GSI-191 (GL 2004-02) Issue Resolution Strategy
A Simplified Risk-Informed Approach

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GSI-191 Resolution

Simplified Risk-Informed Strategy Objectives

• Completely address GL 2004-02 utilizing a methodology or methodologies that will:
  - Be fully acceptable to the NRC, minimize plant impact, and shorten the time to closure of GL 2004-02
    • Financial impact to plant from an implementation perspective
    • Financial impact from an outage duration perspective
    • Challenges to industrial and radiological safety
    • Simplified approach could shorten completion schedule by 1 – 2 years

• Plants have selected Option 2 (Full Risk-Informed Regulatory Treatment) for GSI-191 resolution
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Simplified Risk-Informed Approach - Overview

• Utilizes a combination of deterministic and risk-informed methodologies for overall resolution
• Based on insights gained from STP pilot effort
• Based on previous NRC acceptance of specific deterministic methodologies
• Relies on results of current PWROG efforts to inform the in-vessel phenomena and establishment of less restrictive in-vessel fiber limits
• Will require a LAR and may require multiple Exemption Requests
• Proposed 50.46c rulemaking should support this approach
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Simplified Risk-Informed Approach - Details

- Next slides provide information on the specific tasks being undertaken, and each of the areas required to be addressed by GL 2004-02 and the November 2007 Revised Content Guide for Generic Letter 2004-02 Supplemental Responses
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Simplified Risk-Informed Approach - Details

- Perform an initial risk quantification to determine if Regulatory Guide (RG) 1.174 can be met
  - Develop break frequencies for each class and size of break using the same methodology as was developed for STP
  - Modify plant PRA Model of Record (MOR) to include failures at the Sump Strainer and In-Vessel
    - Strainer differential pressure (DP) ≥ NPSH Margin
    - Strainer DP ≥ Strainer structural design limit
    - Strainer void fraction ≥ 2%
    - Core fiber load ≥ hot leg break fiber limit for flow blockage
    - Core fiber load ≥ cold leg break fiber limit for flow blockage
  - This effort is intended to inform those areas where additional refinement may be required
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INITIAL QUANTIFICATION

- START ALTERNATE RESOLUTION
- CONTAINMENT CAD MODEL
- ASSEMBLE BASE INPUTS
- DEVELOP INFLUENCE MATRIX
- REVISE INFLUENCE MATRIX
- PERFORM QUANTIFICATION
- REFINE DEBRIS GENERATION
- REFINE DEBRIS TRANSPORT
- MODIFY OPERATIONAL STATES
- MODIFY PLANT PRA MODEL TO INCLUDE SUMP & CORE FAILURE MODES

DO RESULTS DEMONSTRATE THAT BREAKS THAT RESULT IN ≥ 1/16" BED THICKNESS ON STRAINER MEET THE RISK REQUIREMENTS OF RG 1.174

- YES
- PROCEED TO FORMALIZE PROCESS

DO RESULTS DEMONSTRATE THAT BREAKS THAT RESULT IN CHALLENGE TO CORE COOLING (as defined by PWROG criteria) MEET THE RISK REQUIREMENTS OF RG 1.174

- YES
- TO RESOLUTION PATH

- NO
- REVISE INFLUENCE MATRIX

- NO
- REFINE DEBRIS BYPASS

- WELD DATA
- DEBRIS GENERATION DATA
- DEBRIS TRANSPORT DATA
- STRAINER BYPASS DATA
- STRAINER AREA
- STRAINER OPERATIONAL INFORMATION
- STRAINER STRUCTURAL LIMIT
- STRAINER HEAD LOSS DATA
- NPSH REQUIRED INFO
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Simplified Risk-Informed Approach - Details

• **Break Selection**
  - Breaks at all weld locations from $\frac{1}{2}''$ to the largest pipe in the RCS (31” or 42”, dependent on plant design)
  - Breaks considered as Small (< 2”), Medium (2” to 6”), Large (> 6”)
    • Small and Medium breaks postulated on larger piping
  - Secondary side breaks not considered for debris generation since recirculation not required for mitigation per plant licensing basis, but are considered in PRA models

• **Debris Generation**
  - All ZOIs used in approach previously accepted by NRC
  - Debris quantity for each break location determined from CAD models, including consideration of orientation
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Simplified Risk-Informed Approach - Details

• **Debris Characteristics**
  - No changes from deterministically established and NRC accepted values

• **Latent Debris**
  - Latent Debris quantity values used are more conservative than measured (sampled) values
  - Sacrificial strainer area remains the same as previously reported in supplemental responses
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Simplified Risk-Informed Approach - Details

• Debris Transport
  - Use the most conservative debris transport fractions (typically break near the strainer) for initial quantification efforts
  - Some plants have installed debris interceptors that may be credited with trapping large and small pieces of debris
  - If quantification does not meet RG 1.174 criteria, then a more refined debris transport model could be developed
    • May be similar to STP approach or some median between deterministic and STP approach
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Simplified Risk-Informed Approach - Details

• Head Loss and Vortexing
  - All breaks that result in ≥ 1/16” fiber thickness when combined with conservative WCAP-16530 chemical effects result in sump strainer failure
  - If quantification does not meet RG 1.174 criteria, then testing may be performed to establish increased quantity of fiber at strainer with chemical effects that will not result in sump strainer failure
  - Temperature scaling will be evaluated based on expected debris bed configuration
  - The vortex and flashing analyses results will be as reported in supplemental responses
  - Near field settling will not be credited for head loss considerations
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Simplified Risk-Informed Approach - Details

