CONCEPT

Risk Based Inspection (RBI) for Static Equipment: Damage Mechanisms and Inspection Planning

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Introduction:

Risk based inspection RBI fails when fixed inspection intervals, generic damage lists and scattered thickness records decide where inspectors go, leaving high-risk vessels and piping under-inspected while low-risk items absorb turnaround budget. This Core Concept course equips inspection and integrity engineers to set up an RBI programme for static equipment, screen damage mechanisms by corrosion loop, rank probability and consequence of failure, judge inspection effectiveness and set risk-driven intervals. Participants produce a Risk-Based Inspection Plan and Reassessment Register for one process unit from their own plant.

Course Objectives:

- Define the scope, team, risk targets and work process of an RBI programme for pressure vessels, process piping and heat exchangers using API RP 580 and ASME PCC-3
- Divide a process unit into corrosion loops and screen each loop for credible damage mechanisms as API RP 571 describes them
- Estimate probability of failure and consequence of failure for equipment items and plot them on a risk matrix at qualitative, semi-quantitative or quantitative depth
- Select inspection methods, coverage and effectiveness category for each active damage mechanism and set the next inspection date from the risk target
- Set integrity operating windows and reassessment triggers that keep the RBI results valid between inspections
- Build a Risk-Based Inspection Plan and Reassessment Register that feeds turnaround inspection scope

Target Audience:

- Inspection engineers who plan and approve inspection scopes for vessels, piping and exchangers
- Integrity engineers who own equipment risk rankings, remaining life estimates and inspection intervals
- Corrosion and materials engineers who assign damage mechanisms and expected degradation rates
- Process engineers who define operating limits that affect equipment degradation
- Turnaround and maintenance planners who convert inspection plans into work packs
- Inspection data coordinators who maintain thickness monitoring locations and equipment history records

Course Outline:

Day 1: RBI Principles and Programme Baseline

- Time-Based Versus Risk-Based Inspection Intervals: Cost and Coverage Comparison
- Risk Definition as Probability of Failure Multiplied by Consequence of Failure
- RBI Programme Scope: Pressure Vessels, Process Piping, Heat Exchangers and Relief Devices
- RBI Team Roles: Inspection, Corrosion, Process, Operations and Risk Facilitator
- Unit Inspection Baseline: Equipment Register, Thickness History and Past Findings Review

Day 2: RBI Standards, Methodology Levels and Corrosion Loops

- API RP 580 Elements of a Risk-Based Inspection Program: Work Process Walkthrough
- API RP 581 Risk Based Inspection Methodology: Calculation Structure at Overview
- ASME PCC-3 Inspection Planning Using Risk-Based Methods: Scope and Comparison
- Qualitative, Semi-Quantitative and Quantitative RBI Selection Criteria
- Corrosion Loop Definition from Process Flow Diagrams and Heat and Material Balances

Day 3: Damage Mechanism Screening and Failure Likelihood

- API RP 571 Damage Mechanism Screening: Thinning, Cracking, Metallurgical and Mechanical Families
- Susceptibility Tables for Wet H2S Cracking, Chloride Stress Corrosion Cracking and High Temperature Hydrogen Attack
- Damage Factor Logic: Thinning Rate, Remaining Life and Inspection History Credit
- Probability of Failure Categories from Generic Failure Frequency and Management System Factor
- Consequence of Failure Modelling: Flammable Release Area, Toxic Impact, Environmental Loss and Business Interruption

Day 4: Inspection Effectiveness, Operating Windows and Reassessment

- Inspection Effectiveness Categories: Highly to Ineffective by Method and Coverage
- Non-Destructive Examination Method Selection per Damage Mechanism: UT, RT, PAUT, TOFD and WFMT
- Integrity Operating Windows: Critical, Standard and Informational Limits with Response Actions
- RBI Data Management: Thickness Monitoring Locations, Inspection Database Quality and Audit Trail
- Reassessment Triggers: Process Changes, Feed Changes, Unexpected Findings and Excursions Beyond Limits

Day 5: Unit Case Study and the Risk-Based Inspection Plan

- Refinery Hydrotreater Case: Loop Screening and Risk Matrix Placement
- Gas Processing Amine Unit Case: Cracking Mechanism Ranking and Inspection Method Choice
- Turnaround Scope Link: Converting RBI Due Dates into Shutdown Inspection Work Packs
- Own-Unit Risk-Based Inspection Plan and Reassessment Register Build
- Peer Challenge Panel on Risk Rankings, Intervals and Deferral Justifications

Skills You Will Gain:

- Corrosion Loop Mapping
- Damage Mechanism Screening
- Failure Probability Estimation
- Consequence Modelling
- Risk Matrix Interpretation
- Inspection Effectiveness Grading
- Operating Window Definition
- Inspection Data Governance

Why Attend This Course:

- Return with a Risk-Based Inspection Plan and Reassessment Register built on a process unit from your own plant
- Move inspection effort from low-risk items to the vessels and piping circuits where failure would hurt most
- Defend inspection intervals, deferrals and turnaround scope to operations and management with risk evidence
- Compare RBI practice with inspection and integrity engineers from refining, petrochemical and gas processing sites

Conclusion:

Inspection resources deliver most when every interval can be traced to a damage mechanism, a probability and consequence estimate and a measured inspection effectiveness. The course moves from RBI principles and the unit baseline, through API RP 580, API RP 581, ASME PCC-3 and corrosion loops, to damage mechanism screening, failure likelihood and consequence, inspection effectiveness, integrity operating windows and reassessment triggers. The final day applies this to refinery and gas processing cases and produces a Risk-Based Inspection Plan and Reassessment Register ready for the next turnaround.