

VOYAGE2007



Early Equipment Failure Detection at Reliant Using PI & SmartSignal

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Agenda

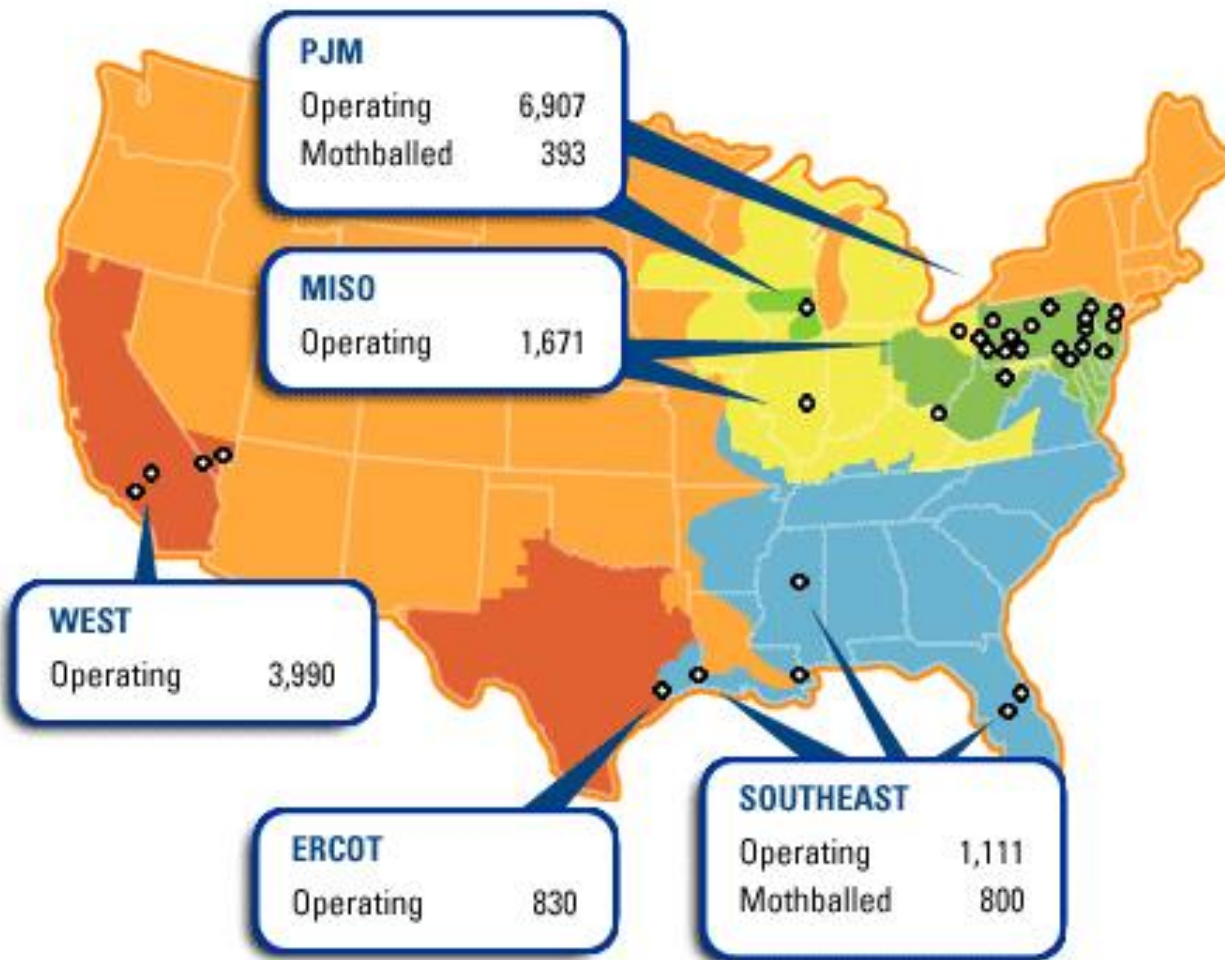
- Who is Reliant Energy?
- How are we configured?
- What is our challenge?
- What are we doing to meet this challenge?
- Real world examples...

Reliant Energy

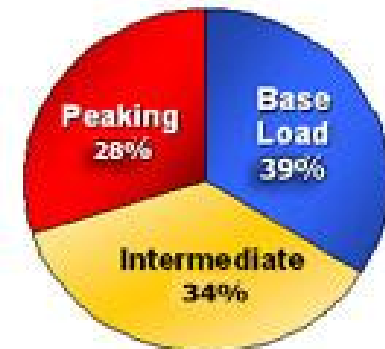
Reliant Energy, Inc. (NYSE: RRI) based in Houston, Texas, provides electricity and energy services to retail and wholesale customers in the United States. In Texas, the company provides service to nearly 1.9 million retail electricity customers, including residential and small business customers and commercial, industrial, governmental and institutional customers. Reliant also serves commercial, industrial, governmental and institutional customers in the PJM (Pennsylvania, New Jersey and Maryland) market.

The company is one of the largest independent power producers in the nation with approximately 16,000 megawatts of power generation capacity across the United States. These strategically located generating assets utilize natural gas, fuel oil and coal. For more information, visit www.reliant.com.

