Advanced Diagnostics:
4 Steps to Better Decision Making

ROSEMOUNT®

EMERSON™
Process Management

Presenters

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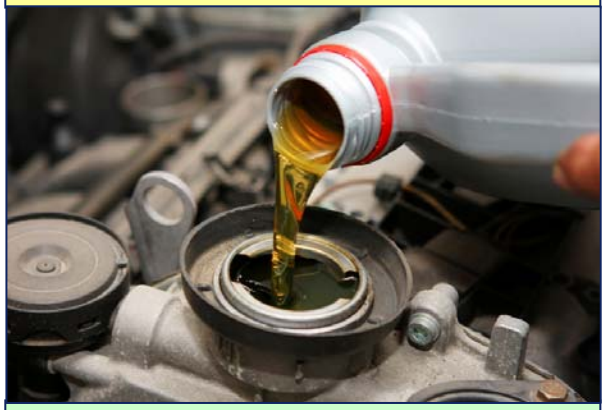
Agenda

- Customer Challenges
- Statistical Process Monitoring Technology
- 4 Steps to Better Decision Making
- Case Study
- More Examples
- Summary

Customer Challenges

Reduce Maintenance Costs	Improve Product Quality	Increase Process Uptime
		
By focus on devices that actually need maintenance	By identify process optimization opportunities	By predicting and preventing abnormal events

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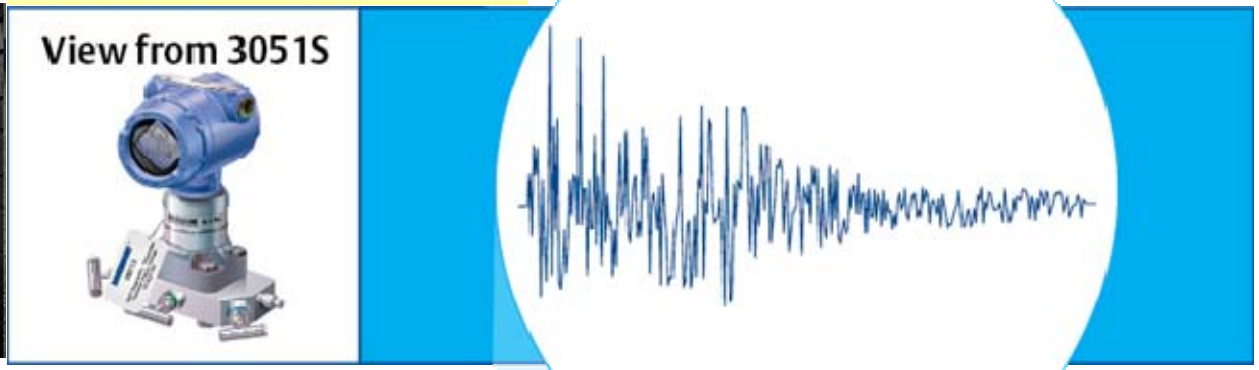
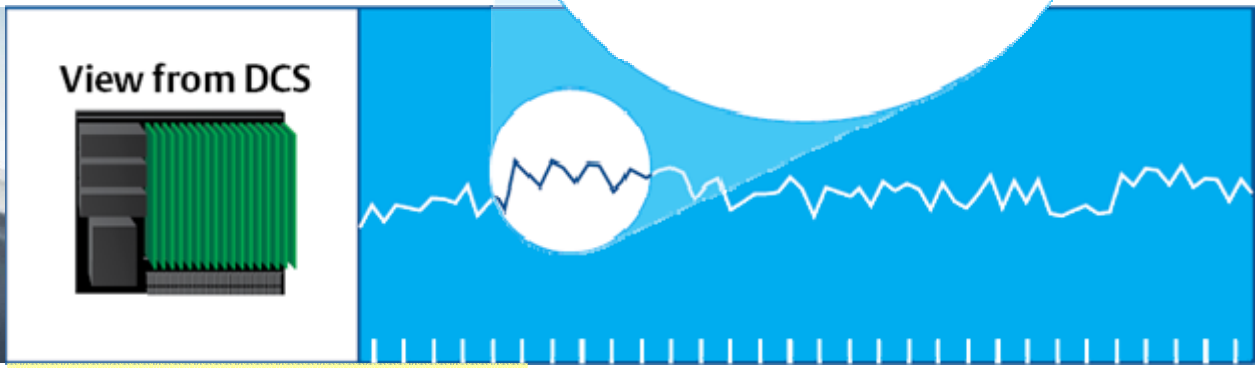
Fast Update Rate Provides Higher Resolution of your Process

Update Rate: 22 times / second





Update Rate: 1-2 times / second

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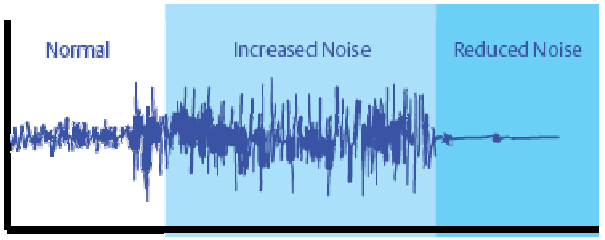
SPM Turns Process Noise into Valuable Information

