



## Executing a Successful PdM Program with a Geographically Diverse Team

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# Traditional Model

## In-House Program

- Purchased equipment
- Internal training requirements
- Small teams
- Verbal information distribution

## Outsourced Program

- Supplier-provided equipment
- Contracted personnel
- Verbal and written report distribution
- Other customer commitments

**Depends on bringing people to where the machines are located!**

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# Traditional Model: **Challenges**

## In-House Program

- Costs – Fixed staff & expenses
- Sustainability - Loss of expertise
- Variability in available expertise
- Visibility of information

## Outsourced Program

- Travel expense
- Intermittent coverage
- Variability in available expertise
- Limited access to data



*“We have had a successful program for a number of years and I see no reason to change something that is working....”*

## But What If...

- Your analyst leaves or retires?
- You need to expand your program?
- Your program funding is cut?
- You need new measurement/analysis tools?
- Your corporation wants consistency at all sites?




# Is There a Better Model?



**Plant: Power Station - A**

**Condensate Pump 1**  
(10LCB11AP001)

 **Status: SERIOUS**

---

**Analysts Reviewed Results**  
PM  
(by Brandon Schaner)

Nov11 Jan12 Feb12 Apr12 Aug12

Nov11 Jan12 Feb12 Apr12 Aug12

**Recommended Actions**  
IMPORTANT: INSPECT SYSTEM FOR DAMAGE

**Identified Problems**  
SERIOUS PUMP CAVITATION OR AI

**Analyst Comments**  
DIAGNOSIS:  
Elevated levels of cavitation are noted range spectral data. When viewed in Accel Additionally, waveform data reveals random pump cavitation noise as opposed to bearing

RECOMMENDATION:  
Unit should first receive inspection for improperly operating valves / controllers, issues are present, then physical impeller issues leading to the cavitation issues curr



**Bringing data and information to the people who need it when they need it!**

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# The Distributed Model

Brings data and information to the people who need it when they need it!



**Data Collection**



**Execute Corrective Actions**



**Program and Plant Management**



**Data Analysis**



**Plan and Schedule Maintenance**

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# Why a Distributed Model?

- Sustainable expertise
- Increased effectiveness
- Controlled costs



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# Sustainable Expertise

- Declining population
- Loss of trained personnel
- Steep learning curve for new hires
- Specialization of expertise
- Workload and distribution of experts

# Increased Effectiveness

- Focuses on results rather than technology
- Maintains involvement and ownership
- Requires routine inspections
- Employs best practices
- Provides responsive analysis





# Controlled Costs

- Scalable expenses
- Predictable coverage
- Reduced vulnerability
- Reduced software and maintenance costs





# Inter-Dependent Stakeholders

Corporate Management

Plant Management

Maintenance Planning and Performance

Data Analysis and Machine  
Health Reporting

Data  
Collection

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# Bi-Directional Communication

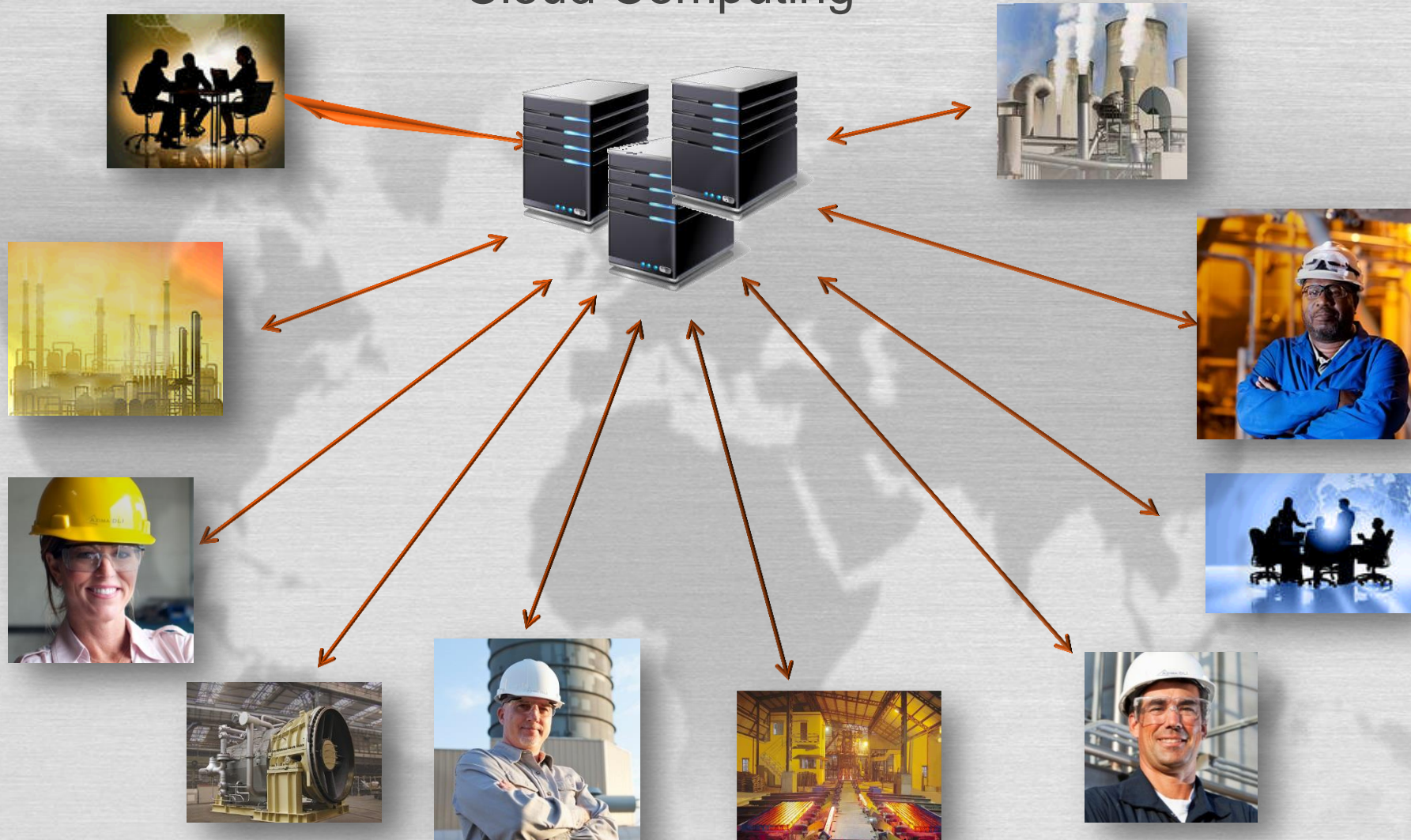


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# Virtualization of Communication

## Cloud Computing

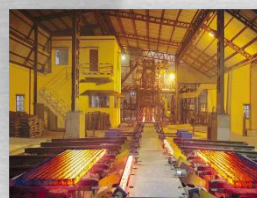


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# Virtualization Benefits

- Centralization
- Collaboration
- Integration
- Transparency
- Communication
- Participation
- Optimization

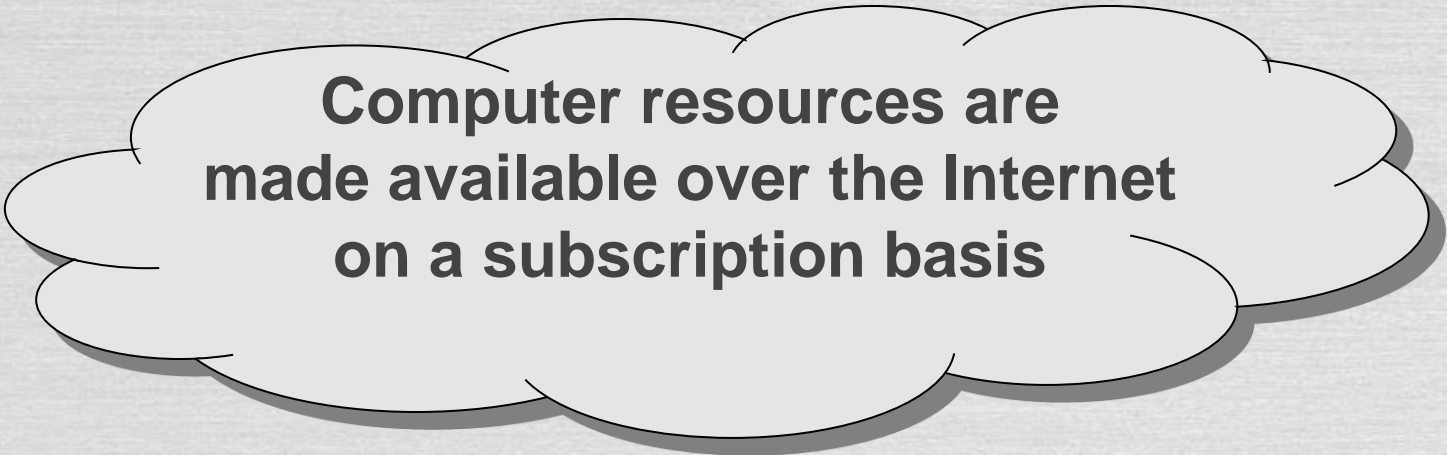


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# What is “Cloud Computing?”

