Exelon Corporation

Innovative Technology – Condition Based Monitoring

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Exelon Generation®

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

Purpose

- ✓ Build Advanced Monitoring infrastructure capable of significant advancement in system ***monitoring***, ***diagnostics*** and ***prognostics*** capabilities
- ✓ Leverage technology for system and component monitoring and obtain critical plant data in OSIsoft PI data historian
- ✓ Improve plant safety by quickly identifying plant anomalies and initiate corrective or mitigative actions
- ✓ Improve plant reliability and maximize availability of safety systems in operator hands
- ✓ Utilize critical plant resources for data analysis and diagnostics rather than data collection
- ✓ Utilize wireless infrastructure to enhance equipment monitoring and switch limited Time Based PMs to Condition Based PMs
- ✓ Optimize Exelon preventive maintenance (PM) strategy
- ✓ Operate nuclear plants sustainably protecting public safety and gain public trust

Drivers

- ✓ Engineering
  - Lack of monitoring capabilities hindering engineer's ability to diagnose plant issues efficiently
  - Plant Experts spend too much time in data collection – analytics suffer
  - Lack of Knowledge Transfer and Retention opportunities
- ✓ Operations
  - Problem areas with no instrumentation
  - High dose accumulation due to manual rounds in high dose areas
  - Critical operation resources spent in once a shift data collection
- ✓ Maintenance
  - Predictive maintenance specialist spend over 50 percent time in data collection – analysis suffer
  - Resources committed to preventive maintenance tasks when it is not needed
  - Incomplete diagnostics due to lack of data or data at discrete sources

Benefit

✓ Engineering

- ~10% system engineer's work load reduction by transferring engineering monitoring and trending function to On-Line Monitoring
- ~30% of unexplained equipment failure can be better understood due to improved wireless equipment monitoring capabilities

