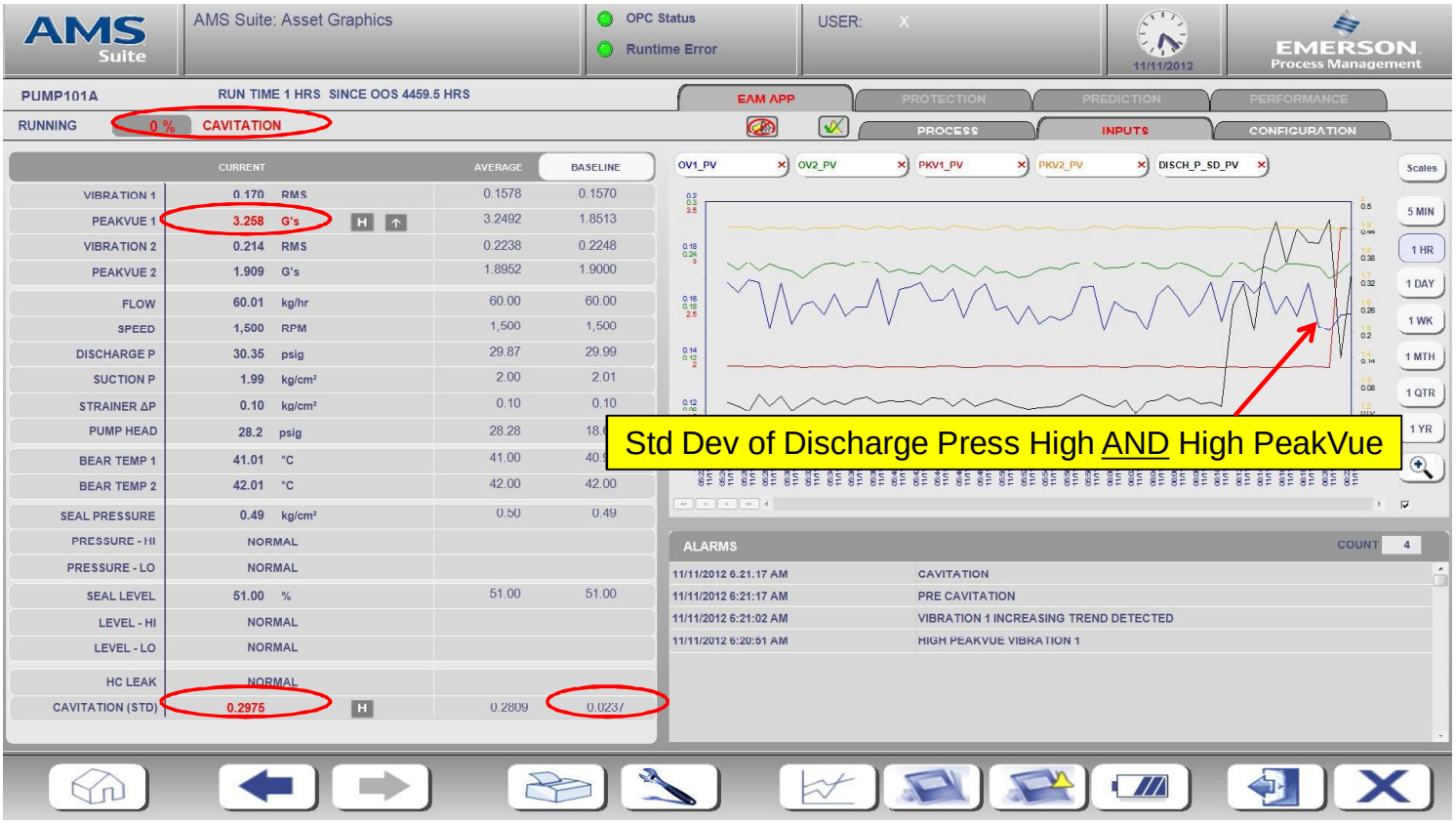
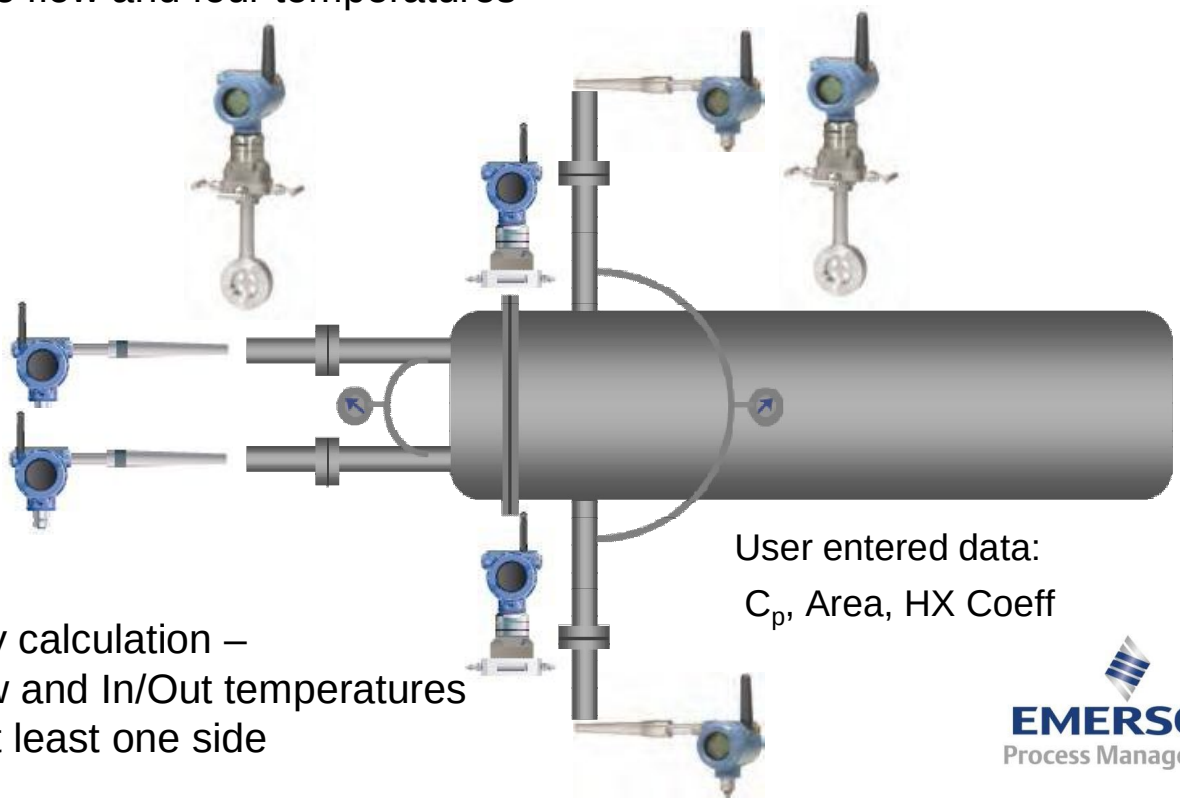
Cavitation Detection with Process and Asset Data



Heat Exchanger Monitoring

Fouling calculation –
One flow and four temperatures



User entered data:

C_p, Area, HX Coeff

Duty calculation –
Flow and In/Out temperatures
of at least one side

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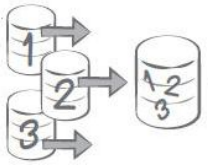
Importance of Heat Exchanger Monitoring

Increased Processing Difficulties

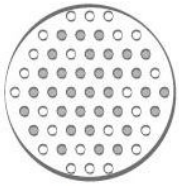
To take advantage of price discounts, many refiners are choosing difficult-to-process “opportunity” crudes.



0.7%
LOST CAPACITY DUE TO INCREASED FOULING AND PLUGGING

Increased Fouling

Fouling rate and severity increase as a result.



2%
FOULING

Wasted Energy

Just 2% fouling causes a 10% energy loss.

