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Protecting People and the Environment

Public Meeting on Draft Regulatory Guide 1216, "Plant- Specific Applicability of Transition Break Size Specified in 10 CFR 50.46a"

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Public Meeting on Draft Regulatory Guide 1216
Rockville, Maryland
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Presentation Objectives

- Provide brief summary of the research conducted which supported the development of the transition break size (TBS)
- Discuss motivation and objectives for developing the draft regulatory guide (DG) to ensure applicability of the research findings
- Provide an overview of the DG
- Provide the status and schedule for the adoption of DG 1216 as a final regulatory guide (RG)

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Technical Basis Supporting the Transition Break Size

Background: NUREGs-1829 & 1903

- Commission direction (SRM-02-0057)
  - "The staff should provide the Commission a comprehensive 'LOCA failure analysis and frequency estimation' that is realistically conservative and amenable to decision-making … with appropriate margins for uncertainty …".
  - "The staff should use expert elicitation to converge (whenever possible) service-data and PFM results …".

- Application in 10 CFR 50.46a
  - NUREG-1829: Provide part of the technical basis for selecting TBS
  - NUREG-1903: Verify that risk associated with seismic-induced direct and indirect pipe failures greater than the TBS are acceptable

NUREG-1829: Executive Summary

- Elicitation used to estimate ***generic*** BWR and PWR passive-system LOCA frequencies associated with material degradation.
- Panelists provided quantitative estimates supported by qualitative rationale in individual elicitations for underlying technical issues.
  - Generally good agreement on qualitative LOCA contributing factors.
  - Large individual uncertainty and panel variability in quantitative estimates.
- Group results determined by aggregating individual panelists' estimates.
  - Uncertainty reflected in 5th and 95th percentiles about median estimates.
  - Confidence bounds used to quantify panel variability.
- **NUREG-1829 was published in April 2008.**

NUREG-1903: Executive Summary

- Reviewed prior PRA, seismic studies and earthquake experience
- Analyzed direct piping failure associated with rare seismic events (i.e., 10^{-5}/yr & 10^{-6}/yr) in piping systems with diameters larger than the TBS
- Analyzed large component support failures that may lead to piping failure (i.e., indirect piping failure) associated with rare seismic events
- Results
  - Unflawed piping: Failure frequency is much lower than 10^{-5}/yr
  - Flawed piping: Critical flaws for long, circumferential flaws ($\theta/\pi = 0.8$) are generally large
  - Indirect failures: Two cases analyzed have a mean piping failure probability of approximately 10^{-6}/yr
- **NUREG-1903 was published in February 2008**

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Plant-Specific Demonstration of Applicability of Transition Break Size: Overview of DG-1216 Development

DG-1216 Motivation: Commission Direction

- SRM-08 10 on SECY-07-0082
  - "The final rule should require licensees to justify that the generic results in the revised NUREG-1829, 'Estimating Loss-of-Coolant Accident Frequencies Through the Elicitation Process,' are applicable to their individual plants."
  - "The staff should develop regulatory guidance that will provide a method for establishing this justification."
- SRM direction is consistent with ACRS recommendations
- Staff has interpreted that this guidance extends to NUREG-1903, "Seismic Considerations For the Transition Break Size"

DG-1216: Scope

- Consider issues and implications associated with generic aspects of NUREGs
  - Assumptions
  - Approach
  - Analysis
- Guidance has been considered in several areas that may be affected by plant-specific factors
  - NUREG-1829 Applicability
    - Safety culture
    - *Current plant operation*
    - *Changes in plant operation that may affect LOCA frequencies*
  - NUREG-1903 Applicability
    - *Frequencies associated with direct piping failures caused by seismic loading*
    - *Frequencies associated with indirect piping failures caused by seismic loading*

DG-1216: Philosophy and Framework

- Addresses breaks larger than the proposed TBS {i.e., primary loop piping (PLP) and pressure boundary structural components (PBSC)}
- Use information submitted under other programs wherever possible {e.g., power uprates, license renewal, Leak-Before-Break (LBB) submittals}
- Evaluation to address NUREG-1829 applicability
  - Intended to be largely qualitative
  - Consider plant-specific effects on variables that affect LOCA frequencies
  - Demonstrate adequacy of current plant conditions and insignificance of proposed plant changes
- Evaluation to address NUREG-1903 applicability
  - Seismically induced direct piping failures
    - Options to maximize applicability of NUREG-1903 analysis
    - Guidance and examples for conducting plant-specific analyses
  - Seismically induced indirect piping failures: No guidance in DG-1216