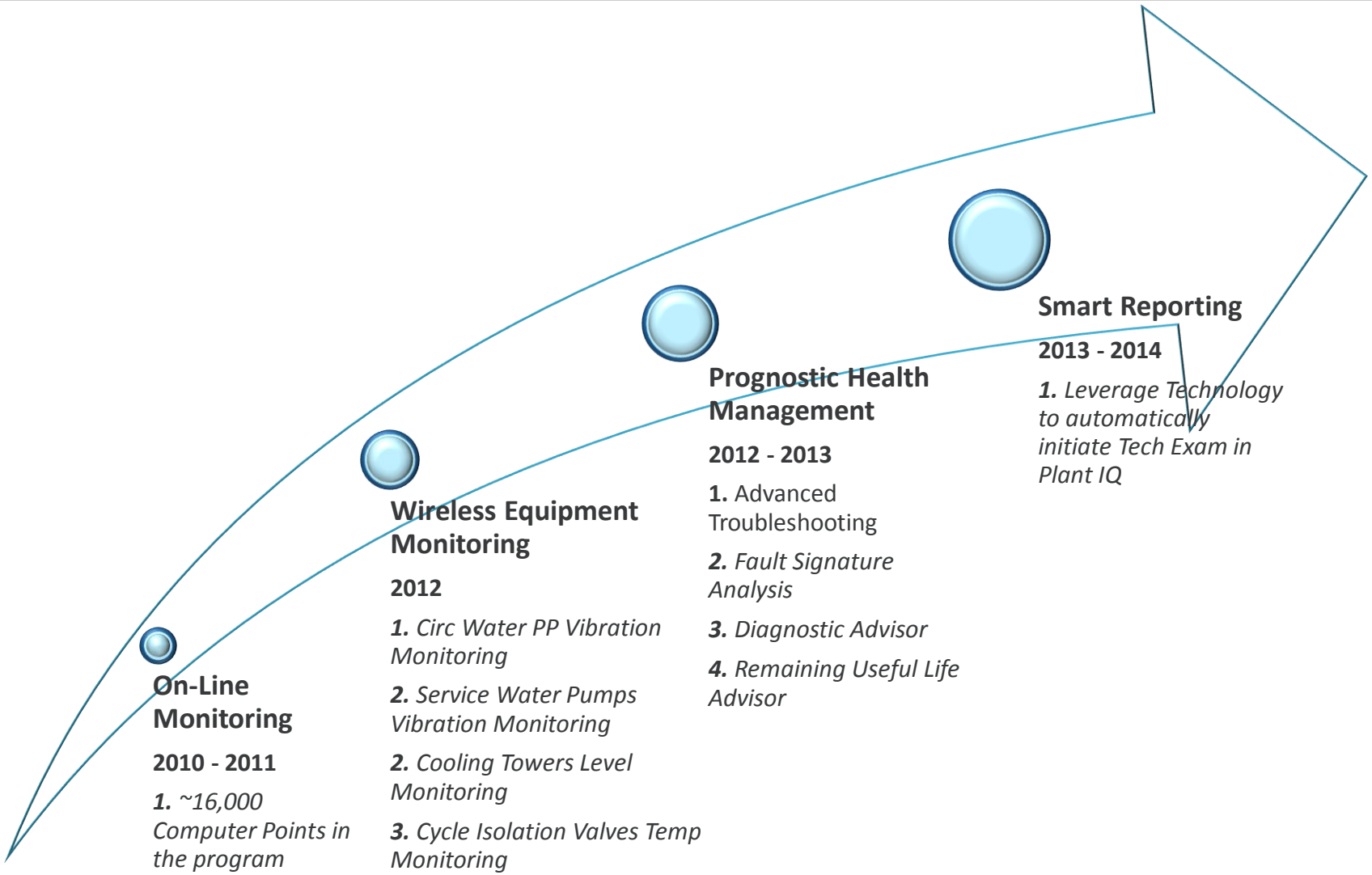
✓ Operations

- ~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
- ~20% PM reduction by switching Time Based PM to Condition Based PM

