

Exelon Corporation

Advanced Performance Monitoring Apr 2013

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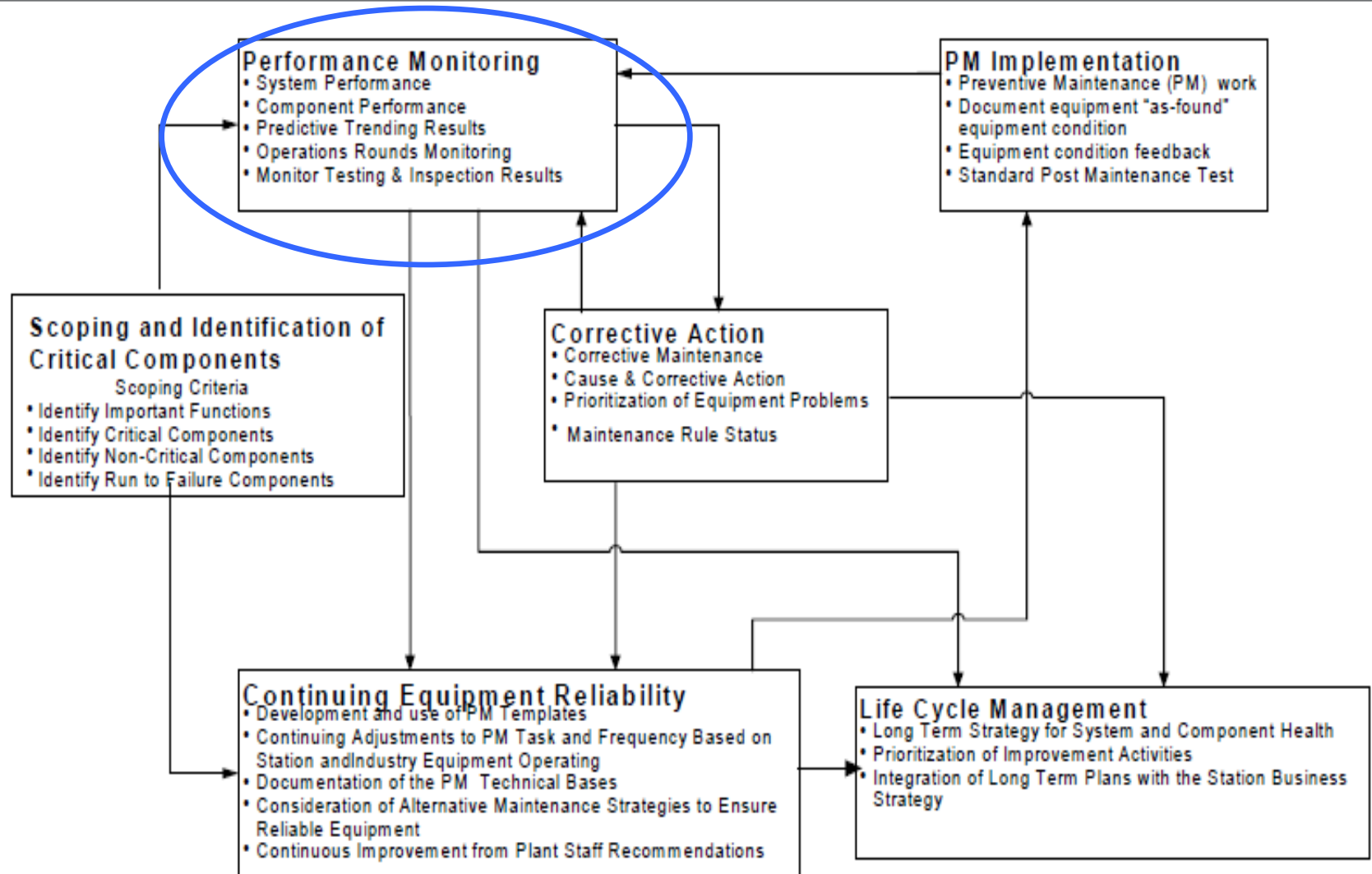
About Exelon

- ✓ Exelon Corporation Headquartered in Chicago has operations and business activities in 47 states, the District of Columbia and Canada
- ✓ Exelon owned 34,650 MW of generating capacity
- ✓ Exelon is the largest owner and operator of nuclear plants in the United States with 19,000 MW of nuclear energy produced from 22 units in Illinois, Pennsylvania, Maryland, New Jersey and New York
- ✓ By the Numbers (Combined for 2011 – Merger closed on March 12, 2012)
 - Operating Revenues \$32.7 billion
 - Assets \$74.5 billion
 - Employees Approximately 27,000
 - Load Served Approximately 164 terawatt-hours (electric) and 372 billion cubic feet (natural gas)
 - Service Territory 15,800 square miles
 - Electric Transmission 7,350 miles

