Meridium Mechanical Integrity
Complies with API Standards
Comparison of Meridium Risk Based Inspection with API Standards

As companies operate in today’s competitive environment, owner operators are continuously striving to improve process safety and environmental stewardship while accomplishing their business objectives of operating in a cost effective manner.

While pursuing these objectives, one of the methodologies that has gained widespread acceptance is Risk-Based Inspection (RBI). The American Petroleum Institute (API) 580 is one of the first RBI standards published that outlines the essential elements of an RBI program specifically as it pertains to secondary failures or failures associated with loss of containment and use of inspection activities to manage the risk associated with these type of failures.

The Meridium Mechanical Integrity work process and RBI software application, as well as its implementation process, were developed in 1996 and is fully aligned with the requirements of API RP580 for RBI as well as API 510, 570 and 653 for Inspection and Thickness Monitoring.

The following information provides details of the Meridium RBI methodology and comparison to the key requirements of API RP580.

Does Meridium RBI Comply with API 580 requirements?

Yes, Meridium fully complies with API 580 requirements for Risk Based Inspection. In fact, Meridium exceeds it in several ways. But first, let’s focus on the compliance facts by walking through a scenario at a facility.

The Plant Scenario

The corporate office contacted the Plant Manager with an updated business strategy for the facility. In order to meet the new goals, the Plant Manager decides he needs to extend inspection intervals.

He contacts his Chief Inspector and asks him to find a way to increase his inspection intervals. The Chief Inspector explains that he will need to complete some research on what the current codes require and he will get back to him with some options.

API 510 Pressure Vessel Inspection Code:

“RBI can be used to determine inspection intervals and the type and extent of future inspection/examinations.”

- API 510 Section 5.2

“An RBI assessment may be used to increase or decrease the inspection intervals and extent defined in the inspection code.”

- API 570 Section 6.1

“External visual inspection intervals can be established by using a valid RBI assessment conducted in accordance with API RP 580.”

- API 570 Section 6.4

“The owner/user chooses to conduct a RBI assessment it must include a systematic evaluation of both the likelihood of failure and the associated consequence of failure, in accordance with API RP 580.”

- API 570 Section 5.1

“An owner-operator may establish the internal inspection interval using risk based inspection (RBI) procedures.”

- API 653 Section 6.4.3
Meridium Mechanical Integrity Complies with API Standards

Did You Know... these key facts about the Meridium RBI methodology?

- The Corrosion Loop concept and definition of the associated operating window streamlines the analysis and adds clarity.
- Execution of the Meridium RBI analysis as a team effort is defined as a pre-requisite, which stimulates cross functional ‘integrity’ team building and exchange of best practices.
- The approach is very practical, easy to apply and transparent.
- The integrated framework of Meridium allows for seamless analysis, consistency of approach and synergy with other strategy assessment methodologies including RCM and SIS.

After reviewing API 510, API 570, API 653 and NB 23, the Chief Inspector finds the following information:

- He reports back to the Plant Manager that extending the inspection intervals is possible by following API 580 and creating a Risk Based Inspection (RBI) program.
- The Plant Manager commissions an RBI study to determine initial inspection interval extension.
- The Chief Inspector creates a Request for Quote (RFQ) for bid by contractors knowledgeable in RBI.

- Meridium Asset Integrity Services provides a bid on the project using an estimated value proposition.

The Chief Inspector reviews the API 580 essential elements, including the 11 steps in applying the principles of a Risk Based Inspection program. They are:

1. Understand the design premise
2. Plan the RBI assessment
3. Data collection
4. Identify damage mechanisms and failure modes
5. Assess POF
6. Assess COF
7. Risk determination, assessment, and management
   - Risk management with inspection and process control
8. Other risk mitigation activities
9. Reassessment and updating
10. Roles, responsibilities, training, and qualifications
11. Documentation and record keeping

– API 580 Section 1.1

What is an RBI Process?

The RBI process is focused on maintaining the mechanical integrity of pressure equipment items and minimizing the risk of a loss of containment. RBI is not a substitute for a Process Hazards Analysis (PHA) or a HAZOP (operational hazards) study. Typically, PHA risk assessments focus on the process unit design and operating practices for a unit, and their adequacy given the unit’s current or anticipated operating conditions. RBI complements the PHA by focusing solely on the mechanical integrity related degradation mechanisms and risk mitigation through inspection.
# How Does Meridium Address RBI?

**The API 580 Standard and Meridium’s Capabilities**

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<th><strong>API 580</strong></th>
<th><strong>Meridium</strong></th>
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<tr>
<td>Understand the design premise</td>
<td>Procedure to review Design as part of PDM assignment</td>
</tr>
<tr>
<td>Plan the RBI assessment</td>
<td>Proven and Implemented Best Practices</td>
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<tr>
<td>Data Collection</td>
<td>Consolidated Data Storage Provided for all Necessary Data Required for Calculations and Inspection Planning.</td>
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<tr>
<td>Identify damage mechanisms and failure modes</td>
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<td>Assess POF</td>
<td>POF Calculated using API 581 ar/t tables</td>
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<td>Assess COF</td>
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<td>Risk determination, assessment &amp; management</td>
<td>Meridium RBI Work Process</td>
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<td>Risk management with inspection and process control</td>
<td>Meridium Strategy Logic Cases integrated with Recommendation Manager</td>
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<td>Other risk mitigation activities</td>
<td>RBI allows the inclusion of other activities Containment, ASM, etc.</td>
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<tr>
<td>Reassessment and updating</td>
<td>Proven and Implemented Best Practices</td>
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<td>Roles, training, responsibilities, and qualifications</td>
<td>Meridium uses HR Roles and Securities</td>
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<td>Documentation and record keeping</td>
<td>Archived Assessments and Reference Documents, Auditable Process</td>
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<td>Relative risk ranking</td>
<td>Meridium uses a 5x5 Matrix that can be used to plot components of an asset or assets within a Unit or Organization</td>
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<tr>
<td>A detailed inspection plan</td>
<td>Meridium Strategy Logic Cases integrated with Recommendation Manager</td>
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<td>Description of other risk mitigation activities</td>
<td>Meridium Integration to EAM allows visibility of Work Histories</td>
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<td>Mitigated risk levels</td>
<td>Meridium can show these results through Future/What If Analyses</td>
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<tr>
<td>Risk drivers identified</td>
<td>Meridium Allows Clear Visibility between drivers such as, Flammability, Toxicity, Production Losses as well as by Damage Mechanisms</td>
</tr>
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<td>Management system for maintaining documentation, personnel qualifications, data requirements, consistency of the program, and analysis updates</td>
<td>Defined Mechanical Integrity Work Processes</td>
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The primary audience for RP 580 is inspection and engineering personnel who are responsible for ensuring the mechanical integrity and operability of equipment covered by this recommended practice. However, while an organization’s Inspection/Materials Engineering group may champion the RBI initiative, RBI is not exclusively an inspection activity.