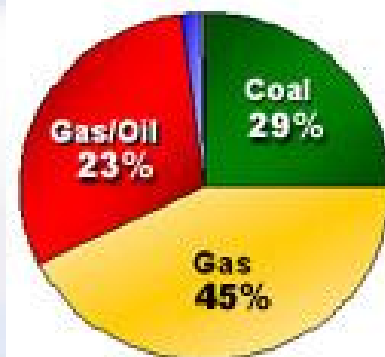
Fleet Breakdown



Dispatch Type



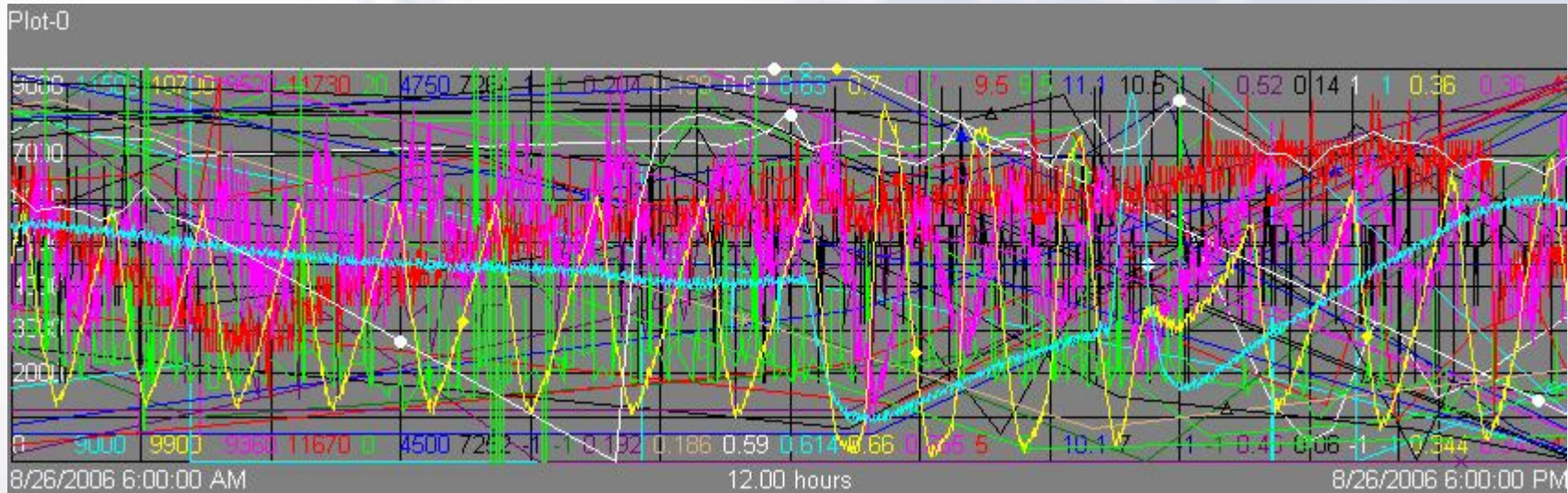
Fuel Type



PI Infrastructure

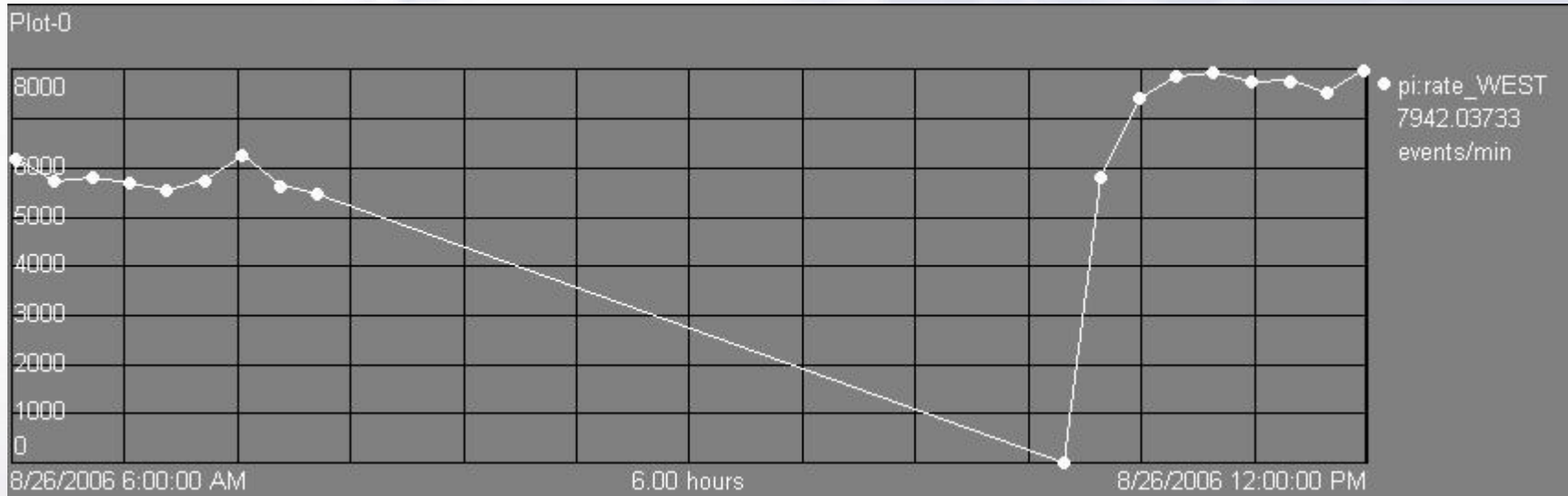
- 31 PI Servers
- ~203 Interfaces to various systems
- 1000+ Process Displays & Reports
- ~350K Tags

The Challenge



- So much data, So little time...
 - ▶ Collect Data
 - ▶ Convert Data into Information
 - ▶ Have Information support Action

The Challenge



- How do you make it obvious to the end user when something is occurring that requires attention?