History



On-Line Monitoring

2010 - 2011

1. *~16,000 Computer Points in the program*

2. Over *1,500 assets being monitored*

Wireless Equipment Monitoring

2012

1. *Circ Water PP Vibration Monitoring*

2. *Service Water Pumps Vibration Monitoring*

2. *Cooling Towers Level Monitoring*

3. *Cycle Isolation Valves Temp Monitoring*

Prognostic Health Management

2012 - 2013

1. Advanced Troubleshooting

2. *Fault Signature Analysis*

3. *Diagnostic Advisor*

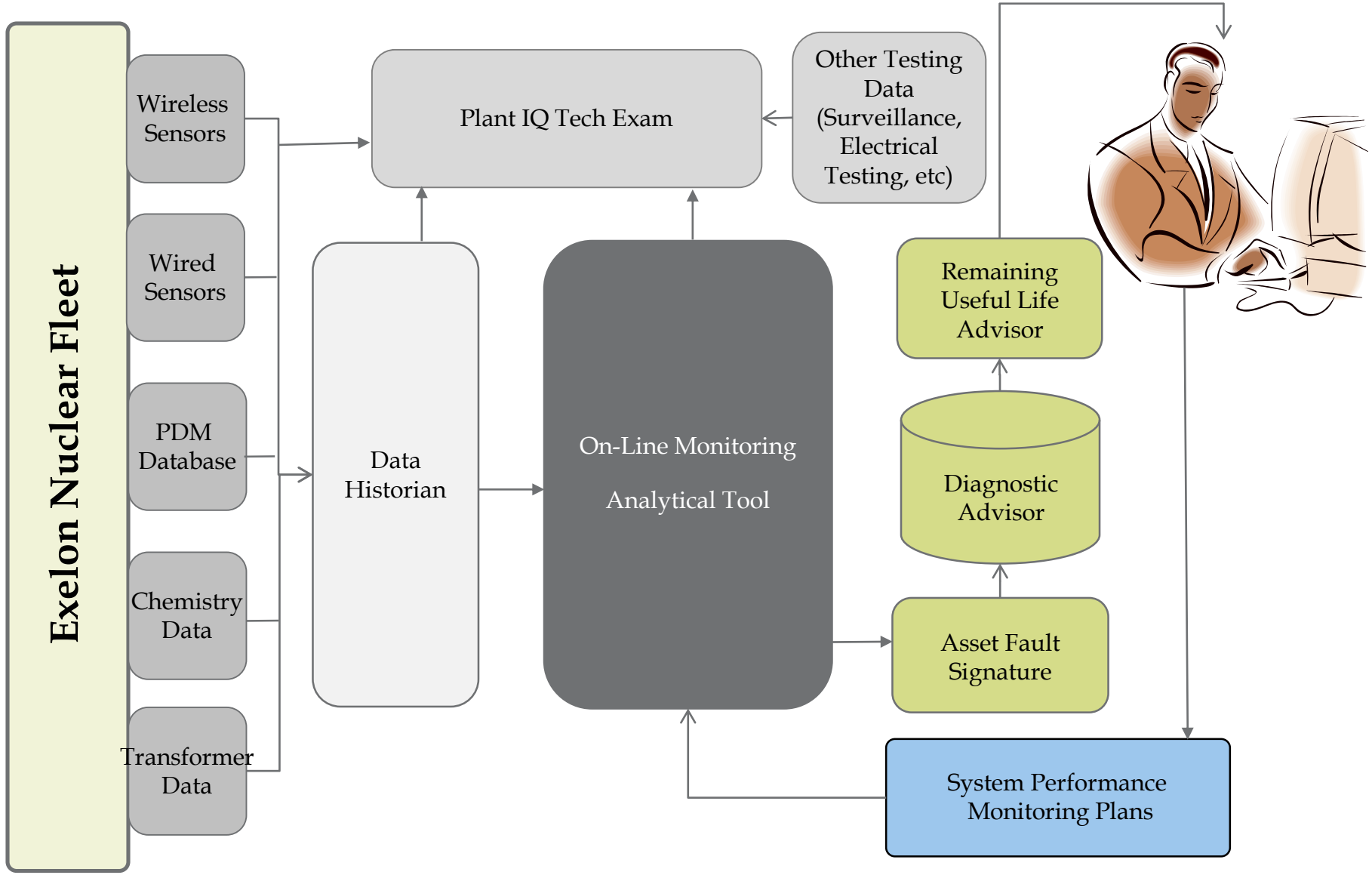
4. *Remaining Useful Life Advisor*

Smart Reporting

2013 - 2014

1. *Leverage Technology to automatically initiate Tech Exam in Plant IQ*

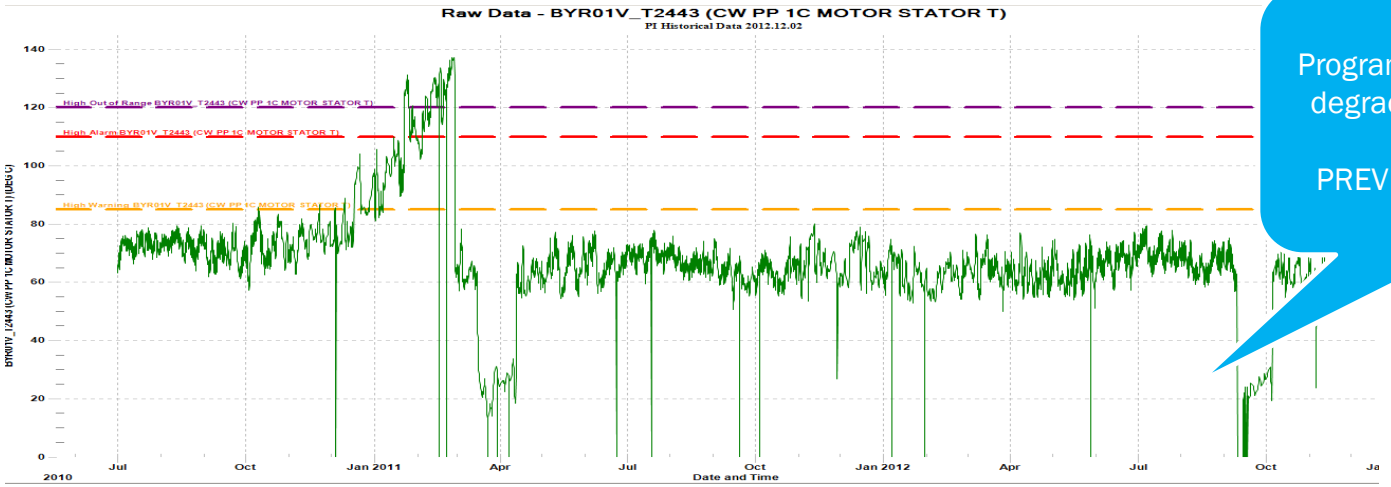
Advanced Monitoring



On-Line Monitoring (OLM)

- ✓The OLM program is a pattern recognition application that monitors plant parameters in real time
- ✓The program acquires raw data from OSIsoft PI
- ✓Designed to provide 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
- ✓Program is currently used by engineering, maintenance and operations
- ✓The Exelon's OLM program is a de-centralized model to improve efficiency of plant staff

