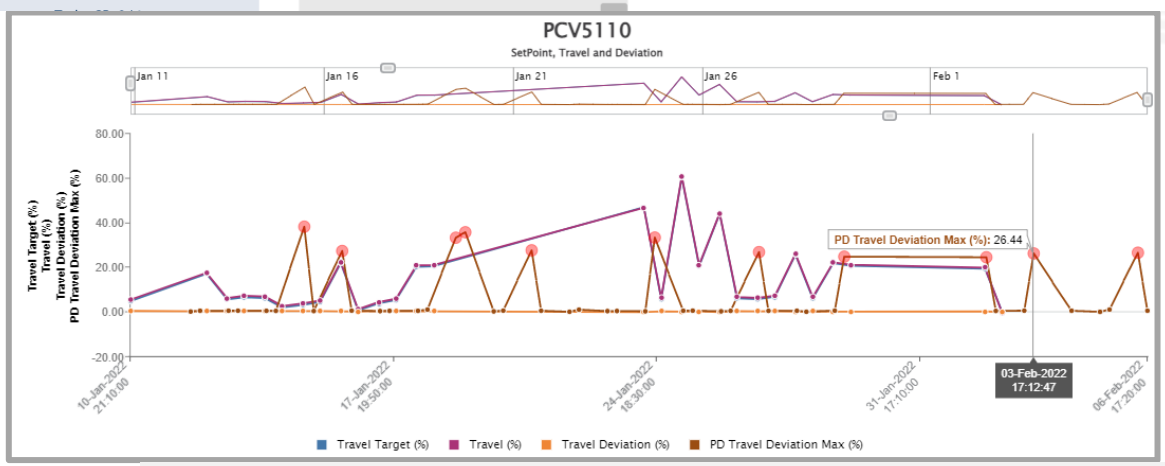
FUGITIVE EMISSIONS SUMMIT AMERICAS

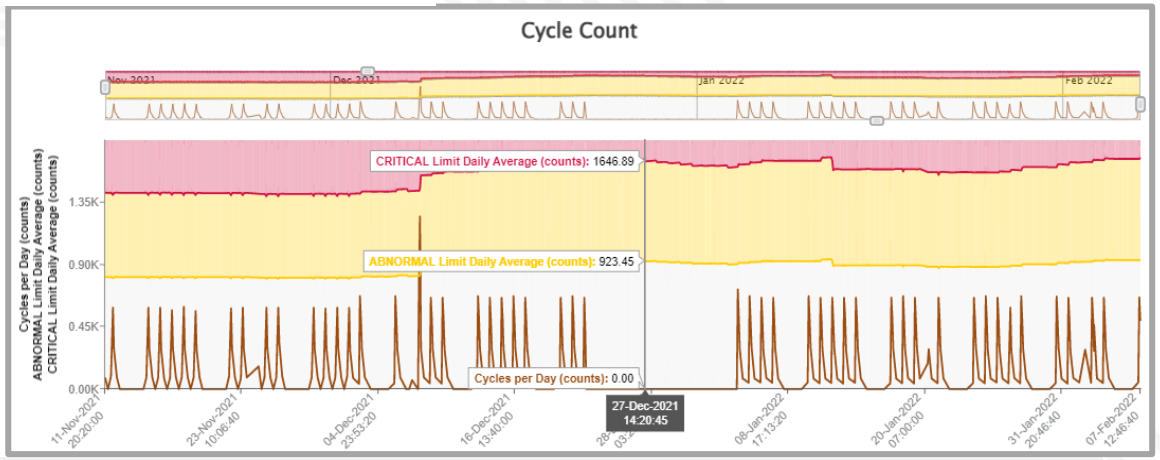
Valve Condition Monitoring Uses Data-Driven Models To Identify Abnormalities and Predict Events

2022



Heatmaps to visualize conditions where device parameters exceed defined thresholds





Multiple **Trending Charts for Time-Series Analysis** against specific user selectable/dynamic valve thresholds

SPONSORED BY: Bonney Forge, Bray, Emerson, MRC Global, TEADIT Sealing for a Safer and Greener Tomorrow, ZWICK Armaturen GmbH