Transforming Data into Dollars

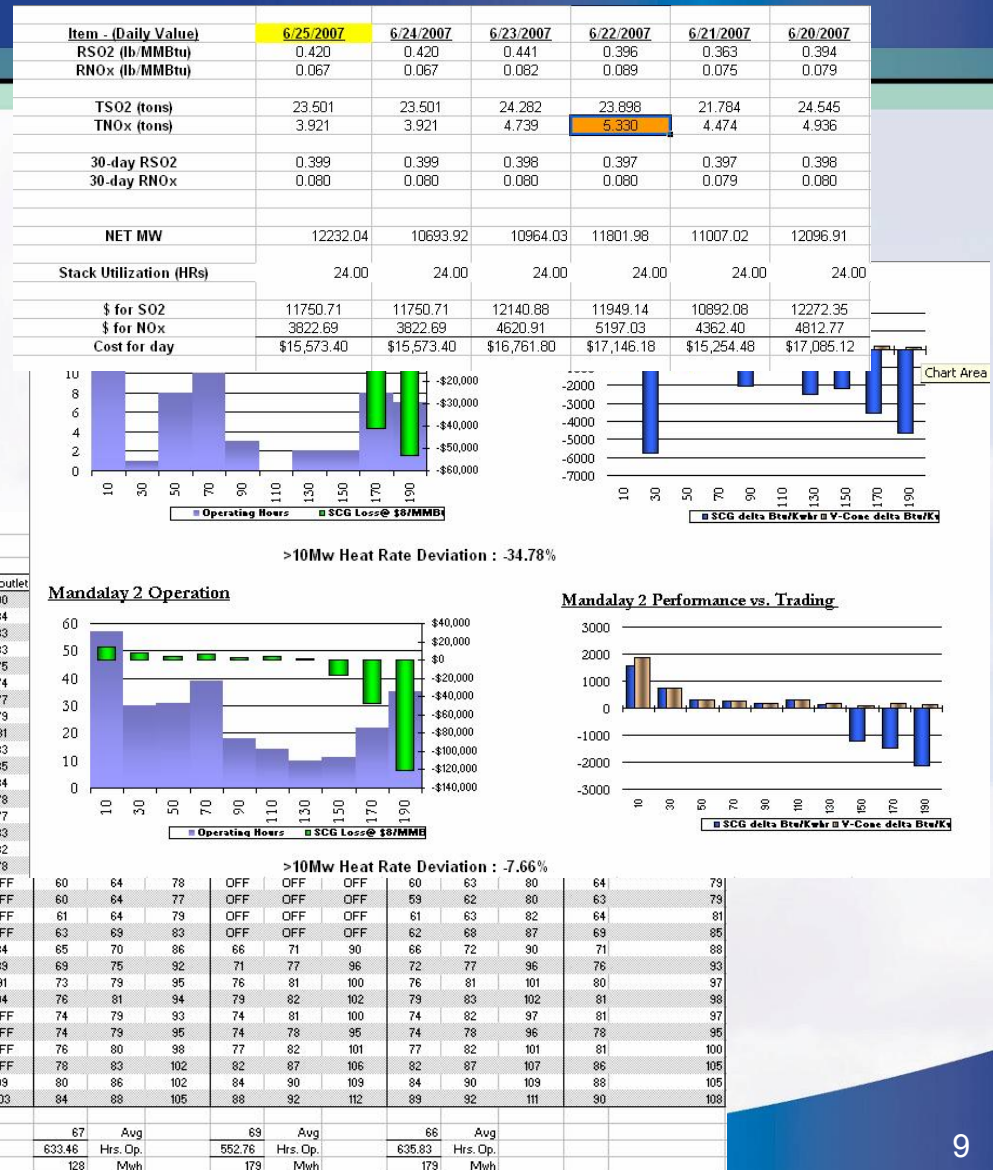
Utilizing these tools Reliant has been able to turn data into actionable information that has an effect on the bottom line.

An Evolution

- PI ProcessBook / Activeview
- PI DataLink
- PI ACE
- SmartSignal EPI*Center / Watchlist

PI DataLink Automation

- Automatically generate reports on a schedule or based on events
- Highlight suspicious data with conditional formatting

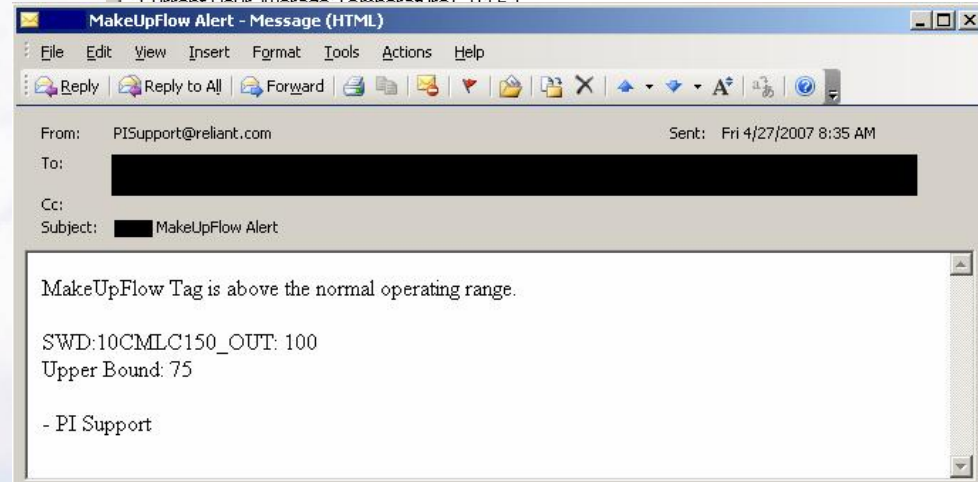
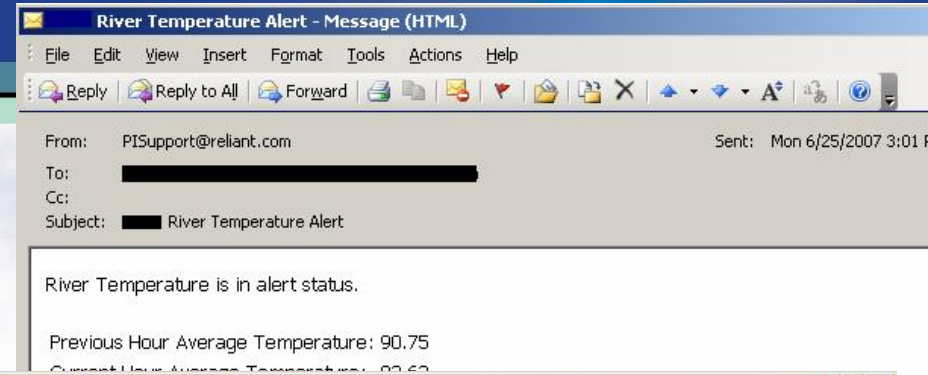


PI ACE

PI Advanced Computing Engine (ACE) allows programming of complex calculations, communication apps, data transfer programs, and just about any other application that does not require user intervention.