DG-1216: Current Plant Operation

- General applicability: Demonstrate consistency with licensing basis
  1. Demonstrate adequacy of PWSCC aging management program (AMP)
  2. Demonstrate adequacy of existing or planned AMPs
     - Reference License Renewal (LR) approval: Evaluate deviations from approved AMPs
     - Reference LR application: Evaluate deviations from Standard Review Plan (SRP)
     - Perform alternative evaluation: Address management of aging mechanisms (primarily those in GALL) applicable to PLP and PBSCs
- Plant specific attributes
  - Modeled after LBB SRP
  - Identify and evaluate effects of unique materials, loading, and geometries/configurations

DG-1216: Plant Changes Under 50.46a

- Ensure that proposed changes don't invalidate operating experience
- Aspects of analysis modeled after review standard (RS) for Extended Power Uprates (EPUs) and LBB SRP
- Two-steps
  1. Evaluate effects on direct PLP or PBSC failure
     - **Option I:** Evaluate effects on LOCA variables (i.e., environment, loading, and/or degradation mechanisms)
     - **Option II:** Evaluate effects on applicable programs, systems, and analyses. Use guidance from RS for EPU guidance
  2. Evaluate effects on indirect PLP or PBSC failure
     - Induced by non primary pressure boundary failures
     - **Option I:** Show that prior analyses (e.g., for LBB or EPU) remain sufficient
     - **Option II**
       - Address impact of changes on dynamic effects and missile protection
       - Determine if LOCA frequencies increase

DG-1216: Seismically Induced Direct Piping Failures

- **Objective:** Demonstrate that frequency of direct failures greater than the TBS is acceptable (i.e., less than ≈ 10^{-6}/yr)
- Requires plant-specific analysis of hypothetically flawed components
- Provides options to maximize applicability of NUREG-1903 analysis
  1. Demonstrate that NUREG-1903 analysis is bounding
  2. Use aspects of NUREG-1903 analysis in plant-specific evaluation
- Analysis steps
  1. Determine limiting locations within PLP
  2. Determine component stresses
  3. Determine material properties
     - Address uncertainty and variability in material properties
     - Address effects of aging on strength and fracture toughness
  4. Conduct best-estimate (BE) critical surface flaw analysis
  5. If seismic criteria met, evaluate acceptability of SCC mitigation

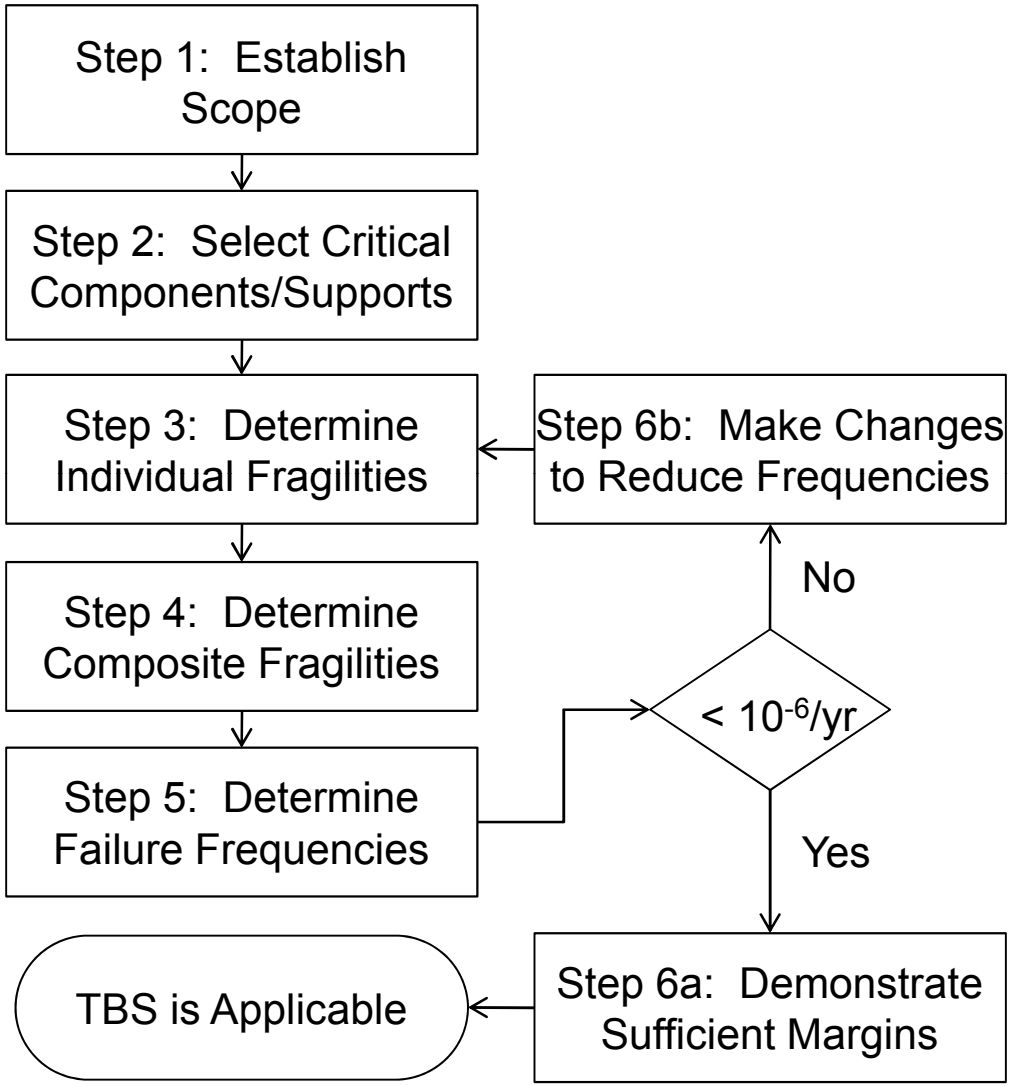
DG-1216 : Seismically Induced Indirect Piping Failures