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INPO AP-913; Equipment Reliability Process



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What is Performance Monitoring

Performance Monitoring

Systematic approach of gathering, evaluating and *analyzing data* that is pertinent to system performance

Direct Monitoring

Process Data
On-Line Monitoring
Vibration
Oil Analysis
Thermography
In-Service Testing
Operator Rounds
Surveillance Test Results
Chemistry Data
Thermal Performance Monitoring

Indirect Monitoring

Equipment Failure Rates
Root Cause Analysis Results
PM/CM Work Results
As Found Condition Code
Maintenance Rule
System Walkdown
EPIX Data
Operator Work Around
Maintenance Cost
System Health

- Plant experts spend too much time in Direct Monitoring Not enough time for diagnostics and analysis
- Direct Monitoring can be done automatically utilizing PI

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Purpose

- ✓ Build Advanced Performance Monitoring (APM) infrastructure capable of significant advancement in system monitoring, diagnostics and prognostics capabilities
- ✓ Leverage technology for system and component monitoring and obtain critical plant data on-line
- ✓ Utilize critical plant resources for data analysis and diagnostics rather than data collection
- ✓ Utilize wireless infrastructure to enhance equipment monitoring
- ✓ Optimize Exelon preventive maintenance (PM) strategy
- ✓ Operate nuclear plants sustainably protecting public safety and gain public trust

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Drivers

✓ Engineering

- Lack of monitoring capabilities hindering engineer's ability to diagnose plant issues efficiently
- Plant Experts spend too much time in manual data collection and less in data analysis and diagnostics
- Experience staff leaving work force
- On-Line Monitoring (OLM) can help but limited due to lack of instrumentation

✓ Operations

- Problem areas with no instrumentation
- High dose accumulation due to manual rounds in high dose areas
- Remote monitoring will reduce operator rounds
- Align local panels data to PI

✓ Maintenance

- 50 -60% time spend in data collection
- Incomplete diagnostics due to lack of data or data at discrete sources

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Benefit

✓ Engineering

- ~10% system engineer's work load reduction by transferring engineering monitoring and trending function to On-Line Monitoring
- ~20% of unexplained equipment failure can be better understood due to improved wireless equipment monitoring capabilities

✓ Operations

- ~10% Ops rounds optimization by aligning local panel data to data historians
- Dose reduction by remotely monitoring local data and reducing entry into high dose areas

✓ Maintenance

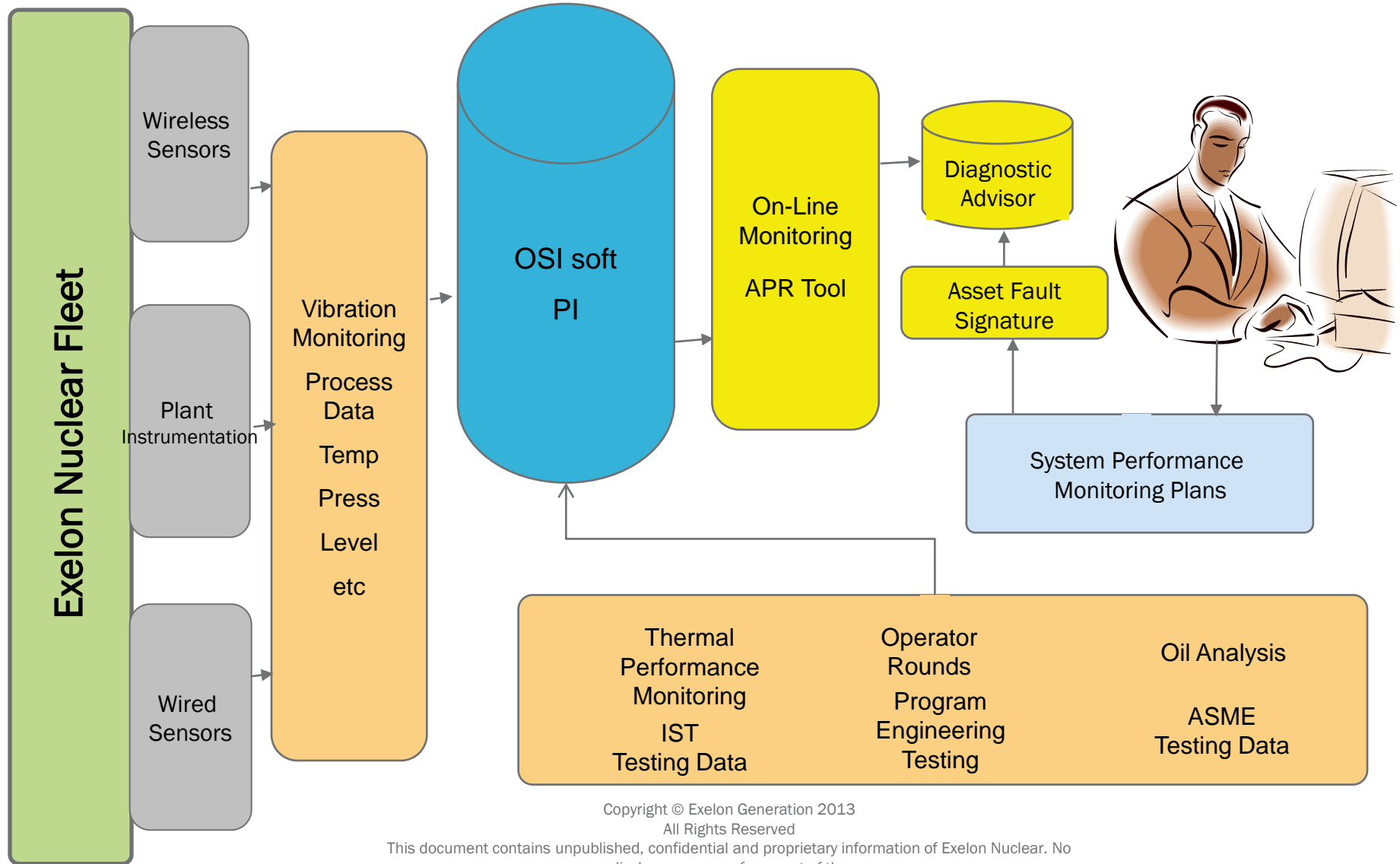
- ~50% of vibration specialist efficiency improvement due to on-line vibration data through wireless equipment monitoring
- Better vibration analysis since the expert will spent more time in diagnostics and less in data collection
- ~5% PM reduction by switching time based PM to Condition based PM