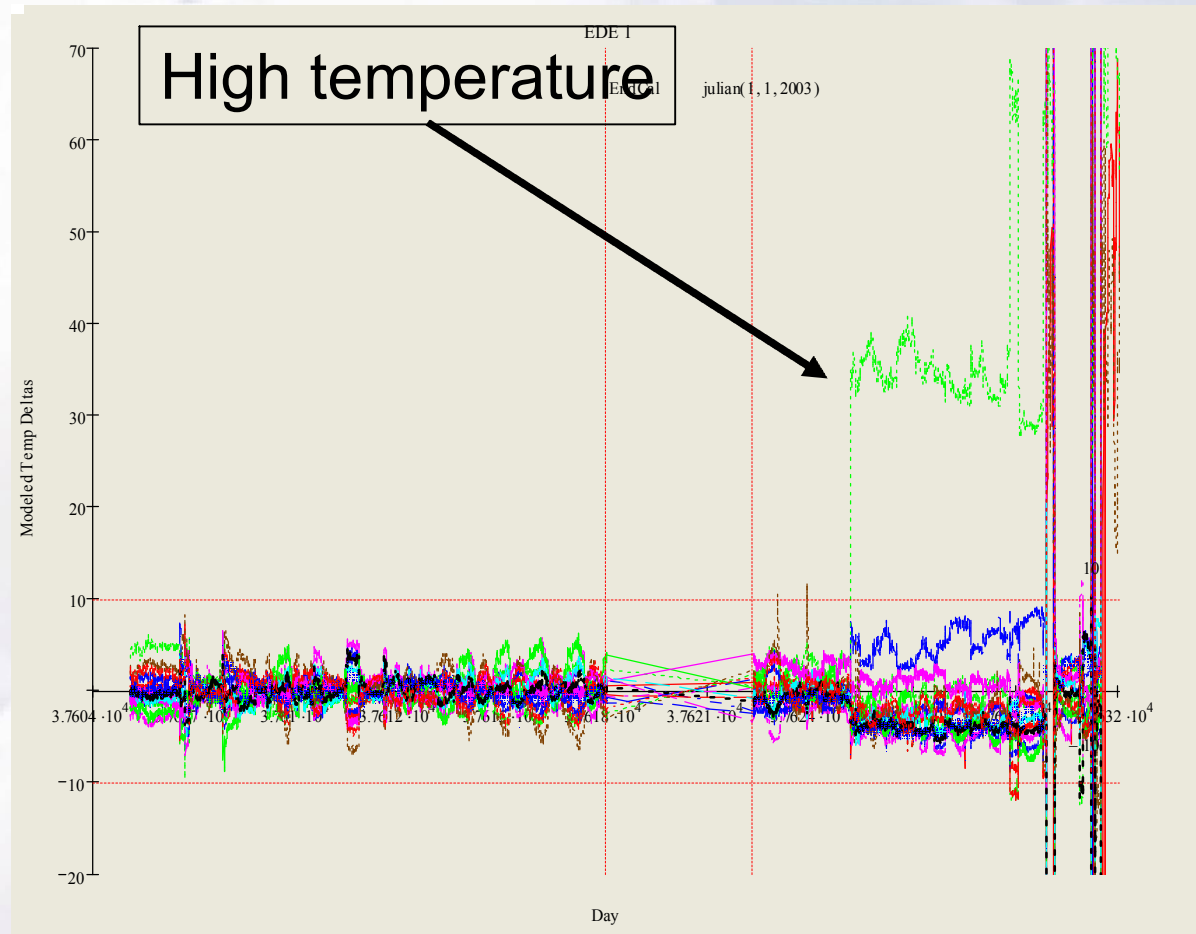
- Applications generate email notifications based on conditional data from PI systems.
- PI Data validation
- PI System Health Monitoring

* Also use ECG's E-Notification for email notifications



```
MOD_ELS_F8_5 has a bad value for 5/4/2007 4:00:00 PM
MOD_ELS_F8_5 has a bad value for 5/4/2007 6:00:00 PM
MOD_ELS_F8_5 has a bad value for 5/4/2007 8:00:00 PM
```

Built Parametric Models



Models ported to PI Processbook / ActiveView

Channelview Unit 1 Blade Path Temperature Spreads

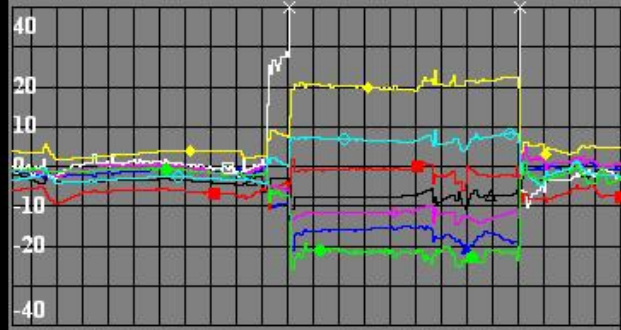
Calibration Date: 11/7/2003 2:17:21 PM

PE #

Result

1	-2.62139
2	-2.45013
3	4.55286
4	0.88621
5	-7.56086
6	-3.33219
7	-0.80253
8	-3.16309
9	11.8025
10	2.62225
11	5.71992
12	1.94506
13	3.87861
14	7.28852
15	5.59275
16	-22.7977