Primary Variable

Process Variable



Statistical Process Monitoring

Statistical Variables

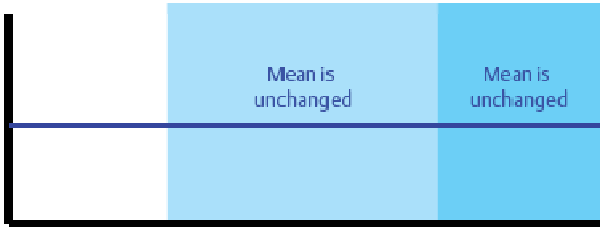
2nd Variable

Standard Deviation

Tracks changing process noise levels

3rd Variable

Mean



Tracks changes in PV (i.e. what the operator sees)

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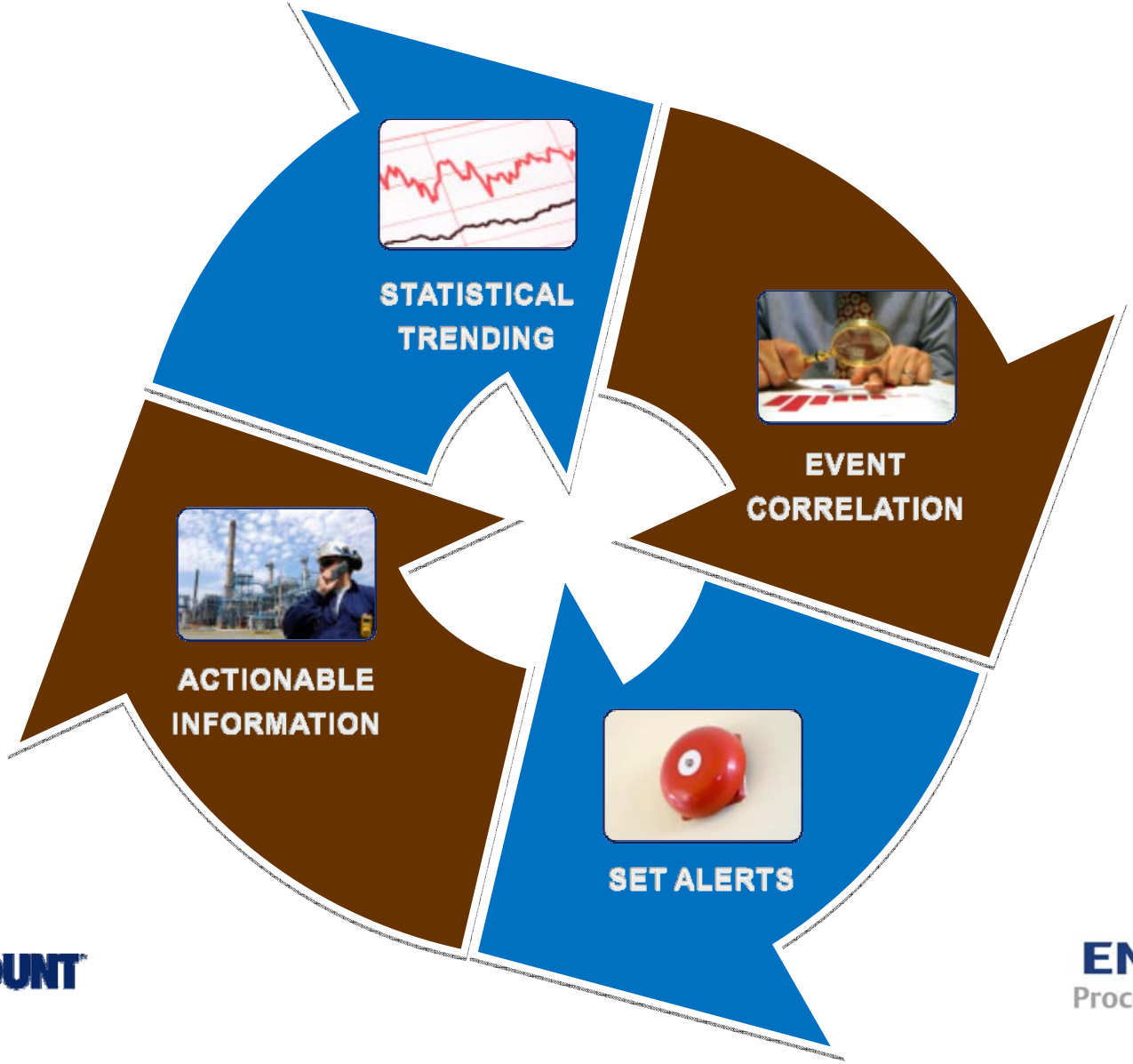
4 Steps to Better Decision Making