*“Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.” – NIST definition*

Plain English:



**Computer resources are  
made available over the Internet  
on a subscription basis**



# Various Configurations

- **Infrastructure as a Service**
  - Vendor: Provides only server infrastructure
  - User: Provides and maintains operating system hardware and software
- **Platform as a Service**
  - Vendor: Provides server and operating system
  - User: Installs and maintains software
- **Software as a Service**
  - Vendor: Provides all hardware/software for the intended application to the Customer
  - Offers additional cost savings over the first two options
- **Expertise as a Service**
  - Vendor: Provides all hardware/software for the intended application and the expert application knowledge (turn-key solution)
  - Offers greatest cost savings and enhanced operational efficiencies



# What is the Cloud Made Of?

- A Server Farm (multiple, connected servers) functions as one “super computer”



Benefits include:

- **Instant Scalability** -- Power up/down servers as needed with no service interruption
- **Outage Protection** -- Multiple “virtual servers” running simultaneously means that the loss of one or more servers does not impact availability

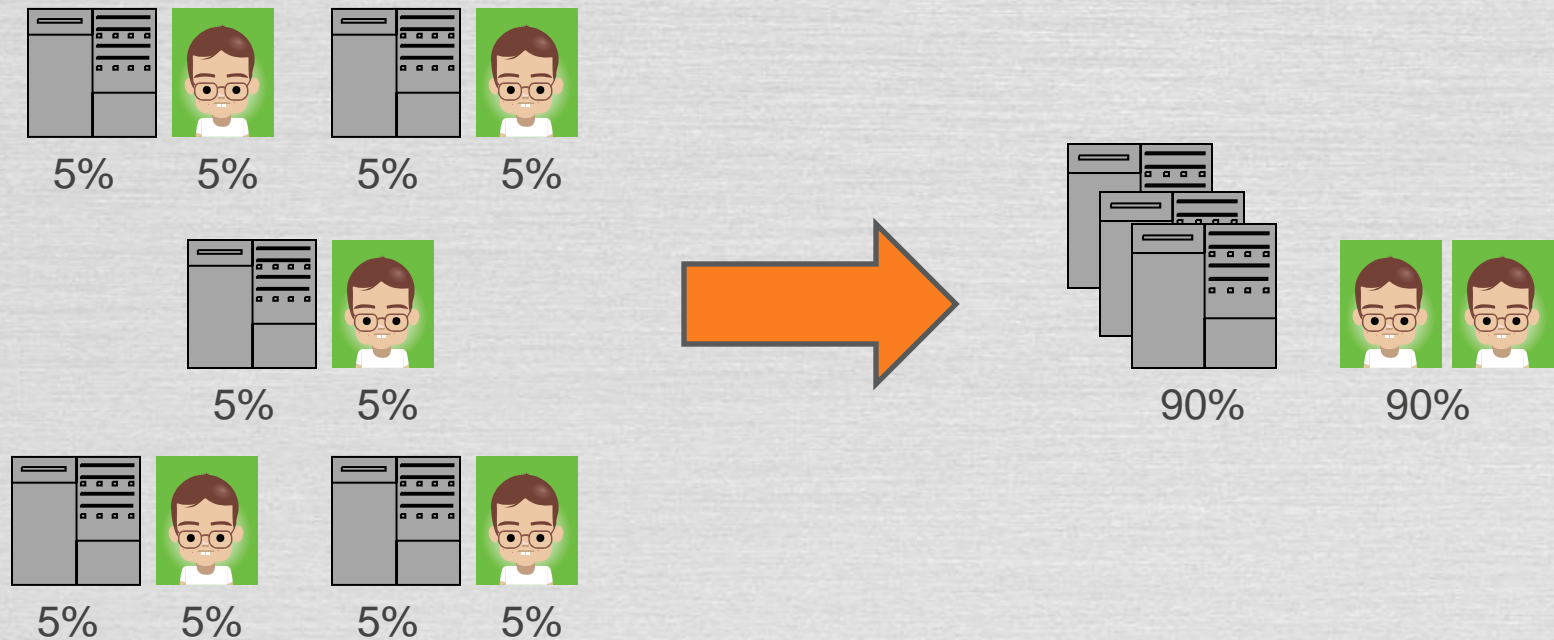
# Advantages of Cloud Computing

- Reduced Implementation Costs
- Reduced Operating Costs
- Increased Productivity
- Easy Access
- Predictable Maintenance Costs & Performance



# Advantages: Reduced Operating Costs

- Savings range from 40% to 95%
- Resource consolidation yields better utilization





# Advantages: Increased Productivity

## **Increased availability boosts user productivity**

- Maintenance and upgrades with zero downtime
- Redundant systems with automatic failover
- Power and data backup systems



# Advantages: Easy Access

## **Internet provides anywhere, anytime access**

- Data and applications are hosted and just a login away
- Access from mobile devices
- Especially advantageous when traveling





# Advantages: Predictable Costs & Performance

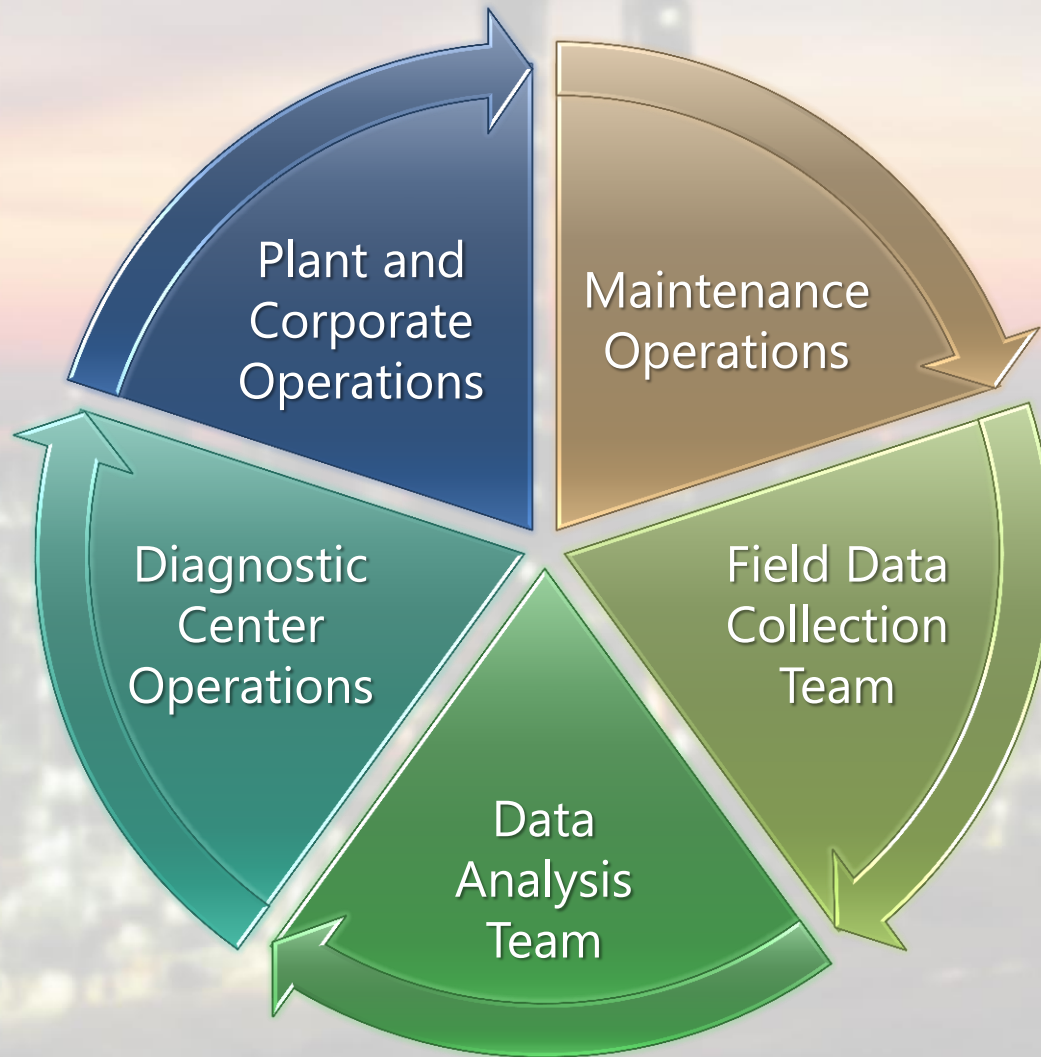
**You pay set service fee; vendor burdened with maintaining performance per service agreement**

- Hard drive failures
- Bug fixes & security patches
- Restoring corrupt data
- Power outages
- KPI's