10%
WASTED ENERGY DUE TO INCREASED FOULING AND PLUGGING

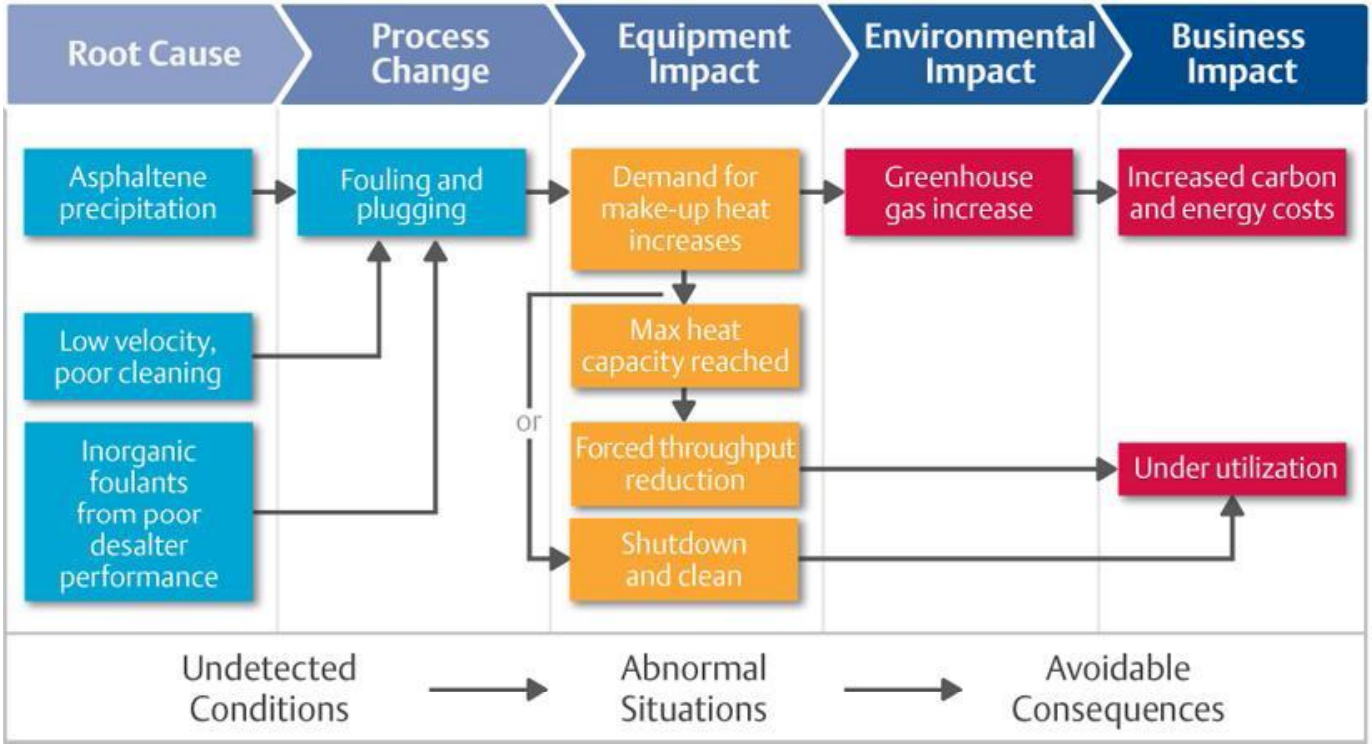
Increased costs

Energy and financial loss associated with fouling totals more than $2 billion/yr in U.S refineries alone.

$2 BILLION
IN LOSSES FROM FOULING AND PLUGGING

Looking at a typical Heat Exchanger Root Cause & Effect Diagram…

Fouling and plugging can impact several process areas:



50% of equipment failures are induced by the process and are avoidable
Source: Ron Moore, Reliability Based Manufacturing

Only with Emerson…
Address critical fault conditions…

Fault Condition	Cold Side Inlet Temp	Cold Side Outlet Temp	Hot Side Inlet Temp	Hot Side Outlet Temp	Cold Side Flow	Hot Side Flow	Cold Side dP	Hot Side dP
HX Cleaning Required					☑	☑	☑	☑
HX Fouling					☑	☑		
Low Flow					☑	☑		
Decreasing HX Duty	☑	☑	☑	☑	☑	☑		

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…using pre-engineered algorithms on a combination of process and equipment data to report asset health

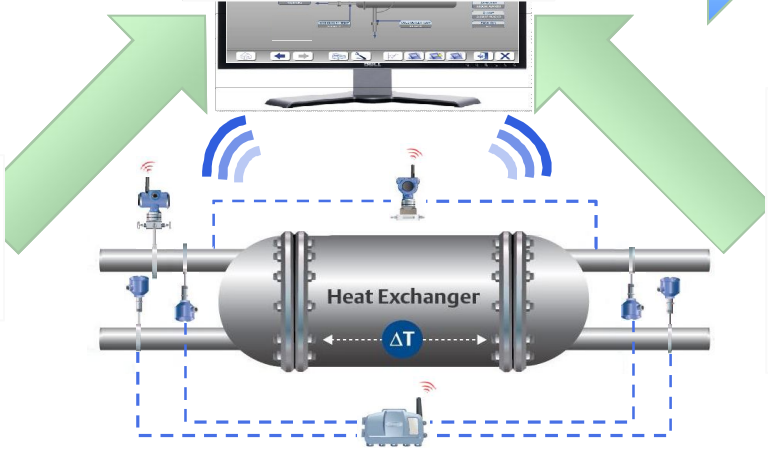
Heat Exchanger Health Indicator

Cleaning Required
Lost Energy Cost
Fouling factor and rates
Duty error
Exchanger In/Out Service

Early warning system that can be easily understood; don't need machinery expert to interpret

Pre-Engineered Software Algorithm

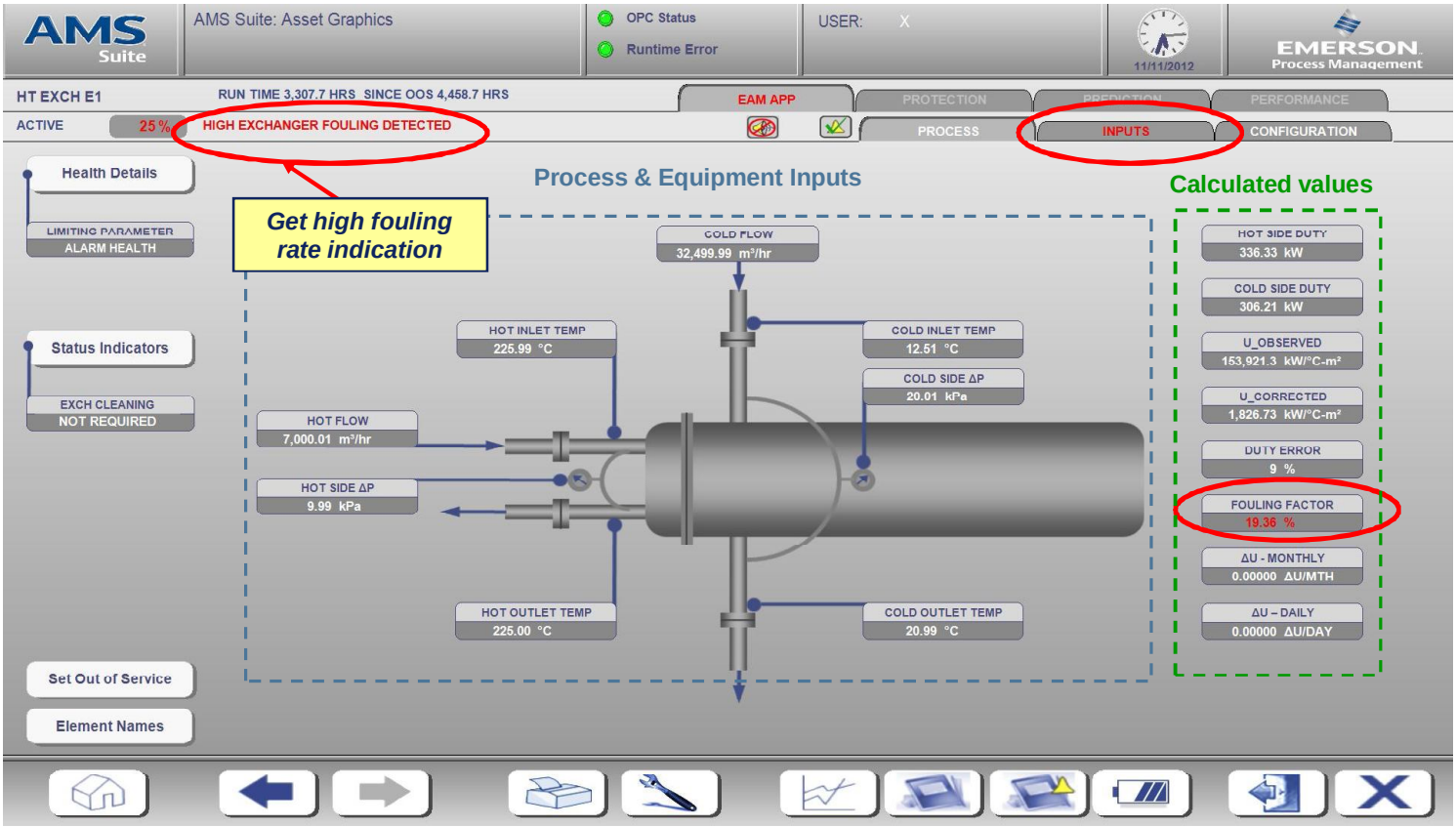
Provide early warning of impending failure and abnormal operation without spurious alarms