Plot-0



6/24/2007 1:14:52 PM

6/25/2007 1:14:52 PM

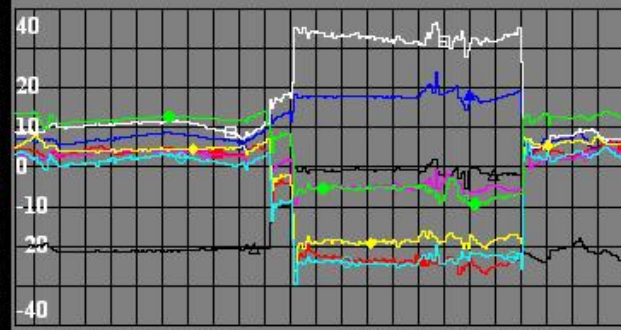
MW



6/24/2007 1:14:52 PM

6/25/2007 1:19:12 PM

Plot-0



6/24/2007 1:14:52 PM

6/25/2007 1:14:52 PM

Change Scale

Set Alarm Limits

Acknowledge Alarm

Reset Alarms

1D

2D

5D

7D

14D

28D

56D

MTD

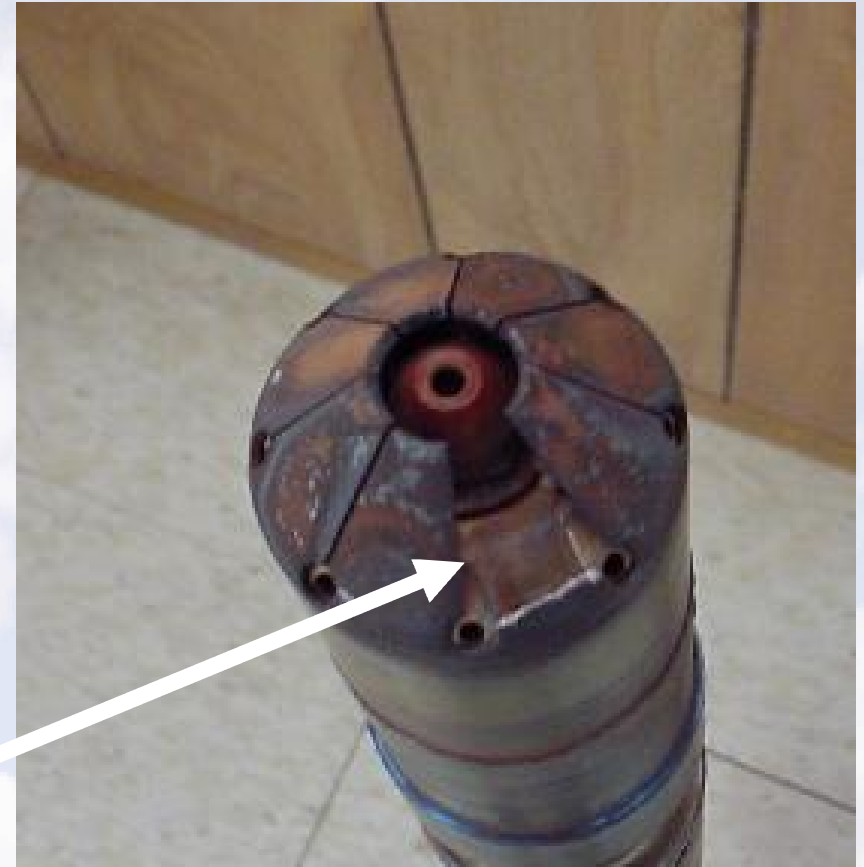
PROS:

- Visual Alerts
- Audible Alarms

CONS:

- Display must be running to get notified

Catch with Parametric Model



Overheated fuel nozzle assembly. Failure caused by overheating.

The Next Step: SmartSignal

SmartSignal's software provides Predictive Analytics using existing PI data.

- Challenges of Manual Monitoring are reduced
 - ▶ Detecting abnormalities across a fleet of assets
 - ▶ Replaces routine manual review of thousands of data points
 - ▶ Very difficult to detect short term (<24 hr.) failure without some form of alarming (for PI data)
 - ▶ Very early detection of slow developing failure is difficult since normal variation in operating conditions often masks emerging problems

SmartSignal – Early Detection

By creating a dynamic band around each sensor value in real time and correlating it to other sensor values, SmartSignal is able to give an early warning.