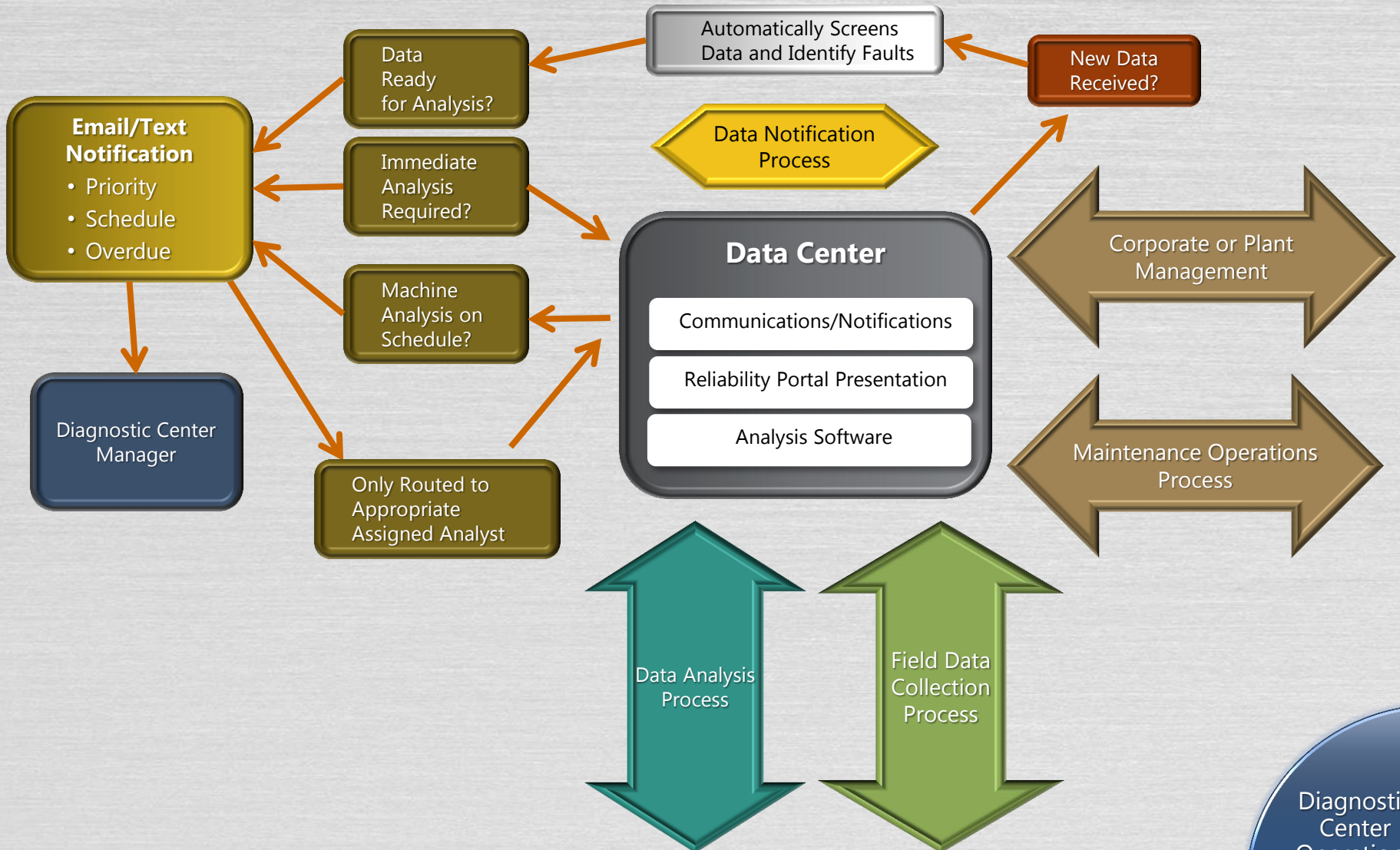


# Connected Communications



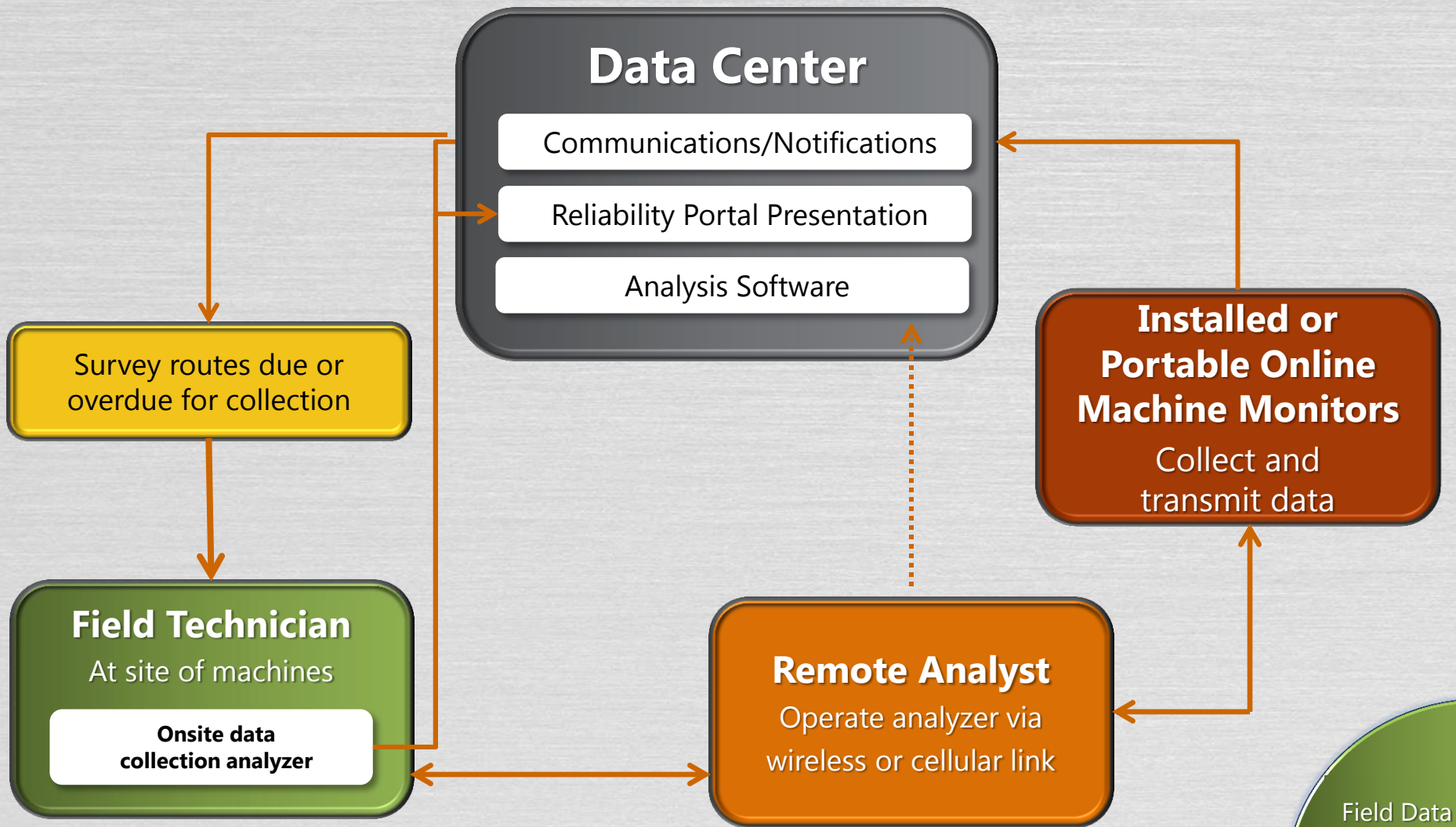
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# Diagnostic Center Operations Process





