Comparison of Tank Risk-Based Inspection (RBI) Methodologies

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Tank Inspections

• Complicated, expensive, time consuming
• Need a program to manage inspections
  – Rule-based
  – Risk-Based Inspection plan
What is RBI

Risk = Probability x Consequence

Consequence

- Low
- Medium
- High

Probability

- Low
- Medium
- High
How to perform RBI Assessment

Gather Data
- Analyze Design Info
- Analyze Process Data
- Review Inspection History

Analyze Data
- Load RBI Software
- Calculate Risk
- Develop Inspection Plans
Methodology Comparison

- Qualitative
- Semi-Quantitative
- Quantitative
- Weibull
Qualitative

- Engineering assessment
- Conservative assumptions
Methodology Overview

Quantitative

- Based on API 581
- ar/t -> Percent wall loss
- Detailed CoF
Semi-Quantitative

- $ar/t \rightarrow$ Percent wall loss
- Relies on data for PoF
- More qualitative CoF
Methodology Overview

Weibull

- No damage factor table (no ar/t)
- Probability distribution used to determine Mean Time to Failure
- Found in API 581
## Methodology Comparison

<table>
<thead>
<tr>
<th></th>
<th>Qualitative</th>
<th>Quantitative</th>
<th>Semi-Quantitative</th>
<th>Weibull</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level of Assessment</strong></td>
<td>Less detailed</td>
<td>Very detailed</td>
<td>Detailed</td>
<td>Detailed</td>
</tr>
<tr>
<td><strong>Data Requirement</strong></td>
<td>Low</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Time Requirement</strong></td>
<td>Low</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
</tbody>
</table>
• **Strength:**
  – Useful when missing data or low on resources

• **Weakness:**
  – High level assessment
Quantitative

• **Strength:**
  – Very comprehensive assessment

• **Weakness:**
  – Trade off between effort and detailed assessment may not be evident
Semi Quantitative

• **Strength:**
  – Compromise between qualitative and quantitative

• **Weakness:**
  – Some may feel more comfortable following API 581
• **Strength:**
  – Weibull distribution most powerful statistical distribution to calculate Mean Time to Failure

• **Weakness:**
  – Not as well known
Case Study

• Large Gulf Coast Refinery
  – 226 tanks
  – Tank inspections range between 10-20 year intervals
  – 15 tanks per year
  – 46 overdue tanks
Benefits

Reduce risk

• 34 Tanks = $18MM

Optimize cost

• Reduced inspection budget by $7MM/year (50% reduction)

Increase compliance

• Zero overdue tanks in 4 years
Conclusion

• Methodology selection is dependent upon:
  – Facility requirements
  – Quantity/quality of data
  – Resource availability