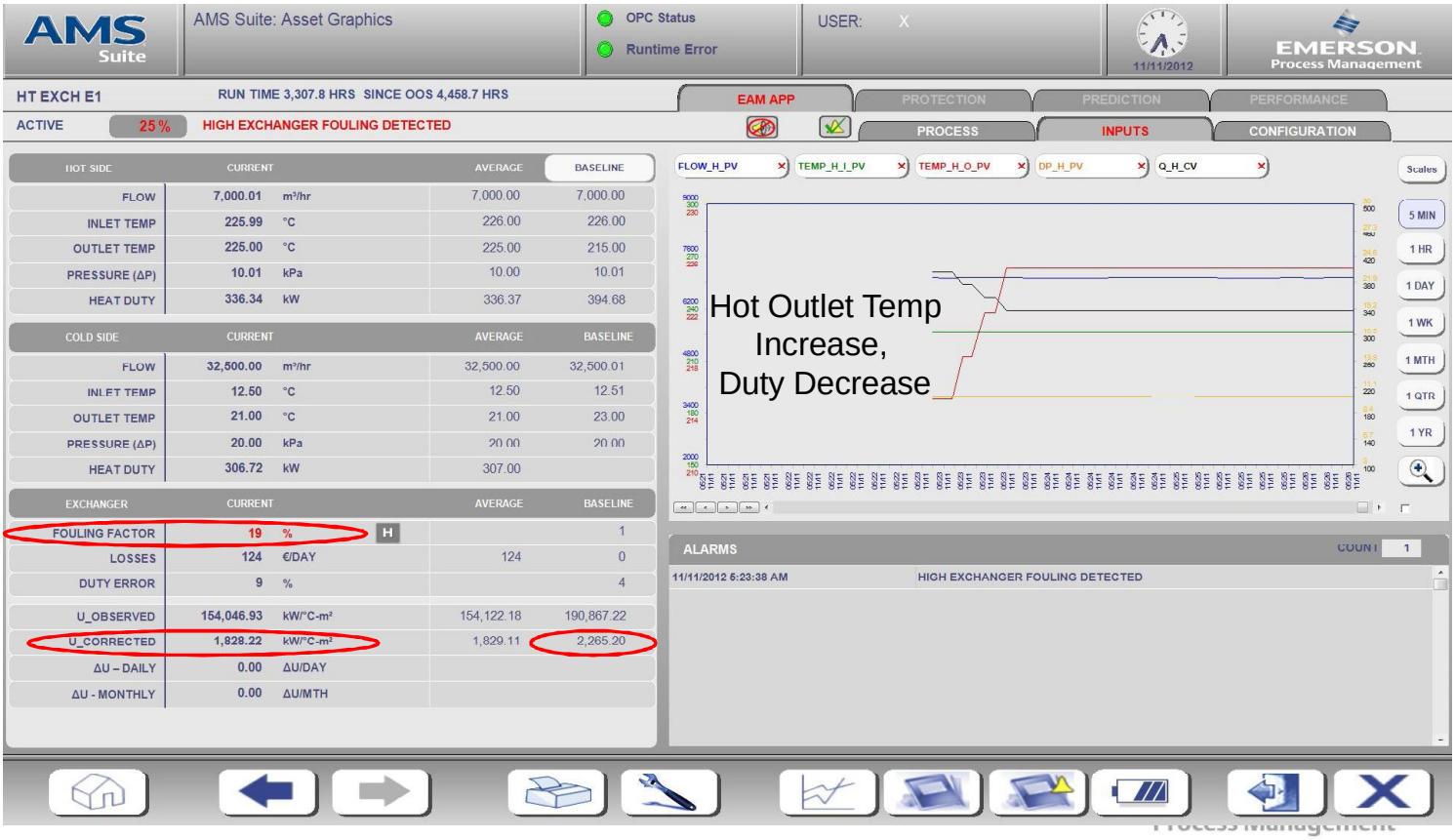
Process Data
Hot/Cold Side Flow
Hot/Cold Side DP
Hot/Cold Side Inlet T
Hot/Cold Side Outlet T

Equipment Data
Exchanger Constants
Exchanger Area
Flowing Condition Constants
Clean Exchanger Coefficient
Run/Stop Indicator
Initial Baseline

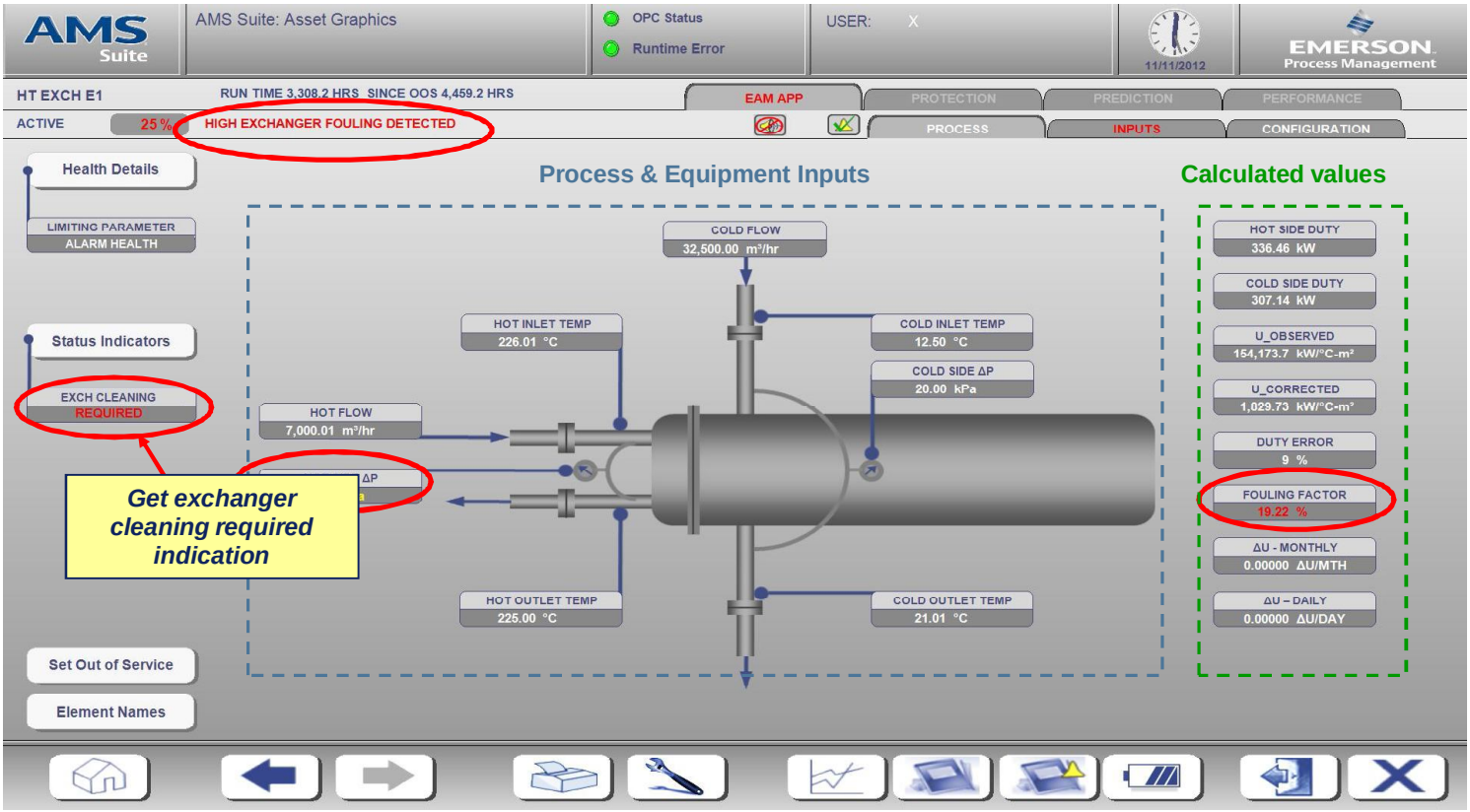
Heat exchanger high fouling rate detection



High fouling rate detection with process <u>and</u> asset data



Clean exchanger indication



Value Proposition for EAM for Heat Exchanger

- Enable Comparison of Efficiency Deterioration Patterns for Different Crude Types & on Different Exchangers
- Enable Identification of Exchangers with Higher Fouling Tendency
- Alarm on “High Cost of Energy Detected” – (Cost of Energy & Efficiency/ Fouling)
- Warnings on & Identification of Operationally Passive Asset
- Alarm on “High Exchanger Fouling Detected”
- Calculate & Alarm on Deviation Between Hot & Cold Side Heat Duty
- Trend & Monitor Deterioration of Efficiency
  - Hourly/ Weekly/ Monthly/ Yearly Trends
- Automatic Snapshot Loading for Crude Change
- Ability to Import Past Historized Data into EAM : Enable Analysis of Fouling History for Period Before EAM Installation
- Export of Data into MS Excel to Enable Offline if Required

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EAM vs. Spreadsheet Trending : Proactive vs. Post-mortem Approach

- Alarms & Early Warnings :
  - Dynamic Identification of Bad Data (e.g. Instrument Failures, Temperature Inversion)
  - Early Warnings & Alarms on High Energy Cost
  - Early Warnings on High Exchanger Fouling – Enable Decision on Maintt.
  - High Exchanger Fouling Rate
  - High Heat Duty Error – Enable Timely Baseline
- Calculation & Trending for Parameters such as:
  - "U Corrected" & "△ U Daily/ Weekly/ Monthly/ Yearly"
  - Fouling
  - Exchanger Health – Penalty Weightage Configurable by User
  - Energy Cost – Enable Timely Decision on Exchanger Maintt.