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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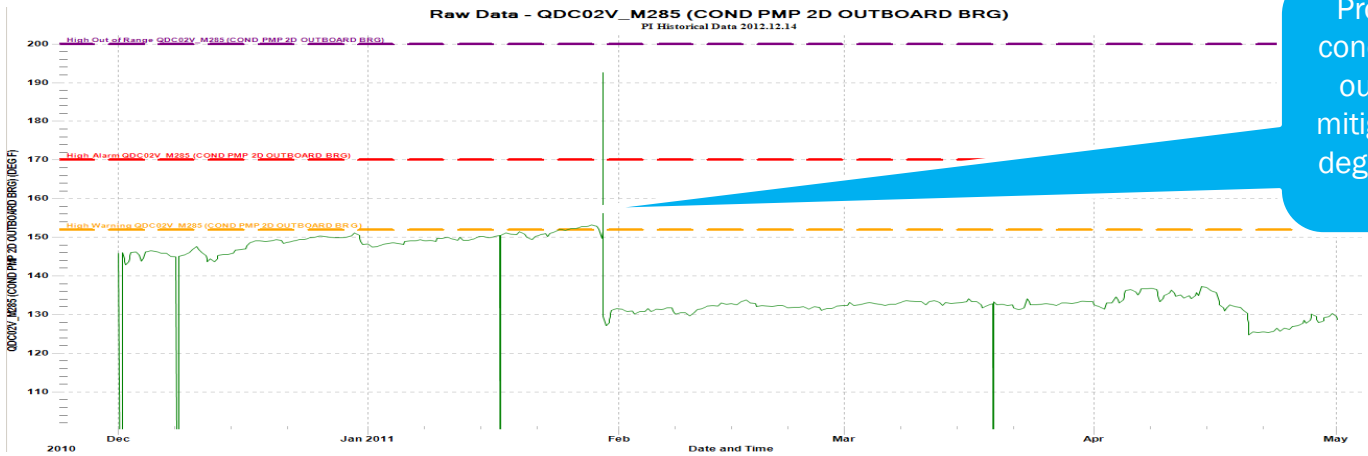
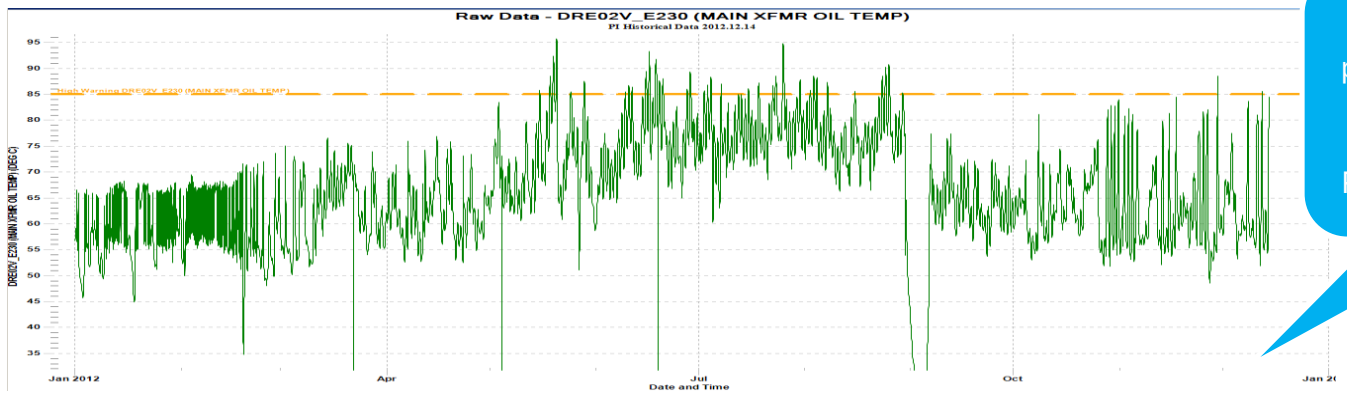
OLM Catches (continued)



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

IT Architecture Summary (OLM)

Engineers Workstations

Client Application

WEB Application

PRiSM Application Server

PRiSM DB SQL Server

WEB Server

PRiSM Server

Universal Service

Storage

Default location for writing results

Read Data (optional write-back results)

Other Servers

OPC Server

Data Historian (PI)

