Risk-based Inspection

API RECOMMENDED PRACTICE 580
FIRST EDITION, MAY 2002

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Downstream Segment

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FOREWORD

This recommended practice is intended to provide guidance on developing a risk-based inspection (RBI) program on fixed equipment and piping in the hydrocarbon and chemical process industries. It includes:

- What is RBI
- What are the key elements of RBI
- How to implement a RBI program

It is based on knowledge and experience of engineers, inspectors, risk analysts and other personnel in the hydrocarbon and chemical industry.

RP 580 is intended to supplement API 510 *Pressure Vessel Inspection Code*, API 570 *Piping Inspection Code* and API 653 *Tank Inspection, Repair, Alteration and Reconstruction*. These API inspection codes and standards allow an owner/user latitude to plan an inspection strategy and increase or decrease the code designated inspection frequencies based on the results of a RBI assessment. The assessment must systematically evaluate both the probability of failure and the associated consequence of failure. The probability of failure assessment must be based on all forms of deterioration that could reasonably be expected to affect the piece of equipment in the particular service. Refer to the appropriate code for other RBI assessment requirements. RP 580 is intended to serve as a guide for users in properly performing such a RBI assessment.

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1 Introduction, Purpose and Scope

1.1 PURPOSE

The purpose of this document is to provide users with the basic elements for developing and implementing a risk-based inspection (RBI) program. The methodology is presented in a step-by-step manner to the maximum extent practicable. Items covered are:

a. An introduction to the concepts and principles of risk-based inspection for risk management; and

b. Individual sections that describe the steps in applying these principles within the framework of the RBI process:

1. Planning the RBI Assessment.
2. Data and Information Collection.
3. Identifying Deterioration Mechanisms and Failure Modes.
4. Assessing Probability of Failure.
5. Assessing Consequence of Failure.
6. Risk Determination, Assessment and Management.
7. Risk Management with Inspection Activities.
8. Other Risk Mitigation Activities.
9. Reassessment and Updating.
10. Roles, Responsibilities, Training and Qualifications.
11. Documentation and record-keeping.

The expected outcome from the application of the RBI process should be the linkage of risks with appropriate inspection or other risk mitigation activities to manage the risks. The RBI process is capable of generating:

a. A ranking by risk of all equipment evaluated.

b. A detailed description of the inspection plan to be employed for each equipment item, including:

1. Inspection method(s) that should be used (e.g., visual, UT, Radiography, WFMT).
2. Extent of application of the inspection method(s) (e.g., percent of total area examined or specific locations).
3. Timing of inspections/examinations.
4. Risk management achieved through implementation of the inspection plan.

c. A description of any other risk mitigation activities (such as repairs, replacements or safety equipment upgrades).

d. The expected risk levels of all equipment after the inspection plan and other risk mitigation activities have been implemented.

1.1.1 Key Elements of a RBI Program

Key elements that should exist in any RBI program are:

a. Management systems for maintaining documentation, personnel qualifications, data requirements and analysis updates.
b. Documented method for probability of failure determination.
c. Documented method for consequence of failure determination.
d. Documented methodology for managing risk through inspection and other mitigation activities.

However, all the elements outlined in 1.1 should be adequately addressed in RBI applications, in accordance with the recommended practices in this document.

1.1.2 RBI Benefits and Limitations

The primary work products of the RBI assessment and management approach are plans that address ways to manage risks on an equipment level. These equipment plans highlight risks from a safety/health/environment perspective and/or from an economic standpoint. In these plans, cost-effective actions for risk mitigation are recommended along with the resulting level of risk mitigation expected.

Implementation of these plans provides one of the following:

a. An overall reduction in risk for the facilities and equipment assessed.
b. An acceptance/understanding of the current risk.

The RBI plans also identify equipment that does not require inspection or some other form of mitigation because of the acceptable level of risk associated with the equipment's current operation. In this way, inspection and maintenance activities can be focused and more cost effective. This often results in a significant reduction in the amount of inspection data that is collected. This focus on a smaller set of data should result in more accurate information. In some cases, in addition to risk reductions and process safety improvements, RBI plans may result in cost reductions.

RBI is based on sound, proven risk assessment and management principles. Nonetheless, RBI will not compensate for:

a. Inaccurate or missing information.
b. Inadequate designs or faulty equipment installation.
c. Operating outside the acceptable design envelope.
d. Not effectively executing the plans.
e. Lack of qualified personnel or teamwork.
f. Lack of sound engineering or operational judgment.