



U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

ISG on PRA-Based Seismic Margin Analysis for New Reactors

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At Public Meeting with Industry

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Outlines

- ISG was jointly developed by NRO, RES, and BNL
 - NRO: DE, DSER, DSRA
 - RES: DE, PRA
 - BNL staff
- Background
- PRA-based seismic margin analysis approach
- Process and scope
- Staff positions
- Implementation schedule

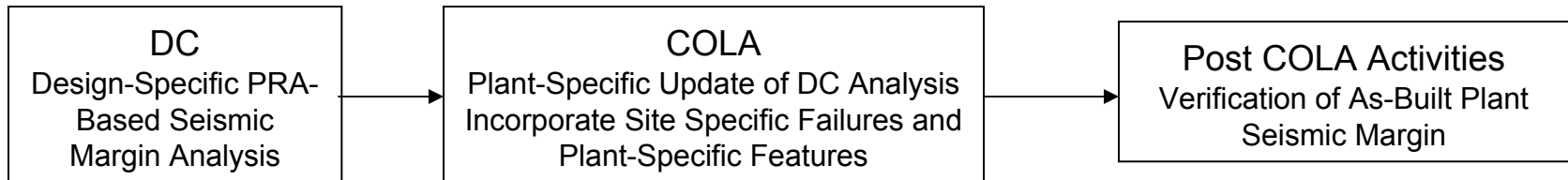
Background

- Severe accident prevention and mitigation for new reactors
 - addressed in 10 CFR Part 52
 - 52.47 (a) (27) for DC PRA, 52.79(a)(46), 52.79 (b) (1) for PRA COL updates
 - 52.47 (b) (1) and 52.80(a) related to ITAAC and
 - 50.71 related to PRA for operation (Not within the scope of this ISG)
 - SECY 93-087 and SRM
 - Staff proposed and Commission approved PRA-based seismic margin analysis to address seismic event
 - PRA ISG 3 addresses internal events PRA scope and accepts seismic margin analysis as an alternative to seismic PRA
- All certified designs certified prior to 2007 used a mixture of approaches including methods adapted from IPEEE program
- Industry PRA standards ANS 58.21 (2007) and ASME/ANS (2009) for PRA
- PRA RG 1.200 does not endorse ASME/ANS margin method
- Proposed ISG on PRA-based seismic margin analysis

PRA-Based Seismic Margin Analysis

- All seismic-induced initiators (transients, LOCA of various sizes, or others appropriate to the standard design)
- Complete logic structures – enhanced from internal event/fault trees to capture seismic failures
- Including non-seismic failures
- Fully developed sequences important for CDF and LRF
- Determination of sequence-level HCLPFs (margins)

Implementation Process From DC to COLA



ISG on PRA-Based Seismic Margin Analysis

- Scope of PRA-based seismic margin analysis (SMA)
 - At design certification stage
 - Design-specific seismic sequences
 - Use of design analysis for fragility analysis
 - For equipment qualified via testing, measures including procurement specs. are provided to ensure the goal for plant-level HCLPF will be met
 - Plant-level/sequence-level High Confidence of Low Probability of Failure (HCLPF) capacities
 - Post DC activities including COL action items, COL Holder action items to ensure assumptions, logic model and capacity analysis are consistently implemented in COL applications and COL Holders

ISG on PRA-Based Seismic Margin Analysis

- At COL application stage
 - Update DC PRA-based SMA to incorporate site-specific effect and plant-specific features
 - Evaluation of site-specific weak links
 - Post COLA activities
 - Seismic walk down to verify as-built SSC capacities
- Post-COLA stage under 50.71 (Not part of this ISG)
 - Need full seismic PRA before fuel load based on DC/COL-
ISG-03
 - PRA is to be available for inspection
 - Keeping PRA up-to-date



ISG Structure

1. Purpose
2. Basic Terms and Concepts
3. Background and Discussions
4. Applicability
5. Technical Positions
6. References

Technical Positions

- Positions on performance of a PRA-based seismic margin analysis for a DC application
 - Use design-specific information for logic model and fragility development
 - System analysis performed according to Capability Category I requirements of Section 5-2.3 of Part 5 of the ASME/ANS Ra-Sa-2009, to the extent endorsed by RG 1.200, except that the analysis should not be based on site-specific and plant-specific information, as well as reliance on as-built and as-operated plant
 - Develop seismic equipment list (SEL) to include SSCs for seismic sequences
 - Fragility analysis performed according to Capability Category I requirements of Section 5-2.2 of Part 5 of the ASME/ANS Ra-Sa-2009, with the exceptions as for system analysis, and:
 - Can use Separation of Variable or Conservative Deterministic Failure Margin (CDFM)
 - Spectrum shape is defined as DC's CSDRS