EAM Enables Informed & Timely Decision for

- **Averting Problems Before They Occur**
- **Cost Effective Operation**

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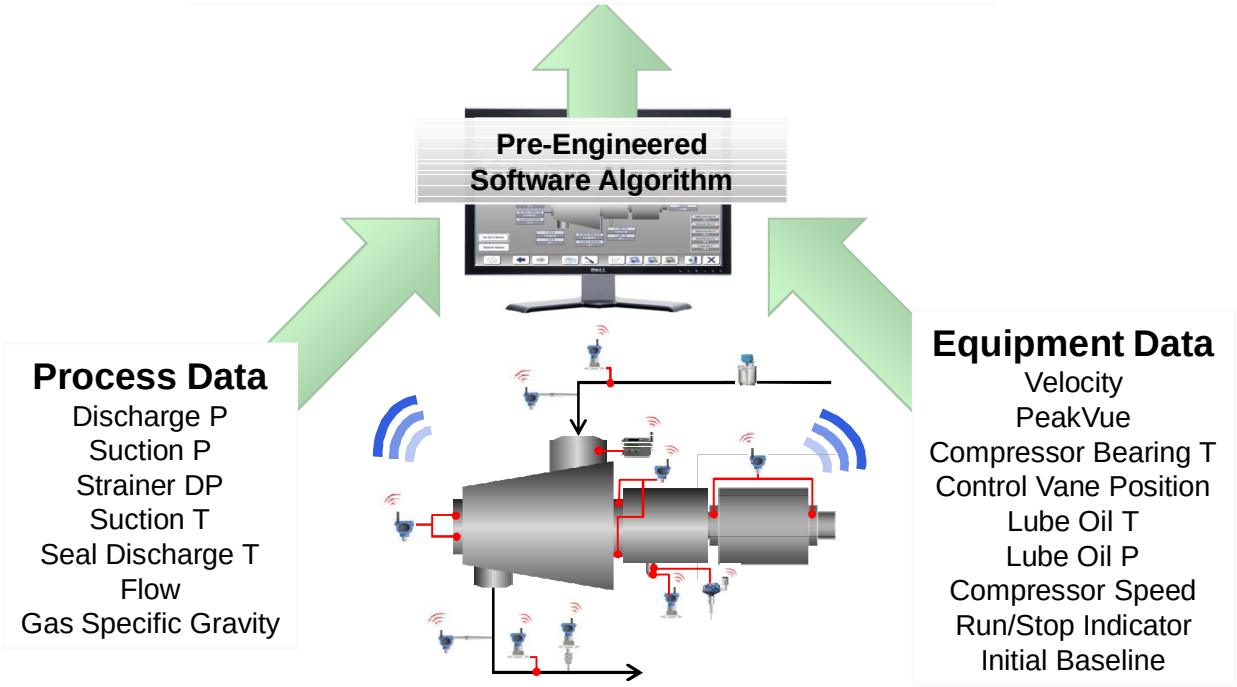
Our solution uses tested algorithms on a combination of process and equipment data

Compressor Health Indicator
Bearing and Gear Wear
Compressor Instability
Control Vane Defect
Low flow
Plugged Suction Filter



Process Data
Discharge P
Suction P
Strainer DP
Suction T
Seal Discharge T
Flow
Gas Specific Gravity

Equipment Data
Velocity
PeakVue
Compressor Bearing T
Control Vane Position
Lube Oil T
Lube Oil P
Compressor Speed
Run/Stop Indicator
Initial Baseline

Our Solution addresses every critical root cause… (Compressor)

Fault Condition	XXX	CSI 9420 (Ideal is 3- 9420's each with 2 accelerometers and no temp.			RMT 3051S				RMT 648		RMT 3051S		FSHR 4320	MM3098
	VFD Speed	Motor Vibration	Compressor Vibration	Bearing Vibration	Intake Filter dP	Flow	Suct Press	Disch Press	Suct Temp	Disch Temp	Lube Oil P	Lube Oil T	Vane Pos.	SG/MW
Resonance Freq Band	☑	☑	☑											
High Vibration	☑	☑	☑	☑										
Bearing Fault	☑	☑	☑	☑										
Plugged Intake Filter					☑									
Process Instability						☑	☑	☑						
Low dP							☑	☑						
High dT									☑	☑				
Lube Oil Monitoring											☑	☑		
Control Vane Defect													☑	
Gas Comp Change														☑

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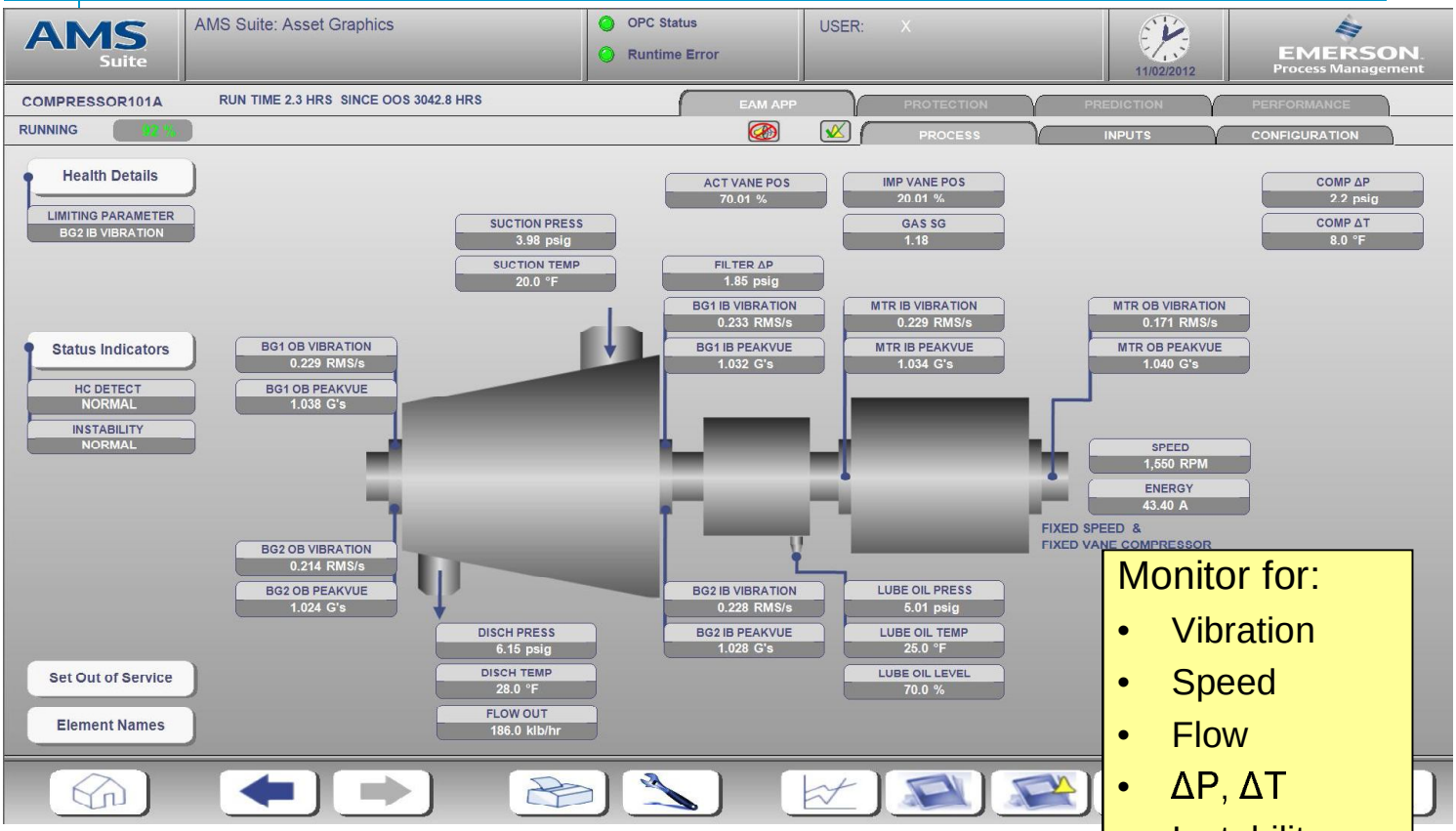
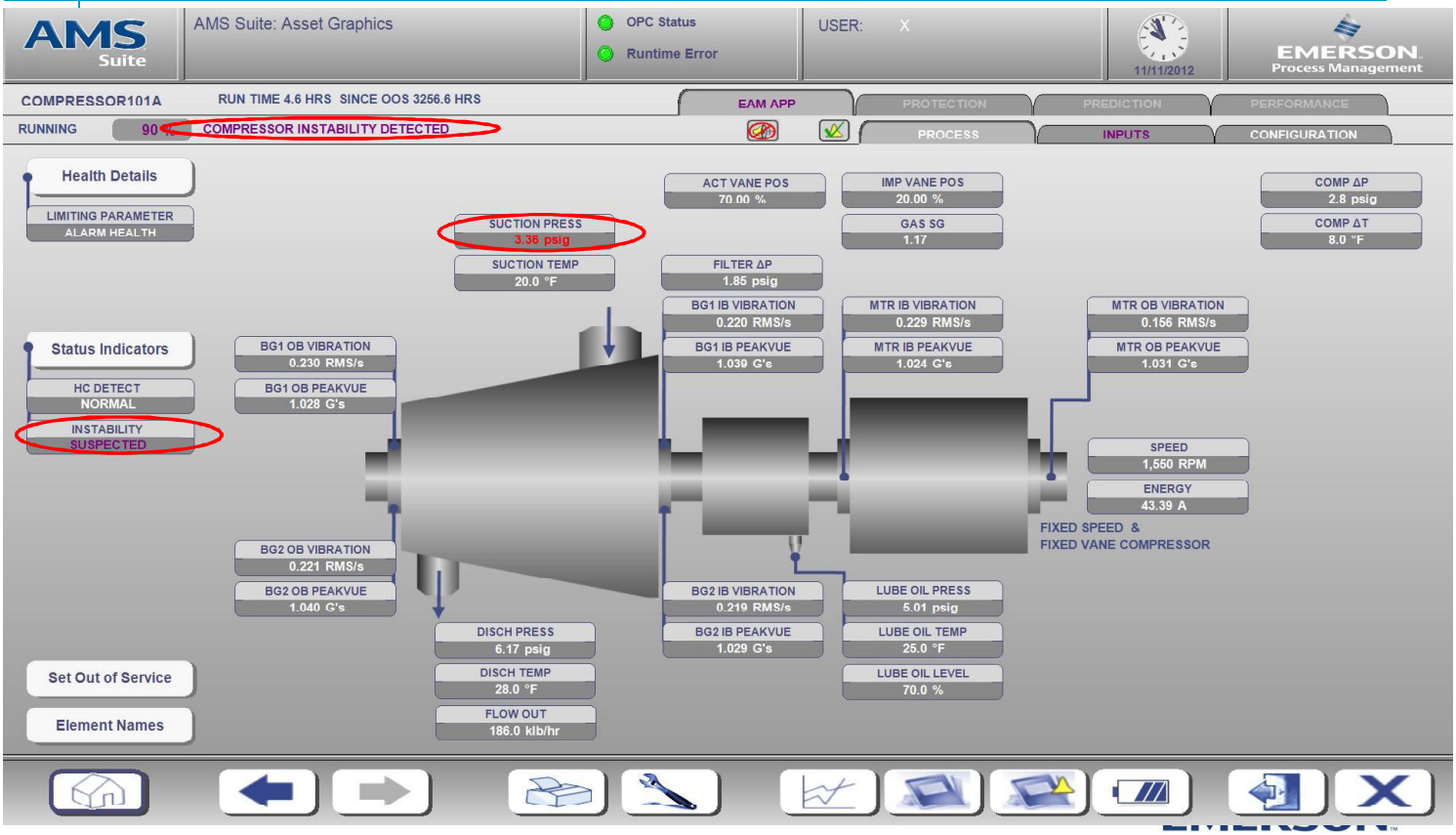
Compressor Monitoring Solution