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APM View



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On-Line Monitoring (OLM)

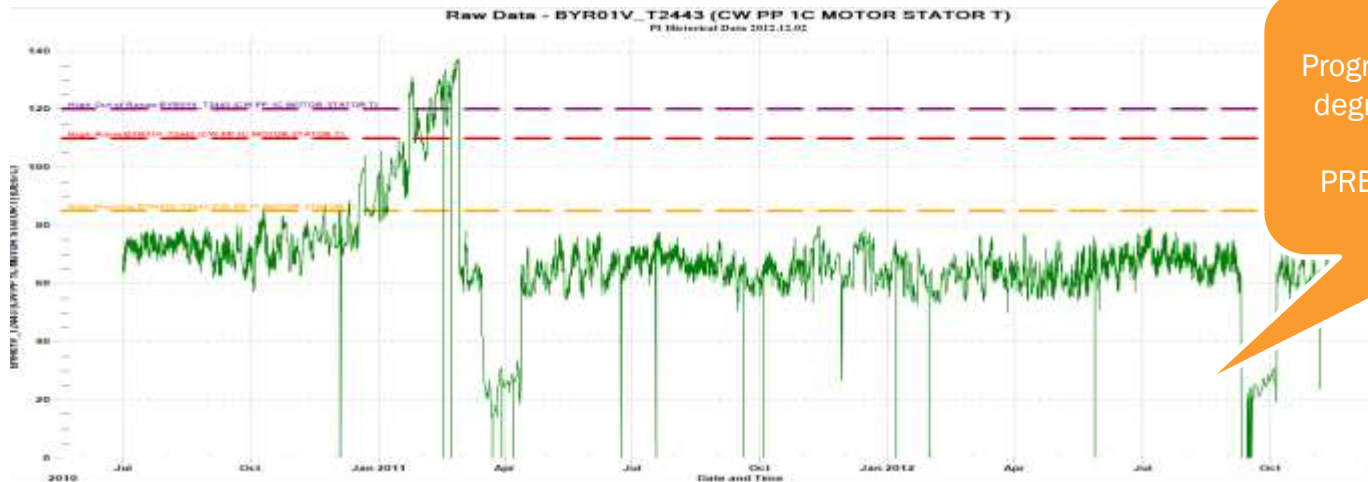
- ✓ The OLM program is a pattern recognition application that monitors plant parameters in real time
- ✓ The OLM program acquire raw data from PI
- ✓ The program provides an early identification of degrading trends
- ✓ The real time plant data is continuously compared with historical good data
- ✓ Any deviation identified by the program is notified automatically to plant staff via email or pager
- ✓ The program is currently used by engineering, maintenance and operations
- ✓ The Exelon's OLM program is a de-centralize monitoring approach to improve efficiency of plant staff

