Assets Condition Monitoring Using ISA100.11A Wireless System
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Michael began his career as an Electrical Hardware Design Engineer with Bently Nevada Corporation, and then progressed to Project Engineer, overseeing several successful products that are still sold today.

After GE acquired Bently Nevada in 2002, Michael moved into an Application Engineering role supporting the U.S. Southern region of GE Oil & Gas, Measurement & Control business. Michael’s experience provides a thorough knowledge of all Bently Nevada products, applications, and system integration.

Michael graduated in 1990 from Texas A&M University in College Station, Texas, with a Bachelor of Science degree in Electrical Engineering.
Introduction

Increase Profit
Improve Production
Raise Availability

Reduce Costs
Decrease Down-time
Eliminate HSE Events
Production Imperatives

Managing production targets

- Can’t predict down time
- Spending too much time on planned outages
- Difficult to identify causes of process inefficiencies
- TMI (too much information)
- Insufficient resources to predict downtime (interpret the data)
- Ensure planned maintenance is focused on the right area
Operation Imperatives

Shortage of skilled and knowledgeable workers
Myopic approach to asset management:
Early foresight
Deeper insight
Risk management
Data management
Information management
Issue management
Machinery insight
“I need to meet or exceed production targets.”

Uncertainty around cause and length of unplanned downtime
- Single platform, Predictive analytics, Decision support, High resolution data capture
  - Know the exact health of your equipment

Time spent on planned outages
- Single platform, Predictive analytics, High resolution data capture
  - Spend less time on planned outages

Automate early detection of anomalies
“I need to control costs.”

- Unplanned maintenance is expensive
  - Predictive analytics, Global expert services team
    - Remove the surprises in equipment maintenance
- Shortage of properly skilled and knowledgeable workers
  - Decision support, Customer training sessions, Global expert services team, Predictive analytics
    - Extend your internal expertise and expand your team
- No correlation between condition monitoring data
  - Single platform, Option to phase-in, Predictive analytics
    - See the whole asset condition story

Act on correlated asset condition data
"I need to reduce environmental, health, and safety risk."

Unplanned outages expose personnel to risk

Distractions can't pull us away from our focus on EHS

Global expert services team, Predictive analytics, Predictive emissions monitoring

Predictive analytics, Global expert services team, Single platform

Reduce risky distractions

Eliminate maintenance surprises

Reduce machinery uncertainty
Key Components of an Integrated Plant Wide Solution

Condition Monitoring and Machinery Diagnostics

Protection & Continuous Monitors
- Rack monitors
- Distributed monitors

Balance of Plant/Supporting Assets
- Wireless
- PDC
- Application Specific
- Continuous
- Scanning

DCS, MMS, ERP
Wireless Target Applications

Target Applications

- Difficult-to-access locations
- Explosive areas – Zone 2, Zone 1, & Zone 0
- Pumps, motors, fans, small gearboxes, valves
- Remote locations
- Safety & Health Hazards
- Brownfield – high cost of retrofitting with wired solutions
Wireless Applications Overview

Protection
Not recommended
Not permitted under API 670
(i.e. “critical” turbomachinery auto-shutdown applications)

Monitoring
Periodic data as part of reliability centered maintenance program

![Pie chart showing asset criticality distribution with 40% Highly Critical, 30% Critical, 15% Mid Criticality, 10% Low Criticality, and 5% No Impact]

![Graph showing the relationship between condition and time, with P-F Interval, Detection of Potential failure using predictive technology, Worst Case Lead Time, and Functional Failure]
Equipment Criticality Ranking

