Rigo Cisneros, PMP
Principal, Strategic Consulting

Rob Bucey, PE, CEM, BCxP
Principal, Strategic Consulting
Bottom Line

Indo-Pacific installation readiness and the reliability of facilities that support mission are at great risk if new strategies and tactics are not taken to control and eliminate continued premature failure of facility systems.
Environmental Root Causes

- **Marine Climate**
  - Salts and Airborne Acids
  - Wind
  - Direct exposure to corrosives
  - Extreme weather
Design Root Causes

- Design and Specifications
  - Location of equipment
  - Serviceability considerations
  - Corrosion resistance materials
  - Sustainment considerations
  - Contractor warranty terms

![Corrosion Rate in Relation to Distance from Shore](image)
Design Root Causes

• Supply Chain Considerations
  – Critical spares and warehousing
  – Availability of OME support from across the world
  – Logistics
  – Lifecycle predictability
Operational Root Causes

• **Start-up and Maintenance Planning**
  – Strategies during warranty periods
  – Untested facilities

• **Work Force Utilization**
  – Limited specialty resources
  – Difficult to attract required capabilities and talent
  – Limitations with DOD/Civ oversight
  – Joint force work agreements
What is Reliability Centered Maintenance

• Logical, structured framework to sustain operational reliability
  – Preserve system function
  – Identify failure modes that can defeat the functions
  – Prioritize function need (via failure modes)
  – Select applicable and effective prioritized Preventive Maintenance (PM) tasks

• Experience-centered approach utilized to deliver high value program that is practical to implement
What is Reliability Centered Maintenance

- RCM summarized in 7 simple questions:
  1. What are the functions of the asset?
  2. In what ways can the asset fail to fulfill its functions?
  3. What causes each functional failure?
  4. What happens when each failure occurs?
  5. What are the consequences of each failure?
  6. What should be done to prevent or predict the failure?
  7. What should be done if a suitable proactive task cannot be found?
“Have you seen this?”
“Have you seen this?”
“Have you seen this?”
RCM as a thought framework

- Assess Risk
  - Clearly define mission requirements
  - Identify failure modes
  - O&M steps to address failure modes
RCM as a thought framework

- Project Delivery
  - Precision installation
  - Maintainability
  - Training
  - Commissioning
  - Turnover process
RCM as a thought framework

• Operations
  – Define and implement maintenance strategy
  – OEM vs. what meets your needs
  – Run to fail
  – Predictive techniques
  – Root cause analysis
  – Apply lessons learned over the lifecycle

Survey the situation.
Take control, Talk to everyone that can help you understand the system and the problem and Take accurate notes.
Organize your information and action plan.
Proceed within approved procedures and processes.
NASA Langley Research Center

- Since 2004, Jacobs has held NASA LaRC’s O&M contract
- 2004 – Reactive O&M program
- Jacobs’ holistic approach and RCM solutions produced significant paradigm shift
- Instilled a culture of Reliability Leadership
- 2017 – Recognized by Uptime Magazine as Best Overall Reliability Program

NASA LaRC is located on 780 acres with 270 buildings and over 42,000 assets
NASA Langley Research Center

- Instrumented ~400 assets using ~3500 discrete points in OSIPi
- Monitor over 94,000 points in our Integrated Operations Center
- Since 2014, $5M in cost savings/avoidance
- Since 2015, only 1 unplanned failure on critical assets
- 82% proactive maintenance resulting in significant reduction in trouble calls

Number of Trouble Calls Received at LaRC

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6,200</td>
<td>4,500</td>
<td>3,555</td>
<td>3,401</td>
<td>3,106</td>
<td>2,886</td>
<td>1,695</td>
</tr>
</tbody>
</table>

RCM Maintenance Strategies

Tailored Approach for Each Building

Address Critical Repairs
- PM changes
- BAS

Value-Added Maintenance
- Predictive Maintenance
- Critical rounds
- Critical spares

Document Maintenance Activities
- Work order form
- CMMS data input
## RCM Assessment Metrics

<table>
<thead>
<tr>
<th><strong>System Performance</strong></th>
<th><strong>Cost</strong></th>
<th><strong>Maintenance Strategy Performance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Availability</td>
<td>• Labor, materials and services</td>
<td>• PM performance</td>
</tr>
<tr>
<td>• Failures by type by building</td>
<td>• PM</td>
<td>• Follow on actions generated by building</td>
</tr>
<tr>
<td>• Mean time between failures</td>
<td>• Repairs</td>
<td>• Failures by building and asset</td>
</tr>
<tr>
<td>• Energy</td>
<td>• Replacements</td>
<td></td>
</tr>
</tbody>
</table>

- **System Performance**
  - Availability
  - Failures by type by building
  - Mean time between failures
  - Energy

- **Cost**
  - Labor, materials and services
  - PM
  - Repairs
  - Replacements

- **Maintenance Strategy Performance**
  - PM performance
  - Follow on actions generated by building
  - Failures by building and asset
Summary

- Improved ability to meet mission requirements
- Engaged, productive workforce
- Ownership at all levels of organization
- Improved effectiveness and efficiency
- Reduced system/equipment down-time
- Extended Lifecycles
- Reduced Costs
- Inherent reliability in future designs

Rigo Cisneros, PMP, Rigo.cisneros@jacobs.com, 817.903.9772
Rob Bucey, PE, CEM, BCxP, Robert.bucey@jacobs.com, 617.640.8646