Other Data

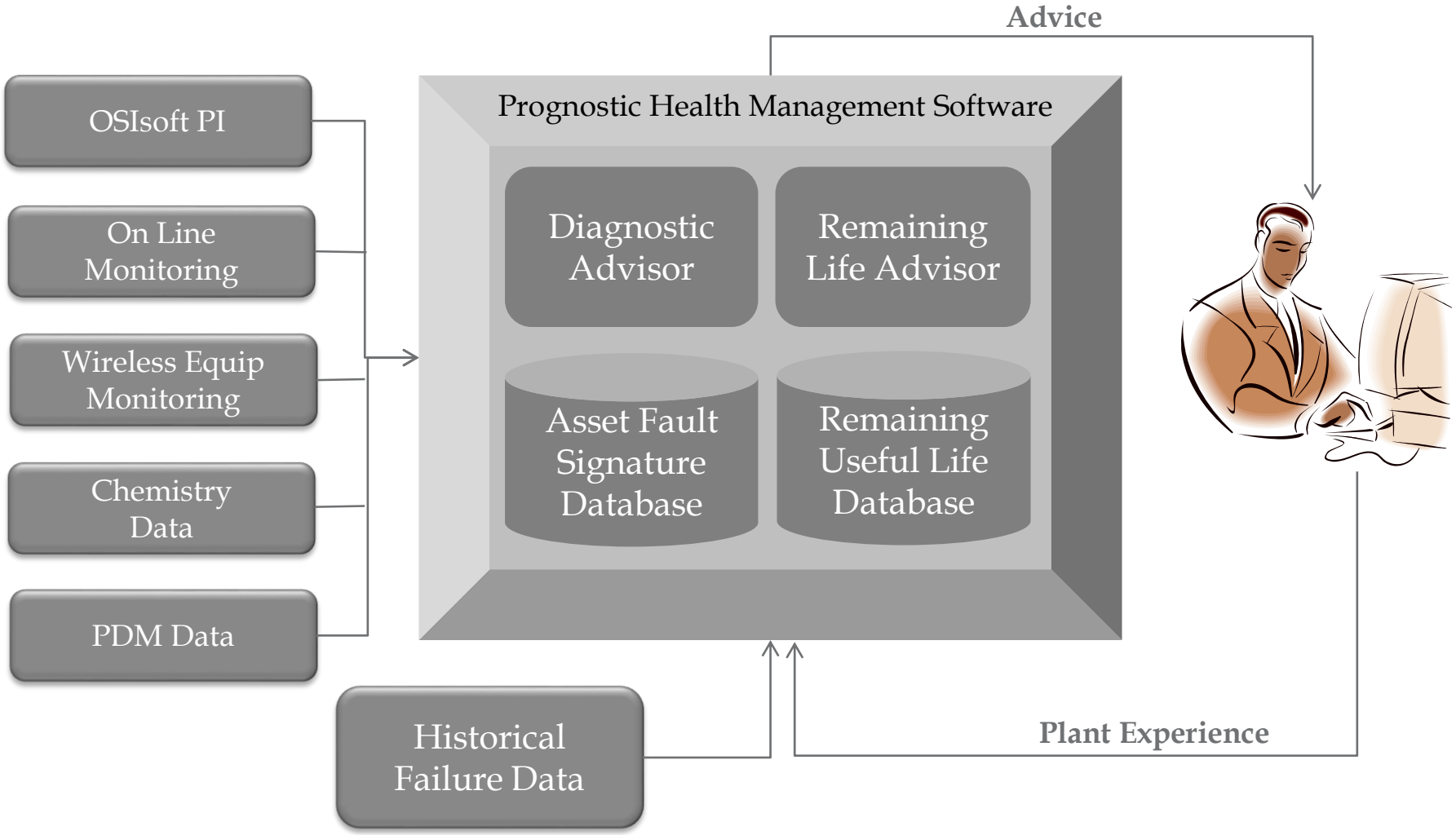
Prognostic Health Management (PHM)

- ✓ An integrated suite of web-based diagnostic and prognostic tools and databases
- ✓ Automated format of Exelon Troubleshooting process
- ✓ Capture human knowledge and retain it in digital format (KT&R)
- ✓ Collaborative project with EPRI and INL
- ✓ Exelon is deploying software for the following projects
  - Diesel Generator
- ✓ Elements of PHM

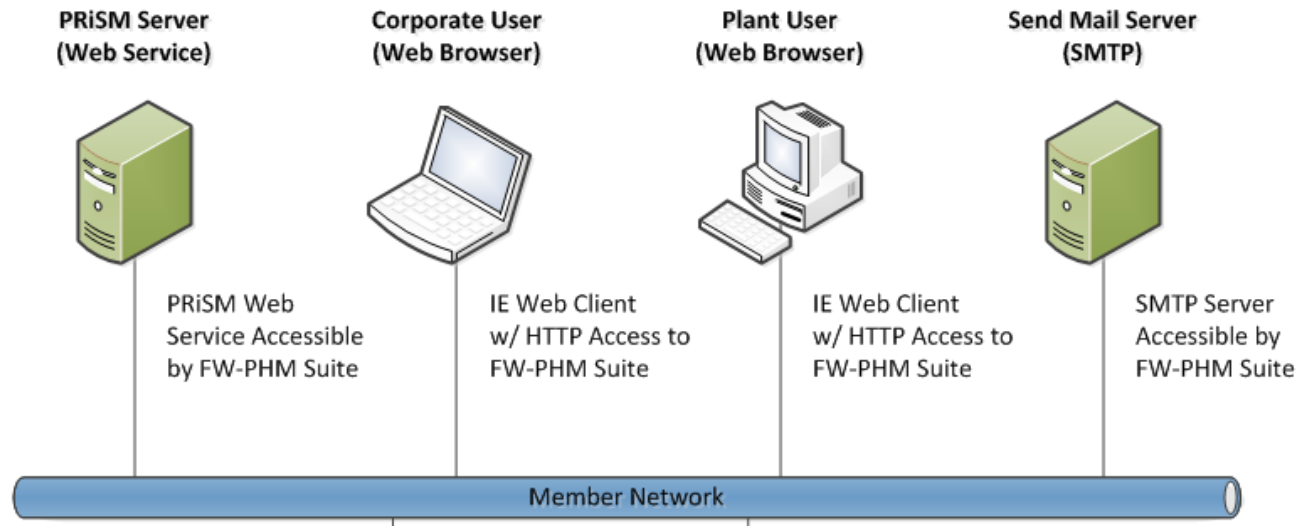
Diagnostic Advisor	Identifies impending failures by comparing asset fault signatures with operating data
Asset Fault Signature Database	Organizes asset fault signatures collected from Exelon and across the industry
Remaining Life Advisor	Estimates how long an aging or faulty asset will continue to provide reliable service
Remaining Useful Life Database	Organizes asset remaining life signatures collected from Exelon and across the industry