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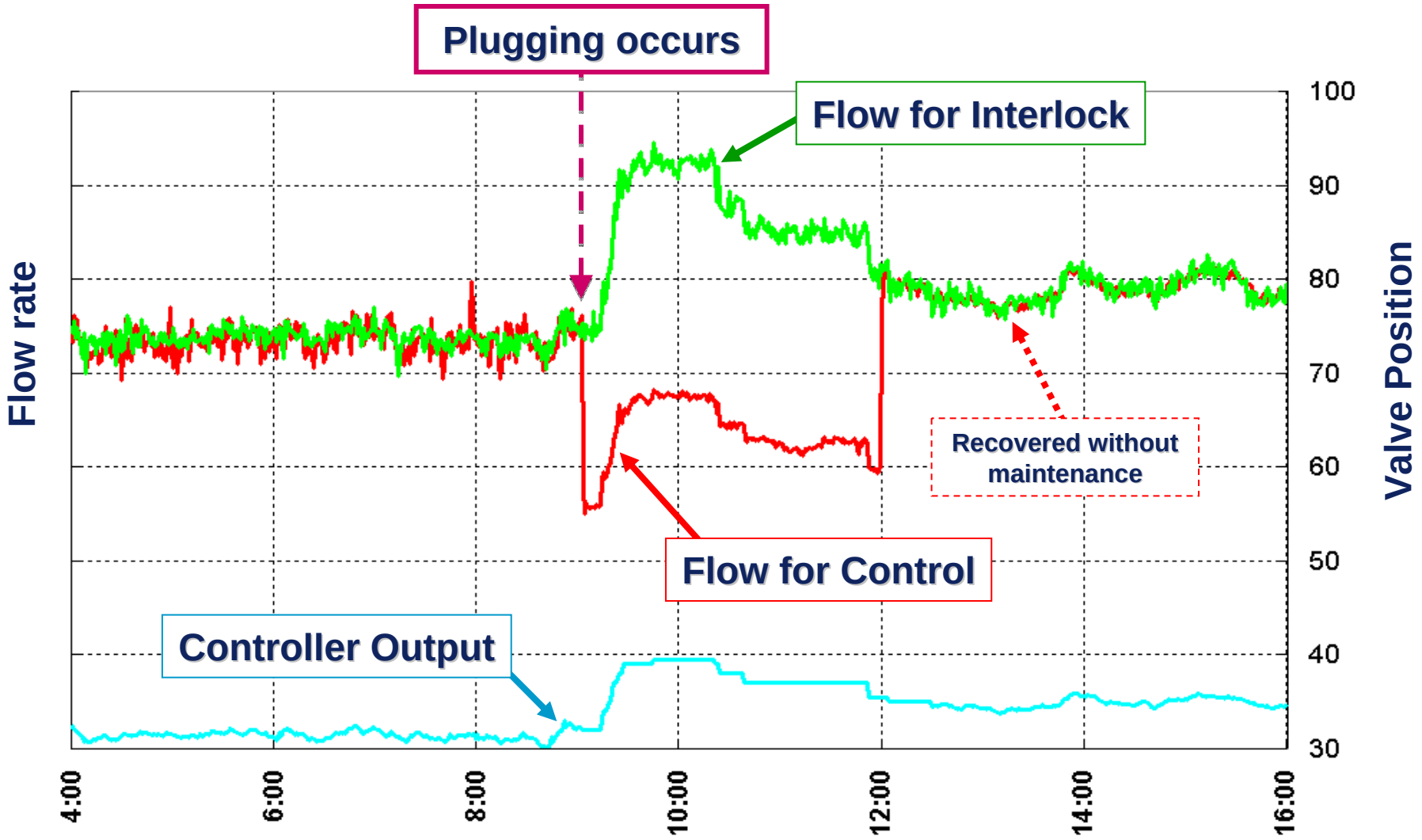