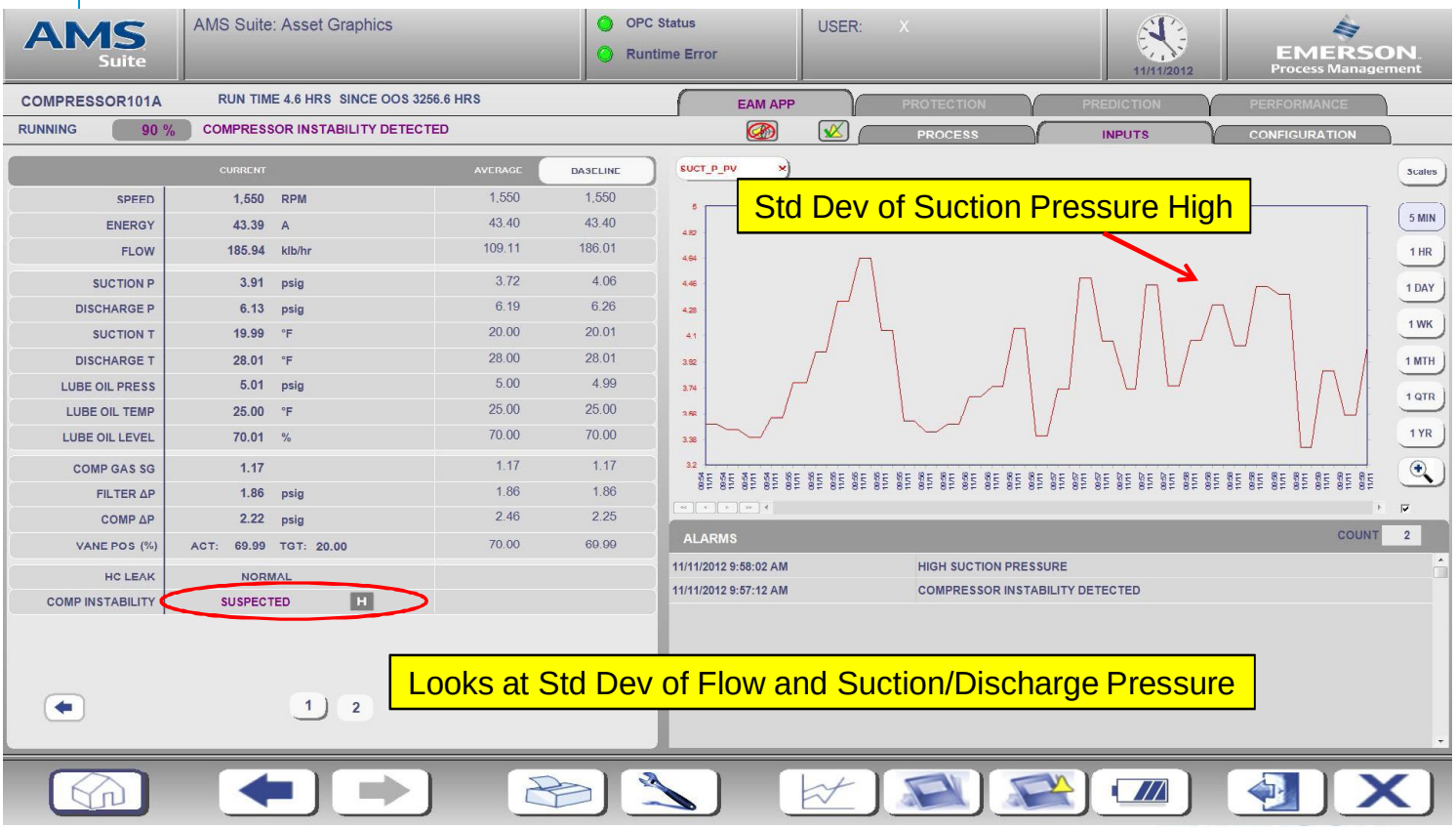
Monitor for:

- Vibration
- Speed
- Flow
- ΔP, ΔT
- Instability
- Vane Position

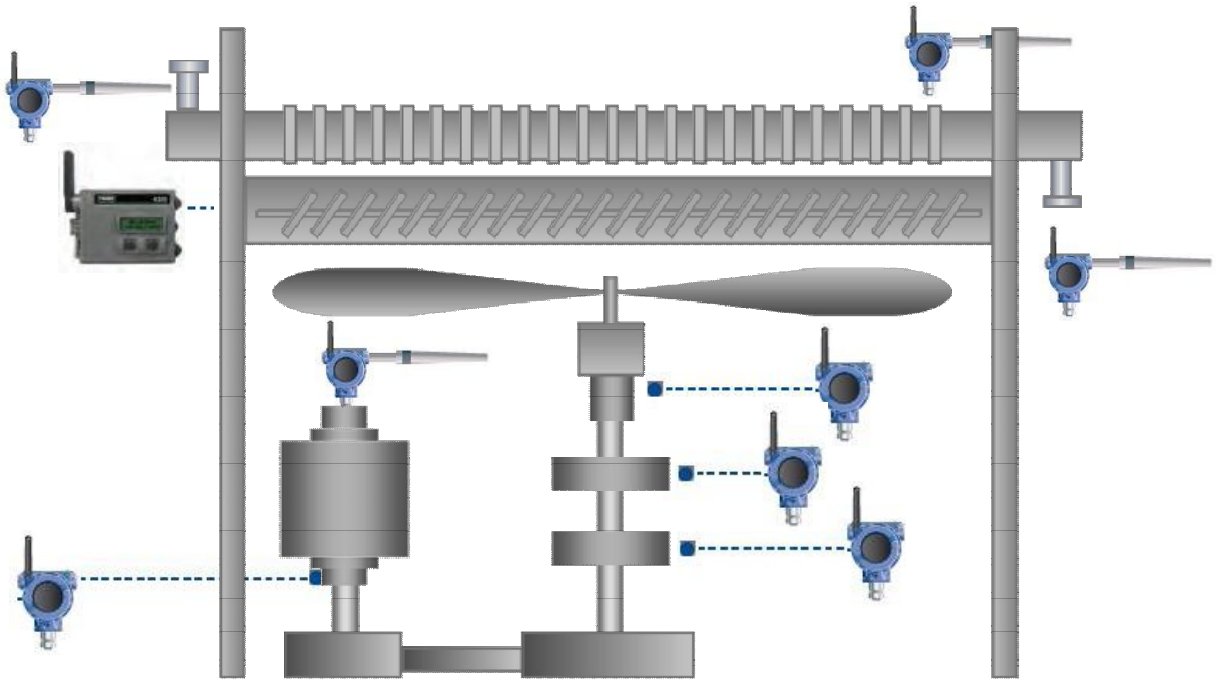
Compressor Instability Monitoring



Compressor Instability Monitoring



Fin Fan Monitoring



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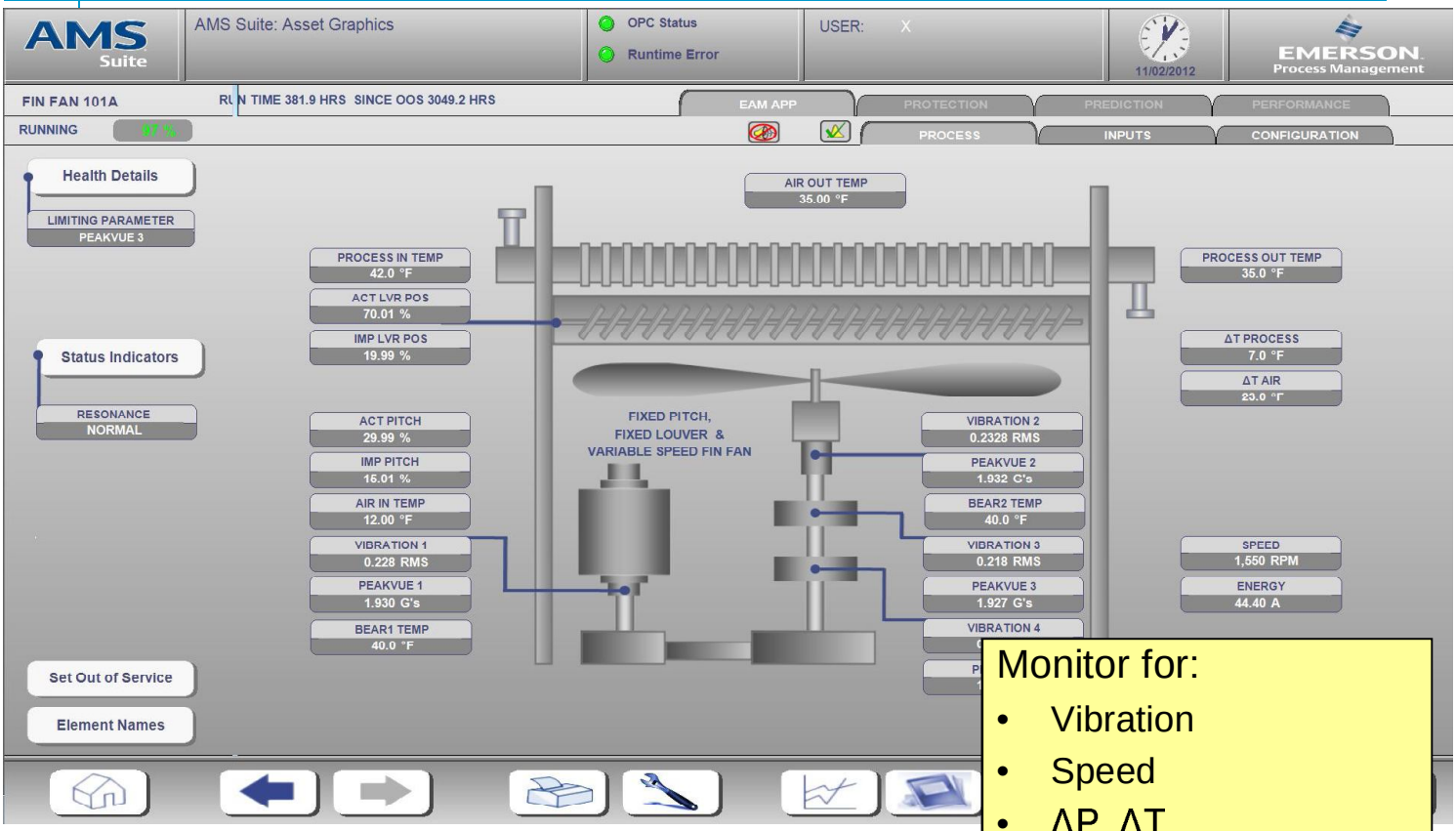
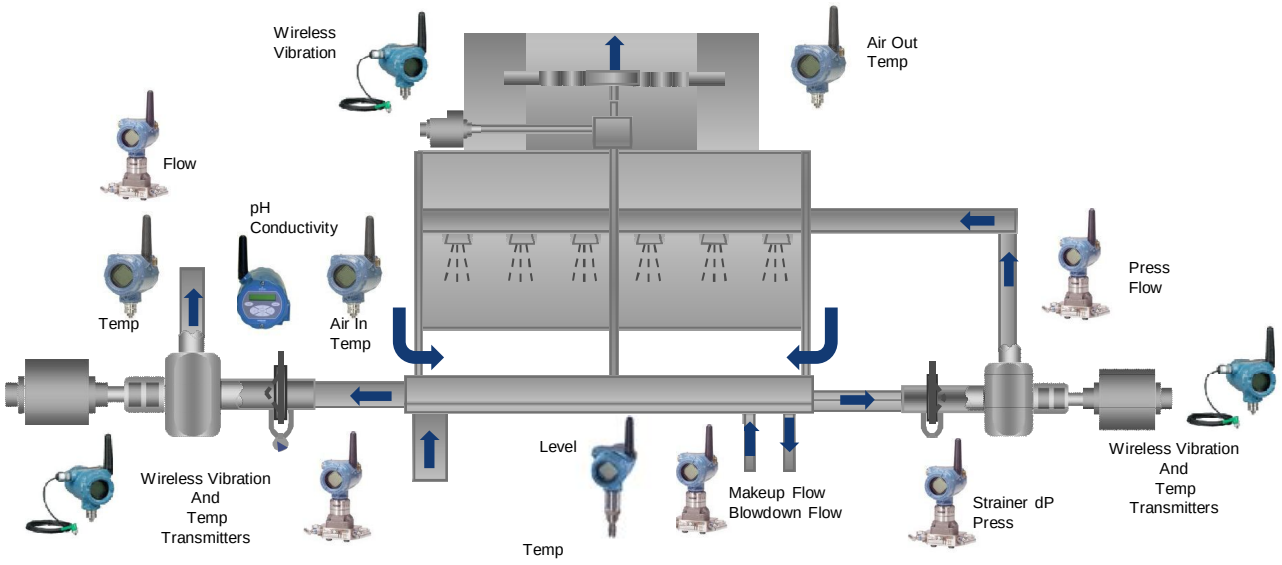
Fin Fan Monitoring Solution



Monitor for:

- Vibration
- Speed
- ΔP, ΔT
- Louver/Pitch Deviation

Cooling Tower Monitoring



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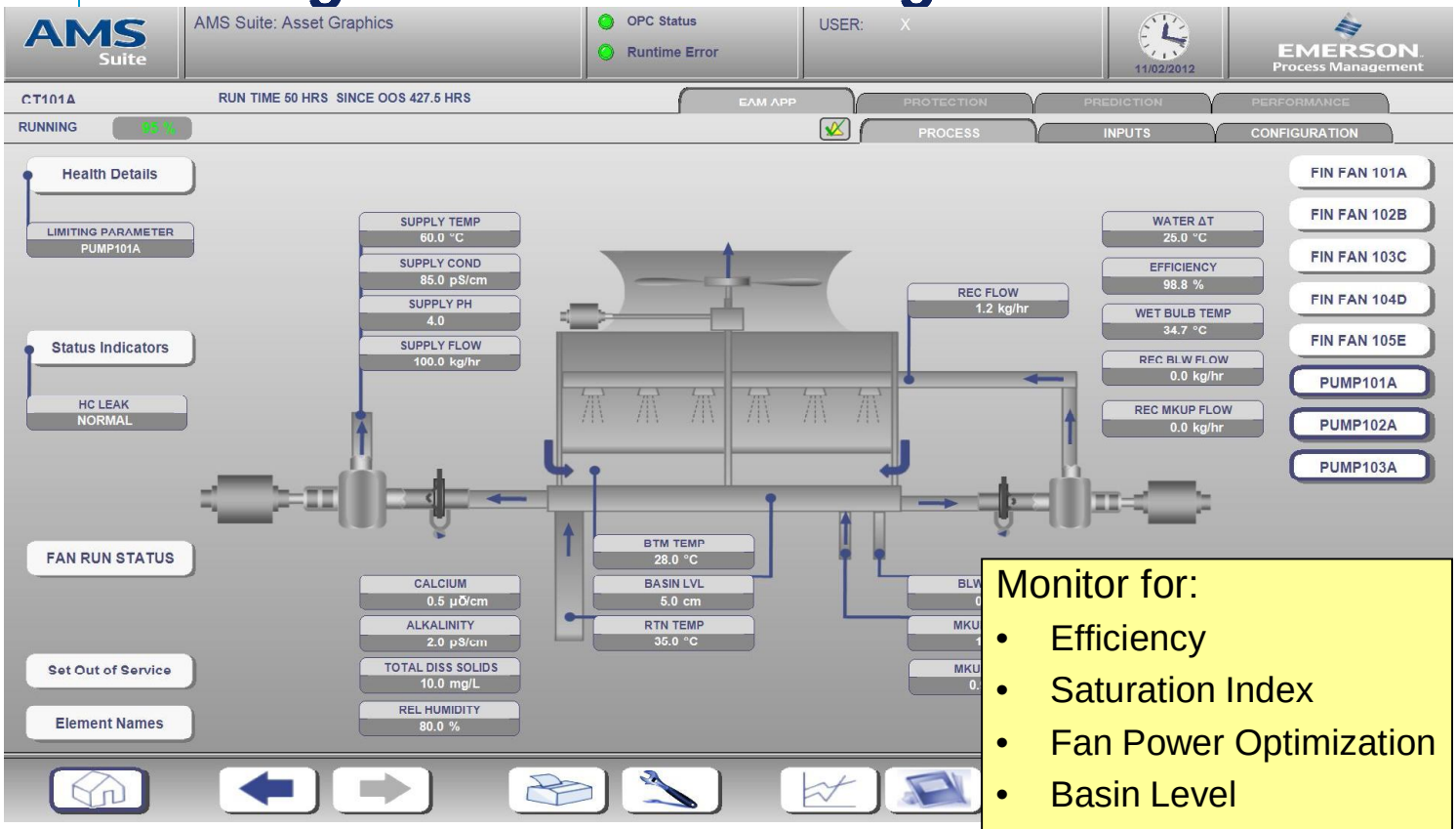
Cooling Towers Monitoring Solution



Monitor for:

- Efficiency
- Saturation Index
- Fan Power Optimization
- Basin Level
- HC Leak Detection
- Conductivity, pH

EAM Summary

- Wireless technology has made real-time monitoring of Essential Assets economical
- Catching an equipment issue before it fails can be many times the cost of the monitoring equipment
- Emerson's new EAM Suite combines process with asset data to make intelligent equipment alerts – In real-time before it fails
- Customer benefits can be substantial

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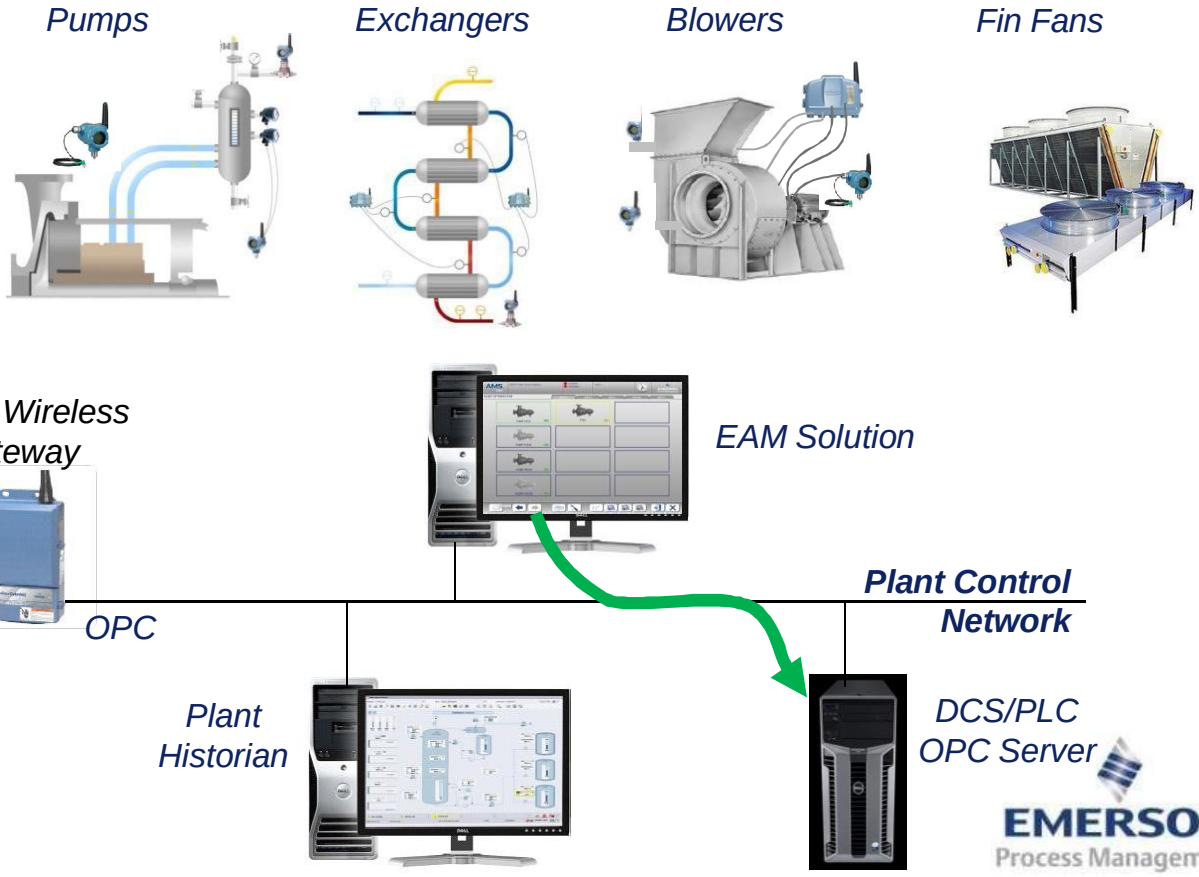
EAM Solution with Plant Control system



Reduce Energy Costs With Automated Steam Trap Monitoring

The Rosemount 708 Wireless Acoustic Transmitter

- Gives you real-time visibility to all your critical steam traps
- Provides information that enables you to make good decisions
- Is fast and easy to install and maintain
- Is proven technology that's easy to use