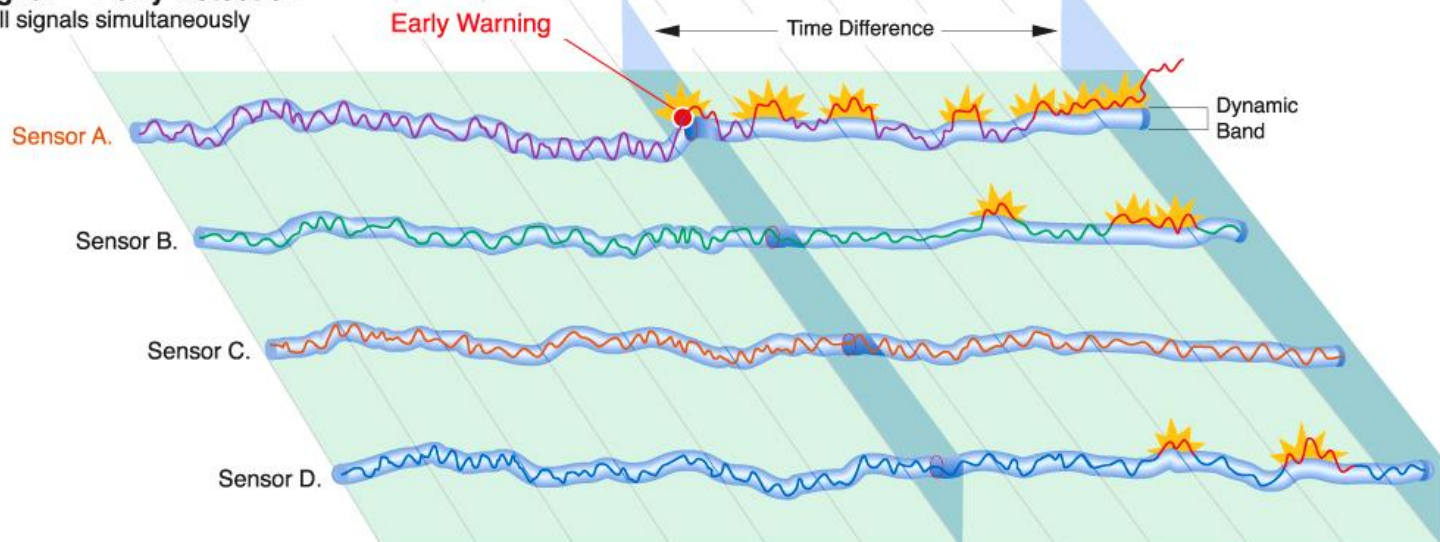
Traditional Condition Monitoring

Monitors all signals separately



SmartSignal – Early Detection

Monitors all signals simultaneously



SmartSignal - Modeling

- Empirical models are built with historical data that represents healthy equipment
- Multiple sensors are used in the model, capturing information about the entire state, not just a single signal or variable
- SmartSignal algorithms generate an estimate of the what the equipment's normal behavior should be, based on the current state
- During operation, an instantaneous sample of data is compared against the model

SmartSignal - Monitoring

- Small residual deviation are expected due to normal system variation
- Large residual deviations are considered abnormal behavior and flag an 'alert' status
- Incidents are reported to the web-based "Watchlist"
- Analysts viewing the Watchlist can investigate and troubleshoot problems remotely and in real time.

SmartSignal eCM System - Microsoft Internet Explorer

USER: Admin Admin
[LOGOUT](#) [CONTACT SS](#)

WATCHLIST:
[EVENT LOG](#)

SmartSignal

SETTINGS | REFRESH LAST REFRESH: 05/03/2002 14:12:33 STATUS WATCHLIST REPORTS ADMINISTRATION

NAVIGATE : [CHOOSE CHILD]

WatchList™

MACHINES ON WATCH (SmartSignal) : 12

Current View Historical View: As Of

MACHINE()	CATEGORY(-)	TRIGGER DT()	TOTAL()	LAST()	FIRST()
VIEW GRP/SENSOR			TOTAL	LAST	FIRST
▶ Combustion Turbine 4	Power Company	03/02/2001 07:30:00	269	03/02/2001 11:58:00	03/02/2001 07:30:00
▶ Combustion Turbine	Electrical Power Generator	08/07/2000 11:40:00	131	08/07/2000 19:10:00	08/07/2000 11:40:00
▶ SN723922	AN810 Pos2	07/26/2001 12:21:00	1	07/26/2001 12:21:00	07/26/2001 12:21:00

SmartSignal- Reliant Project Scope

- 67 natural gas & coal power units across the US
- Total 13,450 MW power
- Rotating & non-rotating balance of plant assets monitored
- 398 Assets, 930 Models
- Turn 30K+ sensors to exception-based monitoring
- Goals include
 - ▶ Early warning of equipment faults & process problems
 - ▶ Minimize impact on maintenance, operations
 - ▶ Maximize availability
 - ▶ Minimize Forced Outages
 - ▶ Improvement of unit heat rates
- Track and Price Catches

Reliant's “Virtual” M&D Center

- Web-based tool enables global support to plants
- Collaboration between Reliant teams:
 - ▶ Plant Operations (20 sites)
 - ▶ Central Support Team (Watchlist Team)
 - ▶ Subject matter experts
 - ▶ PI Team
- Expect to find natural champions

What is being looked for?

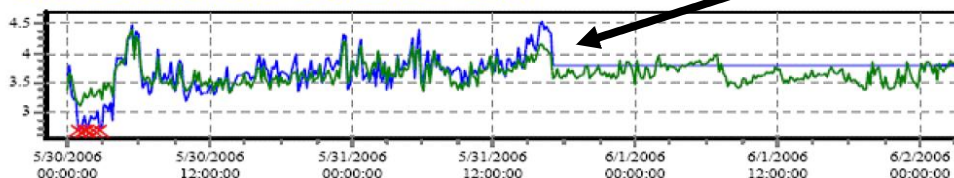
- Is it dead or just a crazy value?
- It is not what it use to be
- Some just very slow changes 1 EU/Day/Week
- Pattern or signature
- With load, temperatures, noise..... what should it be? A complex model needed to isolate issue

Catch -Instrument Failures

Subject: Bad Tag ??? SHA:4-O2RIGHTB, RIGHT B BOILER EXIT O2 (%)

Bad Tag

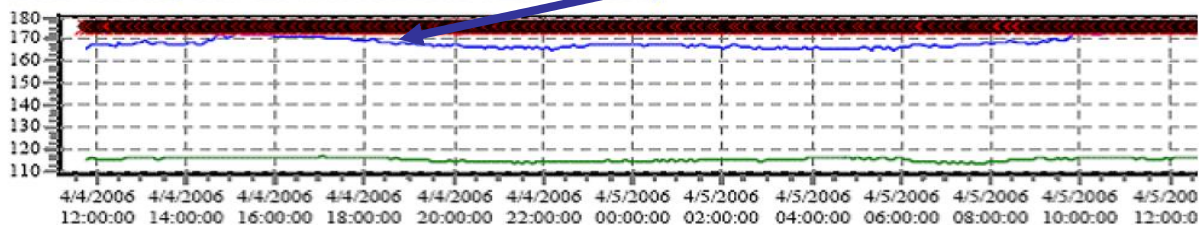
SHA:4-O2RIGHTB, RIGHT B BOILER EXIT O2 (%)