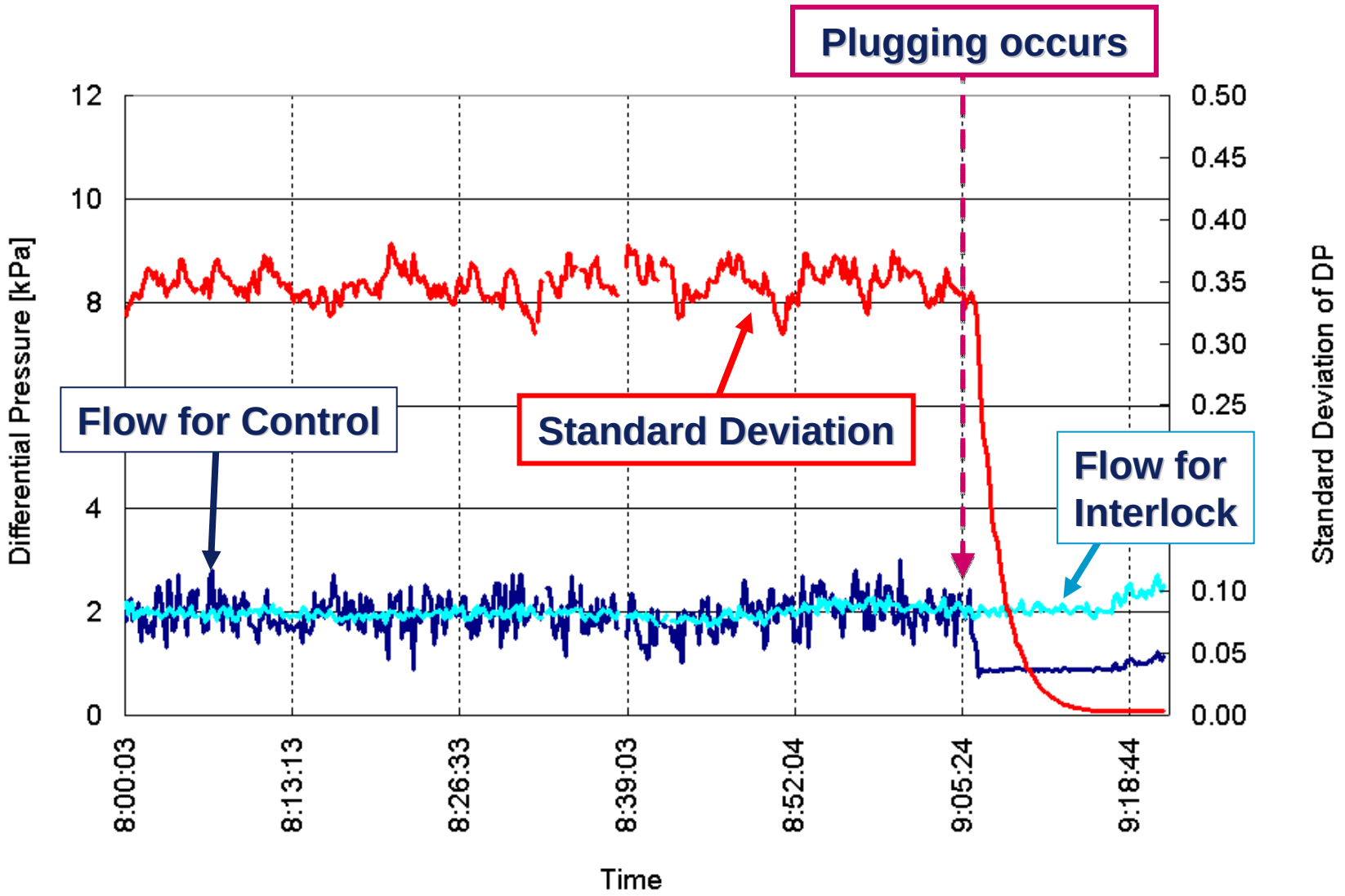
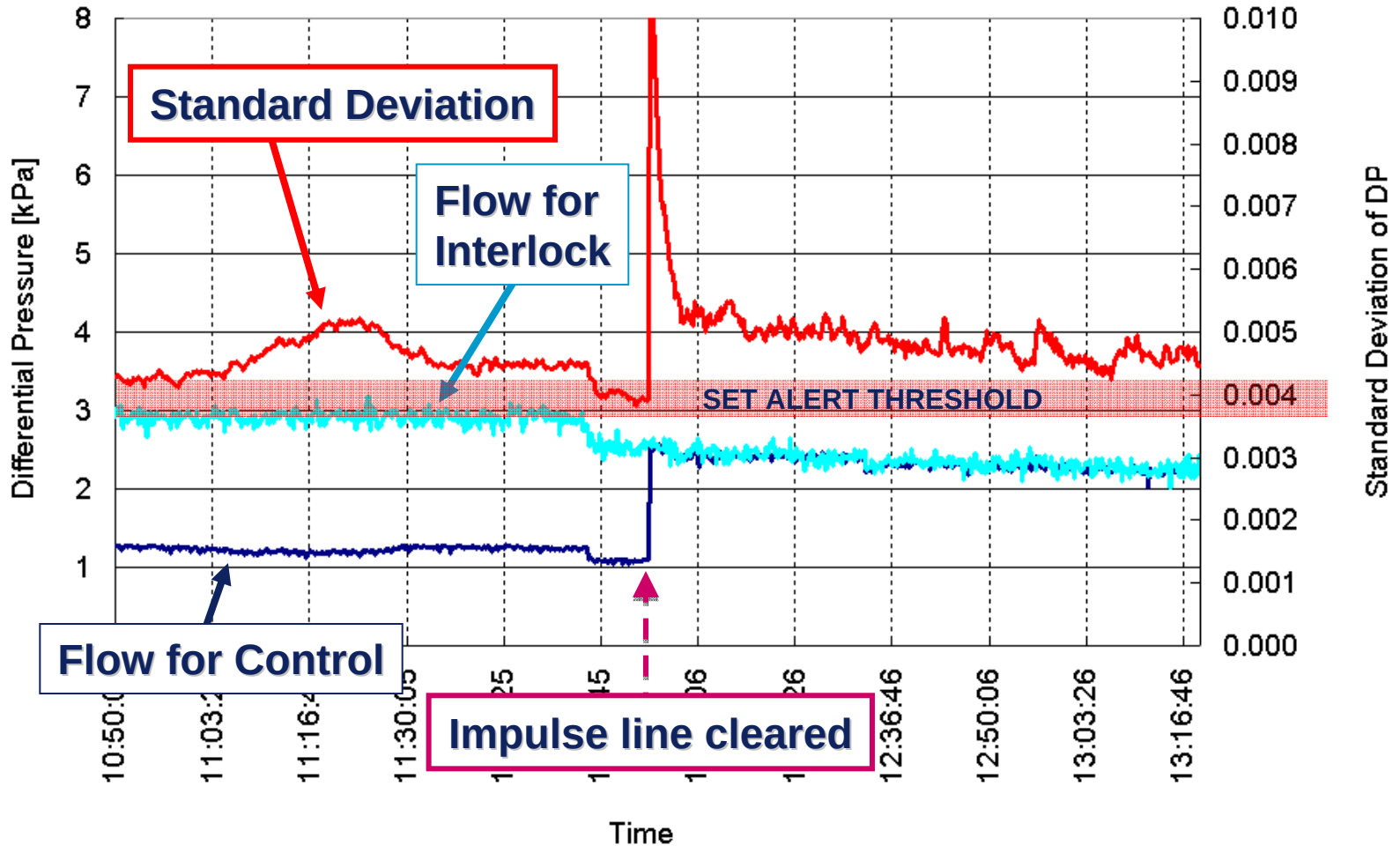
Plugged Impulse Line Situation