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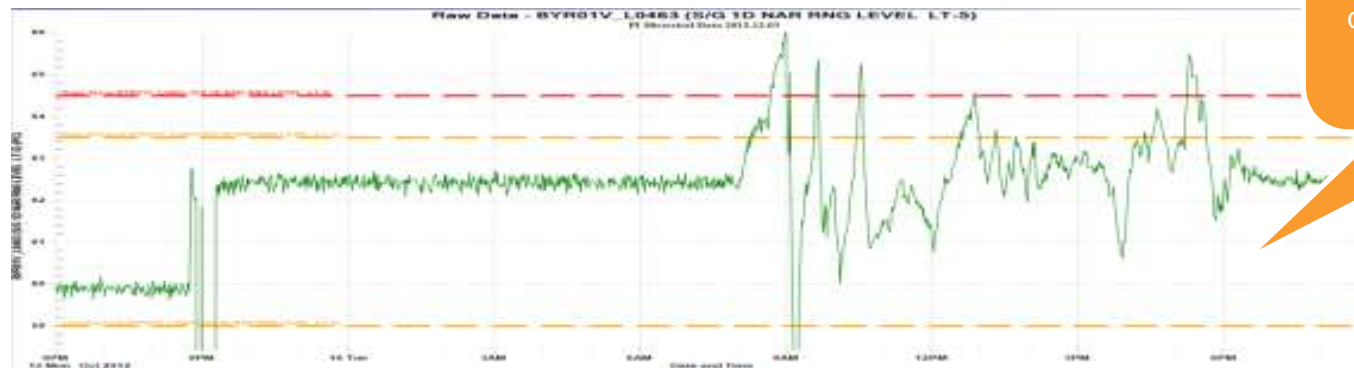
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OLM Catches



Program identified CW motor degradation at an incipient stage.
PREVENTED UNIT DERATE



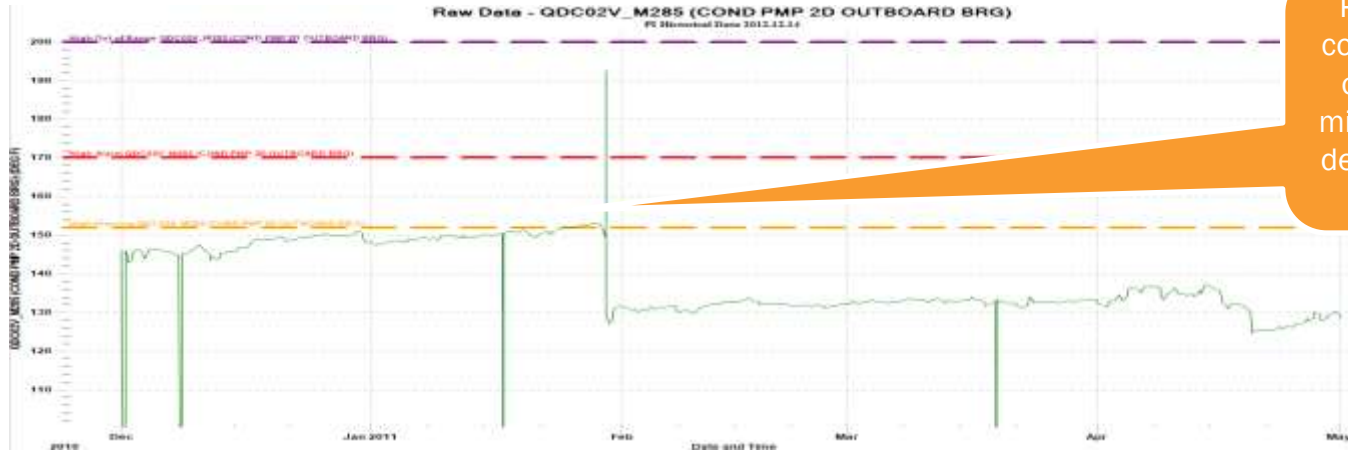
Program identified SG level control card failure. The early identification help operators to control level in manual.
PREVENTED UNIT TRIP