Dead signal

Looks too hot..
but was actually
water in TC
head

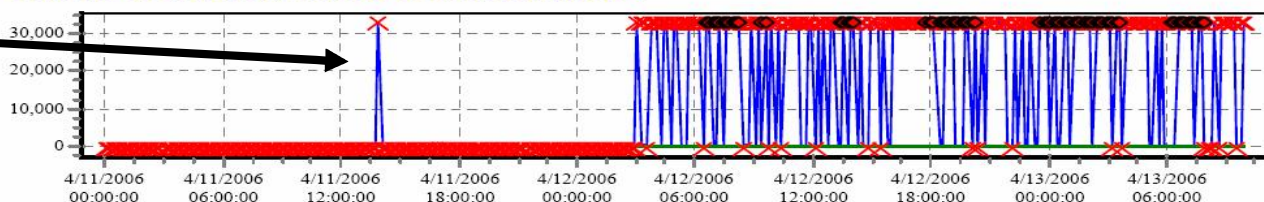
2TEFW305B, BFP 2B MTR DE BRG TEMP (DEGE)



30,000 °F

Really?

CIR H2O OUTNORTH, CIR H2O OUTNORTH (DEG F)



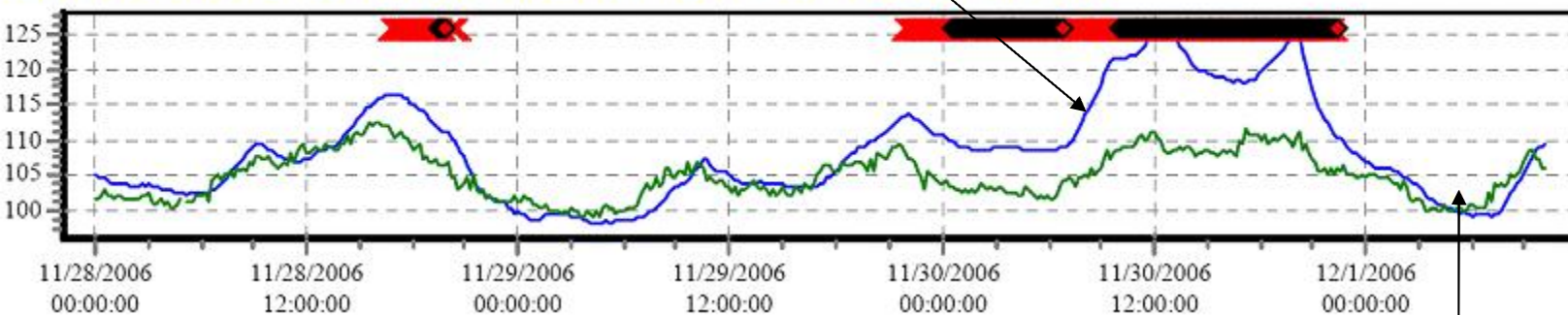
Catch- when things work correctly

From:

Sent: Thursday, November 30, 2006 1:34 PM

This is a pretty significant movement on FD Fan Motor outboard bearing (about 17 deg above expected currently).

3D124-3TE273, WEST FD FAN MTR OUTBD BRG (DEGF)



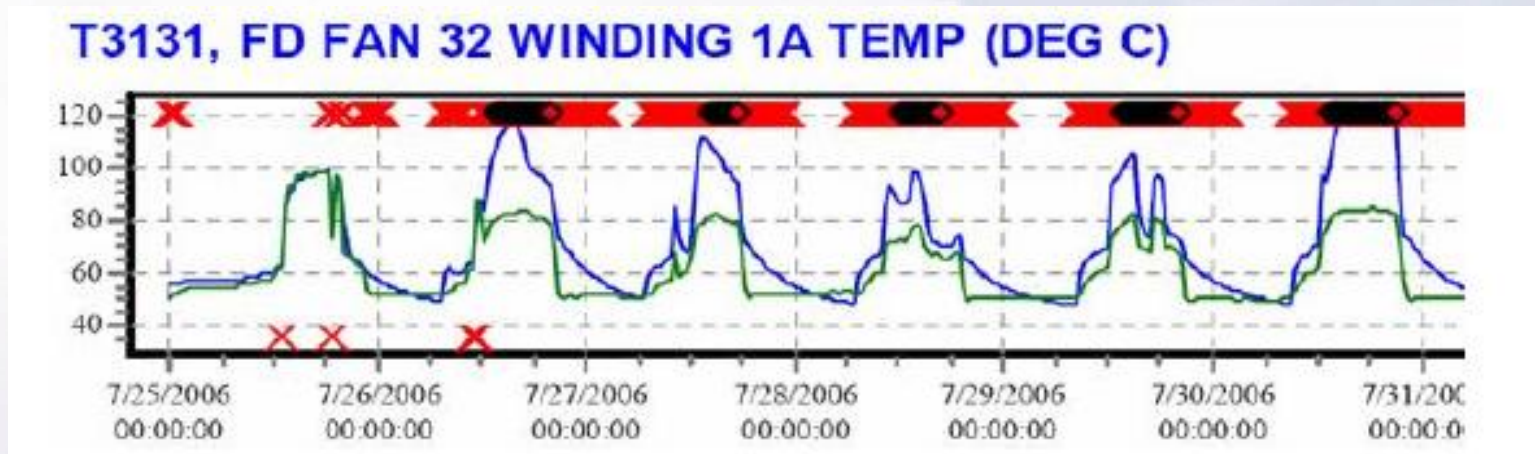
The oil levels are all good and the filters have been changed. The filters were dirty and the temps are dropping on the motor after the change out.

Catch – just about perfect case

With the early warning
the replacement motor
was on site when....