Plugged Impulse Line Seen Through Standard Deviation



Set Proper Alert Based on Standard Deviation



Actionable Information Help Reduce Maintenance Costs

ACTIONABLE INFORMATION

- Dirt covered all around the inside wall of the pipe before cleaning the pipe
- Tore off dirt sometimes caused plugging the impulse line

Inside wall

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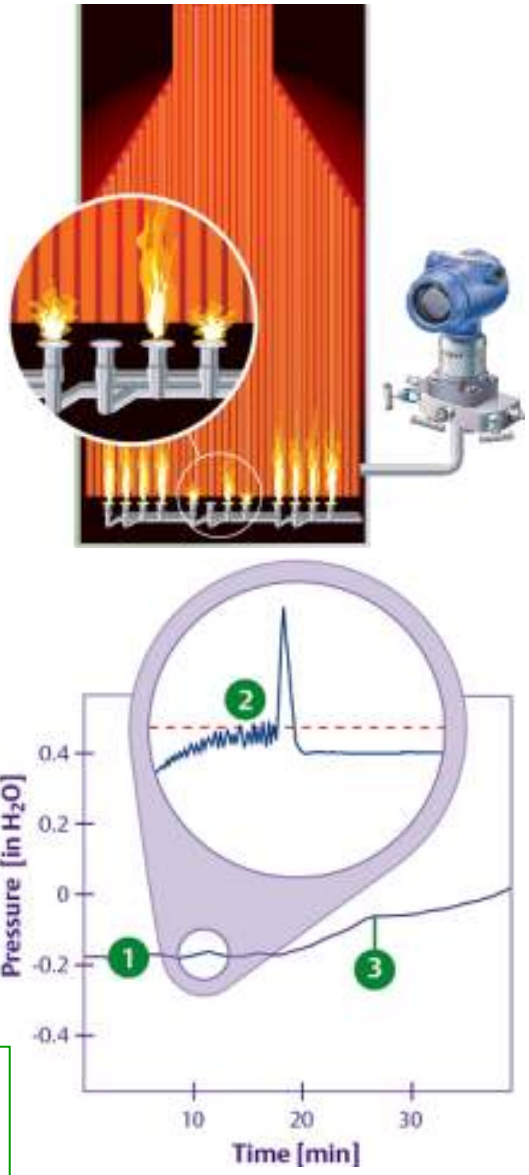
Furnace Flame Instability

Challenge

- Feed is waste gases with varying BTU content; can cause flameout
- Flameout is a dangerous condition - shutdown required, resulting in outage, restart and lost production time

Solution

- Sharp increases in standard deviation is an indicator of flame instability and a precursor to flameout
- Monitor for significant increase in standard deviation with no mean change



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1. *Normal furnace operation*
2. *Early detection of flame instability*
3. *Flame-out occurs*

