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ELIMINATE FAILURE_

Threat Based Maintenance (TBM)

A New View on Real-Time Maintenance Management in the Commercial Power Generation Industry

NREL Wind Condition Monitoring Workshop

David R. Bell
VP Application Engineering
SmartSignal

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Can you Imagine this Happening to You?

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Conventional Approaches Reached their Limits

PdM…

Reactive…

TPM…

CBM…

RCM…

PM…

They help, but failures still happen…

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New Approach

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TBM!

Threat Based Maintenance

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What is TBM?

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Find and Eliminate Small Problems before they Become Big Ones… in Real Time

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What are the Benefits?

- Improved availability
- Lowered maintenance cost
- Improved efficiency

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Why Conventional Approaches Come up Short

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- Systems are complex
- External events damage or degrade equipment
- Gradual, but variable wear
- Accumulated stresses over time

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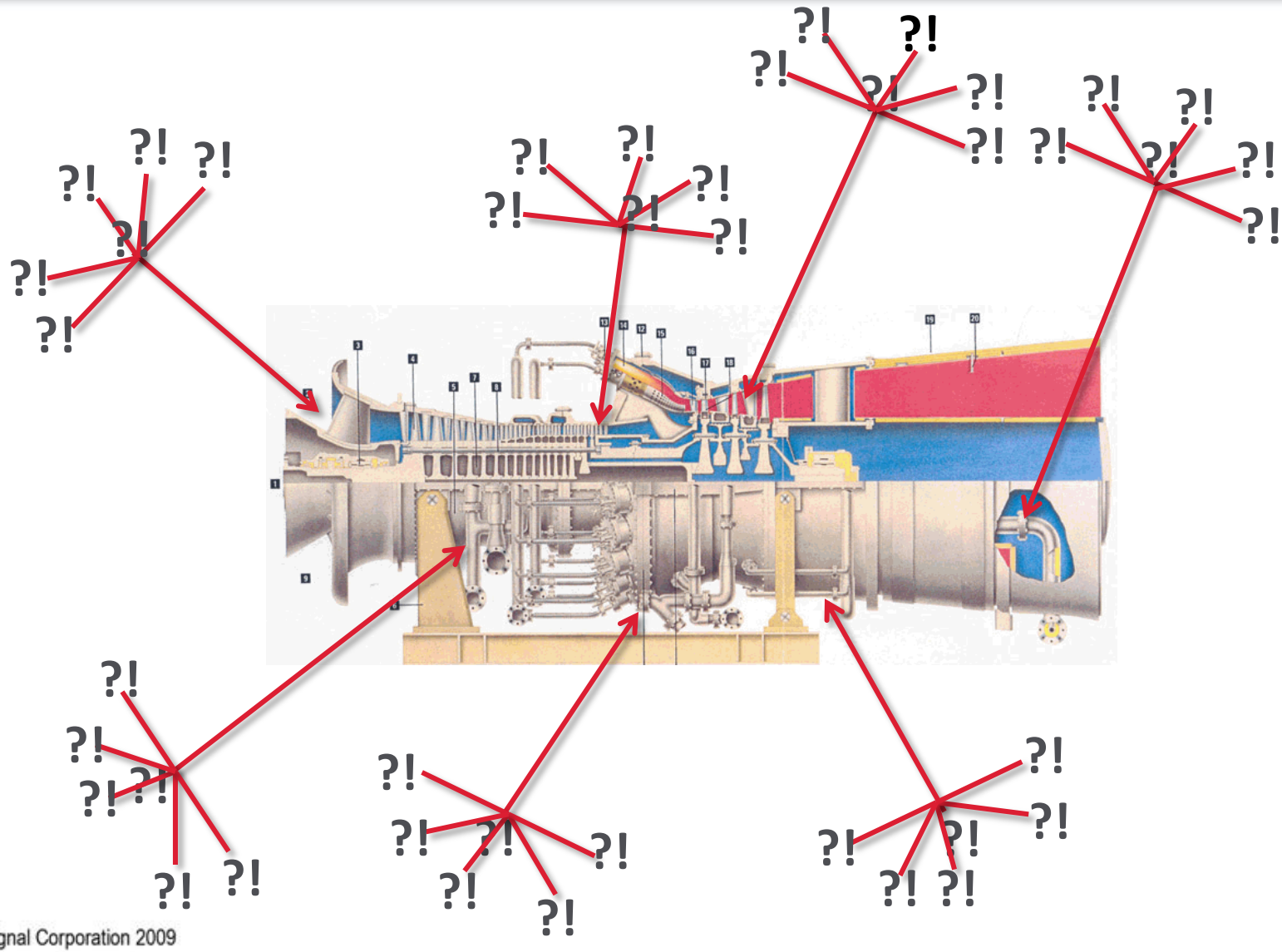
Complexity and Reliability