FUGITIVE EMISSIONS SUMMIT AMERICAS

Detect Abnormalities During Plant Operation 2022

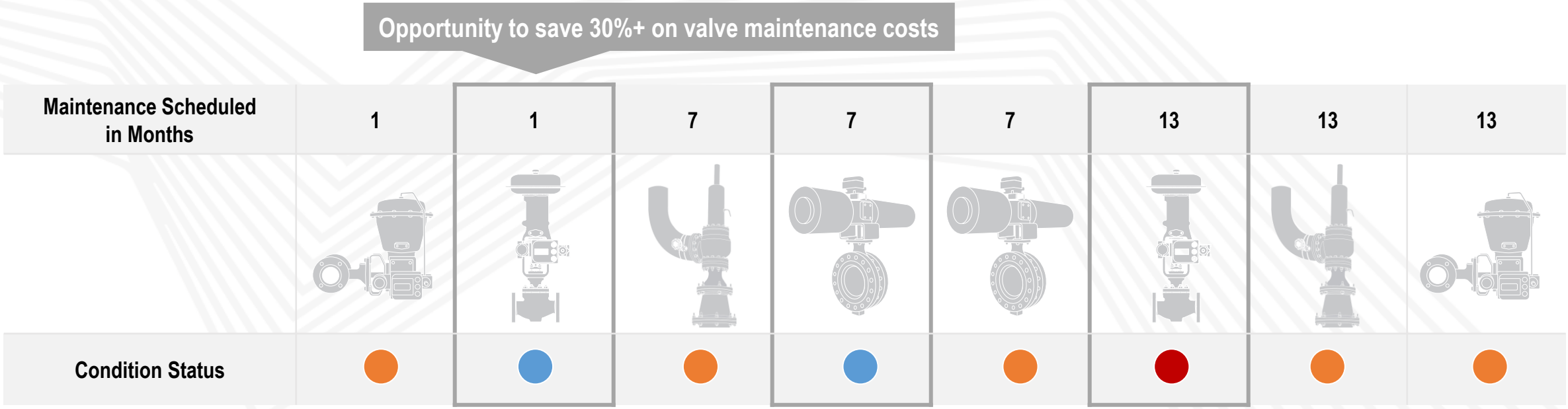
Example Conditions Identified	Potential Impacts if Not Detected and Mitigated
Gradual increase in travel deviation	Instability with valve unable to track setpoint
Developing air supply issues	Limitations in the operating range of the valve may bottleneck the process
Unexpected cycle count increases	Valve oscillation may impact loop stability
Unexplained gradual change in valve control range indicating trim plugging or erosion	Costly loss of process fluid/gas; can cause additional valve damage with high pressure/low flow scenarios
Temperature rise at positioner, possibly related to process change or packing leak	Elastomers may degrade, causing control issues
PSA Application: Valve opening and closing times are greater that open/close time limits	Out-of-tune stroke time can cause contamination from one PSA bed to another, damages to the bed, compromising industrial gas purity
Numerous Device Alerts that are hard to view and unravel over a time-period.	With Device Alerts visualized on colored heatmap tiles across easy to review 4 categories, it is easier to detect and distinguish Failure and Maintenance alerts from Function Check and Out of Specs alerts for quicker and focused corrective actions.

Using Valve Condition Monitoring to Optimize Shutdowns, Turnarounds and Outages

FUGITIVE EMISSIONS SUMMIT AMERICAS 2022

Online Diagnostics Fill a Gap Left by Offline Diagnostics

- Measurement of how a valve operates when process conditions are present
- Ability to trend valve key performance indicators over months and years
- Once a subset of valves are identified for maintenance, offline diagnostics can be run to solidify scope



Incorporating how the valve is behaving through online diagnostics can focus decision-making