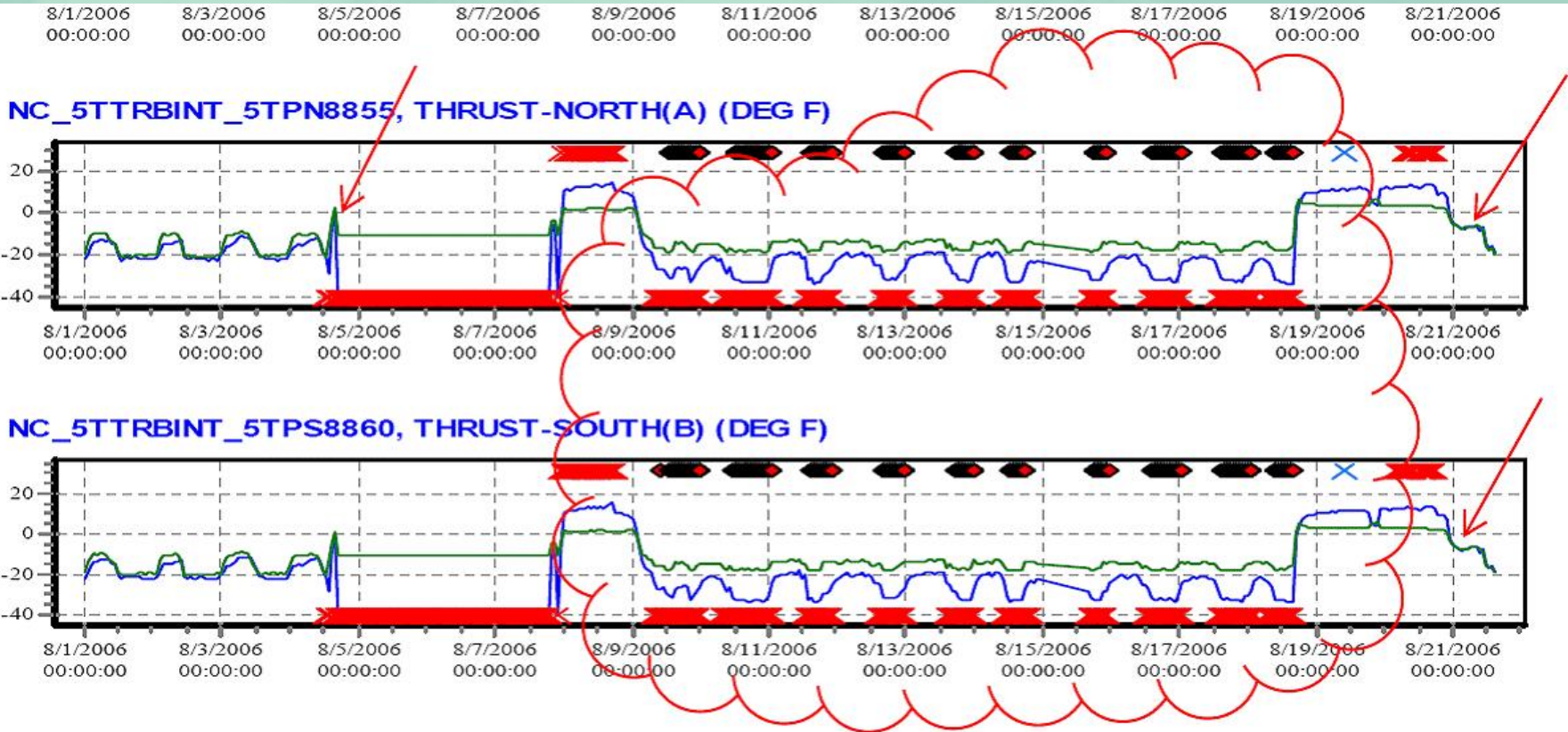
You cannot model for everything



The motor was hot for July... but the issue was a penthouse vent fan.

You model to detect Changes

Complex Example

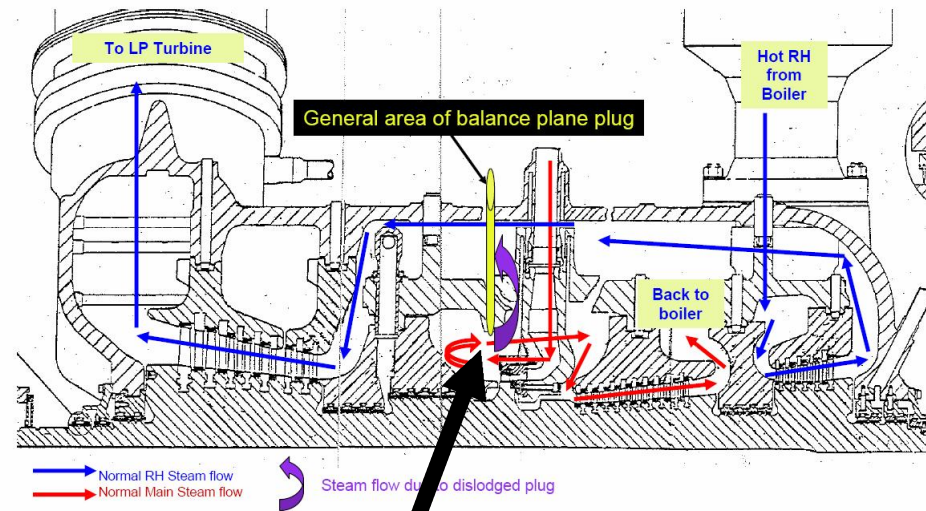


Thrust problem indicated and solution confirmed.

Complex Example



Balance plane plug thread failure



Location of the plug in the HP-IP Turbine

Lessons

- Tools are not complete solutions
- PI Data Points should be tuned
- Roll out speed vs. Value capture
- Payback
- Nothing is standard

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***Thank
You***

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VALUE NOW, VALUE OVER TIME