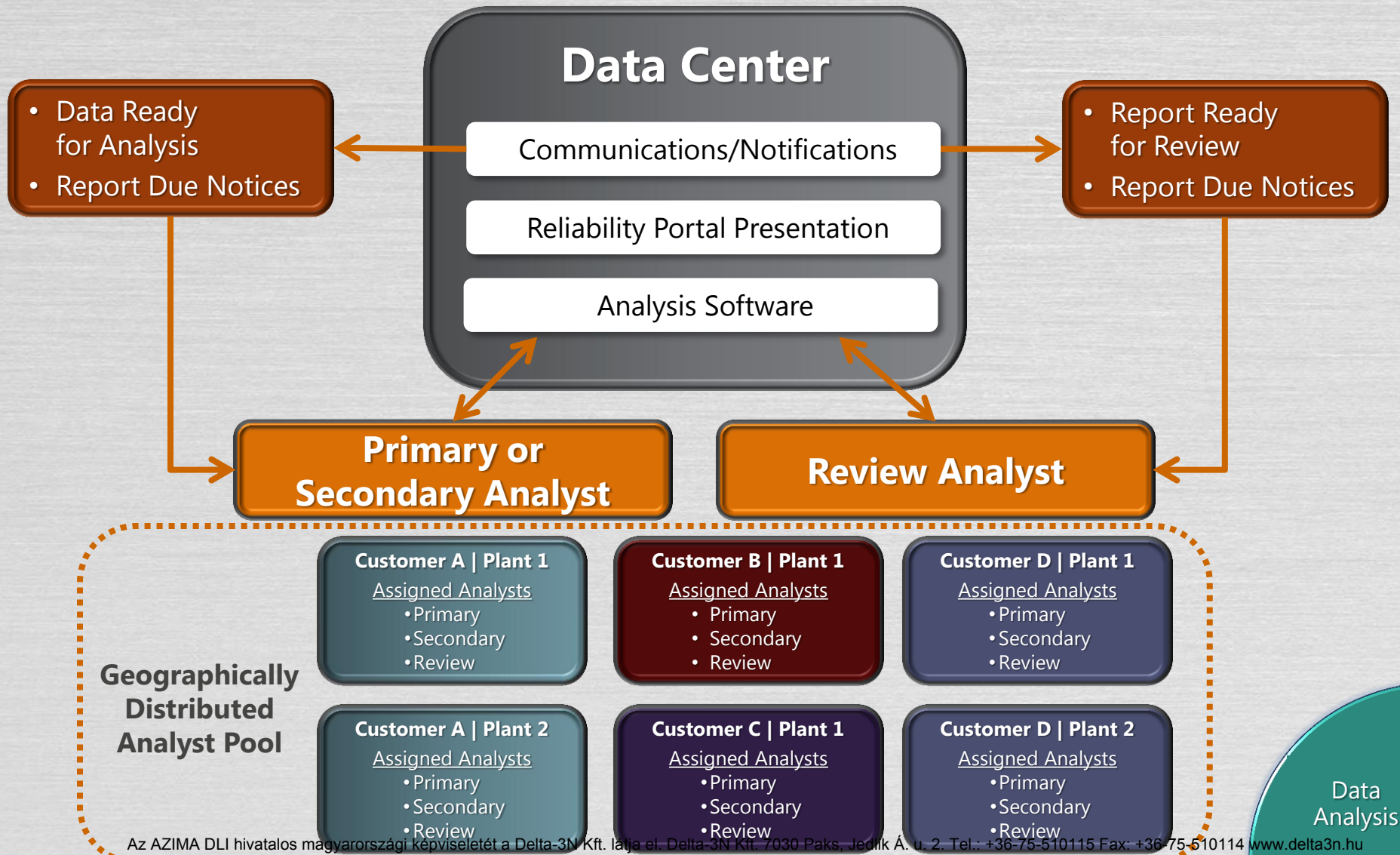
# Field Data Collection Process



Field Data  
Collection

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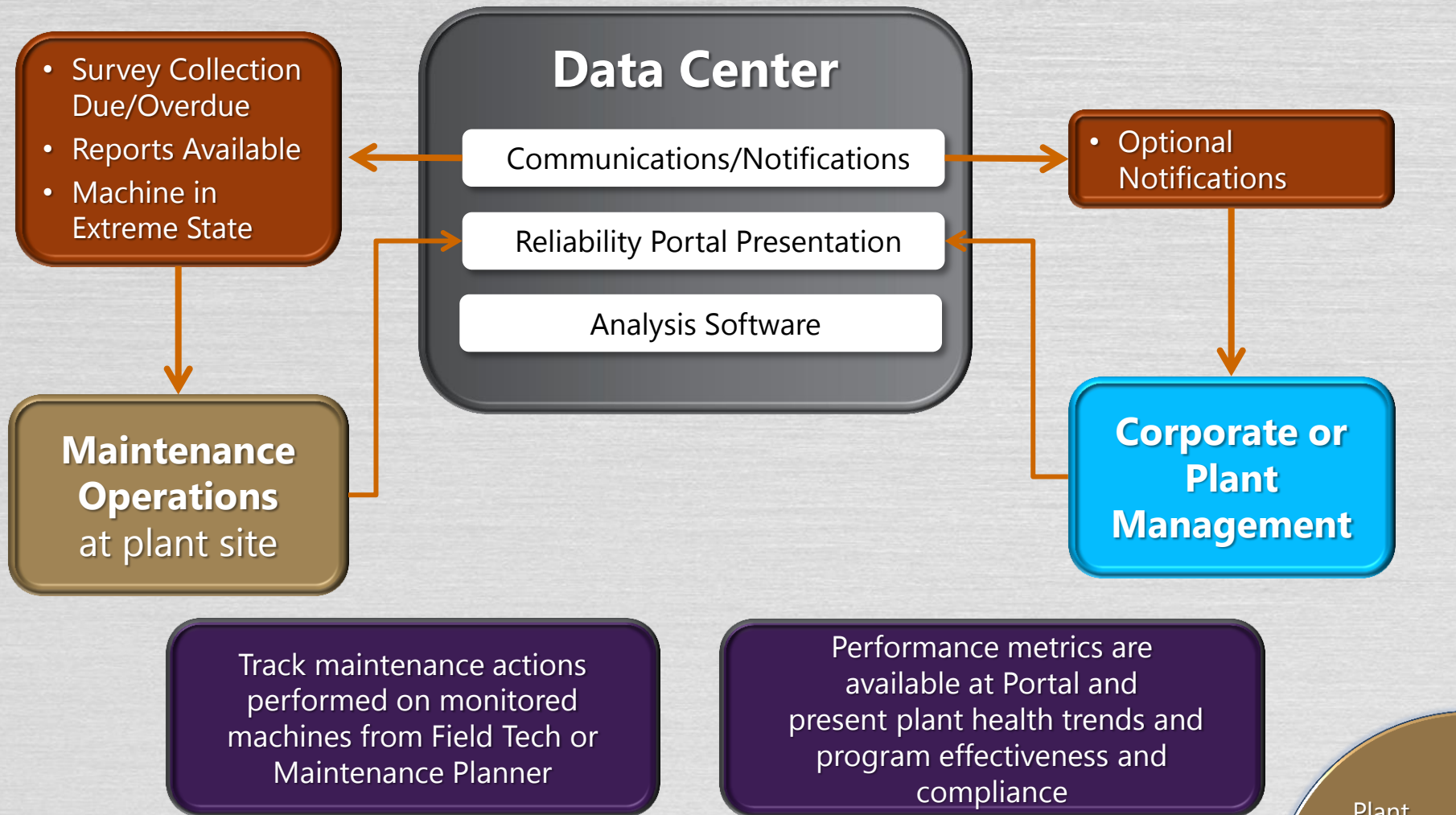
# Data Analysis Process



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# Plant Maintenance Operations Process



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Plant  
Maintenance  
Operations

Processes for Program Success

# COMMUNICATION PATHS IN PRACTICE



# Replication: Sharing the Database

- Two standalone computers
- Across a Local Area Network (LAN)
- Across a Wide Area Network (WAN)
- Across LAN and WAN



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# Databases Synchronized to Master

- Synchronized to the most recent changes
  - Database setup
  - Measured data
  - Automated Expert System Results
  - Reviewed Report by Analyst



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# The Trio – A Two Component Analyzer Design

(versus a purpose-built instrument)

Tablet



Smartphone



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# Trio Analyzer - Desktop



























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# Analyzer - Navigation Layout

 Start	 ID Tag	 New Note	 New Speed	 More Data	 Voice	 Options	 Analysis	 Unload	 Help	 Exit
---	--	--	---	---	--	---	--	--	--	--

<b>Aeration Blower #1</b>	<b>1780 RPM</b> (Nominal)
<b>Motor Drive End</b>	Last tested 9/20/2012 2:52 PM

Machine List	Status	Picture	Test Setup	Details										
<ul style="list-style-type: none"> <li>[-] Bainbridge Water Authority Demo Plant           <ul style="list-style-type: none"> <li>[-] Day Road Main Facility               <ul style="list-style-type: none"> <li>[1] Aeration Blower #1                   <ul style="list-style-type: none"> <li><b>Motor Drive End</b></li> <li>Blower Drive End</li> <li>Blower Free End</li> </ul> </li> <li>[1] Downtown Service Pump #1</li> <li>[2] Main Service Pump #1</li> <li>[1] Main Service Pump #3</li> <li>[4] Service Pump #1</li> <li>[X] Service Pump #2</li> </ul> </li> <li>[+] Example Setup Plant</li> <li>[-] Ken Piety Plant               <ul style="list-style-type: none"> <li>[-] Test Area #123                   <ul style="list-style-type: none"> <li>[X] Machine A1</li> </ul> </li> </ul> </li> </ul> </li> </ul>			<p>POS: 2      RAT      ID: 23</p> <table style="width: 100%;"> <tr> <td style="width: 50%;">Previous Machine </td> <td style="width: 50%;">Previous Location </td> </tr> <tr> <td>Next Machine </td> <td>Next Location </td> </tr> <tr> <td>Stop Test </td> <td style="background-color: #00FF00; color: white;">Start Test </td> </tr> <tr> <td>View Data </td> <td></td> </tr> <tr> <td>Stored Notes </td> <td></td> </tr> </table>	Previous Machine 	Previous Location 	Next Machine 	Next Location 	Stop Test 	Start Test 	View Data 		Stored Notes 		
Previous Machine 	Previous Location 													
Next Machine 	Next Location 													
Stop Test 	Start Test 													
View Data 														
Stored Notes 														

11/29/2012 1:15 AM

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# Analyzer - Current Machine Status

Start	ID Tag	New Note	New Speed	More Data	Voice	Options	Analysis	Unload	Help	Exit
-------	--------	----------	-----------	-----------	-------	---------	----------	--------	------	------

**Service Pump #1** **1780 RPM**  
(Nominal)  
Last tested 1/10/2013 3:02 PM

Machine List	1 Status	Picture	Test Setup	Details
<p><b>Expert System Results</b></p> <p>MID: 1      Averages: 2      Rulebase: 20120525            Date Acquired: 1/10/2013 2:55 PM      Report Generated: 1/10/2013 3:00 PM</p> <p>Machine Speed: 1802 RPM      Figure of merit: 841            Maximum Level: 133 (+51) VdB at 1.00x on Motor Drive End Axial</p> <p><b>RECOMMENDATIONS:</b>  <span style="color: red;">&lt;1&gt;</span> MANDATORY: OVERHAUL MOTOR</p> <p><b>DIAGNOSTICS:</b>  <span style="color: red;">&lt;1&gt;</span> EXTREME MOTOR IMBALANCE  <span style="color: red;">&lt;1&gt;</span> EXTREME MOTOR DRIVE END SHAFT LOOSENESS  <span style="color: red;">&lt;1&gt;</span> EXTREME MOTOR THRUST BEARING PROBLEM</p>				
		<p>Previous Machine </p> <p>Next Machine </p> <p>Stop Test </p>		<p>Previous Location </p> <p>Next Location </p> <p>Start Test </p> <p>ID Location</p> <p>ID Machine</p>
<p>Attention Required!</p> <p>Run Expert System</p> <p>OK </p>		<p>Prev</p> <p>Next</p>		