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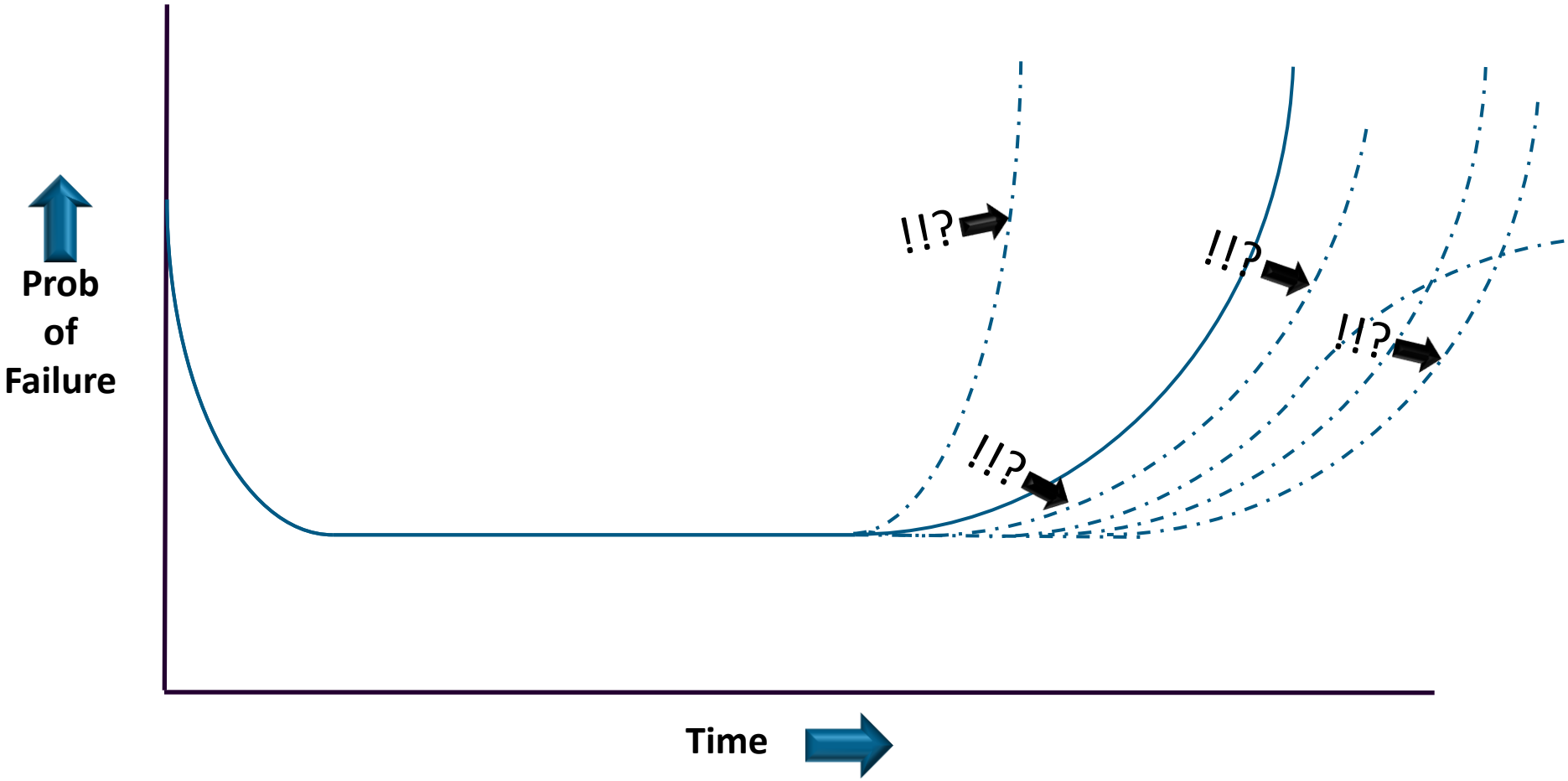
It Gets Worse



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What Does this Mean?

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In Complex Systems, Failure is Effectively Random!

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However, the PF Curve is not Inevitable

- Most failures start with something small… then progress
- …the leaky oil seal…
- …the small cooler leak…
- …the failed sensor…
- …the minor operator error…

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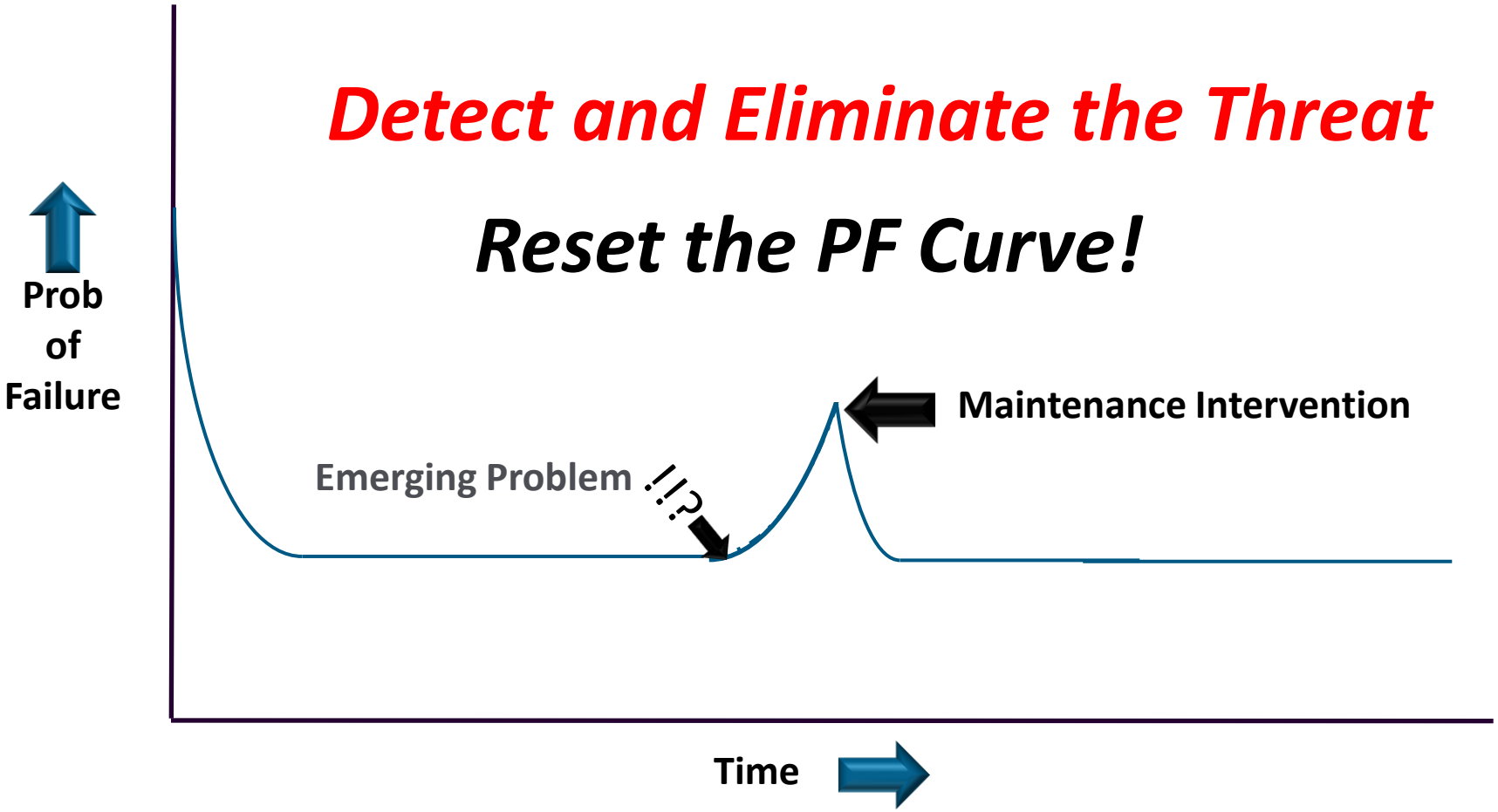
What if you Could…?



