A Practical Approach to Asset Reliability Improvement focused on Turbo Machinery

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- Management accountabilities
Background

Turbo Equipment Maintenance (TEM) Structure:

- TEM (147)
- Turbo 2 (38)
- Turbo 3 (30)
- Turbo 4 (22)
- Turbo Monitoring and Balancing (27)
- Asset Health (25)
Background

- Baseline Performance (2009):
  - 3.17% Unintended Downtime on critical equipment (Compressors and Turbines)
  - 19 months MTBF on pumps
  - 7 Recordable Case Injuries
  - 9% overspend on annual budget
Key Performance Metrics

Results Achieved:

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>2009 Actual</th>
<th>2015 Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Unavailability</td>
<td>3.17%</td>
<td>0.09%</td>
</tr>
<tr>
<td>Process Pump MTBF</td>
<td>19 months</td>
<td>34 months</td>
</tr>
<tr>
<td>Recordable Case Injuries</td>
<td>7</td>
<td>0 injuries for 3 years</td>
</tr>
<tr>
<td>Budget Comparison</td>
<td>1</td>
<td>0.93</td>
</tr>
<tr>
<td>Cost Performance</td>
<td>9% over budget</td>
<td>1% under budget</td>
</tr>
</tbody>
</table>

Still pushing the boundaries...we are not done yet!
Asset Lifecycle

- Acquire
- Operate and Maintain
  - Strategy
  - Plan
  - Execute
  - Review
- Dispose

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Operate Within Agreed Parameters

Are either of these deviations a concern?
Methodology

IDEFo Notation

Constraint

Activity

Input | Resource | Output

FIPS Publication 183 released of IDEFØ December 1993 by the Computer Systems Laboratory of the National Institute of Standards and Technology (NIST).
Methodology

Establish Asset Management Standards

New and Existing Plant → Design Standards

Plan

Operate and Maintain to standard

Do

Raw Materials, Parts and Services

Review

Evaluate and Improve Asset Performance

Breakdowns → Products
Evaluate Performance - Uptime

Diagnostic Overview

I) Characteristics of the Business
II) Maintenance Strategy
III) Organizational Arrangements
IV) Human Resource Management
V) Maintenance Administration
VI) Planning
VII) Scheduling
VIII) Work Orders
IX) Use of Tactics
X) Equipment Records
XI) Purchasing
XII) Stores
XIII) Inventory Control
XIV) Performance Measures
XV) Customer Satisfaction
XVI) Computerized Maintenance Management Systems

Methodology from: Uptime, John Dixon Campbell, 1995
Key Focus Area

Stores

- Layout, locations, access, space, racking, security
- Requisitioning procedures
- Equipment, mobile equipment
- Consignment stock locations, vendor access
- Degree of automation, bar coding
- Telephone orders, delivery, kitting/pick lists
- Substores, shop-floor stores, free access items
- Receiving, issuing, stocking schedules, labor, procedures
- Quality assurance, accuracy
- Direct charge item storage

Methodology from:
Uptime, John Dixon Campbell, 1995
Key Focus Area

Inventory Control

- Catalogs, referencing, on-line information
- Stock counting policies, schedules
- Service level/stockout measures, back orders
- Control of repairable, rotables
- Stock control techniques, max-min, EOQ, EOP
- Inventory reconciliation and absolute value of deviation
- Use of statistical analysis by inventory category, stock history
- Measures of investment efficiency, turnover, value, number of SKUs
- Obsolescence review, no usage analysis

Methodology from:
Uptime, John Dixon Campbell, 1995

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<table>
<thead>
<tr>
<th>Concern</th>
<th>Raised By</th>
<th>Date Raised</th>
<th>Action</th>
<th>Responsible Person</th>
<th>Due Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect stock levels at Stores</td>
<td>Poovan</td>
<td>12-May-11</td>
<td>Evaluate required stock levels and create business case to increase inventory for deficiencies</td>
<td>Poovan</td>
<td>30-Nov-11</td>
<td>Prioritise compressors and turbines with high unreliability.</td>
</tr>
</tbody>
</table>
Methodology

Establish Asset Management Standards

New and Existing Plant

Design Standards

Operate and Maintain to standard

Manage/ Govern the change

Raw Materials, Parts and Services

Update standards

Breakdowns

Products

Evaluate and Improve Asset Performance

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Performance Tracking

- Determine Key Performance Indicators
  - Related to improvement activities and influence diagram
- Regular review of performance indicators and gap closure plan status
- Maintain focus on actions and due dates
- Give recognition where improvement is noted
- Manage change with the team
Implementing Asset Management in the Lifecycle

- Define Operating Parameters
- Assess requirements/capability
- Design Asset
- Modify Asset
- No change to asset
- Update maintenance strategy/operating philosophy
- Change operating parameters (outside of agreed operating parameters)
- Update production budget
- Operate Asset
- Operate within agreed parameters

- Work Management Process
- Spares strategy
- Quality Control

- Code, Standards, Policies, Procedures, Practices

- Basis of maintenance budget and strategy work in work management process

- Execute Maintenance Strategy

- Root Cause Analysis and Identification

- Engineer Out Problem

- Dispose

- Stable Plant/Process

People
Money
Facilities
Information
Raw Materials
Equipment
Utilities
Believe in your team
Set the expectation on standards – aim for achievable, incremental improvements
Actively support gap closure activities
Instill discipline to follow standards
Encourage and reward proactive maintenance and improvement actions
Management Accountabilities

- Make the difficult decisions to do the right thing
- Empower the team to make decisions and implement improvement actions
- Focus the team on the next critical item
- Be involved and remove obstacles
Questions?