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# Predefined Field Notes by Categories

**Start** **ID Tag** **New Note** **New Speed** **More Data** **Voice** **Options** **Analysis** **Unload** **Help** **Exit**

**AC Motor Pump A IPS RAT** **1785 RPM**

### Enter New Notes

**Categories**

- 1 Status/safety issues
- 2 As-Is State
- 3 Structural Conditions
- 4 Bearing-Belt-Blade-Motor-Shaft
- 5 Filter-Leaks-Fluid
- 6 **Overheating**
- 7 Pressure-Load
- 8 Sounds
- 9 Modify Database

**Predefined Notes**

- 601 Temperature Exceeds Safe Levels
- 602 Arcing/Sparks Being Generated
- 603 Burned/Discolored Surfaces
- 604 Burning Smell
- 605 Hot Bearing
- 606 Hot Casing
- 607 Melted Materials/Components
- 608 Insulation - Cracked/Missing

**Component**

**Location**

**Voice Note**

**Photo Note**

**Free Text**

**Selected Notes**

- 406 Belts - Flapping/Resonating
- 605 Hot Bearing

**Shift Up** **Add Note**

**Shift Down** **Remove Note**

**Clear Notes**

**Save** **Cancel**

Battery: AC DP1: Disconnected 10/11/2012 12:30 AM

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# Define the Component and Location

Start ID Tag New Note New Speed More Data Voice Options Analysis Unload Help Exit

AC Motor Pump A IPS RAT 1785 RPM

### Enter New Notes

**Categories**

- 1 Status/safety issues
- 2 As-Is State
- 3 Structural Conditions
- 4 Bearing-Belt-Blade-Motor-Shaft
- 5 Filter-Leaks-Fluid
- 6 Overheating
- 7 Pressure-Load
- 8 Sounds
- 9 Modify Database

**Select Location:**

- 1 Motor Free End Brg 1
- 2 Motor Drive End Brg 2
- 3 Pump Drive End Brg 3
- 4 Pump Free End Brg 4
- 5 Housing
- 6 Foundation
- 7 Structural Support
- 8 Piping

**Component**

**Location**

Voice Note

Photo Note

Free Text

**Selected Notes**

- COMPONENT: Motor
- LOCATION: Motor Drive End Brg 2

Shift Up Add Note

Shift Down Remove Note

Save Cancel

Clear Notes

Battery: AC DP1: Disconnected 10/11/2012 12:34 AM

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# Free-form Text Entry Notes

TRIO Remote Support

More Data \*\*Voice \*\*Options \*\*Analysis \*\*Unload \*\*Help \*\*Exit

Rotational Speed RPM 1500 on All 1500 \*\*RPM

**\*\*Enter New Notes**

**\*\*Categories**

- 1 \*\*Status/safety issues
- 2 \*\*As-Is State
- 3 \*\*Structural Conditions
- 4 \*\*Bearing-Belt-Blade-Motor-Shaft
- 5 \*\*Filter-Leaks-Fluid
- 6 \*\*Overheating
- 7 \*\*Pressure-Load
- 8 \*\*Sounds
- 9 \*\*Modify Database

**\*\*Compone**

**\*\*Location**

**\*\*Voice**

**\*\*Photo**

**\*\*Free Text**

**\*\*Enter Free Text**

*This is a free text note.*

On-Screen Keyboard

Esc ~ ` ! @ # \$ % ^ & \* ( ) \_ + = Bksp Home PgUp

Tab q w e r t y u i o p { [ ] \ / Del End PgDn

Caps a s d f g h j k l ; ' " < > ← Insert Pause

Shift z x c v b n m < , > . ? / ↑ Shift PrtScn ScrLk

Ctrl Win Alt Alt Ctrl ← ↓ → Fn Options Help

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# Sound Recordings

Start ID Tag New Note New Speed More Data Voice Options Analysis Unload Help Exit

AC Motor Pump A IPS RAT 1785 RPM

Enter New Notes

Categories

- 1 Status/safety issues
- 2 As-Is State
- 3 Structural Conditions
- 4 Bearing-Belt-Blade-Motor-Shaft
- 5 Filter-Leaks-Fluid
- 6 Overheating
- 7 Pressure-Load
- 8 Sounds
- 9 Modify Database

Record Voice Note

Record Play Stop Erase

Component Location Voice Note Photo Note Free Text

Selected Notes

Shift Up Add Note

Shift Down Remove Note

Save Cancel

Clear Notes

Battery: AC DP1: Disconnected 10/11/2012 12:36 AM

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# Picture Field Notes

Start ID Tag New Note New Speed More Data Voice Options Analysis Unload Help Exit

**Downtown Service Pump #1** 1775 RPM

### Enter New Notes

Categories

- 1 Status/safety issues
- 2 As-Is State
- 3 Structural Conditions
- 4 Bearing-Belt-Blade-Motor-Shaft
- 5 Filter-Leaks-Fluid
- 6 Overheating
- 7 Pressure-Load
- 8 Sounds
- 9 Modify Database

Press "Snapshot" to Take Photo

Component  
Location  
Voice Note  
**Photo Note**  
Free Text

Selected Notes

**Snapshot**

Shift Up Add Note  
Shift Down Remove Note  
Clear Notes

Save Cancel

Battery: AC DP1: Disconnected 10/18/2012 2:48 PM

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# Analyzer - Special Test Measurements

Start ID Tag New Note New Speed More Data Voice Options Analysis Unload Help Exit

Downtown Service Pump #1  
Motor Free End

1784.9 RPM  
(Latest)

Last tested 7/27/2010 12:40 PM

## Take Additional Test Data at This Location

### Advanced Tests

- 1 Custom Setup
- 2 High Frequency
- 3 High Resolution
- 4 Demodulation
- 5 Low Frequency
- 6 Order Tracking
- 7 Time Synchronous Average
- 8 Bump Test (Equipment ON)
- 9 Bump Test (Equipment OFF)
- 10 Runup/Coastdown (Waterfall)
- 11 Runup/Coastdown (Bode)
- 12 Runup/Coastdown (Peak-Hold)
- 13 Long Time Capture

Goal: To allow the user to define any test setup within the capability of the data acquisition hardware.

This setup will default to the setup that was defined on the last selection of this test. If the test that is desired is a slight variant of one of the other test selections, then it will likely be easier to select that predefined test but use the Custom Setup button available when the default test settings are displayed. Regardless of which path is taken to the Custom Setup options, any changes to the test settings can be saved and named using the Save Settings button. These user-defined tests are added to the list of tests and can be recalled to provide convenient access to measurements that are likely to be repeated in the future.

More Tests    ↑    ↓    Test Settings    Cancel

10/11/2012 1:00 AM



# Special Test Measurements Notes

Start ID Tag New Note New Speed More Data Voice Options Analysis Unload Help Exit

AC Motor Pump A IPS VHA + Ovr 29.87 RPS  
Motor Free End Brg 1 (Latest)  
Last tested 10/17/2012 1:43 AM

### Stored Notes

10/17/2012 1:25:44 AM	Administrator	High Frequency test collected from Motor Drive End.
10/12/2012 1:12:33 AM	Administrator	Custom settings test collected from Motor Free End Brg
		Waterfall test collected from Motor Free End Brg

Note saved by: Administrator  
10/17/2012 1:25:44 AM

Edit Note Delete Note OK

Battery: AC DP1: Disconnected 10/18/2012 1:56 PM

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# Analyzer - Requested Action

AC Motor Pump A IPS VHA + Ovr

29.87 RPS  
(Latest)

Motor Free End Brg 1

Last tested 10/17/2012 1:43 AM

Machine List	Status	Picture	Test Setup	Details
<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> AC Motor Pump A IPS RAT</li> <li><input checked="" type="checkbox"/> AC Motor Pump A IPS VHA #3 No Ovr</li> <li><input checked="" type="checkbox"/> AC Motor Pump A IPS VHA #4 RPS All</li> <li><input checked="" type="checkbox"/> AC Motor Pump A IPS VHA #5</li> <li><input checked="" type="checkbox"/> AC Motor Pump A IPS VHA #9 wLS630fpm</li> <li><input checked="" type="checkbox"/> AC Motor Pump A IPS VHA + Ovr                             <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Motor Free End Brg 1</li> <li><input checked="" type="checkbox"/> Motor Drive End Brg 2</li> <li><input checked="" type="checkbox"/> Pump Drive End Brg 3</li> <li><input checked="" type="checkbox"/> Pump Free End Brg 4</li> </ul> </li> <li><input checked="" type="checkbox"/> AC Motor Pump A IPS VHA RPM1st</li> <li><input checked="" type="checkbox"/> AC Motor Pump A IPS-1xOv VHA</li> <li><input checked="" type="checkbox"/> AC Motor Pump B VdB RAT</li> <li><input checked="" type="checkbox"/> AC Motor Pump B VdB VHA</li> <li><input checked="" type="checkbox"/> Circulating Fan A</li> <li><input checked="" type="checkbox"/> Co-Common Setup Example</li> </ul>			<div style="text-align: center; font-weight: bold; font-size: 1.1em;">POS: 1 VHA ID: 45</div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div style="width: 45%;"> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;">                     Previous Machine  </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;">                     Next Machine  </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;">                     Stop Test  </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;">                     View Data  </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;">                     Stored Notes  </div> </div> <div style="width: 45%;"> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;">                     Previous Location  </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;">                     Next Location  </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px; background-color: #00ff00; color: white; text-align: center;">                     Start Test  </div> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 5px;">                     Requested Action  </div> </div> </div>	

Battery: AC DP1: Disconnected 10/18/2012 2:09 PM ...