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How? It's All in the Data

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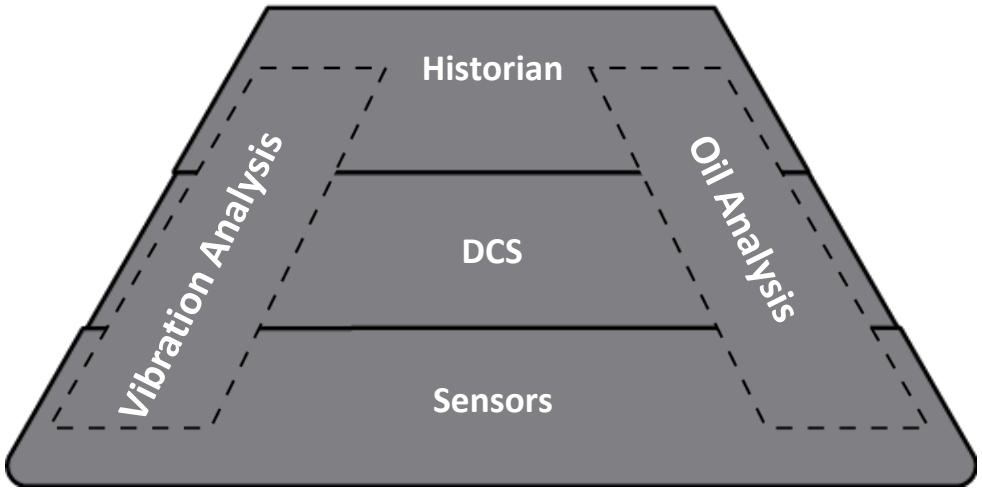
Volume of data and alarms overwhelms:

- Resources
- Analysis capabilities

Result:

- Surprises still happen
- Unplanned outages
- Excessive maintenance cost



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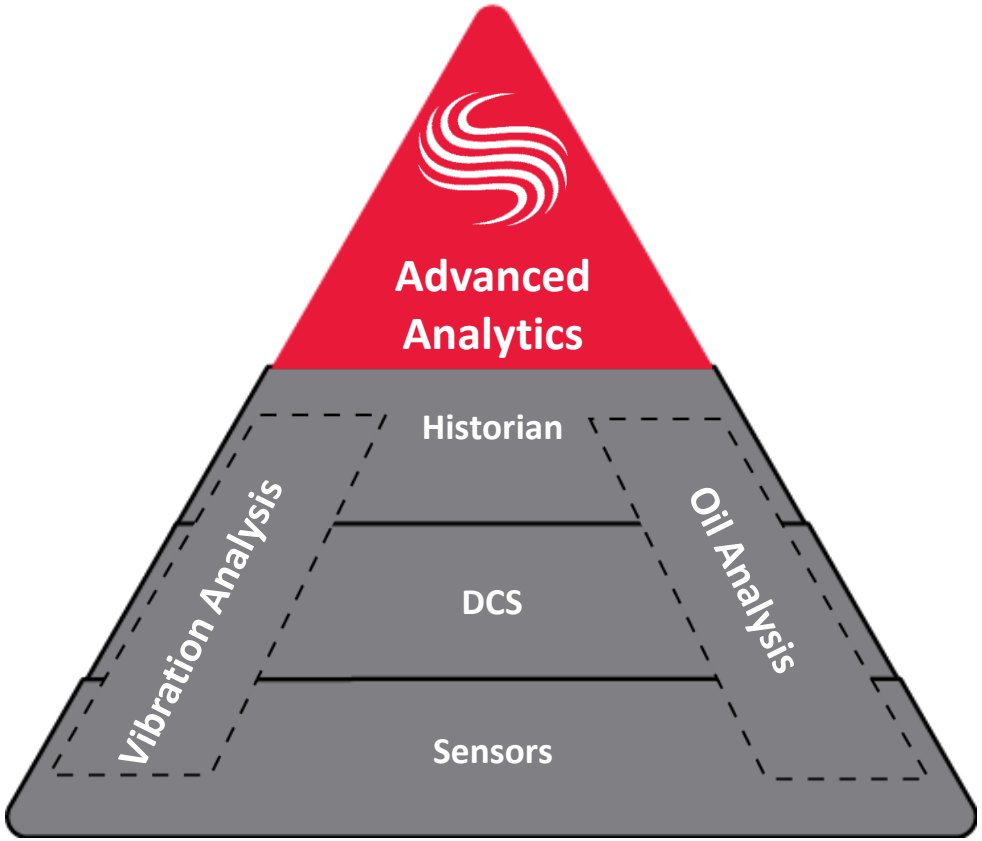
How? It's All in the Data