<table>
<thead>
<tr>
<th>Failure Mitigation Strategy</th>
<th>Asset Ranking</th>
<th>Typical Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCM</td>
<td>Highly Critical</td>
<td>~ 10-20%</td>
</tr>
<tr>
<td></td>
<td>Critical</td>
<td>~ 30-40%</td>
</tr>
<tr>
<td>FMEA</td>
<td>Mid-level critical</td>
<td>~ 45-55%</td>
</tr>
<tr>
<td>Templates</td>
<td>Low-level critical</td>
<td>~ 5-10%</td>
</tr>
<tr>
<td>RTF</td>
<td>Non-critical</td>
<td></td>
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</tbody>
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Criticality – Drives strategy & spend

Based upon failure modes, detectability and criticality apply technologies across the asset base.
Wireless Monitoring Value Proposition

- Fewer surprises
- Reduces costs
- Enables production improvements
- Increases equipment availability
- Easily expandable
- Temporary & long term surveillance and diagnostics
- Improves human and capital resource utilization
Technology Positioning

Wireless Scanning offers potential towards:
- higher scanning frequency
- lower cost per point

Frequency of Measurements
- 1/month
- 1/week
- 1/day
- 1/hour
- 1/minute

Portable Data Collector
- Wired Scanning

ISA logo
Wireless Device Power Options
Diagnostics

Waterfall spectrum

Acceleration Enveloping Spectrum
1. Historical data shows increasing vibration at higher frequencies.

2. Spectral analysis pinpoints a bearing outer ring failure

3. Physical inspection verifies diagnostics
Target Applications

Fin fan heat exchangers

Tank Farm Pumps
Target Application
Tank Farm Assets

Current Practice:
Walk-arounds @ 3 week intervals

Failure Modes:
Undetected Failure occurs between rounds

Solution:
Monitoring vibration at key points several times per day with wireless system
Current Practice
Monthly walk-arounds with portables

Failure modes
Reduced efficiency from fouling or environmental conditions, undetected failure between rounds

Our solution
Condition monitoring system analysis of essential measurements brought in daily by wireless sensors.
Example Deployment

Steam Turbine BoP machinery
Integrated to existing condition monitoring system
Remote access for support and monitoring
21 points deployed in two days on:

boiler feed pumps       service water pumps
condensate pumps        FD fan
lube oil pumps          circulation water pumps
Example Deployment

Results

- Validated ease of deployment, rapid deployment
- Quick and easy anomaly identification
- System detected anomaly on cooling water pump; verified detection using a portable.

*Critical to repair this pump in summer months to avoid loss of generating capacity.*
ISA100 Wireless™
Benefits

Low costs of entry; technology specifications included in ISA100 WCI membership entitlements.

Open source (free) ISA100 wireless communication stack
  Major milestone in the evolution of the ISA100 standard and its community
  Proves maturity of the standard and the community’s commitment to making this successful
  Attracts additional industrial companies and end users to ISA100.11a

Flexible application layer
  ISA100 Wireless™ technology is the only protocol that supports large data sets such as wave forms and FFT.
  Wired HART devices communicate over ISA100 Wireless™ networks using adapters.
  Proprietary supplier protocols can communicate with ISA100 Wireless™ gateways.

Opportunity for any supplier to participate since all certified ISA100 Wireless™ products interoperate in any ISA100 Wireless™ network.

ISA100 Wireless™ ensures lower cost of installation, operation and, maintenance throughout its lifecycle.
ISA100 Wireless™
Technical Superiority

Proven distributed control in the field (object technology in smart devices).
Functionality beyond traditional WSN applications.
Comprehensive two-level security features including AES-128.
Easy to use - provision over the air (OTA) or directly using out of band (OOB).
Scalable and reliable network tested to 500 devices (so far).
Proven reliable in congested wireless environments.
IPv6 based technology (6LoWPAN) for industrial applications: “Big Data and Smart Machines”

¹ IEEE paper presenting research completed by NASA Johnson Space Center, March 2012
ISA100 Wireless Compliance Institute

Rigorous compliance testing to ensure interoperability among all certified products.

A single source supporting implementation of ISA100 Technology™.

Develops the essential specifications needed by vendors to produce products that users want.
Thank You!