SPONSORED BY: Bray EMERSON MRC Global TEADIT ZWICK

FUGITIVE EMISSIONS SUMMIT AMERICAS

Service Execution Process

2022

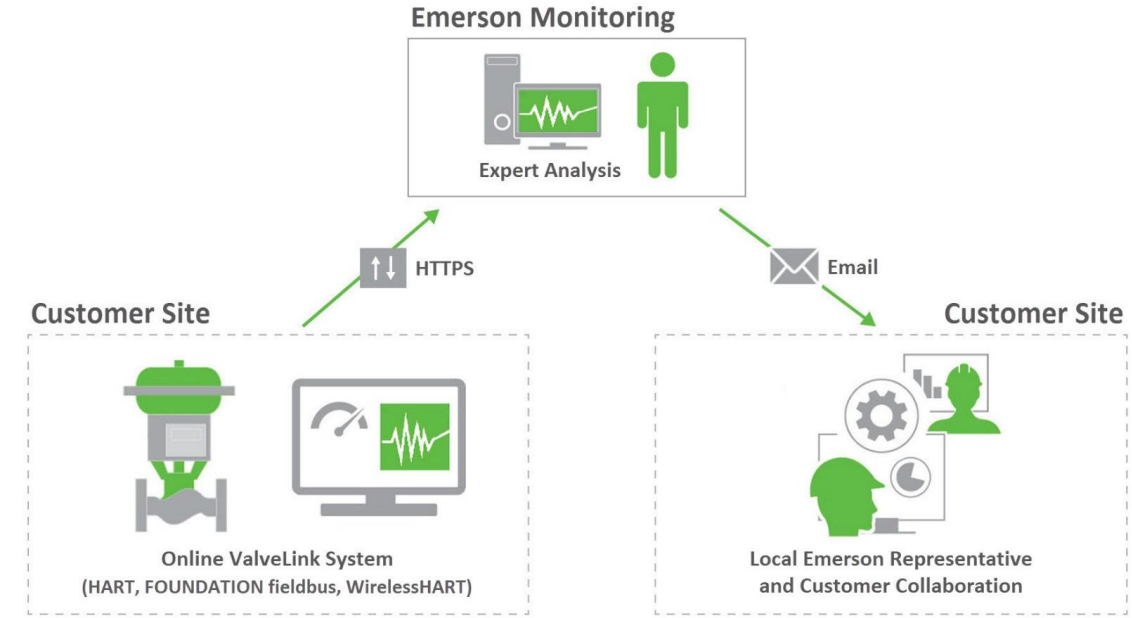
Weekly

- Customer's ValveLink dataset is sent to Emerson (either manually or on-line)
- Analysts reviews diagnostic data and provides recommendations to Site Impact Partner / Customers if urgent issues exist.

Monthly

- Analysts review and interpret diagnostic data and provide a formal report to Sales Channel & Customer
- Urgent issues are communicated as soon as they are observed
- The analyst, Sales Channel, and customer review the report
- Follow-up, as needed, to confirm that actions provided expected outcomes

Analyst Workspace



SPONSORED BY: Bonney Forge, Bray, Emerson, MRC Global, TEADIT Sealing for a Safer and Greener Tomorrow, ZWICK Armaturen GmbH

FUGITIVE EMISSIONS SUMMIT AMERICAS

Valve Condition Monitoring – 3 Case Studies

2022

Ice Build-Up on Valves

- Ice build-up on two valves caused feedback arms to jam, resulting in a significant travel deviation
- Valves would not travel to the closed position when travel set point was at 0%
- Issue identified and confirmed a few days prior
- Fixed immediately once replacement part arrived onsite

Compressor Anti Surge Valve

- FIELDVUE diagnostic identified Air leak in the subsystem – identified in volume boosters
- Required replacement – valve put on bypass
- Valve would have failed

Heater Valves

- 5 of 6 valves around heater had air leaks
- Identified incorrect seal material issue causing leaks
- Recommended appropriate material
- Added to STO scope

FUGITIVE EMISSIONS SUMMIT AMERICAS

Why Track, Fix and Monitor Fugitive Emissions

2022

- EPA Leak Detection and Repair – A Best Practices Guide Numbers
- Elements of a Leak Detection and Repair (LDAR) Program
- Quad O standard & Potential Cost Reduction

FUGITIVE EMISSIONS SUMMIT AMERICAS

EPA Leak Detection and Repair – A Best Practices Guide Numbers

2022

#1: Reducing Product Losses

Lost product generally translates into lost revenue.

#2: Increasing Safety for Facility Workers and Operators

Reducing emissions from leaking equipment has the direct benefit of reducing occupational exposure to hazardous compounds.

#3: Decreasing Exposure for the Surrounding Community

#4: Potentially Reducing Emission Fees

A facility with an effective program for reducing leaking equipment can potentially decrease the amount of these [state and local] annual fees

#5: Avoiding Enforcement Actions

A facility with an effective LDAR program decreases the chances of being targeted for enforcement actions and avoids the costs and penalties associated with rule violations

Table 3.2 – Equipment component counts at a typical refinery or chemical plant.

Component	Range	Average
Pumps	10 – 360	100
Valves	150 – 46,000	7,400
Connectors	600 – 60,000	12,000
Open-ended lines	1 – 1,600	560
Sampling connections	20 – 200	80
Pressure relief valves	5 – 360	90

Source: "Cost and Emission Reductions for Meeting Percent Leaker Requirements for HON Sources." Memorandum to Hazardous Organic NESHAP Residual Risk and Review of Technology Standard Rulemaking docket. Docket ID EPA-HQ-OAR-2005-0475-0105.

Table 3.3 – Uncontrolled VOC emissions at a typical facility.

Component	Average Uncontrolled VOC Emissions (ton/yr)	Percent of Total Emissions
Pumps	19	3
Valves	408	62
Connectors	201	31
Open-ended lines	9	1
Sampling connections	11	2
Pressure relief valves	5	1
Total	653	

Source: Emission factors are from Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017, Nov 1995, and equipment counts in Table 3.2.

More recent data indicates that open-ended lines and sampling connections each account for approximately 5-10% of total VOC emissions.

Example – Cost of product lost.

In previous rulemaking efforts, EPA has estimated that the average value of product lost due to equipment leaks is $1,370 per ton.[a]

Applying this cost factor results in a potential savings of $730,000 per year per facility.

