RISK-INFORMED INSERVICE INSPECTION ACTIVITIES

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STEPHEN DINSMORE NRR/DSSA/SPSB
SYED ALI RES/DET/ERAB
ANDREA KEIM NRR/DE/EMCB

OBJECTIVE

- Objectives of ISI Program is to identify degraded conditions that are precursors to pipe failures

- Regulatory requirements for ISI are specified in 10 CFR 50.55a(g)

- 10 CFR 50.55a(g) references ASME Code Section XI for ISI requirements
  - The Code inservice inspection requirements did not consider risk insights. Inspection resources should be focused in those areas which are most safety and risk significant.

- 10 CFR 50.55a(a)(3)(i) provides for authorization of alternative ISI programs by Director of NRR

- Relief request required for staff review and approval

RI-ISI GUIDANCE

- **NRC issued Regulatory Guidance**
  - **RI-ISI Regulatory Guide 1.178, September 2003**
    ***"An Approach For Plant-Specific Risk-Informed Decisionmaking Inservice Inspection of Piping"*.**
  - **Standard Review Plan Section 3.9.8, September 2003**
    "Standard Review Plan for the Trial Use For the Review of Risk-Informed Inservice Inspection of Piping".

- **Approved well defined generic methodologies via Topical Reports (WOG and EPRI)**
  - **SER for WOG Topical Report issued in December 1998.**
  - **SER for EPRI Topical Report issued in October 1999.**

- **Adopted "template" submittal specifying the contents of the relief request**
  - **brief description of evaluations performed**
  - **overview of results from each major evaluation**
  - **any deviations from methodologies must be identified and justified**

UPDATES ARE KEY TO RI-ISI PROGRAMS

- RI-ISI programs should be living programs and should be changed if needed to reflect new relevant information such as
  - major updates to plant PRA models
  - new trends in service experience with piping systems at the plant and across the industry
  - new information on element accessibility

- At a minimum, risk ranking should be reviewed and adjusted on an ASME-period basis

- RI-ISI programs should be updated and submitted to NRC
  - at the end of the 10-year ISI interval
  - prior to the end of the 10-year interval if there is a deviation from the RI-ISI methodology described in the initial submittal, or if industry experience determines that there is a need for significant revision to the program

CURRENT STATUS

- Number of Plants With RI-ISI Programs: 78 (of 103 US plants)
  - Based on EPRI Methodology: 54
  - Based on WOG Methodology: 24

- Both EPRI and WOG have developed methodologies to expand RI-ISI methodology to piping within the break exclusion region (BER).
  - SER on EPRI submittal completed in June 2002
  - SER on WOG submittal completed in March 2004
  - when BER program is in FSAR, the extension of RI-ISI to BER piping may be done via the 10 CFR 50.59 process

- ASME has issued three Code Cases and a non-mandatory Appendix R for RI-ISI applications consistent with both EPRI and WOG methodologies.
  - NRC may endorse the Code Cases in RG 1.147, with limitations and conditions where appropriate.
  - NRC may use 50.55a rulemaking to incorporate Appendix R by referencing the ASME Code addendum

RISK-INFORMED INSERVICE INSPECTION OF PIPING
RI-ISI PROCESS OVERVIEW

- Divide systems into piping segments
- Evaluate consequences of each segment's failure
- Determine failure potential of each segment
- Categorize risk significance of each segment
- Select welds and elements for inspection
- Assess impact on CDF and LERF from changing number and locations of inspection

METHODOLOGY COMPARISON

WOG METHODOLOGY

- Detailed fracture mechanics method used to calculate piping failure probability/frequency
- Consequence of segment failure determined using PRA
- Piping segments categorized considering importance measures, key principles, and qualitative assessments

EPRI METHODOLOGY

- Failure potential determined qualitatively based on existence of degradation mechanism
- Consequence of segment failure determined using PRA
- Piping segments categorized based on failure potential and consequences of failure

BACK-UP/DETAILED INFORMATION SLIDES

COMPARISON OF ASME XI AND RI-ISI

ITEM	ASME XI	RI-ISI
Applicability	As defined in the appropriate ASME XI	Currently applicable to piping only
Percentage of examinations for Class 1 piping	Category BF Welds: 100% Category BJ Welds: 25%	As Defined in the Approved RI-ISI Program for the Plant
Percentage of examinations for Class 2 piping	Categories C-F-1, C-F-2 Welds: 7.5%	As Defined in the Approved RI-ISI Program for the Plant
Examination locations	Terminal ends, locations of high stresses and fatigue usage factors, etc	As defined in the approved RI-ISI program for the plant

Item	ASME XI	RI-ISI
Examination method	As defined in the appropriate ASME XI table, usually depends on pipe size and weld type	As defined in the applicable approved topical report, usually depends on degradation mechanism
Examination volume	As defined in the appropriate ASME XI Table	As defined in the applicable approved topical report, depends on degradation mechanism and usually more volume than ASME XI
Examination Frequency	10 Year inspection interval defined in ASME XI	Same as ASME XI

Item	ASME XI	RI-ISI
Definition of inspection periods	Three periods as defined in ASME Xi	Same as ASME XI
Minimum examinations during inspection periods	16%, 50%, and 100% at the end of three periods	Same as ASME XI
Examination acceptance standards	Defined in ASME XI	Same as ASME XI
Flaw evaluation standards	Defined in ASME XI	Same as ASME XI

ASME CODE CASES AND APPENDIX

- Code Case N-560 (Class 1, EPRI Method).
- Code Case N-577 (Class 1, 2, 3, WOG Method).
- Code Case N-578 (Class 1, 2, 3, EPRI Method).
- Appendix R (Class 1, 2, 3, WOG and EPRI Methods).

WOG RISK MATRIX

High Failure Importance $P_{Large\ Leak} > 10^{-4}$	3 Owner Defined Program	1(A) Susceptible Locations (100% 1(B) Statistical Inspection Location Selection Process
Low Failure Importance	4 Only System Pressure Test & Visual Examination	2 Statistical Inspection Location Selection Process
	Low Safety Significant	High Safety Significant RRW > 1.005

EPRI RISK MATRIX

FAILURE POTENTIAL	CONSEQUENCE CATEGORY CCDP and CLERP Potential			
	NONE	LOW	MEDIUM	HIGH
HIGH	LOW (Cat 7)	MEDIUM (Cat 5)	HIGH (Cat 3)	HIGH (Cat 1)
MEDIUM	LOW (Cat 7)	LOW (Cat 6)	MEDIUM (Cat 5)	HIGH (Cat 2)
LOW	LOW (Cat 7)	LOW (Cat 7)	LOW (Cat 6)	MEDIUM (Cat 4)