Advanced Analytics:

- Find the "needles in the haystack"
- Leverage investment in existing data infrastructure

Result:

- Detect and eliminate threats to generation
- Reduce unplanned outages
- Reduce maintenance cost

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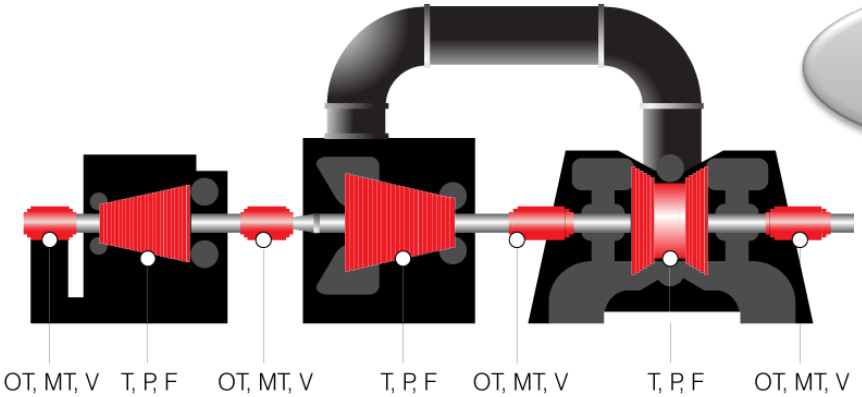
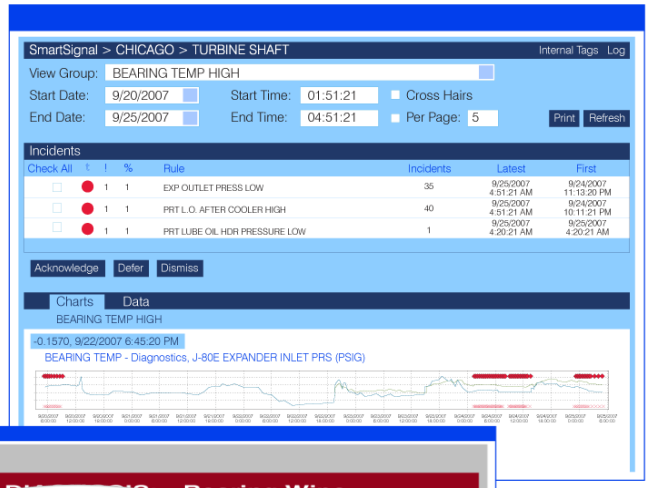
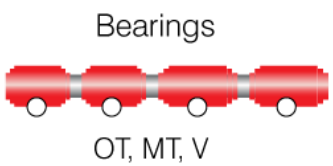
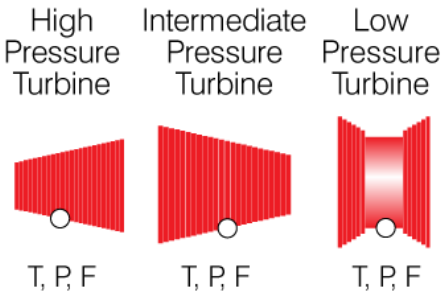
The SmartSignal Solution



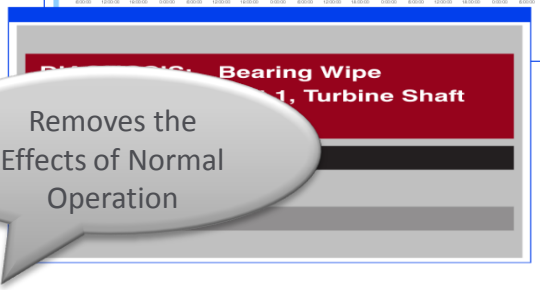
Starts with Data from Your Equipment







Personalized Empirical Models



Removes the Effects of Normal Operation

Posts Emerging Threats to WatchList

Pulls every 5-10 minutes

EPI*Center

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Leader in Predictive Analytics

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AEP American Electric Power
Allegheny Energy, Inc.
Ameren
APS
BC hydro
bp
Bruce Power
Chevron
Constellation Energy
cps Energy
Direct Energy Simple. Friendly. Direct.
DTE Energy
Duke Energy
DYNEGY
EDF
Edipower
Electrabel GDF SUEZ
Energy Transfer
Entergy
EPCOR
한국동서발전(주)
gasNatural
HITACHI Inspire the Next
IBERDROLA
KCP&L
Kelson Energy
KEYSPAN
LABORELEC
Luminant Energy
MIRANT
MITSUBISHI Power Systems, Inc.
한국남동발전(주)
NRG
NUON
NVEnergy
OG&E
PGE Portland General Electric
ppl
Progress Energy
Reliant Energy
RWE The energy to lead
SCANA Power For Living
CATERPILLAR
South Mississippi Electric
SKF
Taiwan power company
TransAlta
UNION FENOSA
we energies
Public Service Wisconsin Public Service Corporation
DELTA
Valero Energy Corporation
Southwest
浙能集团 Zhejiang Energy Group