Technical Positions

- Generic data can be used with adequate justifications
- Sequence-level HCLPF calculated using mean fragility curve (corresponding to 1% failure probability)
- Plant-level HCLPF shall be the lower bound of the sequence-level HCLPF
- Demonstrate Plant-level HCLPF to be 1.67 times the CSDRS PGA
- Peer review in accordance with Part 5 of ASME/ANS PRA standard
- Post DC activities
 - COL action items to ensure the DC design-specific PRA-based SMA will be updated to incorporate site-specific effects (soil liquefaction, slope failure etc.) and plant-specific features (safety related site-specific structures), to update SEL using the site-specific GMRS scaled by a factor of 1.67, and to demonstrate plant-level HCLPF capacity to be 1.67 times GMRS
 - Post-COL action items - COL Holder to verify the plant/sequence level HCLPF capacity based on the as-designed, as-built configuration of the plant prior to the initial loading of fuel

Technical Positions

- Positions on update of DC SMA by COL applications
 - Use site-specific and plant-specific information for updating logic model and fragility development
 - Part 5 of the ASME/ANS Ra-Sa-2009, to the extent endorsed by RG 1.200, except that the updates should not be based on as-built and as-operated plant
 - Site-specific fragility analysis uses GMRS spectrum shape
 - Fragility for seismically-induced liquefaction can use EPRI report - Seismic Fragility Application Guide with the limit state defined in terms of the allowable settlements specified in the referenced DC
 - Generic data can be used to support fragility analysis, but require justifications (consistent or conservative with applicable to the site- and plant-specific information of SSCs)
 - Demonstrate updated sequence-level and plant-level HCLPF to be 1.67 times the site-specific GMRS PGA

Technical Positions

- Should plant-level HCLPF be less than 1.67 time GMRS PGA, two options are acceptable:
 - the COL identifies the affected SSCs and upgrade their capacity to ensure the plant level HCLPF capacity be maintained at the level of 1.67 times GMRS PGA or,
 - the COL performs full convolution of sequence fragility for all sequences with the site mean hazard curve to develop risk metrics to demonstrate that the seismic risk is acceptably low for the licensed plant, which will be reviewed and accepted on a case-by-case basis
- Post COL application activities including updating COL Holder items for verification of as-built plant HCLPF capacity and updating FSAR

Technical Positions

- Positions on post COL verifications
 - COL Holder perform the plant SSC capacity verification:
 - demonstrate that the plant/sequence level HCLPF capacity is consistent with the COL license conditions provided in accordance with the COL Holder action items
 - Using as-designed, as-built plant
 - Walkdown process as described EPRI NP-6041 can be used for the capacity verifications
 - Demonstrate plant-specific HCLPF to be 1.67 times the site GMRS

Technical Positions

- Position on documentation (Part 5 of ASME/ANS PRA Standard)
 - DC Application includes:
 1. seismic accident initiation events,
 2. a summary of the operating modes, accident sequences and event/fault trees, damage levels considered in the analysis,
 3. (the definition of the response spectrum shape utilized for the fragility analysis of SSCs, accident sequences and plant,
 4. identification of the methods used to calculate sequence level and plant level HCLPFs for the sequences, operating modes and damage levels considered,
 5. a table with the capacities, e.g., in terms of the median and logarithmic standard deviation of the fragilities, for the SSC in SEL,
 6. a summary description of the methods used for the derivation of the component fragilities including a summary description of how the component probability of failure is related to the ground motion parameter,
 7. for equipment in SEL which is qualified via tests, a description of procurement specification including the enhanced RRS as described in Section 5.1.2 of this ISG to ensure appropriate HCLPF capacity of the procured equipment
 8. risk significant SSC, dominant cut-sets and sequences, seismic event/fault trees,
 9. sequence-level and plant-level HCLPF capacities for the operating modes and damage levels,
 10. Independent peer review
 11. analysis assumptions, COL action items, interface items, and COL Holder action items.

Technical Positions

- COL Application referencing a DC includes:
 1. updated seismic initiating events based on available site- and plant-specific information if the COL application references a design certification,
 2. identification of site-specific effects and plan-specific features including those that correspond to single event sequences,
 3. a summary of the systems model update for incorporating site-specific plant features and site-specific effects if the COL application references a design certification,
 4. a table with the HCLPF capacities for the effects and features in item (2) of this list expressed in terms of the site GMRS for the COL scope,
 5. a list of those cases, e.g., sequences, for which there is no significant change from the certified design PRA-based seismic margin analysis,
 6. updated sequence level and plant level HCLPF capacities for those cases with significant change from the certified design PRA-based seismic margin analysis if any,
 7. Site hazard information if the option 2 in Section 5.2.3 is performed and risk metrics are calculated
 8. COL Holder action items and interface requirements to be verified prior to initial fuel loading.

Implementation Schedules

- Draft ISG issued for public comments (10/09)
- Staff will finalize ISG during November and early December 2009
- Aiming at officially issuing the ISG in mid February 2010.