MAXIMIZING EFFICIENCY THROUGH REMOTE MONITORING AND DIAGNOSTICS

Greg Tanck

ASSET MANAGEMENT SERVICES
BLACK & VEATCH ENERGY
BLACK & VEATCH CORPORATION IS A LEADING GLOBAL ENGINEERING, CONSULTING AND CONSTRUCTION COMPANY

- Founded in 1915
- Global workforce of more than 9,000
- More than 100 offices worldwide
- Projects in more than 100 countries on 6 continents
- Ranked on Forbes “America’s Largest Private Companies” listing
- One of the largest majority employee-owned company in the U.S.
- Reputation of integrity, competence and highest safety standards
BLACK & VEATCH CONSULTING PVT LTD (PUNE)

- Business in India from 1977; office established in 2004
- Business Areas – Energy and Telecom
- Workforce – 200 professionals
- Energy Departments – Engineering (Mechanical, Electrical & Controls, Civil & Structural), Project Control, Proposals, Procurement, Quality, Human Resources, and Administrative
- Office with project execution capabilities
- Equipped with commercial and B&V proprietary engineering tools

BVCPL-Global talent and knowhow brought locally
REMOTE MONITORING & DIAGNOSTICS
REMOTE MONITORING & DIAGNOSTICS

• Turning data into actionable knowledge.
• The concept grew from on-line performance monitoring systems.
• Leverages existing data* to extract maximum value.
• Combines performance and condition monitoring to identify and diagnose emerging issues.
• Uses centralized group of experts focused on performance across multiple units.
• Combination of a structured process and advanced tools.

Helps identify cause and prioritize actions
Monitoring is required to remain proactive

MONITORING

- Equipment performance and health indicators
- Actual fuel utilization
- Variances between current and forecast operation
- Variances between current and historical operation
- Tools plus experts
WHAT IS DIAGNOSTICS

Helps identify cause and prioritize actions

DIAGNOSTICS

• Identify the cause of a variance
  • External factors
  • Equipment operations
  • Condition of equipment
  • Inaccuracies in fuel blend

• Monetize the potential impact

• Identify corrective action

• Prioritize actions based on highest plant goals

• Incorporate in routine or planned maintenance activities
IMPLEMENTING M&D SOLUTIONS

- Remote
- Centralized
- By Owner or third party
- Key advantages of implementing M&D are:
  - Proactive rather than reactive approach
  - Helps increase efficiency, reliability, and availability
  - Creates critical “TEAM” link between O&M team and strategies
  - Returns lost capacity
  - Captured knowledge
  - Provides outage assessment
  - Effective resource allocation

“TEAM” link and capturing knowledge is critical
KEY MESSAGE

Remote Monitoring & Diagnostics as a collaborative tool is also a very logical solution to ensuring health and performance of aging fleets.
“TEAM” link and capturing knowledge is critical
IMPORTANT ELEMENTS OF THE M&D TOOLSET

Presentation Layer

Monitoring & Diagnostics Layer

Communications Layer

Data Layer

Performance Dashboard
Issues Tracking Portal

Historian
Supplemental Analytics
Issues Database
Anomaly Detector

Plant Instruments
Process Historian
Performance Calcs
Other Data Sources
TYPICAL M&D SET-UP

IT access-based on capabilities required
REMOTE M&D SOLUTION: CONSIDERATIONS

- Compliance with cyber security rules
- Monitored parameters include all major plant equipment
- Facilitates communication between M&D center and key plant personnel
- Process allows for direct communication of highly critical issues
- Capture Wins in a Knowledge Database
- Can be applied across all generation technologies
M&D BENEFITS

- Improve plant performance
- Minimize environmental costs
- Reduce derates
- Minimize plant life erosion
- Avoid catastrophic failures
- Proactive process
- Knowledge capture – Aging workforce issues
- Minimal Upfront cost
- Short payback

Helps with risk and cost management
CASE STUDIES
REMOTE MONITORING & DIAGNOSTICS PAYBACK

• The typical payback with the proper tools and process in place is less than 1 year.

• Average fuel savings greater than 7 times program costs.