- Federal Register Notice (Vol. 74, No. 152, August 10, 2009) and DG-1216 currently have no requirements or guidance for demonstrating that the frequency of indirect failures greater than the TBS is acceptable (i.e., $< 10^{-6}$/yr)
- Original basis for staff position
  - NUREG-1903 only evaluated one failure mode for two plants
  - Generic changes to seismic design, testing, analysis, qualification, and maintenance requirements (i.e., seismic design basis) not allowed under 10 CFR 50.46a
  - Plant-specific analysis required to justify proposed changes to seismic design basis
- ACRS subcommittee feedback
  - Licensee should have to demonstrate that the frequencies associated with these failures is acceptable
    - Consistent with treatment of direct failures
    - Possibility that indirect failure frequency may be equal to or greater than direct failure frequency
  - Staff agrees that indirect failures should be demonstrated to be insignificant risk contributors because
    - Updated seismic hazard information (GI-199)
    - Smaller allowable risk increase in draft final rule

DG-1216 : Seismically Induced Indirect Piping Failures

- Lawrence Livermore Study (NUREG/CRs – 3660, 3663, 4290, 4792) findings and recommendations
  - Seismically induced support failure is the most likely cause of indirectly induced double-ended guillotine breaks
  - Strength of component supports, currently designed for the combination of SSE plus DEGB, should not be reduced.
- NUREG-1903 review of seismic PRAs, seismic safety margin research program, and IPEEE submittals confirmed LLNL recommendations
  - Unflawed piping and other passive components of the RCS generally exhibit very high seismic capacities
  - Valves, piping, and pipe supports have a significantly higher capacity than other RCS components
  - RCS components, especially component supports, are more vulnerable than the piping and pipe supports
  - Most significant NSSS failure modes are attributable to failures of major components or their supports

DG-1216 : Seismically Induced Indirect Piping Failures



Regulatory Guide: Status and Schedule

- 2010: Recent and Upcoming Activities
  - ACRS waived review of DG-1216 prior to public comment: March
  - DG-1216 published for public comment: June 28th
  - ACRS subcommittee meeting on 10 CFR 50.46a: September 22nd
  - Public meeting on DG-1216: September 30th
  - ACRS meeting on 10 CFR 50.46a: October 7th
  - End public comment period: November 25th
- 2011: Key Milestones
  - Address public comments and finalize DG-1216: January
  - Initiate pilot study to evaluate RG: January (tentative)
  - Brief ACRS on final RG: February – March
  - Publish guidance 6 months after final rule to Commission: TBD
- Long-Term Milestones
  - Complete pilot study: 1 – 2 years
  - Revise RG: 2 months after completing pilot study
  - Publish revised RG: 8 months after completing pilot study

Regulatory Guide: Summary

- Guidance currently provided in areas that may be affected by plant-specific factors
  - NUREG-1829 Applicability
    - Current plant operation
    - Changes in plant operation that may affect LOCA frequencies
  - NUREG-1903 Applicability
    - Frequencies of seismically induced direct piping failures
- Evaluation required only for breaks larger than the proposed TBS
- Uses information submitted under other programs wherever possible
- No current guidance to ensure that frequencies of seismically induced indirect piping failures remain acceptable
  - Modified draft final rule based on ACRS feedback
  - Sample evaluation method has been proposed
  - Plan to add method to DG-1216
- Plan to publish interim RG in 2011 coincident with final rule
- Soliciting pilot applications for exercising RG approach