RBI requires the involvement of various parts of the organization such as maintenance and operations. Implementation of the resulting RBI product (e.g. inspection plans, replacement/upgrading, etc.) may rest with more than one organization. In this context, while the primary audience may be inspection and materials engineering personnel, others within the organization who are likely to be involved should be familiar with the concepts and principles embodied in the RBI methodology.

What are the Expected Outcomes of Applying an RBI Process?

Back at the plant, the Chief Inspector inquires about the expected outcomes of applying an RBI process. API 580 states that there is a “Linkage of risks with appropriate inspection, process control or other risk mitigation activities” (API 580 Section 1.1).

This means that there is a reason for everything we do. In the past, we may have been conducting inspections because it was time-based, regulatory defined, or simply because that is what we were told to do. RBI allows us to create inspection plans that are based on risk. In addition to inspections, risks can also be mitigated by other activities such as changing/monitoring process conditions, adding non-corrosive liners, etc. Additionally, if there is no or limited risk, we can move the inspections to greater intervals.

Additionally, outcomes are:
- Relative risk ranking
- A detailed inspection plan
- Description of other risk mitigation activities
- Mitigated risk levels, and
- Identifying risk drivers.

RBI Assessment Approaches

There are 3 assessment approaches, described in API 580. They are:
- Quantitative
- Semi-Quantitative
- Qualitative.

What are the key elements in any RBI program?

- Management system for maintaining documentation, personnel qualifications, data requirements, consistency of the program, and analysis updates.
- Documented method of POF determination.
- Documented method of COF determination.
- Documented methodology for managing risk through inspection, process control, and other mitigation activities.

But which is the best? Back at the plant, the Chief Inspector and decides to review the benefits of each, and then review API 580 for additional input.

When we talk about the Qualitative approach to RBI, we mean a group of experts decide the level of risk through consensus. This approach is faster than the others. However, it is critiqued as being based on “opinion,” having a lower number of options and non-repeatable. This is due to the experts determining a low/medium/high risk value, and the fact that the group may not be the same 5 years later during the next risk assessment.

On the other end of the continuum, we have the Quantitative approach. This approach is “data-intensive,” with high associated cost and time. This approach considers factors far beyond the scope of the risk of the asset, such as weather patterns and surrounding populations.

The intermediate approach is Semi-Quantitative. This approach provides a “consistent” approach to risk assessment as it is repeatable, cost-effective, efficient, and combines the best of both the Qualitative and Quantitative approaches.

So how does API 580 define the approaches?
# Comparison of RBI Assessment Approaches

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<th>RBI Assessment</th>
<th>Characteristics (as described by API 580)</th>
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| **Quantitative** | • Results should be a fair approximation of the actual risk of loss of containment due to deterioration.  
                             • Analysis has high level of detail and is more precise  
                             • Uses logic models (event trees and fault trees)  
                             • Requires more detailed quantitative input data for the models  
                             • Uses logic models (event trees and fault trees) Results are usually numeric (ex: $/yr)  
                             • Sensitivity analysis becomes more important |
| **Semi-Quantitative** | • Not as rigorous as quantitative  
                             • Faster than quantitative  
                             • Results usually given in consequence and probability categories  
                             • Less detailed data required than quantitative  
                             • Less time required for data gathering and analysis than quantitative |
| **Qualitative** | • Based on engineering judgment and experience  
                             • Low level of detail  
                             • Generally conservative  
                             • Effective screening tool  
                             • Does not require detailed quantitative data  
                             • Inputs given in data ranges instead of discrete values  
                             • Results are typically qualitative (High, Med, Low)  
                             • Requires a higher level of judgment, skill, and understanding |

**Meridium Mechanical Integrity Complies with API Standards**
Meridium uses the Semi-Quantitative Approach

The Meridium APM Mechanical Integrity and RBI toolset uses the Semi-Quantitative approach for RBI assessment.

Meridium utilizes the benefits of a Qualitative assessment in that it is cost- and time-efficient.

Furthermore, it employs up to 30 inputs to estimate risk enabling a repeatable risk assessment process.

By balancing the two, Meridium is able to provide a process that is practical and easy to apply.

Make sure your work processes and your software support Mechanical Integrity compliance.
Meridium is the global leader in asset performance management (APM) software and services for asset-intensive industries. Meridium provides insights into industrial assets for mitigating risk and improving operational excellence. Founded in 1993 and headquartered in Roanoke, VA (USA), Meridium pioneered the vision, software and technology behind APM. Today, Meridium serves market-leading companies with more than 1,000 licensed sites around the globe.