• Savings from avoided derates and unit capacity increases push savings even higher.
### Early Detection: What Was Found?
- LP Turbine efficiency reduced by 2.5-3%.
- Turbine stage performance indicated possible last stage issue. Required additional investigation.

### Quantify the Loss: What Was the Cost and Risk?
- Rs 2,000,000 per month in heat rate
- Capacity loss of 2.6 MW

### Action: What Should Be Done?
The inner casing inspection port gasket had partially failed. Repair was made at the next available outage.
# CASE STUDY – CONDENSER PERFORMANCE

<table>
<thead>
<tr>
<th>Early Detection: What Was Found?</th>
<th>Performance calculations showed low condenser performance due to air infiltration.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantify the Loss: What Was the Cost and Risk?</td>
<td>Rs 3,100,000 per year in heat rate and capacity</td>
</tr>
<tr>
<td>Action: What Should Be Done?</td>
<td>The problem was discovered in sufficient time to schedule the material and labor required to fix the leak at the next available outage.</td>
</tr>
</tbody>
</table>
**CASE STUDY – OPTIMAL CONDENSER CLEANING METHODS AND TIMING**

<table>
<thead>
<tr>
<th><strong>Early Detection:</strong> What Was Found?</th>
<th>Rapidly degrading condenser performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantify the Loss:</strong> What Was the Cost and Risk?</td>
<td>Rs 150,000,000 per year in heat rate and capacity</td>
</tr>
<tr>
<td><strong>Action:</strong> What Should Be Done?</td>
<td>Analysis showed that cleaning was cost-justified. Additional analysis showed that installing an on-line cleaning system was cost effective and produced rapid</td>
</tr>
</tbody>
</table>

**Equipment Performance**
Early Detection: What Was Found?
- Within the first 6 months of the HP/IP turbine upgrade, capacity dropped 17 MW.
- HP and IP turbine efficiency dropped
- 8% reduction in steam flow

Quantify the Loss: What Was the Cost and Risk?
- Rs 2,000,000 per month in heat rate
- Capacity loss of 17 MW

Action: What Should Be Done?
A chemical wash was performed that restored turbine performance.

Equipment Performance
CASE STUDY – ECONOMIZER FLUE GAS BYPASS DAMPER ISSUE

**Early Detection: What Was Found?**
- Deviation in Economizer flue gas temperature
- Loss of bypass damper signal

**Quantify the Loss: What Was the Cost and Risk?**
- Rs 3,500,000 per month heat rate
- Risk of forced outage

**Action: What Should Be Done?**
- Broken damper linkage
- Repair made during next available outage

Equipment Performance
| **Early Detection:**  
| What Was Found? |
| Slowly increasing terminal temperature difference |

| **Quantify the Loss:**  
| What Was the Cost and Risk? |
| • Rs 700,000 per month heat rate  
| • 0.4 MW capacity loss |

| **Action:**  
| What Should Be Done? |
| Non-critical issue was repaired during scheduled maintenance outage |

Equipment Performance
## CASE STUDY FAILING INTERNAL LOW-PRESSURE FEED WATER HEATER EXTRACTION LINE – OFFLINE REPLACEMENT OF ALL SIMILAR EXPANSION JOINTS

| Early Detection: What Was Found? | • Deviation in FWH extraction line pressure  
| • Extraction line failure suggested |
| Quantify the Loss: What Was the Cost and Risk? | • Rs 825,000 per month heat rate  
| • Risk of forced outage |
| Action: What Should Be Done? | • Repair scheduled, parts ordered  
| • Replacements made during outage |

**Equipment Performance**
CASE STUDY – UNDERSTANDING FUEL COSTS

Goal
Understand how different fuels will affect the entire fleet

Challenges
• Identify fuel-related impacts to existing plant equipment – without test burn
• Identify potential fuel-related capital modifications to improve availability with new coals
• Prioritize modifications and suggest operating and performance changes to minimize detrimental fuel impacts

Benefits
• Detrimental maintenance and availability impacts with potential future fuel supplies were quantified
• Cost of unavailability justified plant upgrades to minimize these impacts
QUESTIONS?
Building a world of difference.

Together

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