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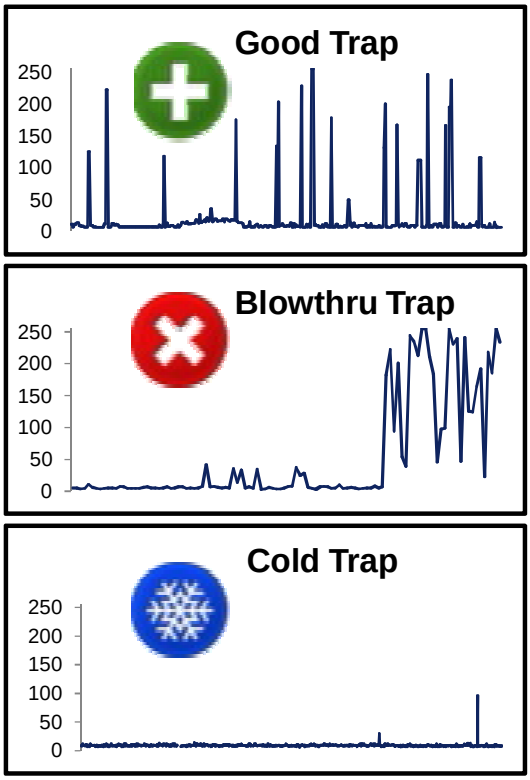
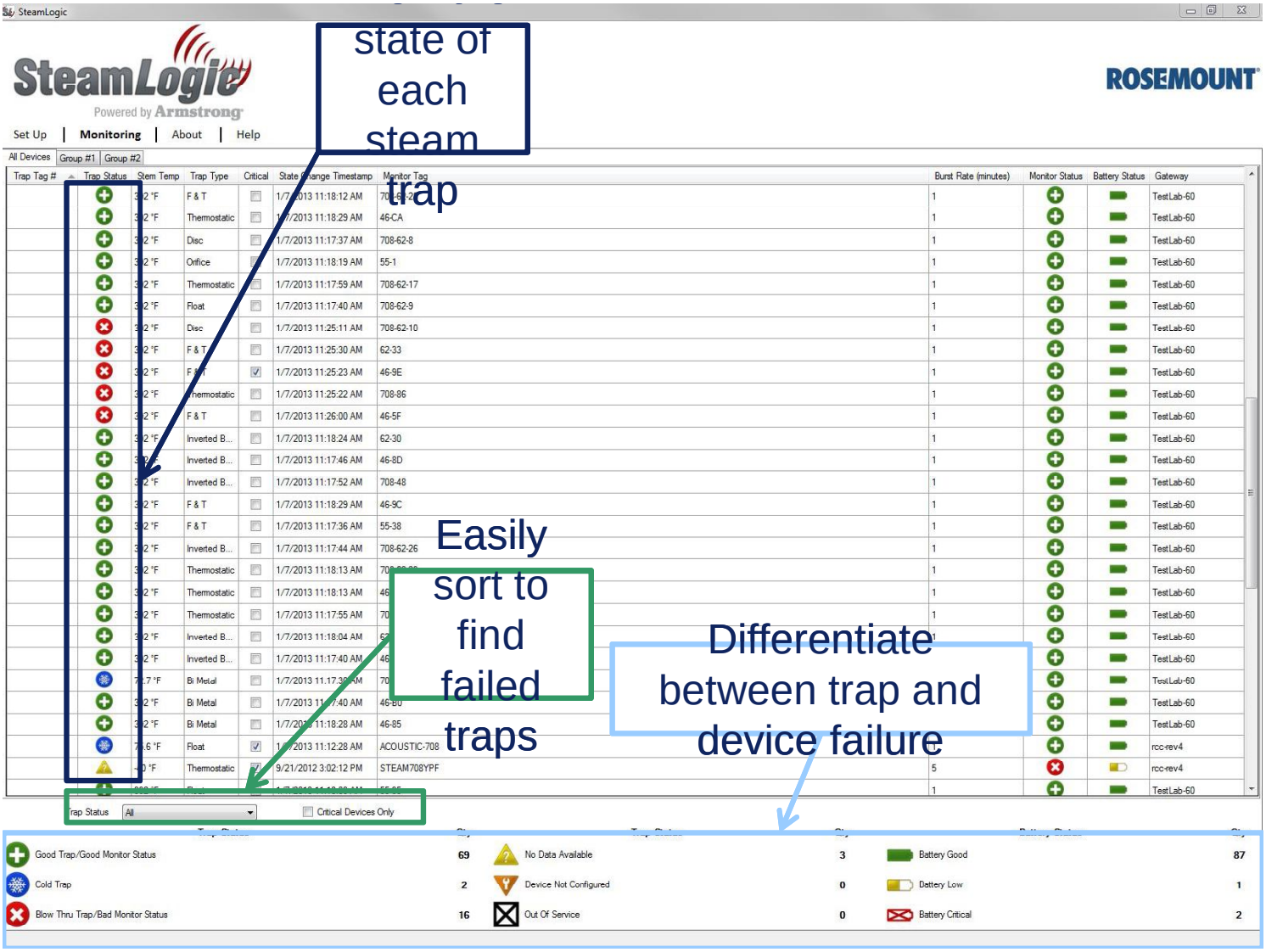
SteamLogic Software

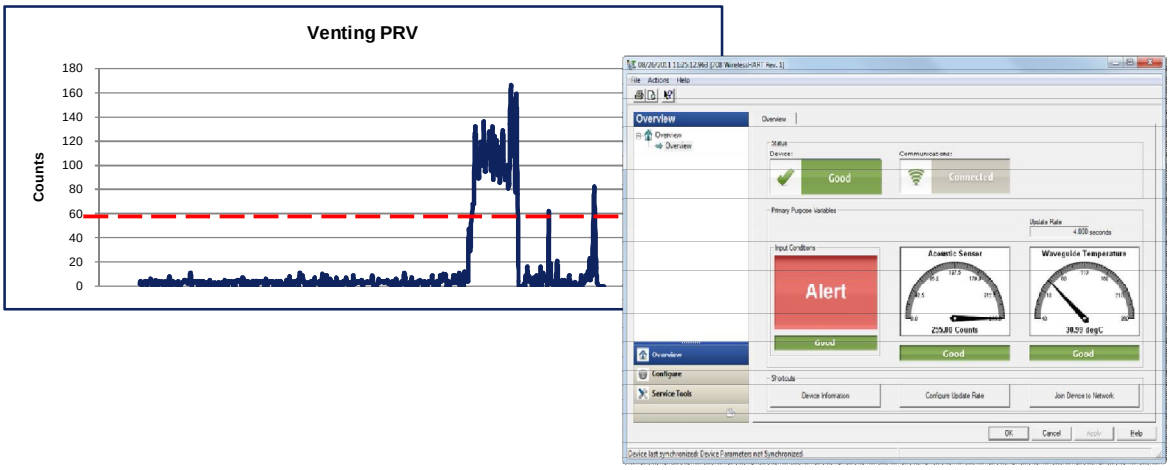
- Steam trap state calculated using algorithms within software
  - Determined based on acoustic counts, temperature, line pressure, and trap type
- Trap states include; good, cold, and blowthru
  - Works with all trap vendors




SteamLogic
Powered by Armstrong
ROSEMOUNT
Set Up | Monitoring | About | Help
state of each steam trap
Easily sort to find failed traps
Differentiate between trap and device failure
Trap Status
All
Critical Devices Only
Good Trap/Good Monitor Status 69
Cold Trap 2
Blow Thru Trap/Bad Monitor Status 16
No Data Available 3
Device Not Configured 0
Out Of Service 0
Battery Good 87
Battery Low 1
Battery Critical 2

Pressure Relief Valve Applications

- An alert can be set to indicate a vent state
  - Install and Learn
    - Listens to background noise and sets the threshold accordingly
  - Manual
    - Typically three times ambient count level



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EAM Summary

- **Wireless technology has made real-time monitoring of Essential Assets economical**
- **Catching an equipment issue before it fails can be many times the cost of the monitoring equipment**
- **Emerson's new EAM Suite combines process with asset data to make intelligent equipment alerts – In real-time before it fails**
- **Customer benefits can be substantial**

IT'S NEVER BEEN DONE BEFORE

Thank you!

Questions?

Setting the Standard for Automation™

SERVOMEX
A MEASURABLE ADVANTAGE

A Tunable Filter Optical System for On-Line and Real-Time Hydrocarbon Gas Analysis

Virlesh N Desai, Servomex Group Ltd

Analysis Solutions in Paradise……See us in Galveston 2013
The 58th Annual Symposium of the Analysis Division
Galveston, Texas, USA; 14-18 April 2013

Hydrocarbon Processing

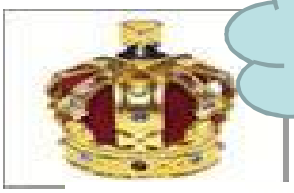
FIVE MAJOR GAS ANALYSER TECHNOLOGIES

- (N.D.) I.R Photometry
- Paramagnetic (Process) O2 and PGC
- T.D.L
- Zirconia O2

- ..the rest is Niche…U.V, Mass Spec, water….

Whither the PGC?

Process GCs derived from Industrial need and push....
(Philips >>Applied Automation>>Siemens)



- King of Analyzers

In terms of value sold PGCs have traditionally been the mainstay of the Process Gas analysis market

Good at hydrocarbon mixtures, trace elements in hydrocarbons (ppm C_2H_2 in C_2H_4)

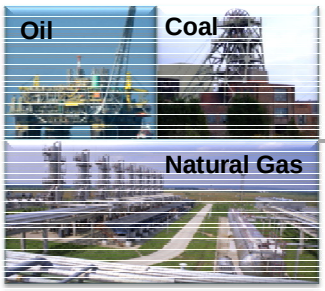
Whither the PGC?

- King of Analyzers

BUT….

Speed of analysis and maintenance

The Hydrocarbon Processing Industry



First Level Processing

- **Refining**
- **Gas Processing**
- **Coal to gas and liquid**
- **Ethane, Propane, etc**

BENZENE
TOLUENE
XYLENE

METHANE
BUTANE
BUTENES
BUTADIENE

ETHYLENE

PROPYLENE

FUEL

Cumene
Cyclohexane,
Caprolactam,
Terephthalic Acid*

Methanol,
Syngas
Adiponitrile

Ethanol,
Ethylene Oxide *
Ethylene Dichloride*,
Acetic acid*

Acrylonitrile
Adiponitrile*
Acrylic Acid

~~Nylon 6,~~
~~PET~~
~~Polystyrene, Resins,~~
~~Fibres, Polyurethane~~

~~Formaldehyde*~~
~~Resins,~~
~~MEK,~~
~~Neoprene,~~
~~P'Butadiene~~
~~Styrene Rubber~~

~~Polyethylene,~~
~~Vinyl Chloride*,~~
~~Polyvinyl Acetate~~
~~Ethylene Glycol,~~
~~Polyvinyl Alcohol~~

~~Polypropylene,~~
~~Acrylic Fibres~~
~~Nylon 66~~
~~Styrene Acrylonitrile~~