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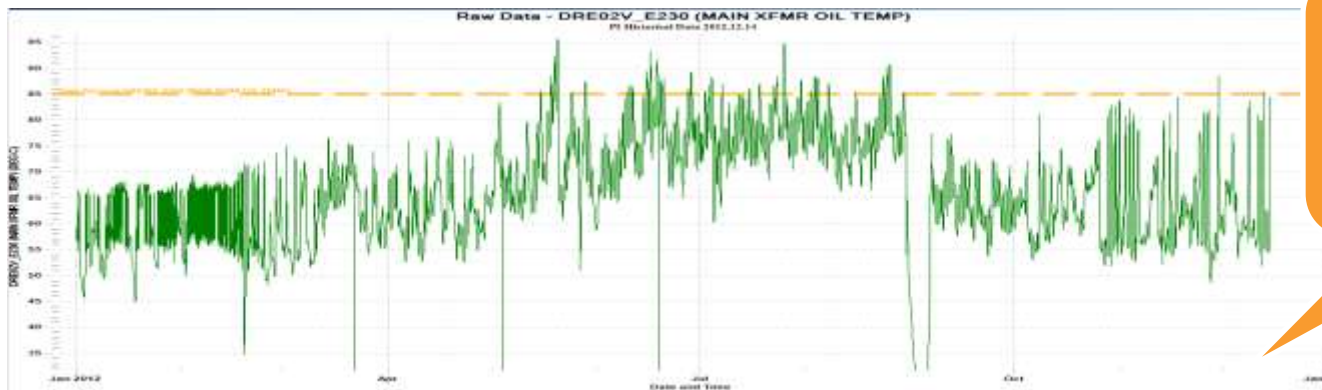
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OLM Catches (continued)



Program identified deviating condition of Condensate Pump outboard bearing temp. The mitigation help prevent bearing degradation. PREVENTED UNIT DERATE



Program identified plugged Main Transformer cooler before summer readiness period. PREVENTED UNIT DERATE

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Prognostic Health Monitoring

- ✓ Develop advance monitoring application to automatically diagnose anomalies identified by OLM program (Fault Signature)
- ✓ Provide initial recommendations to plant staff to mitigate the deviating condition (Diagnostic Advisor)
- ✓ Leverage technology to automatically perform initial troubleshooting
- ✓ Help with knowledge transfer and retention (KT&R) due to retiring experienced work force

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Wireless Equipment Monitoring

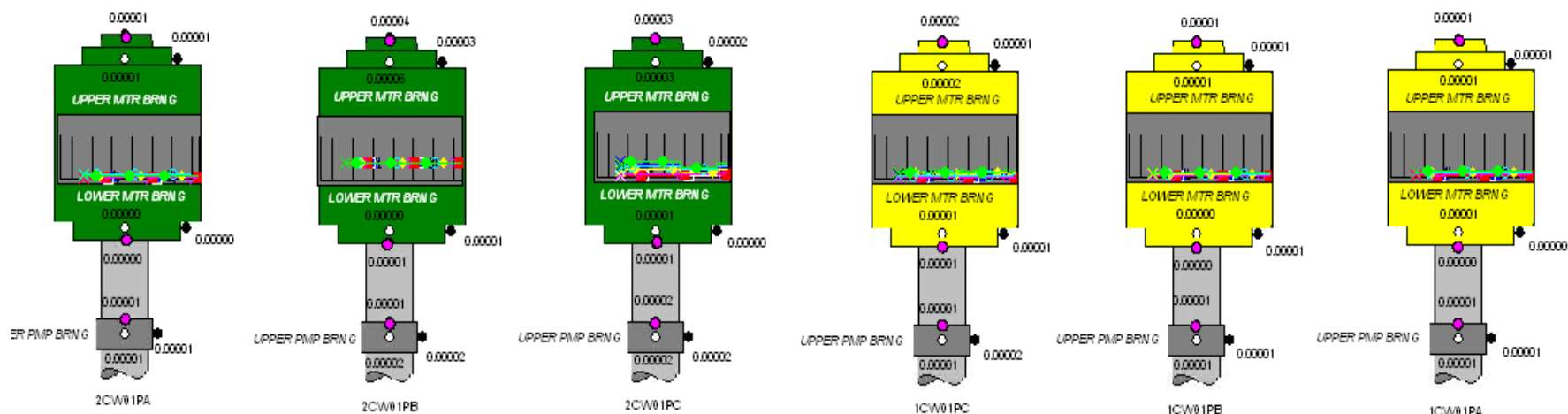
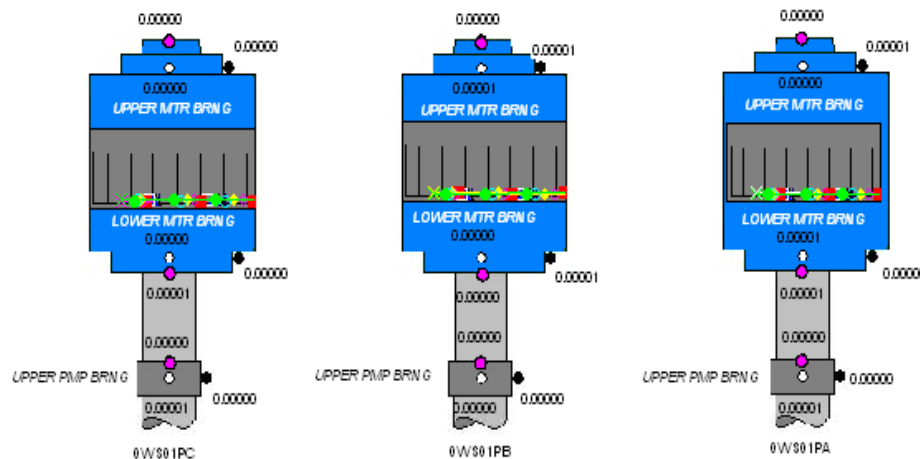
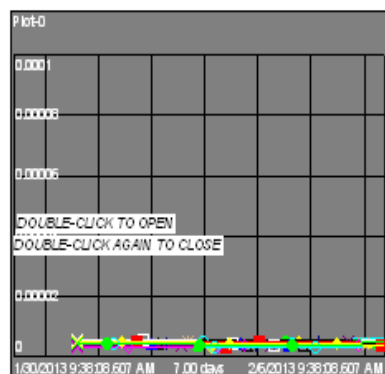
- ✓ Plant staff utilizes significant resources and time in data collection to assess real time equipment health
- ✓ The time spent in data collection keep the experts away from data analysis and prognostics
- ✓ Adding wired sensors in plants are not cost effective
- ✓ Wireless equipment monitoring is the solution
- ✓ Pilot projects are in progress to prove the concept of wireless equipment monitoring