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TBM in Action…

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Minor Problem-Bearing Temperature Threat

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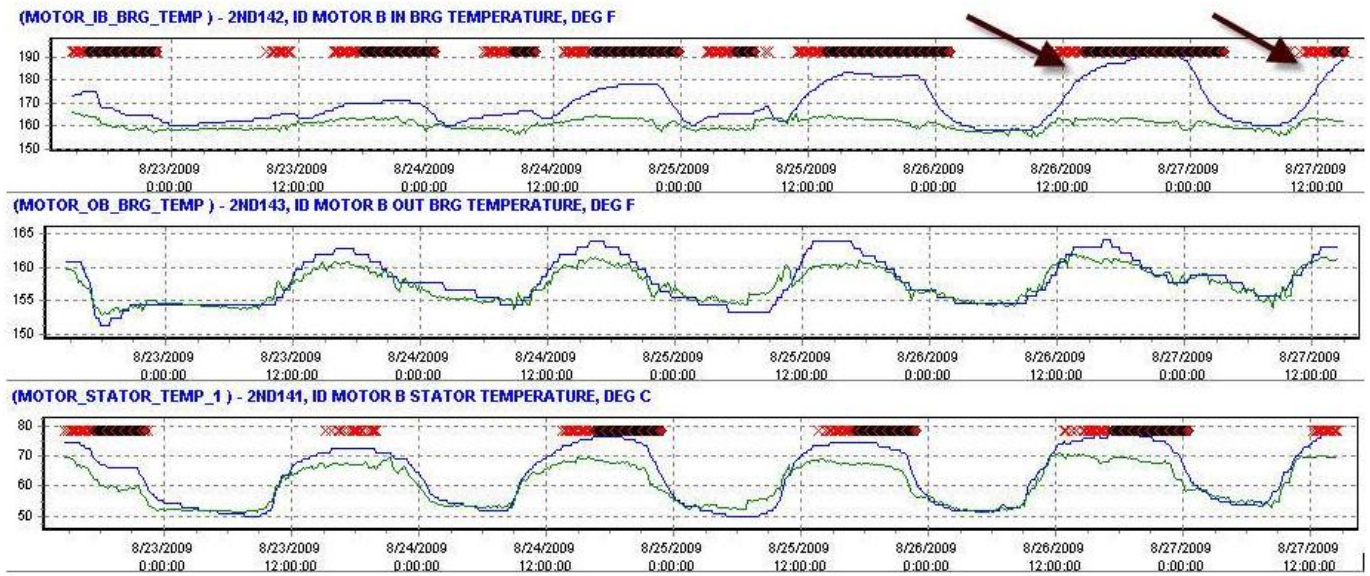
Plant Notified on Increasing Bearing Temps—Possible Air Filter Fouling

Subject: High Priority: CP2 ID Fan B Mtr IB Brg and Str Temp High
Attachments:

James,

As the outside air temps are still very warm CP2 ID FAN B the 2ND142, ID MOTOR B IN BRG TEMPERATURE has increased recently to peak values of ~190 deg the OB side has not increased as much. Also, the 2ND141, ID MOTOR B STATOR TEMPERATURE has peaked at ~77 deg. ID FAN A Motor Stator Temp tracks at ~60 deg. Is there a cooling issue for the ID Fan B motor such as possible plugged filters? Please let me know that you have received this email. Thanks.



Unknown Zone (Mixed) | Protected Mode: On 100%

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Minor Problem-Bearing Temperature Threat

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Plant Confirmed---Added External Blower to Maintain Cooling

Subject: High Priority: CP2 ID Fan B Mtr IB Brg and Str Temp High
Attachments:

James,

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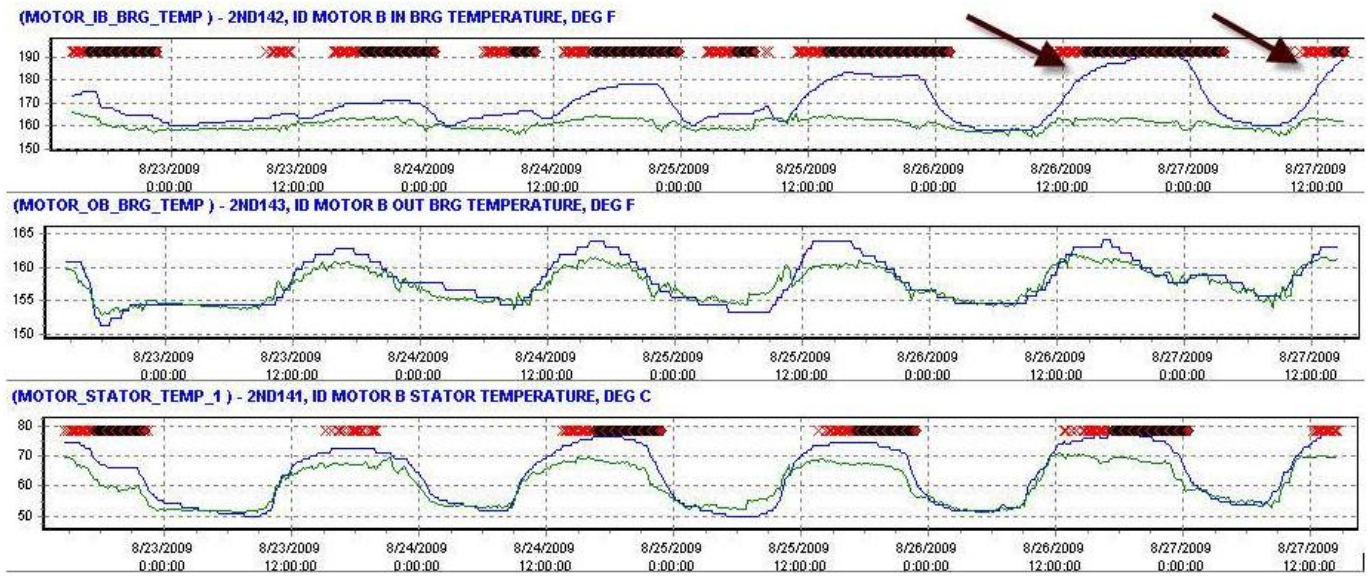