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# Analyzer - Requested Actions Review

Start ID Tag New Note New Speed More Data Voice Options Analysis Unload Help Exit

**AC Motor Pump A IPS VHA + Ovr** 29.56 RPS (Nominal)

Machine List	Status	Picture	Test Setup	Details
AC Motor Pump A IPS RAT				
AC Motor Pump A IPS VHA #3 No Ovr				
AC Motor Pump A IPS VHA #4 RPS All				
AC Motor Pump A IPS VHA #5				
AC Motor Pump A IPS VHA #9 wLS630fpm				
<b>1</b>				
Motor Free End Brg 1				
Motor Drive End Brg 2				
Pump Drive End Brg 3				
Pump Free End Brg 4				
AC Motor Pump A IPS VHA RPM1st				
AC Motor Pump A IPS-1xOv VHA				
AC Motor Pump B VdB RAT				
AC Motor Pump B VdB VHA				
Circulating Fan A				
Co-Current Setup Example				

Perform Bump Test-Machine On for motor bearings.  
Any repairs been done since last survey?  
Take photo of motor nameplate.

Note saved by: Administrator 10/12/2012 1:12:33  Don't show again

OK

Battery: AC DP1: Disconnected 10/18/2012 1:48 PM

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# Analyzer - Expert System Results

Start ID Tag New Note New Speed More Data Voice Options Analysis Unload Help Exit

AC Motor Pump A IPS-1x0v VHA 2240.5 RPM

Expert System Results

MID: 8 Averages: 0 Rulebase: 20120525  
Date Acquired: 1/5/2013 9:07 PM Report Generated: 1/5/2013 9:22 PM


Machine Speed: 1792 RPM Figure of merit: 214  
Maximum Level: 2.6 (1873%) in/s at 1.05x on Pump Drive End Brg 3 Axial  
ANALYST ALERT: CHECK SPECTRA MANUALLY, MAX LEVEL MAY INDICATE A PROBLEM


**RECOMMENDATIONS:**


- <1> MANDATORY: CHECK SHAFT ALIGNMENT; IF SAT, INSPECT COUPLING AND CHECK FOI
- <2> IMPORTANT: CHECK PUMP END FOR MOUNTING INTEGRITY AND PROPER ALIGNMEN
- <3> DESIRABLE: INSPECT PUMP FOR PROPER INTERNAL FIT AND ALIGNMENT


**DIAGNOSTICS:**


- <1> EXTREME INDICATION OF POSSIBLE MISALIGNMENT
- <2> SERIOUS INDICATION OF POSSIBLE PUMP MOUNTING WEAKNESS
- <3> MODERATE PUMP BEARING OR ROTOR MISALIGNMENT
- <4> SLIGHT INDICATION OF POSSIBLE COUPLING WEAR OR LOOSENESS
- <4> SLIGHT MOTOR FREE END BALL BEARING DEMOD
- <4> SLIGHT PUMP FREE END BEARING DEMOD
- <4> SLIGHT PUMP DRIVE END BEARING DEMOD

Attention Required! 

View Data 

Next Report 

Previous Report 

OK 

Attempting connection 1/15/2013 12:10 AM ..

12:10 AM 1/15/2013

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# ALERT Software - Diagnostic Report

The screenshot shows the ExpertALERT software interface. The left sidebar displays a tree view of the plant structure, with 'Downtown Service Pump #1' selected. The main window shows the 'Expert System Results' for this pump, including machine speed, rulebase, and figure of merit. Below this, there are sections for 'RECOMMENDATIONS' and 'DIAGNOSTICS' with color-coded severity levels.

**ExpertALERT**  
 File Edit View Data Collection Reports Expert In-Tray Utilities Help

Report Trend Screening Sheet Report Editor Event Tracker Comments  Include Cited Peaks

**Expert System Results**

**Downtown Service Pump #1**

MID: 9  
 Averages: 3  
 Report Generated: 7/21/2011 11:29:58 AM (GMT-05:00)  
 Date Acquired: 7/27/2010 12:45:03 PM (GMT-05:00)

Machine Speed: 1778 RPM  
 Rulebase: 3.5.001  
 Figure of merit: 735  
 Maximum level: 113 (+12) VdB at 1.00x on Pump Drive End Tangential

**RECOMMENDATIONS:**

**<1> MANDATORY:** REPLACE MOTOR BEARINGS  
**<2> IMPORTANT:** REPLACE PUMP FREE END BEARING

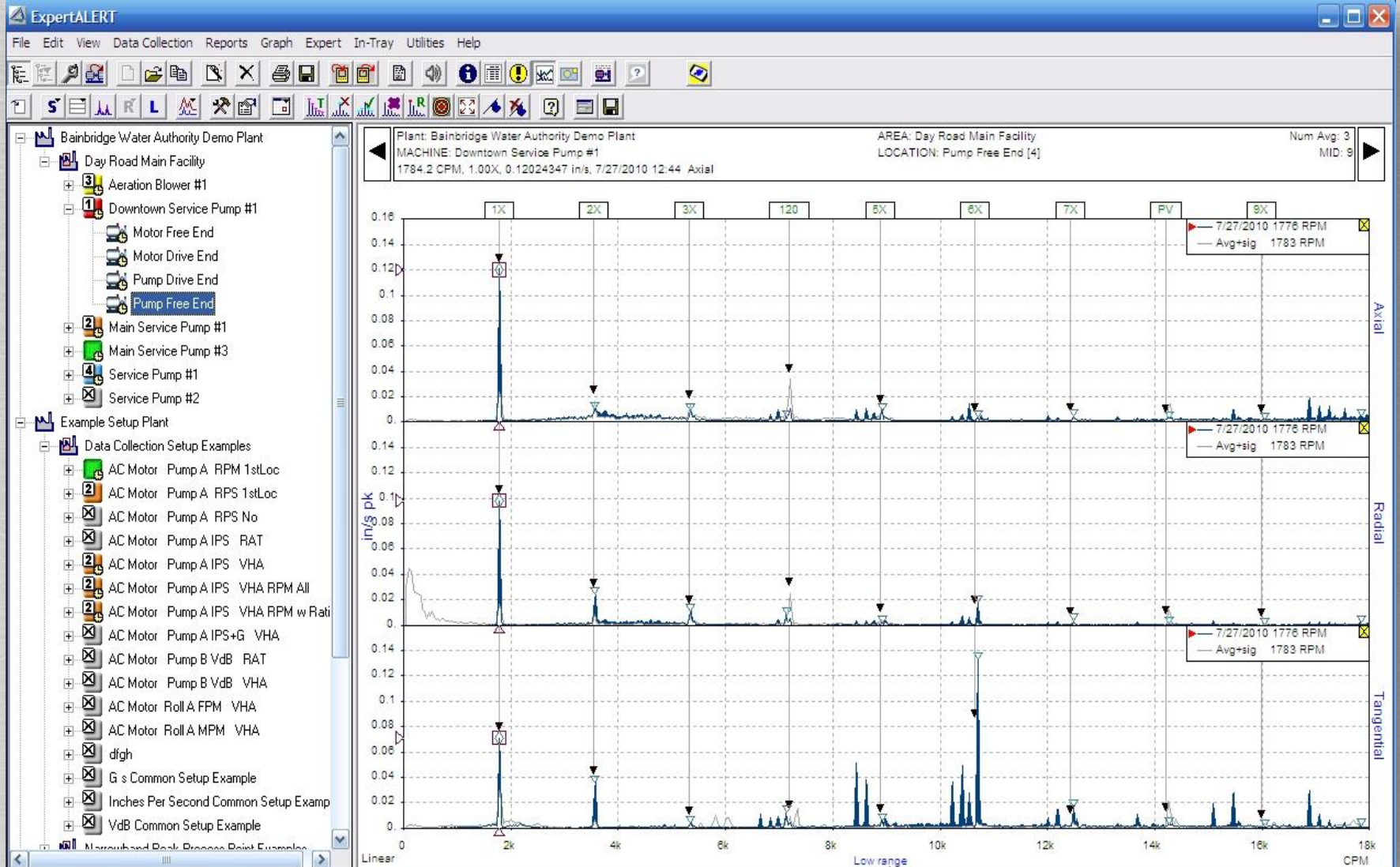
**DIAGNOSTICS:**

**<1> EXTREME** MOTOR FREE END BEARING LOOSENESS  
**<1> EXTREME** MOTOR DRIVE END BEARING LOOSENESS  
**<2> SERIOUS** MOTOR THRUST BEARING PROBLEM  
**<2> SERIOUS** MOTOR DRIVE END BEARING WEAR  
**<2> SERIOUS** PUMP FREE END BALL BEARING WEAR  
**<3> MODERATE** PUMP DRIVE END BALL BEARING WEAR  
**<3> MODERATE** MOTOR FREE END BEARING WEAR  
**<3> MODERATE** PUMP DRIVE END LOOSENESS OR BEARING CLEARANCE PROBLEM

Date	Type
7/27/2010 12:45:03 PM	Expert system results
1/14/2010 10:51:33 AM	Analyst reviewed results
1/14/2010 10:51:33 AM	Expert system results
10/7/2009 9:08:42 PM	Analyst reviewed results
10/7/2009 9:08:42 PM	Expert system results
7/17/2009 6:32:25 PM	Analyst reviewed results
7/17/2009 6:32:25 PM	Expert system results
4/22/2009 11:42:52 AM	Analyst reviewed results
4/22/2009 11:42:52 AM	Expert system results