PHM Software

- ✓Open architecture, Fleet Wide application for component operations and health monitoring



IT Architecture Summary (PHM)



Interfaces and Services Required on the Member Network

HTTP (Default Port 4110)
PRiSM Service TBD
SMTP (Default Port 25)

FW-PHM Suite Web Server

Requires a static IP address.
Web client login uses Windows authentication or domain user credentials

Oracle Database Server
64 bit Oracle 11g R2 Standard

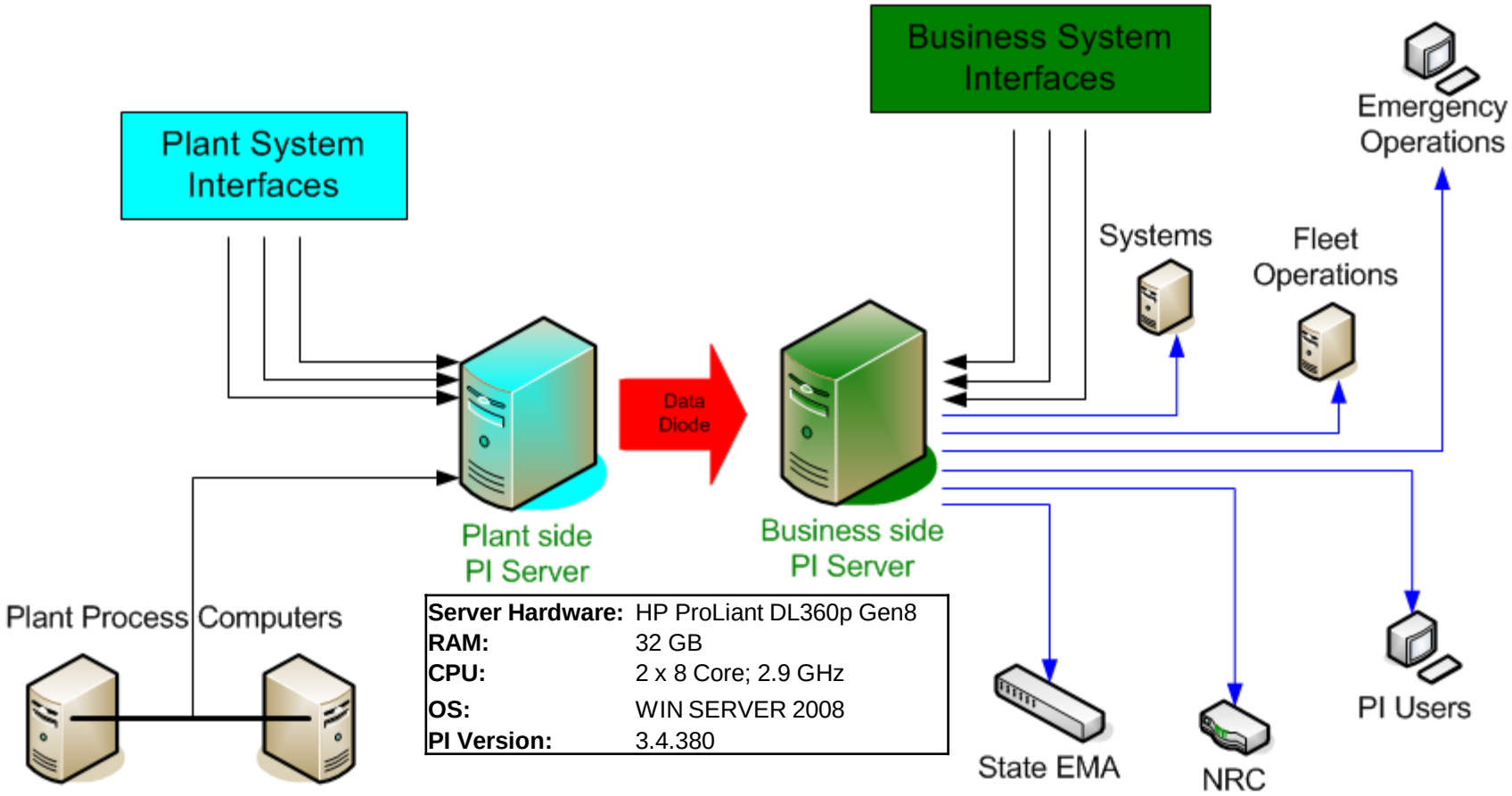
Fleet-Wide Prognostic and Health Management (FW-PHM) Suite Web Server

