Risk-Based Inspection Technology

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SECOND EDITION, SEPTEMBER 2008
Risk-Based Inspection Technology

Downstream Segment

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Foreword

This publication provides quantitative procedures to establish an inspection program using risk-based methods for pressurized fixed equipment, including pressure vessel, piping, tankage, pressure relief devices, and heat exchanger tube bundles. This document is to be used in conjunction with API 580, which provides guidance on developing a risk-based inspection program for fixed equipment in the refining and petrochemical, and chemical process plants. The intent of these publications is for API 580 to introduce the principals and present minimum general guidelines for RBI while this publication provides quantitative calculation methods to determine an inspection plan using a risk-based methodology.

The API Risk-Based Inspection (API RBI) methodology may be used to manage the overall risk of a plant by focusing inspection efforts on the process equipment with the highest risk. API RBI provides the basis for making informed decisions on inspection frequency, the extent of inspection, and the most suitable type of NDE. In most processing plants, a large percent of the total unit risk will be concentrated in a relatively small percent of the equipment items. These potential high-risk components may require greater attention, perhaps through a revised inspection plan. The cost of the increased inspection effort may sometimes be offset by reducing excessive inspection efforts in the areas identified as having lower risk.

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Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, D.C. 20005, standards@api.org.
PART 1

INSPECTION PLANNING USING API RBI TECHNOLOGY
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1 SCOPE

1.1 Purpose
This recommended practice provides quantitative procedures to establish an inspection program using risk-based methods for pressurized fixed equipment including pressure vessel, piping, tankage, pressure relief devices, and heat exchanger tube bundles. API RP 580 [1] provides guidance on developing a risk-based inspection program for fixed equipment in the refining and petrochemical, and chemical process plants. The intent of these publications is for API RP 580 to introduce the principles and present minimum general guidelines for RBI while this recommended practice provides quantitative calculation methods to determine an inspection plan.

1.2 Introduction
The calculation of risk in the Risk-Based Inspection (API RBI) methodology involves the determination of a probability of failure combined with the consequence of failure. Failure in API RBI is defined as a loss of containment from the pressure boundary resulting in leakage to the atmosphere or rupture of a pressurized component. As damage accumulates in a pressurized component during in-service operation the risk increases. At some point, a risk tolerance or risk target is exceeded and an inspection is recommended of sufficient effectiveness to better quantify the damage state of the component. The inspection action itself does not reduce the risk; however, it does reduce uncertainty thereby allowing better quantification of the damage present in the component.

1.3 Risk Management
In most situations, once risks have been identified, alternate opportunities are available to reduce them. However, nearly all major commercial losses are the result of a failure to understand or manage risk. API RBI takes the first step toward an integrated risk management program. In the past, the focus of risk assessment has been on on-site safety-related issues. Presently, there is an increased awareness of the need to assess risk resulting from:
   a) On-site risk to employees,
   b) Off-site risk to the community,
   c) Business interruption risks, and
   d) Risk of damage to the environment
The API RBI approach allows any combination of these types of risks to be factored into decisions concerning when, where, and how to inspect equipment.

The API RBI methodology may be used to manage the overall risk of a plant by focusing inspection efforts on the process equipment with the highest risk. API RBI provides the basis for managing risk by making an informed decision on inspection frequency, level of detail, and types of NDE. In most plants, a large percent of the total unit risk will be concentrated in a relatively small percent of the equipment items. These potential high-risk components may require greater attention, perhaps through a revised inspection plan. The cost of the increased inspection effort can sometimes be offset by reducing excessive inspection efforts in the areas identified as having lower risk. With an API RBI program in place, inspections will continue to be conducted as defined in existing working documents, but priorities and frequencies will be guided by the API RBI procedure.

API RBI is flexible and can be applied on several levels. Within this document, API RBI is applied to pressurized equipment containing process fluids. However, it may be expanded to the system level and include additional equipment, such as instruments, control systems, electrical distribution, and critical utilities. Expanded levels of analyses may improve the payback for the inspection efforts.

The API RBI approach can also be made cost-effective by integrating with recent industry initiatives and government regulations, such as Management of Process Hazards, Process Safety Management (OSHA 29 CFR 1910.119), or the proposed Environmental Protection Agency Risk Management Programs for Chemical Accident Release Prevention.