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# ALERT - Data Review



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# ALERT - Report Editor

**ExpertALERT**

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Report Trend Screening Sheet **Report Editor** Event Tracker Comments

**Downtown Service Pump #1**

Add new summary/reviewed record

Priority	Recommendation
Mandatory	REPLACE MOTOR BEARINGS
Important	REPLACE PUMP FREE END BEARING
*	

Severity	Fault
EXTREME	MOTOR FREE END BEARING LOOSENESS
EXTREME	MOTOR DRIVE END BEARING LOOSENESS
SERIOUS	MOTOR THRUST BEARING PROBLEM
SERIOUS	MOTOR DRIVE END BEARING WEAR
SERIOUS	PUMP FREE END BALL BEARING WEAR

Maximum Level  
[113 (+12) VdB [3T] at 1.00x

Cited peaks

106 (+21) VdB [1A] at 1.00xM
104 (+10) VdB [1T] at 1.00xM
103 (+36) VdB [1A] at 5.00xM
100 (+ 9) VdB [1R] at 1.00xM
98 (+21) VdB [1T] at 2.00xM
95 (+16) VdB [1A] at 4.00xM
95 (+23) VdB [1A] at 3.00xM
94 (+13) VdB [1A] at 2.00xM
94 (+ 9) VdB [1R] at 2.00xM
92 (+25) VdB [1T] at 5.00xM
91 (+20) VdB [1R] at 3.00xM
91 (+28) VdB [1T] at 3.00xM
90 (+13) VdB [1T] at 6.00xM
88 (+26) VdB [1T] at 7.00xM
86 (+20) VdB [1A] at 6.00xM
85 (+18) VdB [1R] at 5.00xM
82 (+25) VdB [1R] at 7.00xM
77 (+18) VdB [1A] at 7.00xM
76 (+11) VdB [1R] at 6.00xM

Discussion by Analyst

Analyst Review  
 Final Review  
 Revised

**Bainbridge Water Authority Demo Plant**

- Day Road Main Facility
  - Aeration Blower #1
  - Downtown Service Pump #1
    - Motor Free End
    - Motor Drive End
    - Pump Drive End
    - Pump Free End
  - Main Service Pump #1
  - Main Service Pump #3
  - Service Pump #1
  - Service Pump #2
- Example Setup Plant
  - Data Collection Setup Examples
    - AC Motor Pump A RPM 1stLoc
    - AC Motor Pump A RPS 1stLoc
    - AC Motor Pump A RPS No
    - AC Motor Pump A IPS RAT
    - AC Motor Pump A IPS VHA
    - AC Mntnr Pumn A IPS VHA RPM All

Date	Type
7/27/2010 12:45:03 PM	Expert system results
1/14/2010 10:51:33 AM	Analyst reviewed results
1/14/2010 10:51:33 AM	Expert system results
10/7/2009 9:08:42 PM	Analyst reviewed results
10/7/2009 9:08:42 PM	Expert system results
7/17/2009 6:32:25 PM	Analyst reviewed results
7/17/2009 6:32:25 PM	Expert system results
4/22/2009 11:42:52 AM	Analyst reviewed results
4/22/2009 11:42:52 AM	Expert system results

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# ALERT - Event Tracker

ExpertALERT

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Report Trend Screening Sheet Report Editor Event Tracker Comments

Latest Priority	Latest Date	Insert Priority	Insert Date	Machine Name	Recommended Action	Work Order Number	Work Order Status	Status Date
Important	1/14/2010 10:51:33 AM	Important	1/14/2010 10:51:33 AM	Downtown Service Pump #1	REPLACE ALL BEARINGS, INSPECT COUPLING AND ALIGN UNIT		Open	7/6/2011 3:04:26 AM
Desirable	10/7/2009 9:08:42 PM	Desirable	10/7/2009 9:08:42 PM	Downtown Service Pump #1	REPLACE PUMP BEARINGS AND INSPECT PUMP FOR PROPER INTERNAL FIT AND ALIGNMENT		Analyst Closed	1/14/2011 10:51:33 AM
Desirable	7/17/2009 6:32:25 PM	Desirable	7/17/2009 6:32:25 PM	Downtown Service Pump #1	MONITOR PUMP DRIVE END BEARING FOR INCREASED VIBRATION		Analyst Closed	10/7/2009 9:08:42 PM
Desirable	4/22/2009 11:42:52 AM	Desirable	4/22/2009 11:42:52 AM	Downtown Service Pump #1	REPLACE PUMP BEARINGS		Analyst Closed	7/17/2009 6:32:25 PM

Date Type

7/27/2010 12:45:03 PM	Expert system results
1/14/2010 10:51:33 AM	Analyst reviewed results
1/14/2010 10:51:33 AM	Expert system results
10/7/2009 9:08:42 PM	Analyst reviewed results
10/7/2009 9:08:42 PM	Expert system results
7/17/2009 6:32:25 PM	Analyst reviewed results
7/17/2009 6:32:25 PM	Expert system results
4/22/2009 11:42:52 AM	Analyst reviewed results
4/22/2009 11:42:52 AM	Expert system results

Administrator, W. Zoltan, AZIMA DLI Rt. 105, Magyarorszag Rep. Viselet, Delta-3N Kft. Iatja el. Delta-3N Kft. 7030 Paks, Jedlik A. u. 2. Tel.: +36 (76) 510115 Fax: +36 76 510114 www.delta3n.hu



# Reliability Portal-Dashboard

demo350



kpiety

Plant View

Machines by Severity

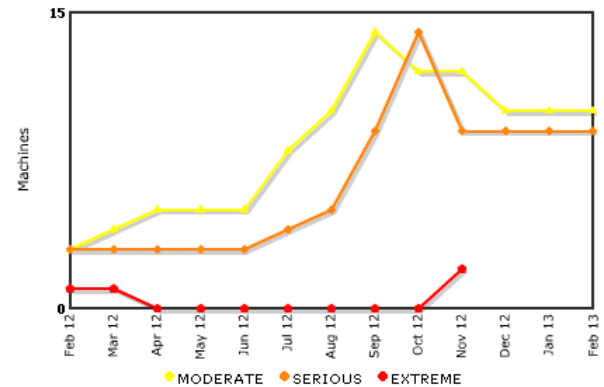
Recent Analysis Results

Manual Collection



Extreme	0
Serious	9
Moderate	10
Slight	4
OK	151
Never Tested	33
<b>Total Machines</b>	<b>207</b>

Monthly Machine Status



My Watch List

Aux Boiler Feed Pump A  
(10QHG11AP001)

Power Station  
Balance of Plant



Status: **SERIOUS**

Date: 7/31/2012 1:44 PM

Online Collection

No machines are monitored online

Data Collection

On Schedule	Overdue	>15 Days OD	>30 Days OD
0	0	0	174

# Portal - Plant Summary View

View ▶ Preferences ▶ Create Custom Report User-Defined Points ▶ Utilities ▶ Help ▶ Print Screen Log Out
Portal 2

**Welcome, kpiety!**  
 You are connected to demo350 in Eastern Standard Time

**Plants**

Select the Area:

- AQCS
- Ash Silo
- Balance of Plant
- Boiler Building
- Coal Handling
- Turbine Hall

**Reports**

- Recent Reports in Plant
- Machines in Plant by Severity
- Analyst Review Required in Plant
- Overdue Machines in Plant
- Event Tracker in Plant

### Plant View - Power Station - Analyst Reviewed Result Status

View Analyst Reviewed Result Status    
  View Current Machine Status

Sort Alphabetically

Area Name	Extreme	Serious	Moderate	Slight	No Faults Detected	Never Tested	Needs Review	Total Machines
Turbine Hall	0	5	1	1	20	11	0	38
Balance of Plant	0	2	2	1	30	13	0	48
AQCS	0	1	5	1	37	4	0	48
Boiler Building	0	1	1	0	49	0	0	51
Ash Silo	0	0	0	0	7	3	0	10
Coal Handling	0	0	0	0	10	2	0	12

**Available Reports**

View all reports in this plant:

[View Reports](#)

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# Portal - Reports

**Plants**

Select the Area:

- AQCS
- Ash Silo
- Balance of Plant
- Boiler Building
- Coal Handling
- Turbine Hall

**Reports**

- Recent Reports in Plant
- Machines in Plant by Severity
- Analyst Review Required in Plant
- Overdue Machines in Plant
- Event Tracker in Plant

**Recent Reports (Last 20)**

[View All Reports](#)

Filter By : All Types

**Plant: Power Station**

Point Name	Report Description	Date Added	Plant Name Area, Machine Or Survey Name
Vibration Reports	<a href="#">December 2012 Longview Power Vibration Report</a>	12/3/2012 11:28:16 AM	Power Station
Infrared Inspection Reports	<a href="#">September 2012 Longview Power Vibration Report</a>	9/16/2012 10:45:46 PM	Power Station
Vibration Reports	<a href="#">Longview Power Monthly Vibration Report August 2012</a>	8/15/2012 10:29:32 AM	Power Station
Infrared Inspection Reports	<a href="#">Longview</a>	8/12/2012 4:32:43 PM	Power Station
Vibration Reports	<a href="#">Longview Power Monthly Vibration Report June 2012</a>	6/13/2012 11:10:55 AM	Power Station
Motor Testing Reports	<a href="#">Longview Power - Motor Analysis Report - March 2012</a>	6/6/2012 4:42:47 PM	Power Station
Infrared Inspection Reports	<a href="#">Longview Power Infrared Report March 2012</a>	6/6/2012 4:29:02 PM	Power Station
Vibration Reports	<a href="#">Longview Power Monthly Vibration Report April 2012</a>	4/25/2012 12:10:20 AM	Power Station
Vibration Reports	<a href="#">Longview Power Monthly Vibration Report March 2012</a>	3/26/2012 9:36:08 PM	Power Station
Vibration Reports	<a href="#">Longview Power Monthly Vibration Report February 2012</a>	2/22/2012 4:38:28 PM	Power Station