Unknown Zone (Mixed) | Protected Mode: On 100%

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Minor Problem-Bearing Temperature Threat

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Excessive Bearing Temperature Reduces Life and Increase Possibility of a Future Problem

Another Threat To Generation Eliminated!

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Major Problem—Cracked Generator Shaft

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- Entergy's Waterford Two Gas/Steam Unit
- 411 MW

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Early Data Showed No Problems

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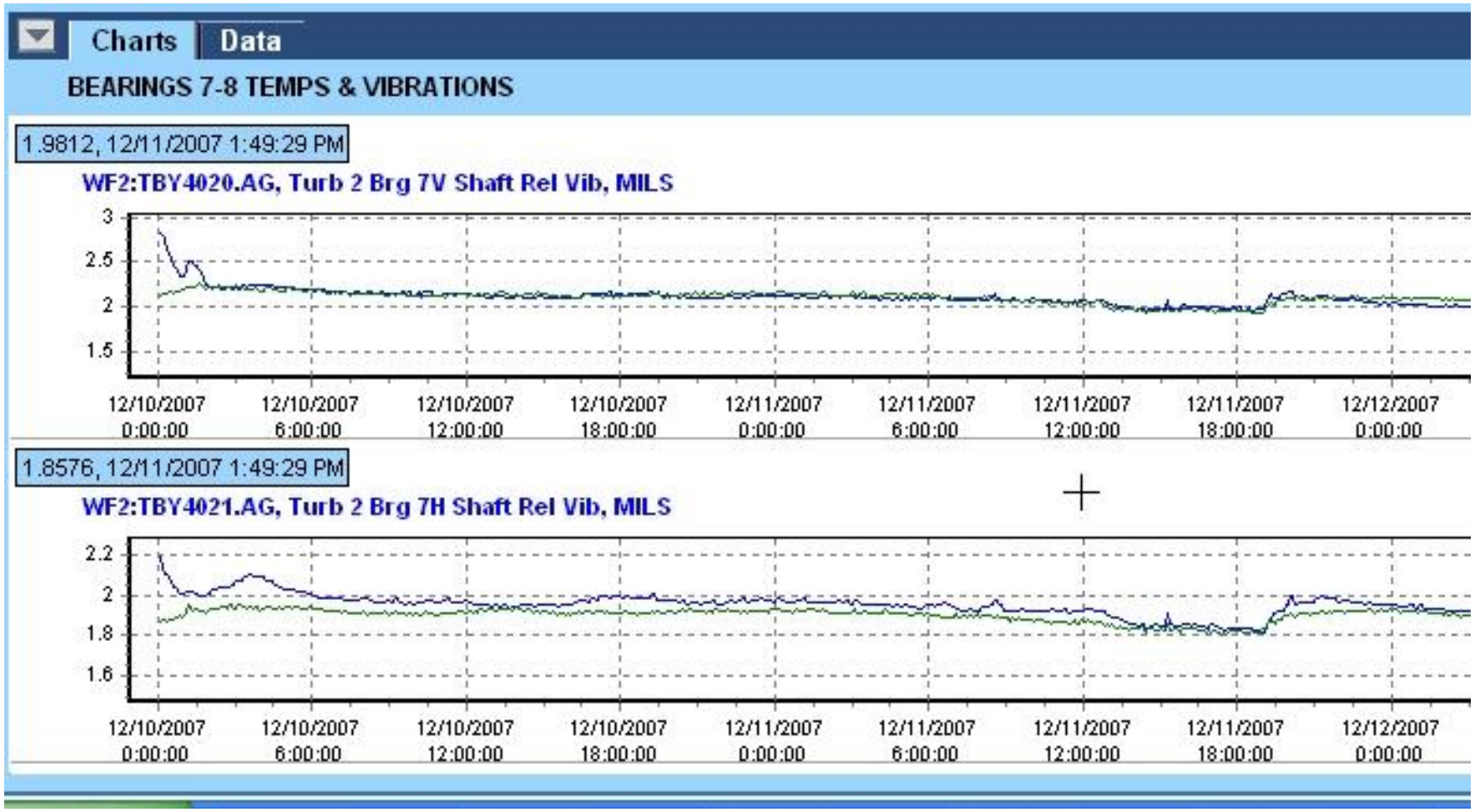

