Health Based Asset Management
Health Care

Proactive and Reactive Approaches

- **Physical**
  - Routine Screenings

- **Symptoms**
  - Targeted Diagnostics

- **Emergency**
  - Targeted Diagnostics
What is the health of the assets?

Is it important to know? How do we assess?
What is the health of the Assets?

Is it important to know? How do we assess?
Asset Health

Find & repair these problems or let them fail?

Fuse Box

Aerial Electrical Cable
Reactive & Proactive Approaches

Reactive: Run to failure – Break / Fix

Preventive: Scheduled tasks that minimize risk of failure.

Predictive/Health-Based: Systematic monitoring to assess machine health
Annual Maintenance Cost Per Horsepower

Predictive $7-9  
Preventive $11-13  
Reactive $17-18

Benefit: $$$$$$ / Reliability

Source: ISA’s InTech Magazine, December 1987, pages 29-32:
A survey\(^1\) disclosed the following objectives:
- Reduce total maintenance by 50%
- Shift the proportion of maintenance:

<table>
<thead>
<tr>
<th>Maintenance Type</th>
<th>Current</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive</td>
<td>50%</td>
<td>15%</td>
</tr>
<tr>
<td>Preventive</td>
<td>35%</td>
<td>40%</td>
</tr>
<tr>
<td>Condition Based</td>
<td>15%</td>
<td>45%</td>
</tr>
</tbody>
</table>

(1) Thomas Marketing Information Center, Dec. 1997

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**Right Balance**
Effective Maintenance programs are guided by the consequences of asset failure.

- Safety & Environmental
- Operational
- Economical
Cost

Focus attention and effort on equipment with highest total costs.

Total Cost

Pump Numbers
Asset Failures

Failure Consequences

Severe

None or Insignificant

Maintenance Effort

Major

$ $$$

None or Insignificant

$
Asset Maintenance / Failure Matrix

Failure Consequences

Severe

None or Insignificant

Maintenance Effort

1  
Crisis Maintenance  
(Reactive)

2  
*Reliability Focused Maintenance  
(Proactive)

3  
Adequate Maintenance  
(Reactive)

4  
Excessive Maintenance  
(Proactive)

Major
Potential - Failure Curve

Reliability Centered Maintenance - John Moubray

- Start of failure
- Failure detection with diagnostic equipment
- Failure detection with human senses

Normal

Time

Health Condition

Point of failure
Health/Condition Assessment & Diagnostic Programs

- Instrument verification
- Infrared inspections
- Ultrasonic leak detection
- Vibration analysis
- Motor testing and inspection
- Motor starter inspections
- Protective relay testing
- Stationary battery testing
- Transformer inspection
- Insulating & Lubricating oil testing
- Wire-to-water efficiencies
- Precision alignment
- Power quality monitoring
Health/Condition Assessment Programs

- Tank Inspections
- Hydrant inspection & flushing
- Valve exercising
- Pipe inspections
- Pipe cleaning
- Corrosion monitoring
- Corrosion protection
- Large meter testing
- Hydraulic monitoring
- Leak monitoring
- Pressure & control valve PM’s
- Backflow device testing
The Cheap Fix
PAW Facilities: July - December, 1999

Repair cost if allowed to fail $117,000
Repair cost of scheduled repair $17,000
Difference $100,000

Benefit: Est. savings (avoided costs) $100,000
Six Patterns of Failure

A
Infant and age related failure with wear out zone - 4% of failures

B
Age related failure with wear out zone - 2% of failures

C
Slowly increasing probability of failure (fatigue) - 5% of failures
Six Patterns of Failure

**D** Few failures when new-then constant probability of failure - 7% of failures

**E** Constant probability of failure at all ages-random failure - 14% of failures

**F** Infant mortality, then constant probability of failure - 68% of failures
Failure Pattern “B”

Constant probability of failure - failure at wear out zone

2% of failures
Lighting – Failure Pattern “B”
Battery – Failure Pattern “B”
Failure Pattern “F”

Infant mortality, then constant probability of failure

68% of failures
Root Causes

- Characteristic of certain devices
- Poor design or manufacturing quality
- Incorrect installation or operation
- Unnecessary & excessively invasive maintenance
- Poor maintenance practices or workmanship
Asset Health

Do You Want

Extended Life?
Reliability?
Efficiency?
Quality?
You **Must** Employ Health Based Programs