64 bit Windows 7, 64 bit Windows Server 2008 R2
Internet Information Services (IIS) 6/7
MS .NET 3.5.1 w/ ASP.NET Enabled
Oracle Data Access Components (ODAC)

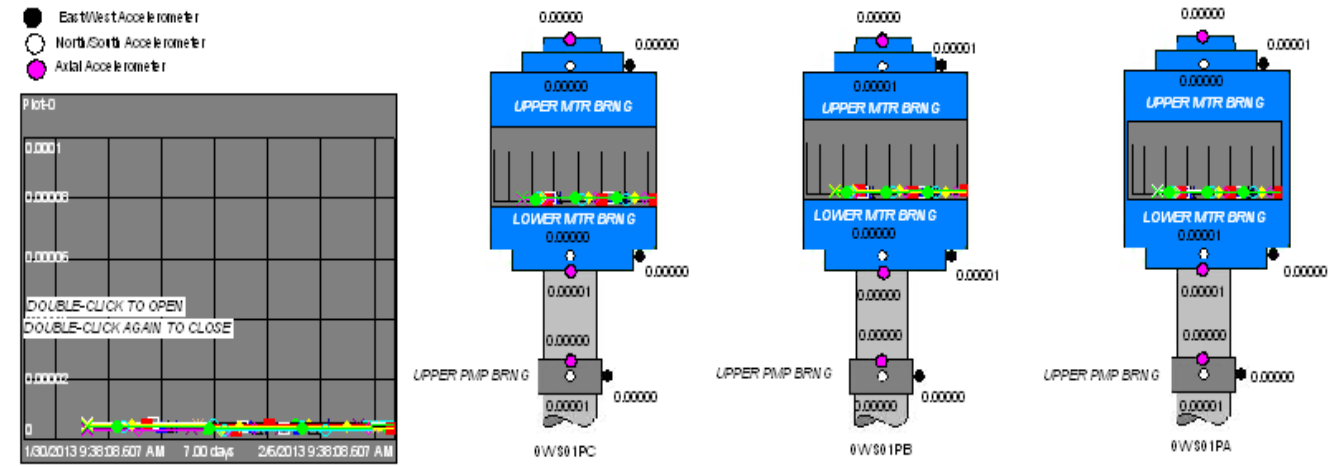
Wireless Equipment Monitoring

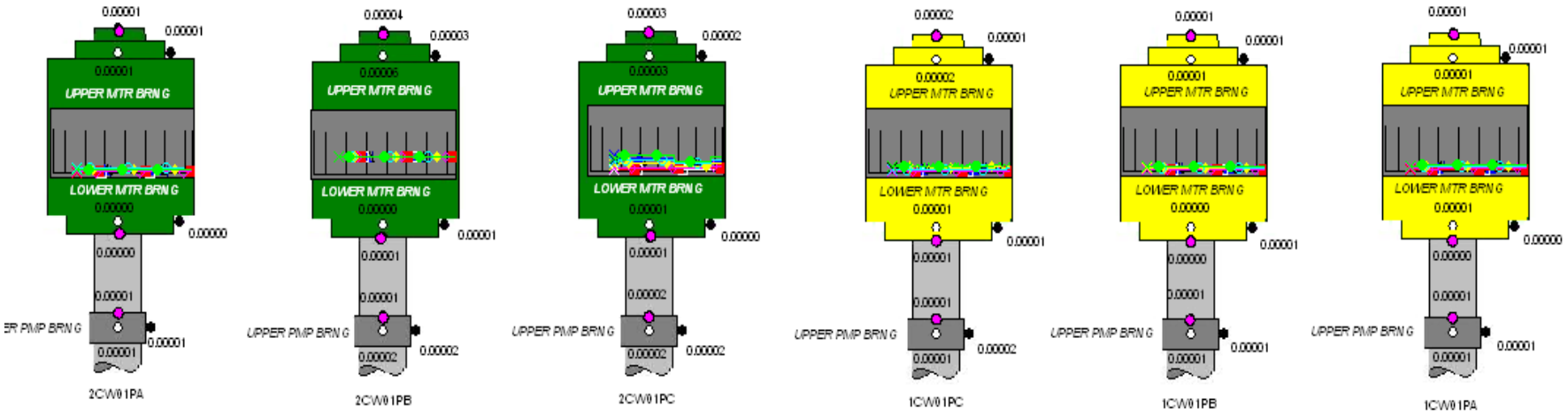
- ✓ Plant staff utilizes significant resources and time in data collection to assess real time equipment health
- ✓ The time spent in data collection keep the experts away from data analysis and prognostics
- ✓ Adding wired sensors in plants are not cost effective
- ✓ Wireless equipment monitoring is the solution
- ✓ Pilot projects completed to proof the concept of wireless equipment monitoring
- ✓ Second phase is in progress to develop wireless projects to support Condition Based Monitoring
  - On-Line Service Air Compressors Monitoring
  - On-Line Circulating Water Pump Motor Current Signature Monitoring
- ✓ Collaborating with OSIsoft to develop advanced monitoring techniques such as Asset Frame Work, Core Sight, PI Notification, Event Frame