[a] Source: Hazardous Air Pollutant Emissions From Process Units in the Synthetic Organic Chemical Manufacturing Industry-Background Information for Proposed Standards, Vol. 1C-Model Emission Sources. Emission Standards Division, US EPA, Office of Air and Radiation, OAQPS, Research Triangle Park, NC. Nov 1992.

FUGITIVE EMISSIONS SUMMIT AMERICAS

Elements of a Leak Detection and Repair (LDAR) Program

2022

Identifying Components

Physically tag each regulated equipment component with a unique ID number (**Asset Management Tags).**

Leak Definition

Walk Down Assets: Many equipment leak regulations also define a leak based on visual inspections and observations (such as fluids dripping, spraying, misting or clouding from or around components), sound (such as hissing), and smell.

Monitoring Components

Valve Condition Monitoring: Utilizing low bleed, Performance Diagnostics that track Travel Deviation, Cycle Count, Travel Accumulation %, Drive Signal, Mass Air Flow and many others. Method 21 is a procedure used to detect VOC leaks from process equipment using a portable detecting instrument.

Repairing Components

The component is considered to be repaired only after it has been monitored and shown not to be leaking above the applicable leak definition.

Recordkeeping

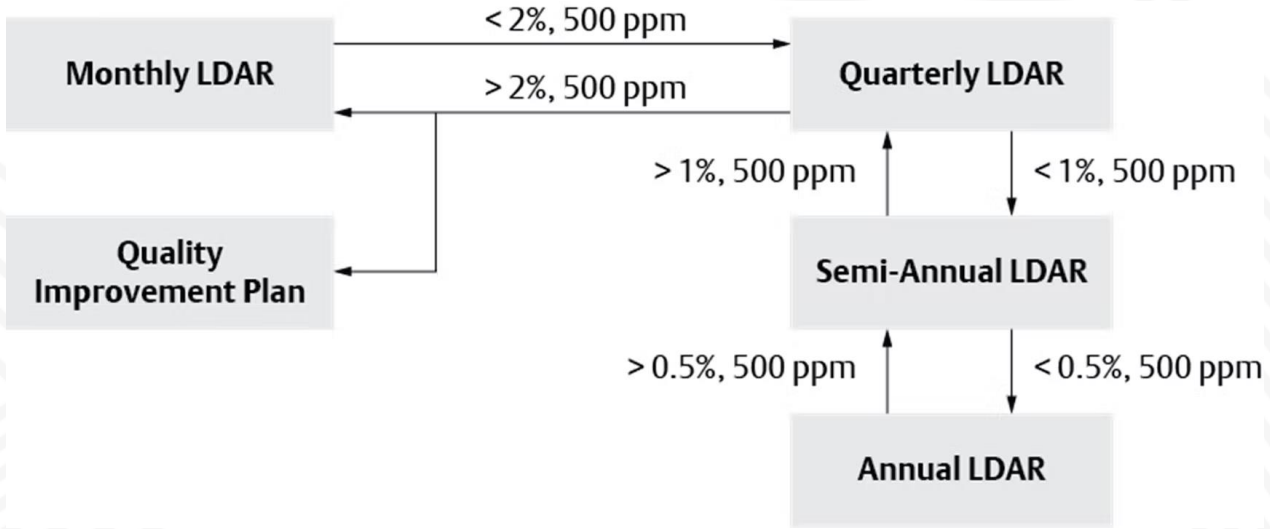
Maintain a list of all ID numbers for all equipment subject to an equipment leak regulation (MyEmerson).
For valves designated as “unsafe to monitor,” maintain a list of ID numbers and an explanation/review of conditions for the designation

FUGITIVE EMISSIONS SUMMIT AMERICAS

Quad O standard & Potential Cost Reduction

2022

Another source of cost reduction is posed by the new LDAR standards. The Quad O standard (short for Code of Federal Regulations (CFR) 40, Part 60, Subpart OOOO) mandates monthly inspections if greater than 2% of the devices have fugitive emissions above the 500 ppm emissions threshold (Figure 1).



However, as the percentage of failed emissions tests fall, the required inspections drop to quarterly, semi-annually and — eventually — to annual inspections if less than 0.5% of the devices fail the test inspections. A company therefore can reduce LDAR inspection costs twelvefold if it can keep fugitive emissions low

FUGITIVE EMISSIONS SUMMIT AMERICAS

3 Steps to Reduce Fugitive Emissions

2022

1) Engineer the correct solution to eliminate or reduce fugitive emissions.

Identify correct parameters.

Size/Select correctly.

Asset Management Tag (RFID).

2) Monitor the correct solution over the entire lifecycle.

Utilize **Valve Condition Monitoring** to identify if there could be a future work order on critical assets.

3) Other Options/Future to Monitor.

My Emerson – My Assets

Advanced Cameras and Walk Downs (Currently Evaluating)

Biggest Sources of Fugitive Emissions