Risk-informed Inservice Inspection (RI-ISI)

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Demystification

What is RI-ISI?

– Alternative way of deciding where to inspect, how many to inspect, what to inspect for, and why

– Supports the mission of:
  • Safety,
  • Reliability,
  • Competitiveness
Demystification

TERMS

– RI-ISI (risk-informed inservice inspections)
– RB-ISI (risk-based inservice inspections)

– PRA (probabilistic risk assessment)
– PSA (probabilistic safety assessment)
– PSS (probabilistic safety study)
RI-ISI

• Background

• Status

• Operating Fleet

• New Build
Background

- EPRI Traditional RI-ISI methodology (TR-112657)
  - Approved by USNRC 1999

- RI-BER (1006937)
  - Break exclusion / high energy line break / no break zone

- N663 (surface examinations)

- N711 (examination volumes)

- 79 units in the USA

- Applications and pilot studies in other countries (GE, CE, B&W, West, VVER, Asea-Atom)
## Consequence Evaluation

### Failure Potential Assessment (Degradation Mechanism)

<table>
<thead>
<tr>
<th>DEGRADATION CATEGORY</th>
<th>CONSEQUENCE CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Rupture Potential</td>
<td>CCDP and CLERP Potential</td>
</tr>
<tr>
<td>LOW (Cat. 7)</td>
<td>LOW</td>
</tr>
<tr>
<td>MEDIUM (Cat. 5)</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>HIGH (Cat. 3)</td>
<td>HIGH</td>
</tr>
<tr>
<td>HIGH (Cat. 1)</td>
<td>HIGH</td>
</tr>
</tbody>
</table>

### Risk Evaluation

- **None**: LOW
- **Low**: MEDIUM
- **Medium**: LOW
- **High**: MEDIUM
EPRI Streamlined RI-ISI Methodology (N716)

• What it is
  – streamlined process for implementing and maintaining RI-ISI
  – based upon lessons learned from previous RI-ISI applications
  – consequence assessment is not required, replaced with
    • pre-determined set of high safety significant (HSS) locations
    • plant-specific assessment of the impact of pressure boundary failure using the plant PSA directly
  – full plant evaluation required

• Status
  – 5 units converting from TR-112657
  – 5 units applying without previous RI-ISI program
  – 6 units converting from other RI-ISI methods
USNRC Regulatory Guide 1.200

• RG1.200
  – Provides USNRC expectations w.r.t. PRA Technical Adequacy
  – Applies to all risk-informed applications
  – Endorses ASME PRA Standard, with exceptions

• EPRI Report 1018427
  – For use with RI-ISI programs
  – Submitted to USNRC February, 2009
  – Expect approval late 2010

• Will support inclusion of RI-ISI into USNRC RG1.147 (i.e.
  – eliminate the need for Regulatory Submittals
Extensions to Other Components

• N716 r1 – Streamlined RI-ISI
  – Incorporates pilot plant lesson learned
  – Incorporates PRA Technical Adequacy Guidelines
  – Extends application to other components (i.e. Class 2
    • Pressure Retaining Welds in Pressure Vessels
    • Pressure Retaining Nozzle Welds in Vessels
    • Pressure Retaining Bolting > 2” Diameter
    • Pressure Retaining Welds in Pumps & Valves
Extension to Other Programs

Repair / Replacement Activities
- Methodology founded on EPRI Traditional RI-ISI Approach
- Pilot plant approved April, 2009
- Generic implementation strategy under development
  - Technical development complete
  - ASME Code Case, or
  - EPRI Topical report

License Renewal (LTO)
- Small bore piping inspection requirements
- Interactions continuing with LR working group
New Build - ISI

Issue:

• New plants are required to:
  – define and conduct preservice inspections (PSI) prior to operation, and
  – define and conduct inservice inspections (ISI) throughout plant lifetime

• Existing rules for new plants are deterministically based
New Build - ISI

Project Description:

• Develop a RI-PSI and RI-ISI methodology for new plants
  – Take advantage of lessons learned from existing plants
  – Take advantage of new plant designs (e.g. similar/identical construction)
  – Assess need for augmented programs (e.g. FAC, LC)
  – Regulatory approval strategy

• Risk Metrics and Acceptance criteria
  – CDF
  – LERF
  – LRF
New Build - ISI

Project Status:

• Completed review of RI-ISI methodologies against DCD/COLAs
  – New Design incorporate lessons learned from existing plants
    • Degradation (e.g. FAC)
    • Spatial separation
  – More Passive (ESBWR, AP1000)
  – Less Passive (ABWR, APWR, EPR)

• Conducted test cases on each design

• Implementation Protocol / Strategy identified
New Build - ISI

Remaining Steps:

• Risk Metrics
• Risk Acceptance Criteria
• PRA Timeline
• Final Report
<table>
<thead>
<tr>
<th>Sec ID 2008 (2009)</th>
<th>Category I</th>
<th>Category II</th>
<th>Category III</th>
<th>TR1018427 Assessment</th>
<th>TR1018427 Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IE-A3 (IE-A3)</strong></td>
<td>REVIEW the plant-specific initiating event experience of all initiators to ensure that the list of challenges accounts for plant experience. See also IE-A7</td>
<td></td>
<td></td>
<td>Plant-specific data not available Can be met at 1st Period</td>
<td>CCI/II/III</td>
</tr>
<tr>
<td><strong>IE-A3a (IE-A4)</strong></td>
<td>REVIEW generic analyses of similar plants to assess whether the list of challenges included in the model accounts for industry experience.</td>
<td>REVIEW generic analyses and operating experience of similar plants to assess whether the list of challenges included in the model accounts for industry experience.</td>
<td></td>
<td>Partial as some components may be unique Will be met via the RI-ISI living program component</td>
<td>CC I/II</td>
</tr>
<tr>
<td><strong>IE-A4a (IE-A6)</strong></td>
<td>When performing the systematic evaluation required in IE-A5, INCLUDE initiating events resulting from multiple failures, if the equipment failures result from a common cause.</td>
<td>When performing the systematic evaluation required in IE-A5, INCLUDE initiating events resulting from multiple failures, including equipment failures resulting from random and common causes, and from routine system alignments.</td>
<td></td>
<td>CC I can be met CC II and III need routine alignment information</td>
<td>CC I</td>
</tr>
<tr>
<td><strong>IE-A6 (IE-A8)</strong></td>
<td>No requirement for interviews.</td>
<td>INTERVIEW plant personal (e.g., operations, maintenance, engineering, and safety analysis) to determine if potential initiating events have been overlooked.</td>
<td>INTERVIEW plant operations, maintenance, engineering, and safety analysis personnel to determine if potential initiating events have been overlooked.</td>
<td>CCI can be met CCII and III require interviews of “plant personnel”</td>
<td>CC I</td>
</tr>
</tbody>
</table>
New Build - RI Procurement

Summary of Issue

– New Build fleet must comply with regulatory accepted codes and standards (e.g. ASME SIII) for safety-related components

– Requirements apply to the design, procurement, construction and acceptance of pressure boundary components

– Existing codes & standards are deterministically based

– Recent experience with the operating fleet identifies path to burden reduction for New Build
New Build - RI Procurement

Scope – Pressure boundary components/systems

Task 1 – Develop, or adapt an approved methodology, to classify safety-related components as either HSS or LSS

Task 2 – For LSS components, identify burden reduction opportunities and develop guidance for implementation (e.g.):

- Exempt LSS components from ASME SIII (e.g. allow use of alternative codes, B31.1 for piping)
- Treat LSS components as Seismic Category II versus Cat I
- Exempt LSS components from QA requirements per Appendix B
- Relax construction tolerances/acceptance criteria for LSS components
- Others?

Task 3 – Identify an appropriate licensing strategy including interaction with appropriate stakeholders
Summary

Risk technology is supporting FBC efforts

Cost is being reduced

Dose is being reduced

Safety is being maintained and / or improved
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