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Circ Water Pump Wireless Monitoring

- East/West Accelerometer
- North/South Accelerometer
- Axial Accelerometer



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Cooling Towers Wireless Monitoring

875' top of basin wall = 0 "

Red -4" to +6"

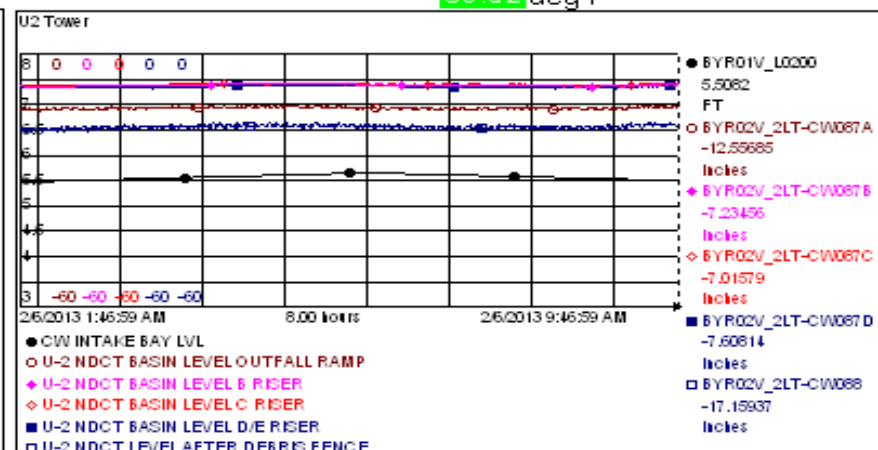
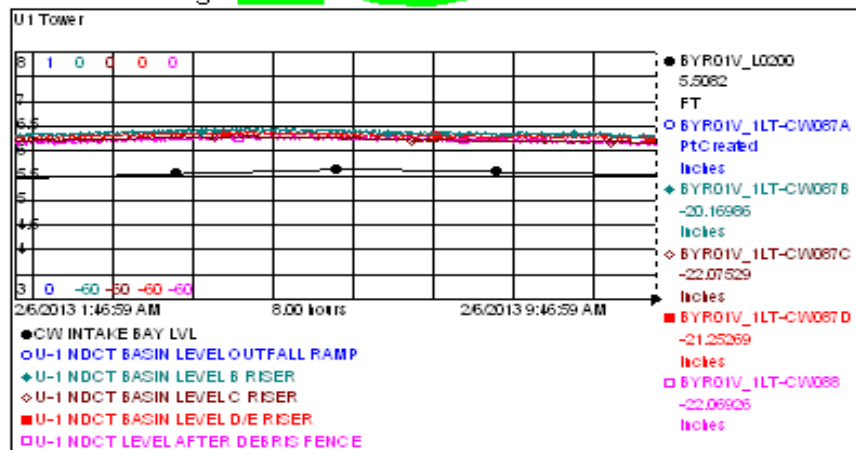
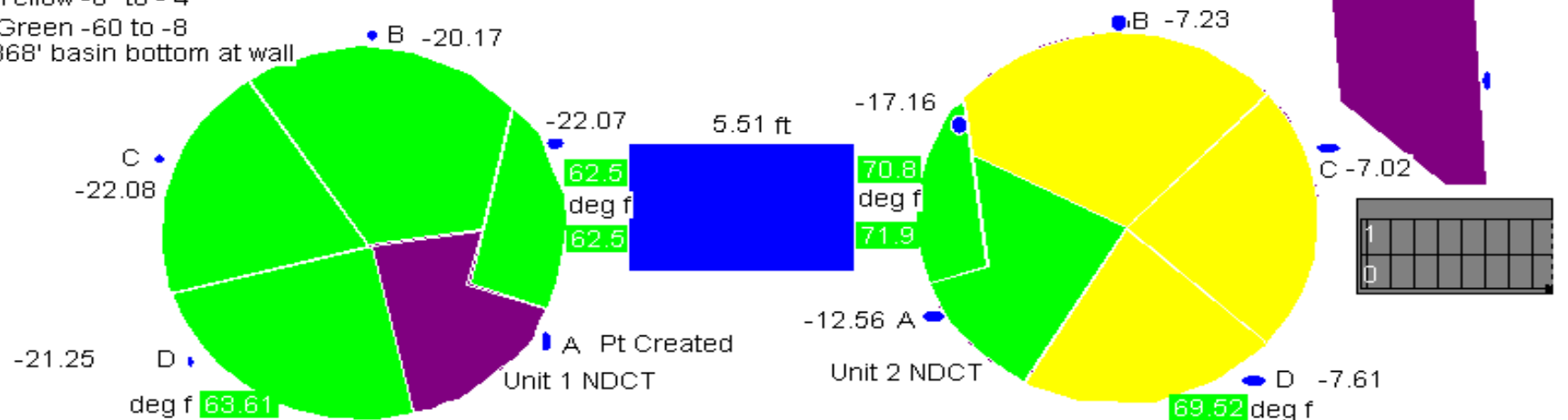
Yellow -8" to - 4"