# Portal - Severity List

**Plants**

Select the Area:

- AQCS
- Ash Silo
- Balance of Plant
- Boiler Building
- Coal Handling
- Turbine Hall


**Reports**


- Recent Reports in Plant
- Machines in Plant by Severity
- Analyst Review Required in Plant
- Overdue Machines in Plant
- Event Tracker in Plant

## Machines in Plant By Severity - Analyst Reviewed Result Status

Filter By :


View Analyst Reviewed Result Status     View Current Machine Status


 **Plant:Power Station- Area:Balance of Plant**  
**[Aux Boiler Feed Pump A](#)** (10QHG11AP001)

 **Analysts Reviewed Results**    Data Acquired: 7/31/2012 1:44 PM

MANDATORY: INSPECT COUPLING AND CHECK SHAFT ALIGNMENT  
IMPORTANT: CHECK PUMP FREE AND DRIVE END BEARING FIT


---


 **Plant:Power Station- Area:Turbine Hall**  
**[Condensate Pump 2](#)** (10LCB12AP001)

 **Analysts Reviewed Results**    Data Acquired: 11/30/2012 4:53 PM

IMPORTANT: INSPECT SYSTEM FOR FLOW ISSUES / INSPECT IMPELLER FOR SIGNS OF DAMAGE


---


 **Plant:Power Station- Area:AQCS**  
**[Mill 2 Product Pump A](#)**

 **Analysts Reviewed Results**    Data Acquired: 6/28/2012 12:04 PM

MANDATORY: INSPECT PUMP DRIVE END BEARING FOR PROPER LUBRICATION

---

 **Plant:Power Station- Area:Boiler Building**  
**[SCAH Condensate Pump B](#)**

 **Analysts Reviewed Results**    Data Acquired: 9/10/2012 2:09 PM

IMPORTANT: CHECK FOUNDATION FOR FLEXING AND / OR LOOSENESS



# Portal - Machine Status View

**Plants** **Areas**

Select the Machine:

- Condensate Pump 1 (10LCB11AP001)
- Condensate Pump 2 (10LCB12AP001)
- Stator Cooling Water Pump 1
- Stator Cooling Water Pump 2
- Turbine Generator
- Condensate Pump 3 (10LCB13AP001)
- Seal Oil Pump 2
- Aux Circulating Water Pump 1 (10PAB51AP001)
- Aux Circulating Water Pump 2 (10PAB52AP001)
- Boiler Feed Pump 1 (10LAC11AP001)
- Boiler Feed Pump 2 (10LAC12AP001)
- Boiler Feed Pump 3 (10LAC13AP001)

**Reports**

- Recent Reports in Area
- Machines in Area by Severity
- Analyst Review Required in Area
- Overdue Machines in Area
- Event Tracker for Machine

**Plant: Power Station - Area: Turbine Hall**

**Condensate Pump 1**  
(10LCB11AP001)

Status: SERIOUS

---

**Analysts Reviewed Results** Data Acquired: 11/30/2012 4:52 PM

(by Brandon Schaner

Nov11	Jan12	Feb12	Apr12	Aug12	Nov12	<b>Last Monthly Test</b>
-------	-------	-------	-------	-------	-------	--------------------------

Nov11	Jan12	Feb12	Apr12	Aug12	Nov12	<b>Maximum Severity Test</b>
-------	-------	-------	-------	-------	-------	------------------------------

**Recommended Actions**

IMPORTANT: INSPECT SYSTEM FOR FLOW ISSUES / INSPECT IMPELLER FOR DAMAGE

**Identified Problems**


SERIOUS PUMP CAVITATION OR AIR INGESTION

Cited Peaks

**Analyst Comments**

DIAGNOSIS:  
Elevated levels of cavitation are noted by the obvious raised noise floor in the high-range spectral data. When viewed in Acceleration format, the levels are reaching 0.3 G's. Additionally, waveform data reveals random impacting at moderate levels, indicated by pump cavitation noise as opposed to bearing defects or other mechanical events.

RECOMMENDATION:  
Unit should first receive inspection for any obvious flow issues; i.e. flow restrictions, improperly operating valves / controllers, uneven system pressure, etc. Assuming no flow issues are present, then physical impeller inspection should be done to check for any issues leading to the cavitation issues currently being experienced.



# Portal - Event Tracker List View

Plants **Areas**
 Event Tracker
Filter By: Pending

Select the Machine:

- Condensate Pump 1 (10LCB11AP001)
- Condensate Pump 2 (10LCB12AP001)
- Stator Cooling Water Pump 1
- Stator Cooling Water Pump 2
- Turbine Generator
- Condensate Pump 3 (10LCB13AP001)
- Seal Oil Pump 2
- Aux Circulating Water Pump 1 (10PAB51AP001)
- Aux Circulating Water Pump 2 (10PAB52AP001)
- Boiler Feed Pump 1 (10LAC11AP001)
- Boiler Feed Pump 2 (10LAC12AP001)
- Boiler Feed Pump 3 (10LAC13AP001)

**Reports**

- Recent Reports in Area
- Machines in Area by Severity
- Analyst Review Required in Area
- Overdue Machines in Area
- Event Tracker in Area

**Plant: Power Station - Area: Turbine Hall**

	Latest Priority	Latest Date	Insert Priority	Insert Date	Machine Name	Recommended Actions	Work Order No.	WO Status	Status Date	Days WO Open	Findings Confirmed
<a href="#">Edit</a> <a href="#">Reject</a>		30-Nov-2012		06-Nov-2012	<a href="#">Condensate Pump 2</a> (10LCB12AP001)	Inspect System For Flow Issues / Inspect Impeller For Signs Of Damage		Open	02-Dec-2012	0	
<a href="#">Edit</a> <a href="#">Reject</a>		30-Nov-2012		30-Nov-2012	<a href="#">Condensate Pump 1</a> (10LCB11AP001)	Inspect System For Flow Issues / Inspect Impeller For Damage		Open	02-Dec-2012	0	
<a href="#">Edit</a> <a href="#">Reject</a>		30-Nov-2012		06-Nov-2012	<a href="#">Stator Cooling Water Pump 2</a>	Correct Soft Foot Issue		Open	02-Dec-2012	0	
<a href="#">Edit</a> <a href="#">Reject</a>		30-Nov-2012		06-Nov-2012	<a href="#">Stator Cooling Water Pump 2</a>	Monitor All Pump Bearings For Increased Vibration		Open	15-Nov-2012	0	
<a href="#">Edit</a> <a href="#">Reject</a>		29-Nov-2012		29-Nov-2012	<a href="#">Turbine Generator</a>	Ensure No Shaft Rubs Present On Generator Lead End		Open	02-Dec-2012	0	
<a href="#">Edit</a> <a href="#">Reject</a>		02-Oct-2012		11-Sep-2012	<a href="#">Stator Cooling Water Pump 1</a>	Check Motor Rotor/Stator Air Gap And Mounts. Verify Soft-Foot Condition Not Present And Base Stability		Open	07-Oct-2012	0	
<a href="#">Edit</a> <a href="#">Reject</a>		02-Oct-2012		02-Oct-2012	<a href="#">Circulation Oil Pump 1</a>	Replace Motor Bearings		Open	07-Oct-2012	0	



# Portal - Recommended Action | Event Details

**Plants** **Areas**

Select the Machine:

- Condensate Pump 1 (10LCB11AP001)
- Condensate Pump 2 (10LCB12AP001)
- Stator Cooling Water Pump 1
- Stator Cooling Water Pump 2
- Turbine Generator
- Condensate Pump 3 (10LCB13AP001)
- Seal Oil Pump 2
- Aux Circulating Water Pump 1 (10PAB51AP001)
- Aux Circulating Water Pump 2 (10PAB52AP001)
- Boiler Feed Pump 1 (10LAC11AP001)
- Boiler Feed Pump 2 (10LAC12AP001)
- Boiler Feed Pump 3 (10LAC13AP001)

**Reports**

- Recent Reports in Area
- Machines in Area by Severity
- Analyst Review Required in Area
- Overdue Machines in Area
- Event Tracker in Area

**Plant: Power Station**  
**Area: Turbine Hall**  
**Machine: Condensate Pump 2**

First Reported: 06-Nov-2012 Latest Priority: 30-Nov-2012

Edit Event Attached Files

**Edit Event**

Work Order Status: Open  
Work Order Number:   
Event Description: --Select--

Status Date: 02-Dec-2012  
Findings Confirmed: --Select--  
Root Cause Performed:   
Root Cause Finding: --Select--  
Financial Impact: \$

Recommended Actions:  
Remove Inspect System For Flow Issues / Inspect Impeller For Signs Of Damage

Additional Findings:

Save Cancel Back



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# THANK YOU!



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