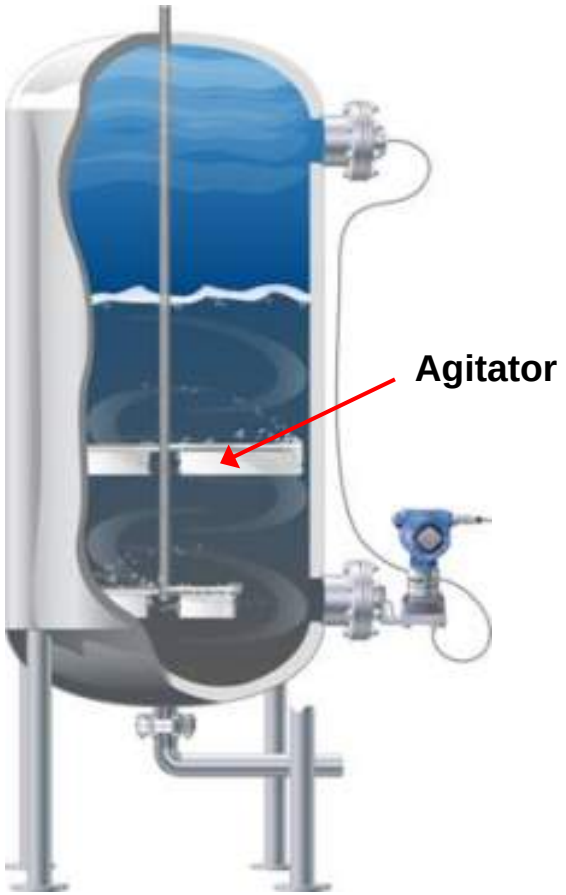
DP Level
Agitation Loss

Challenge

- Agitation motors can burn out without detection
- Undetected loss of agitation may result in poor product quality or batch loss
- DP level is subject to impulse line plugging

Solution

- Loss of agitation results in significant reduction in standard deviation
- Plugged impulse lines also are detected through a reduction in standard deviation.



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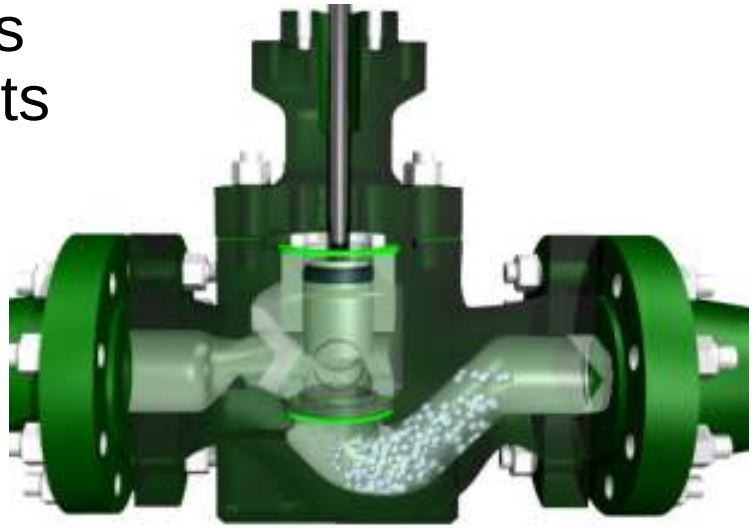
Pump / Valve Cavitation

Challenge

- The onset of cavitation results in several negative side effects
  - Process efficiency
  - Elevated process noise
  - Increased vibration
  - Risk of physical plant damage



Solution

- Use Advanced Diagnostics with SPM enabled to monitor for high variations due to elevated process noise

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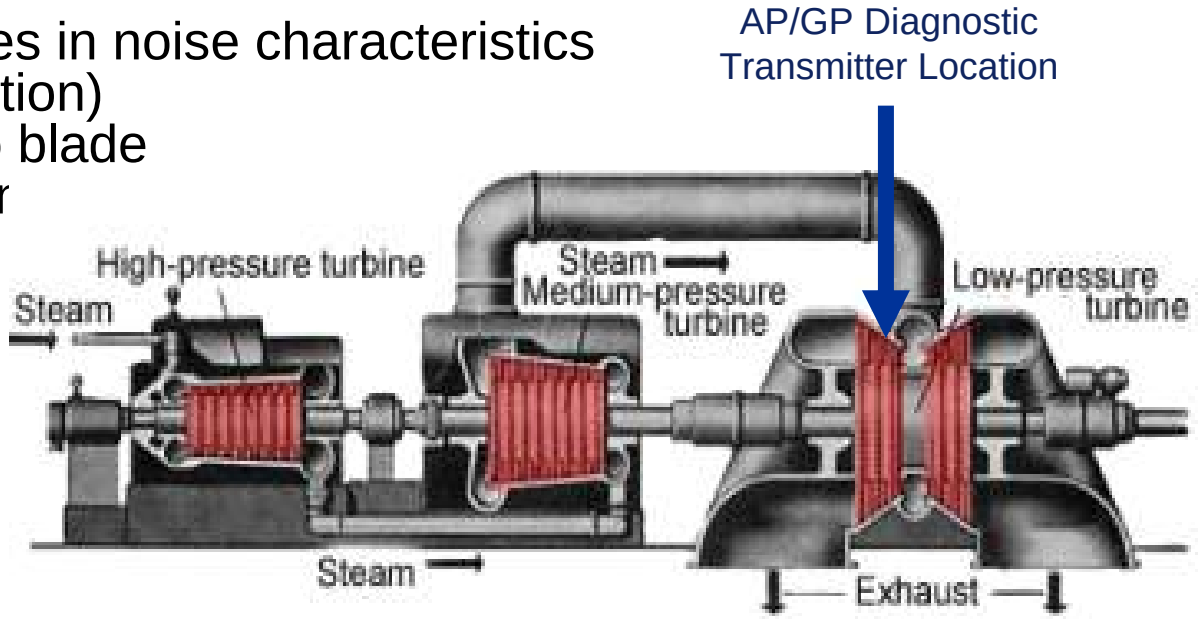
Rotary Equipment Wear
Turbine Blades