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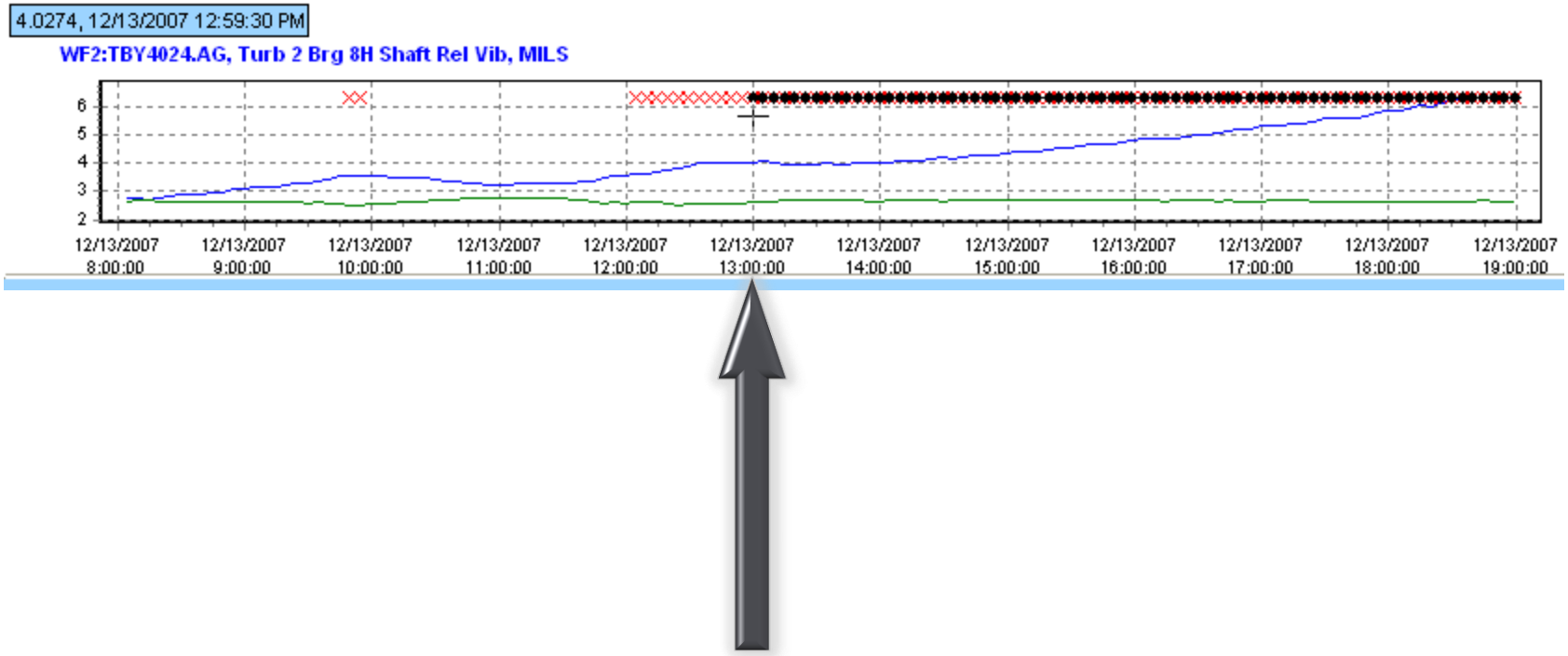
First Indication of Problem on 12/13/07

Bearing 8H (Exciter bearing) Vibration on the rise and posted to the WatchList at 12:59:30



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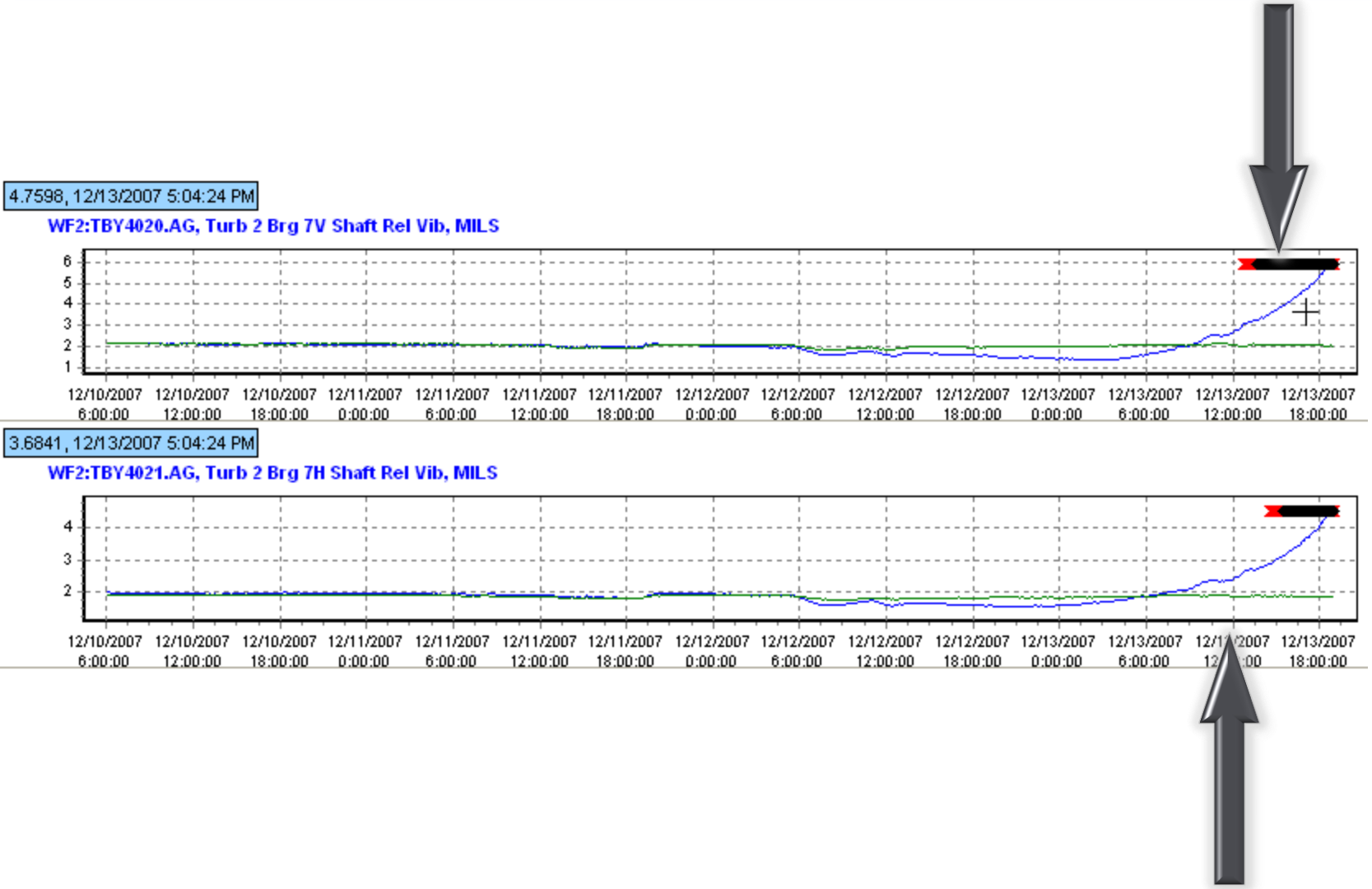
Increasing Indications