IT Architecture/Nuclear Plant (PI)

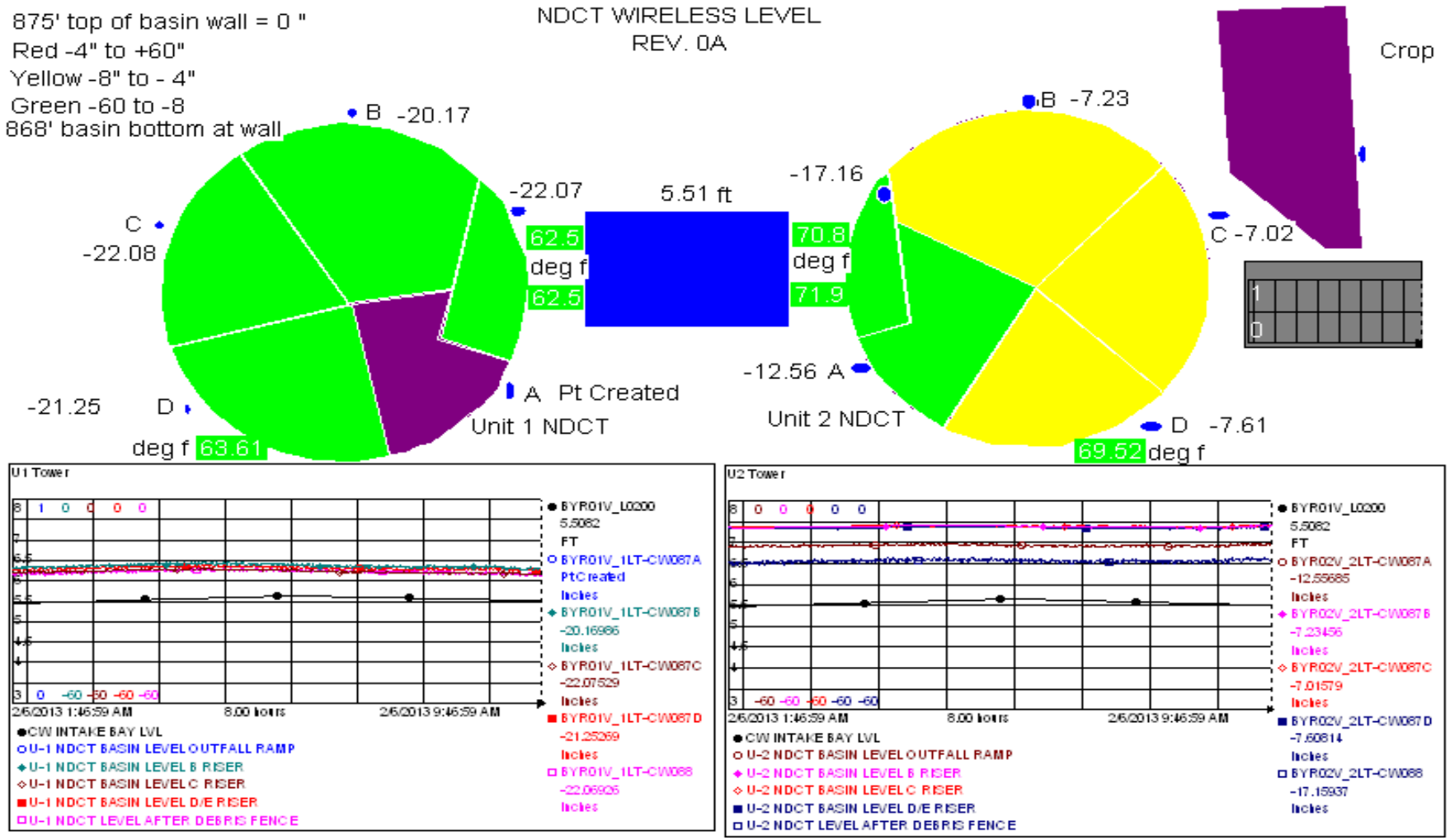


Circ Water Pump Vibration Monitoring





Cooling Towers Level Monitoring



Presenters

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