Challenge

- Turbine blades wear out from liquids or solids in steam
- Costly repair and maintenance
- Reduces efficiency of plant

Solution

- Install an inline device to monitor line pressure noise to signal ratio of low pressure turbine blades
- Look for changes in noise characteristics (standard deviation) and correlate to blade condition and or



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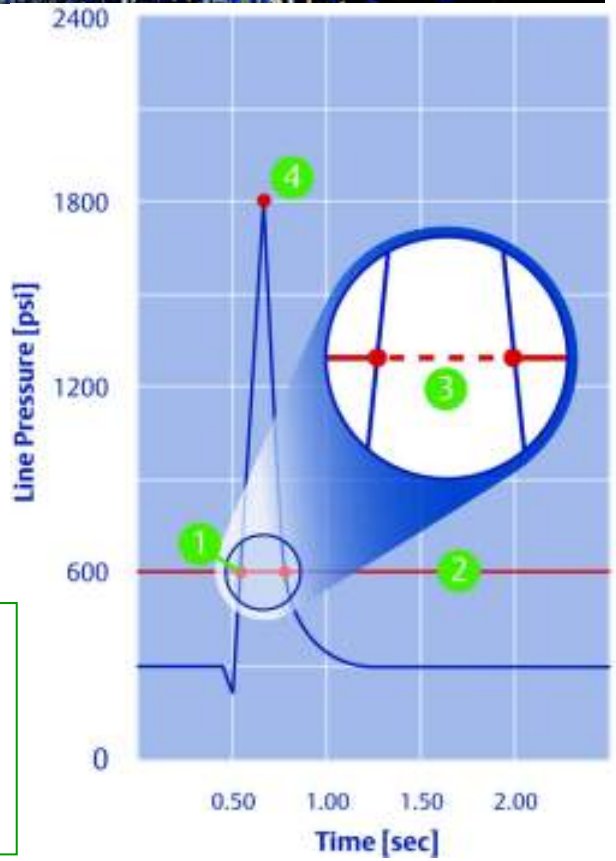
Pressure Transient Detection

Challenge

- Sudden changes in pressure and velocity of flow caused by valves, pumps, power failures, or changes in delivery rates
- Insufficient monitoring and lack of detection leads to transients exceeding design pressure of pipe
- May result in reduced delivery efficiency and pipes made vulnerable to leakage or rupture

Solution

- Use variable logging to record peak pressure reading and time stamping to know when the transient occurred
- Use process alerts to provide early warning of pressure transient



1. Pressure transient triggers process alert and time stamp upon exceeding user configured threshold
2. User configured threshold is used to trigger an alert based on high or low pressure values
3. Duration of pressure transient is logged
4. Extreme pressure values and time since occurrence are logged