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M&D Center Actions

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- Contacted plant—take local vibes data
- Brought in vibes specialist
- Plan to investigate that evening
- Decided to bring down early and faster then normal
- Investigation found:

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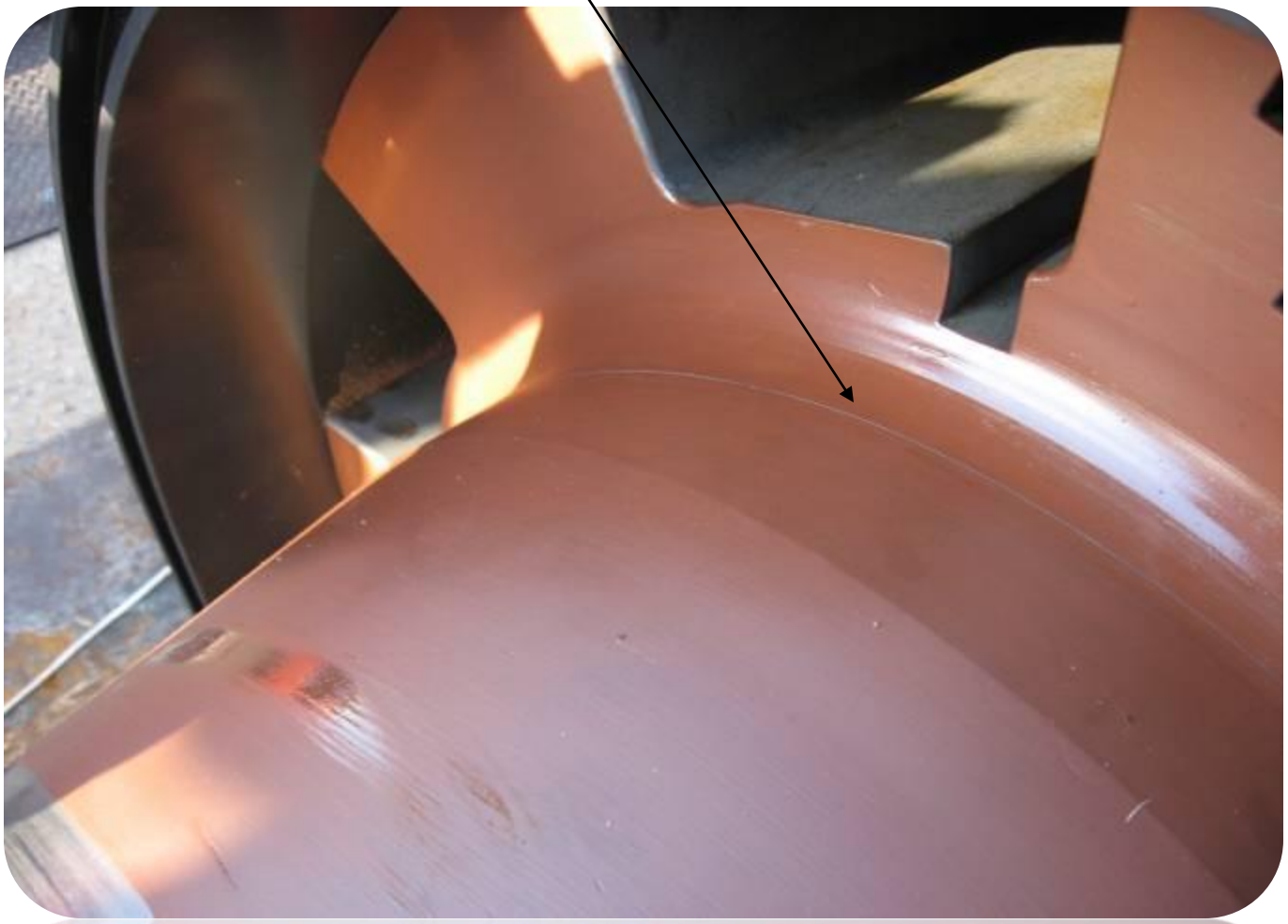
Crack in Generator Shaft



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Rough Indication of Crack Depth

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TBM & SmartSignal in Wind

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alternativenergy™

bp

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In Summary

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TBM- Eliminate <u>Threats</u> to Generation

Availability ↑

Maintenance Cost ↓

Peace of Mind ↑↑↑

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For Further Information

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  - 630-829-4006

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