Green -60 to -8

868' basin bottom at wall

NDCT WIRELESS LEVEL

REV. 0A

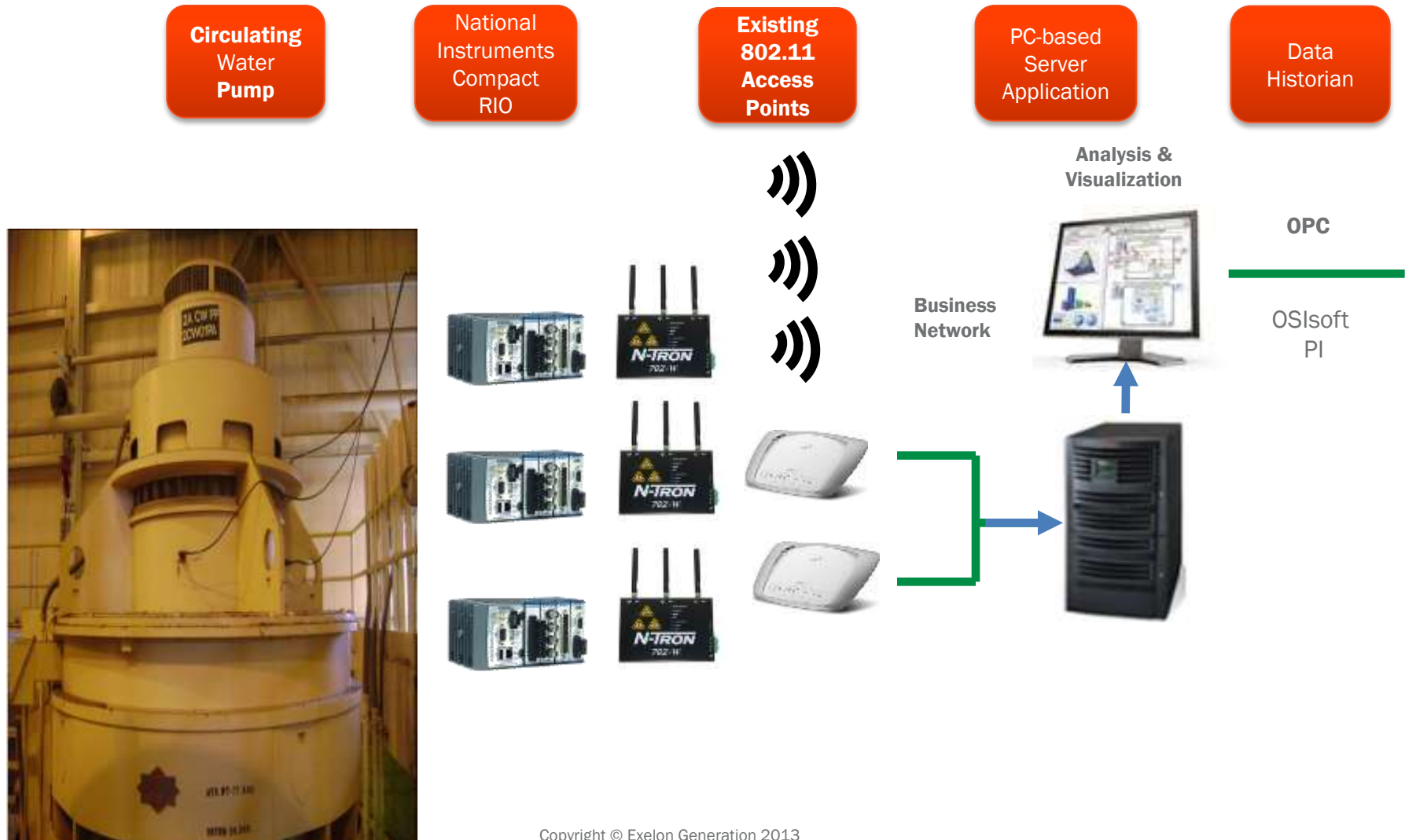


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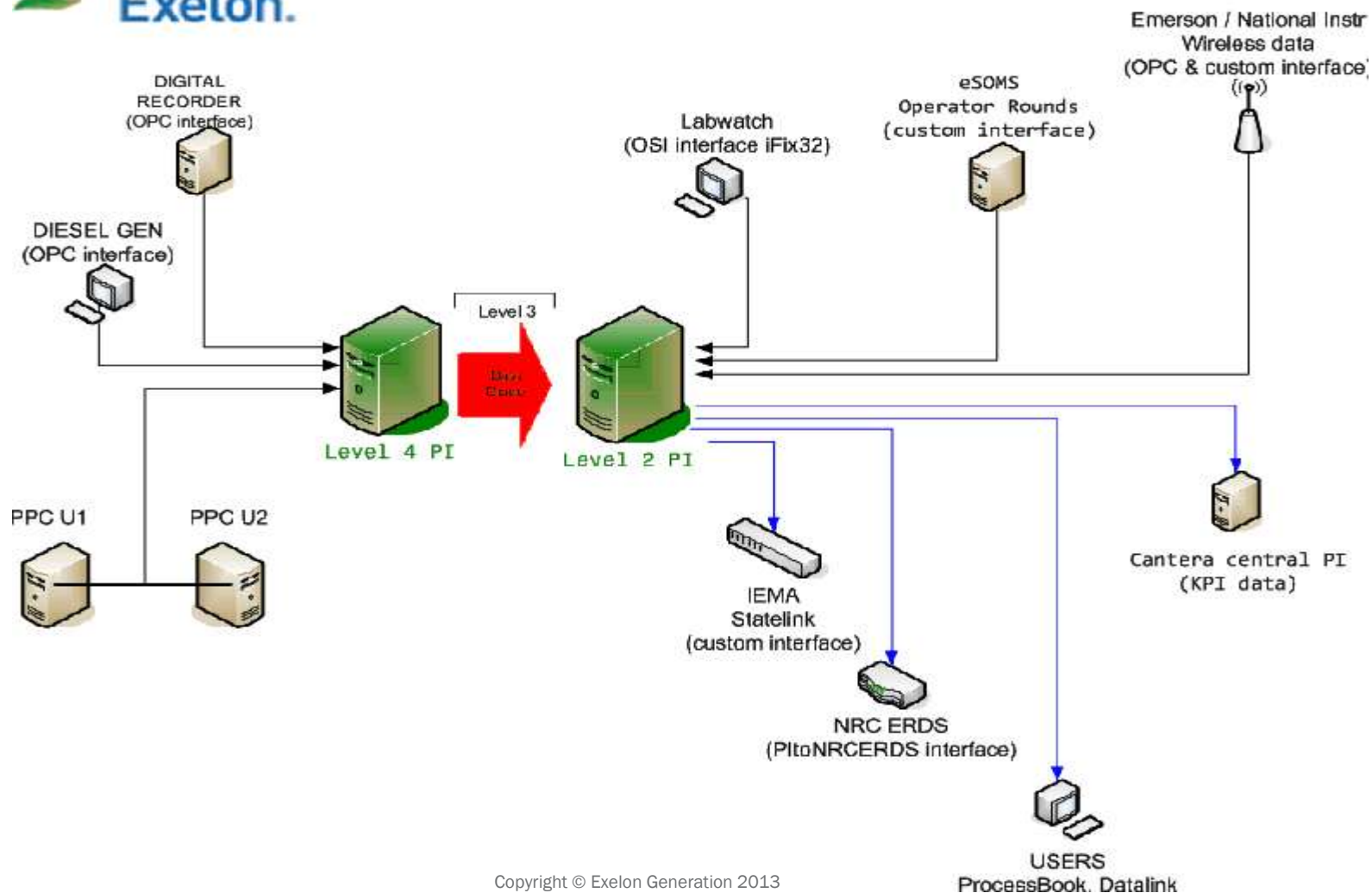
Wireless Monitoring Architecture



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IT Architecture



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✓ Questions