Defining Equipment Reliability

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Reliability measures the capacity of equipment or processes to operate without failure for a time interval when put into service and operated correctly.

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Reliability Is?

- Reliability is concerned with avoiding failures of equipment and processes by proper design and careful operation of the equipment by trained personnel in a specified environment for a given time interval.
- The ultimate aim of reliability is a failure free environment.

MIL-HDBK-338: Reliability - 1) The duration or probability of failure-free performance under stated conditions. 2) The probability that an item can perform its intended function for a specified interval under stated conditions.
Which Is More Important?

• Avoiding failures OR fixing failures?
  – You cannot repair yourself to happiness!
• Equipment OR processes?
  – Equipment = pawns, Processes = king
• Trained operators OR maintainers?
  – Untrained operators can break equipment faster than trained maintainers can repair

Maintenance Is?

- Maintenance is concerned with retaining function or quickly correcting failures, by use of trained employees using correct procedures.
- The ultimate aim of maintenance is minimizing maintenance costs and downtime to keep equipment operating as designed.

MIL-HDBK-338: Maintenance-All actions necessary for retaining an item in or restoring it to a specified condition.
Business Is?

- Business is all about making money. This is a balance between avoiding failures, repairing failures, and keeping the process operating to make money.
- In the end, reliability and maintenance are all about money.
- The ultimate aim of business is satisfying customers with on-time deliveries of quality products while producing a satisfactory long-term return for stockholders.

Which Is More Important?

- In business:
  - The process is the king ➔ big $’s!
  - The pawns are the equipment ➔ little $’s.
- For the business you must think:
  - Top down
  - Prioritize by use of $ Pareto distributions
  - Unemotionally rather than love affairs
  - Protect the money stream
Engineers Are---?

- Reliability Engineers - Strategic Assets
  - Dedicated to mainly preventing failures
- Maintenance Engineers - Tactical Assets
  - Dedicated to mainly correcting failures
- You need ~10 Maintenance Engineers to every 1 Reliability Engineer
  - No increase in plant head count

Need job descriptions?:
http://www.barringer1.com/jobdescriptions.htm

Get Organized

- Most managers talk about reliability but emphasize maintenance they cross communicate!!
  - Get your organization right
  - Get your emphasis right—say the right things
  - Get your motivation right—what’s the reward?
  - Be consistent—no wishy-washy positions!
  - Work for long terms improvements
  - Work your Pareto list based on $’s
Attack Problems Top Down

- You’ve got to know **where** to attack & **what** to do
- Do you accept the risk of failure?
  - $\text{Risk} = (\text{probability of failure})\times\text{Consequence of failure}$
  - This is the do-nothing case. Can you afford it? What are your **alternatives**? Price out the details—say it in $’s.
- Do you reject the risk of failure?
  - Measure your alternatives against the do nothing case
  - Don’t take too much risk. You can’t afford the exposure.
  - Don’t take too little risk. Timidity waste money.

Where To Improve

- Go for the money—not your love affair!
- Does the system need improvement?
- Does a device need improvement?
- Does a component need improvement?
- What are your alternatives?—say it with money
- Can you avoid the big $ problems by an alternative called redundancy—think of the Gordian knot solution
Best Place For Gains?

- Improve **people performance**—≈38% of problems
  - Make it easy for people to do right & hard to do wrong
- Improve **procedures and practices**—≈34%
  - Write it down correctly and train, train, train
- Improve **hardware**—≈28% of problems
  - Hardware problems may disappear if above corrected
- Engineers, by nature, think reliability issues are resolved with hardware and components and thus they often work on the wrong issues!

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The Pump Curve Issue

- **BEP** = Best Efficiency Point
  - This is the correct point for achieving the greatest inherent life for the pump
- Centrifugal pump curves are NOT useful for the entire curve. To get long life, only a portion of the curve is useful!
Racing For Reliability

Pump Curve Practices

<table>
<thead>
<tr>
<th>Pump Curve % Off BEP</th>
<th>L/D</th>
<th>Suction Straight Runs</th>
<th>Rotational Shaft Alignment</th>
<th>Piping Alignment</th>
<th>Rotational Balance</th>
<th>Foundation Design</th>
<th>Grouting</th>
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</thead>
<tbody>
<tr>
<td>Best Practice</td>
<td>5%</td>
<td>±0.003 inch error</td>
<td>10 to 12 inches/inch error</td>
<td>All 900 inch</td>
<td>92%</td>
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<tr>
<td>Reliability Curve</td>
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<tr>
<td>Good (Commercial) Practice</td>
<td>-20% to +10%</td>
<td>2.0 to 4.0 inches/inch error</td>
<td>75%</td>
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<tr>
<td>Better Practice</td>
<td>+10% to -20%</td>
<td>1.5 to 2.0 inches/inch error</td>
<td>75%</td>
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<tr>
<td>Worst Practice</td>
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<td>0.5 to 1.0 inches/inch error</td>
<td>25%</td>
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Reliability practices must be connected with costs to find the lowest long term cost of ownership calculated by net present value.
Summary

• Get your reliability program right
• Think about reliability issues strategically
• Look for gains first via people, second by processes and procedures, and last by way of components—many component issues disappear when people/processes/procedure issues are solved to achieve inherent component reliability!
• Make money decisions—watch your love affairs!

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