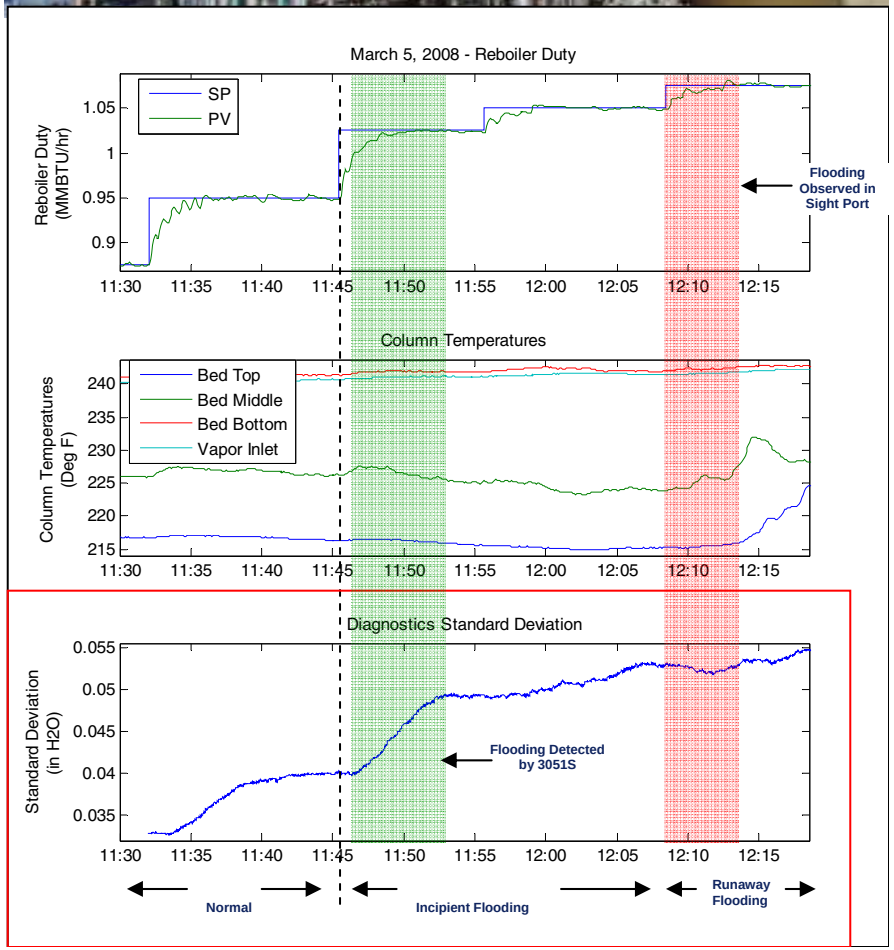
Distillation Column Flooding

Challenge

- Common process problem
- Column stops efficient separation
- Difficult to diagnose, can take a long time to correct
  - Traditional indication (Packing temperatures) only change after flooding occurs

Solution

- Tested at University of Texas
- Monitor the DP across the packing
- Increases in standard deviation previously correlated to flooding serve as a leading indicator of incipient flooding



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Application List

Tested Applications:

- Plugged Line Detection
- Furnace Flame Instability
  - Gas
  - Coal
- Distillation Column Flooding
- Catalyst Circulation in FCC
- Fluid Composition Changes
  - Wet Gas Detection
  - Entrained Air Detection
- Pulsation Induced Measurement Errors
- Impulse Line Leak Detection

Applications in Test:

- Rotary Equipment Wear
  - Steam Turbine Blade Wear
  - Coal Pulverizer Primary Wear
- Wet Steam Detection
- Steam Trap Failure
- Agitator Loss (Reactor Tank)
- Pressure Transient Detection
- Cavitation Detection
  - Pump and Valve
- DP Level
  - Plugged Impulse Lines
  - Wet Leg Drying Out
  - Dry Leg Getting Wet

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3051S Advanced Diagnostics for HART

3051S SuperModule®
(All Vintages)

+

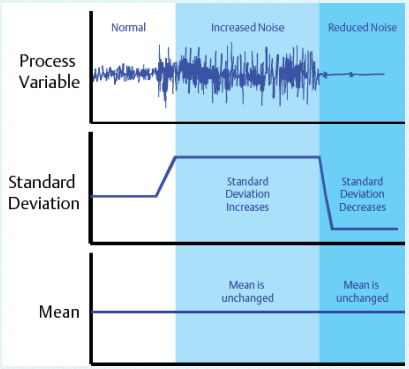
ASP™ Diagnostics Suite

=

3051S with Advanced HART Diagnostics

Statistical Process Monitoring (SPM)
- Detect abnormal process changes

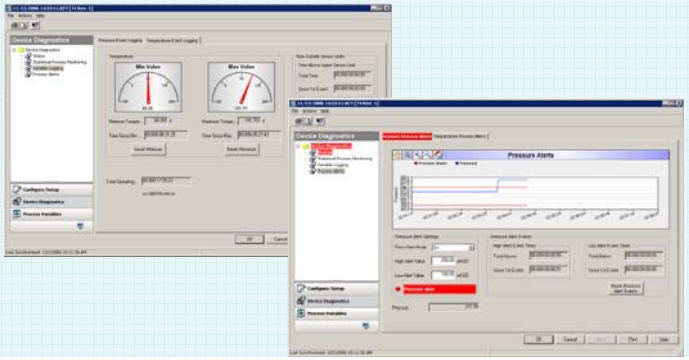
Process Standard Deviation & Mean
- Get more insight into the process with additional variables



Variable Logging
- Improve troubleshooting by tracking process variables

Advanced Process Alerts
- Indicates process and environmental changes

Time Stamping
- Know the timeline to diagnostic events



Enhanced EDDL
- Intuitive and user-friendly interface for a better view into your process

2006 ENGINEERS' CHOICE AWARDS
CONTROL ENGINEERING

2007 Innovation AWARDS WINNER

Safety Certified

Quick Connect

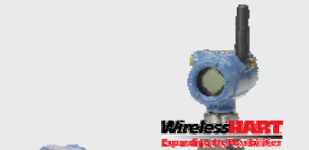
Remote Display and Interface

Integral Manifolds

Pressure
Best Practices

Scalable Connectivity

Scalable Process Connections



Wireless

Advanced Diagnostics

Fieldbus

Advanced PlantWeb Functionality

Flow Control Awards

2006 ENGINEERS' CHOICE AWARDS CONTROL ENGINEERING

Control Engineering Award

Rated #1 for 14 years in a row.

DP Level
Best Practices

Tuned-Systems™

Sanitary Quick Connect

DP Flow
Best Practices

Multivariable

Ultra for Flow

Direct Mounting

Integrated DP Flowmeters

Summary
Rosemount 3051S Advanced Diagnostics

- Fast updating pressure transmitter provides more insight into the process
  - Standard Deviation
  - Mean
- Applying best practices with Diagnostics can help detect and prevent abnormal situations
- Many applications are possible, where ever there is process noise, we can use Advanced Diagnostics!

- On the web: http://www.rosemount.com/3051s