- **Net Positive Suction Head (NPSH)**
  - Intent is to utilize the previously established deterministic criteria that was reported in supplemental responses

- **Coatings Evaluation**
  - Intent is to utilize the previously established deterministic criteria that was reported in supplemental responses

- **Screen Modification Package**
  - No changes expected from that reported in supplemental responses

- **Sump Structural Analysis**
  - No changes expected from that reported in supplemental responses
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Simplified Risk-Informed Approach - Details

• **Upstream Effects**
  - No changes expected from that reported in supplemental responses

• **Downstream Effects – Components and Systems**
  - No changes expected from that reported in supplemental responses

• **Downstream Effects – Fuel and Vessel**
  - Will use the criteria established by the PWROG, and as accepted by the NRC, to evaluate success or failure for in-vessel blockage
  - Strainer bypass testing will be performed to establish transient fibrous debris bypass
  - LOCADM results will be as reported in supplemental responses or reflect power uprates at the applicable plants
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Simplified Risk-Informed Approach - Details

• **Chemical Effects**
  - Preferred path is that WCAP-16530 chemicals will be used to evaluate sump strainer head loss if testing is determined to be required
  - Intent is to use the criteria established by the PWROG, and as accepted by the NRC, to evaluate success or failure for in-vessel blockage with chemical effects

• **Licensing Basis**
  - Will require a LAR, and may require multiple exemption requests, for review by the NRC and subsequent issuance of a license amendment
    • 10 CFR 50.46c rulemaking could eliminate need for exemption requests
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Simplified Risk-Informed Approach – Additional Steps

- Defense in Depth and Mitigative Measures
  - As described in the March 5, 2012 letter from NEI to the NRC (ML120730654 and ML120730660), there are multiple methods to prevent, detect, and mitigate challenges to long term cooling as a result of debris resulting from a LOCA
  - Many of these measures are already contained within plant procedures
  - Evaluation of additional mitigative measures will proceed during the implementation phase of the approach
    - This may include physical changes to the plant or changes to the procedures that govern operation of the systems required to mitigate this event
    - May also include FLEX strategies currently under development
  - The Defense In Depth and Safety Margins required per RG 1.174 will be maintained
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Simplified Risk-Informed Approach

• Comparison to STP Approach
  - Utilizes insights gained from overall STP approach
    • Quantification results from break frequency contribution
    • Sensitivity of parameters to overall results
  - Utilizes insights gained from STP use of a complex specialized software
    • Follow on plants may require limited scope software for integration of uncertainties
  - Utilizes insights gained from STP thermal hydraulic modeling
    • Follow on plants may not require thermal hydraulic modeling beyond PWROG in-vessel blockage methodology
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Simplified Risk-Informed Approach

• **Comparison to STP Approach (cont’d)**
  - Utilizes insights gained from STP and PWROG chemical effects modeling
    • Follow on plants may not require refined chemical effects modeling

• **SRM-SECY-10-0113**
  - The proposed resolution approach is consistent with this SRM:
    "….alternative options for resolving GSI-191 that are innovative and creative, as well as risk informed and safety conscious"
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Proposed Draft Schedule

• The schedule provided on the next page is a current best estimate of when submittal of LARs could be expected for a simplified risk-informed resolution path (for selected plants) and expected submittal dates for full risk-informed LARs that would be essentially similar to the STP approach

• The full risk-informed LAR submittal dates reflect the input from those plants that are currently pursuing a SECY 12-0093 Option 2b approach
  - Submittals are staggered to provide more effective utilization of the limited resources necessary to prepare and review the requests

• Schedule also includes projected dates for 10 CFR 50.46c rulemaking efforts
  - Coordination with this effort may reduce the scope of the LAR and exemption requests necessary for a risk-informed resolution of GSI-191
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Risk-Informed Plants Licensing Submittal Schedule and 10 CFR 50.46c Rulemaking Activities Timeline

Simplified Approach

Timeline →

- Nov 2013: STP Revised Submittal
- Mar 2014: Proposed 10CFR 50.46c Rule Published
- Jun 2014: NRC Concurrence With Approach
- Feb 2015: PWROG In-Vessel Debris Limits Established
- Sep 2015: 10 CFR 50.46c Public Meeting on Implementation
- Dec 2015: STP SE Issued
- Feb 2016: 10 CFR 50.46c Final Rule to Commission
- Jun 2016: 10 CFR 50.46c Final Guidance
- Jun 2016: Plant 1 Licensing Action Submittal
- Dec 2016: Plant 2 Licensing Action Submittal
- Dec 2016: Plant 3 Licensing Action Submittal
- Mar 2017: Plant 4 Licensing Action Submittal
- Sep 2017: Plant 8 Licensing Action Submittal
- Jun 2017: Plant 6 Licensing Action Submittal
- Dec 2017: Plant 10 Licensing Action Submittal

6/1/2013

Dates for licensing action submittals developed through discussions between 2b plants with consideration of expected receipt of SE for STP and desire to stagger the submittals.

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Simplified Risk-Informed Approach Summary

- The proposed approach represents an “innovative and creative” methodology for resolving GSI-191 in a timely manner
- The proposed approach maintains alignment with the STP approach yet eliminates many of the complexities of that approach
- We expect some challenges in the path to resolution but based on some simplistic evaluations performed in support of this approach, we fully expect a successful result
- Frequent communication with the NRC on this approach is necessary to ensure success
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QUESTIONS / COMMENTS?