Draft Interim Staff Guidance on NRC SMA for Use in Recommendation 2.1 Evaluations

September 11, 2012
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Reasons for Including NRC-SMA

- **Recommendation 2.1 50.54(f) letter considers use of either Seismic PRA (SPRA) or NRC Seismic Margin Analysis (SMA) appropriate for plant evaluations if hazard screening criteria are not met**
- **NRC-SMA outlined in the 50.54(f) is an enhanced approach from the original NRC-SMA**
- **NRC-SMA is a fault-space based approach using PRA system logic but limiting analysis to two seismic initiators; transient and small LOCA**
- **Approach is capable of providing risk insights and suitable for sites with lower seismic hazard. SMA is not suitable for high hazard sites**
- **Because of the fault-space based model, the NRC-SMA approach can be easily extended to more detailed PRA type of analysis, if needed**

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Outline of the Draft Interim Staff Guidance (ISG)

- Purpose
- Basic Terms and Concepts
- Background, Overview and Issues Related to Seismic Margin Methods
- Staff Position on Individual Technical Issues
- Documentation
- Peer Review Attributes, Activities, and Documentation

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Purpose

- **Supplemental guidance to nuclear power reactor licensees on an acceptable method for performing a Seismic Margin Assessment (SMA) as referred to in the March 12, 2012 NRC letter**

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Background on NRC-SMA

- NRC-RES supported the Seismic Safety Margin Research Program (SSMRP) in late 1970s and early 1980s
- As the SSMRP was wrapping up, ACRS raised the question of actual seismic margin beyond design basis
- NRC formed an expert panel to address the question of seismic margin (early 1980s)
- NRC expert panel addressed easier task and defined the following analysis approaches:
  - review the plant against a specific earthquake level (i.e., SME) and determine whether plant has a high confidence of low probability of failure for SME (this earthquake level is called review level earthquake (RLE) in this ISG)
  - if less than SME, then calculate the plant "high-confidence low probability of failure (HCLPF)" capacity of individual SSCs and ultimately of the plant-as-a-whole

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Background on NRC-SMA

- The expert panel used insights from the then available SPRAs as follows:
  - Retained fault-space based approach
  - Only focused on selected functions, simplifying logic structure significantly
  - Introduced screening tables for use in conjunction with the specified RLE
  - Developed min-max approach to calculate sequence/plant HCLPF
- NRC Method published in NUREG/CR-4334 (1985) followed by NUREG/CR-4882 and NUREG/CR-5076
- Maine Yankee trial application, NUREG/CR-4826

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Reasons for Enhancements

Reasons for the NRC enhancements for this ISG are as follows:

- To define the scope of analysis needed for information requested in 50.54(f) letter
- To provide staff positions on the major elements of SMA
- To update references to allow use of the recent advances in methods and guidance
- To incorporate references to applicable provisions of the ASME/ANS standard and positions of industry (SPID) endorsed by the NRC

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Staff Positions on Technical Issues

SMA Scope 4.2	• Addition of certain containment functions and systems to assess large early release • HCLPF capacities for core-damage and large early release sequences • Separate analysis of HCLPF capacities of sequences with and sequences without non-seismic failures and human errors • Chatter analysis and treatment of high-frequency response of certain SSCs
Ground Motion and In-Structure Response 4.3	• Selection of the Review Level Earthquake • Soil failures • Development of in-structure response spectra • Median seismic responses of systems and components
Systems Analysis 4.4	• Enhancements to the PRA-type systems SMA model beyond those in the original guidance • “Mission time” for the accident analysis • Selection of the Seismic Equipment List
Fragility and Capacity 4.5	• Plant walkdown methodology • Screening approach and level for SSCs • Fragility analysis method for evaluation of the HCLPF capacity of an SSC • CDFM method for evaluation of the HCLPF capacity of an SSC
SMA Integration 4.6	• Plant margin evaluation using the Convolution Method for sequence-level and plant-level HCLPF capacity • Guidance on using the “Min-Max” method for sequence-level and plant-level HCLPF capacity

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SPID Approach

- Screening, Prioritization, and Implementation Details (SPID) Guide
  - Being developed by industry with NRC interactions
  - Objective is to be endorsed by NRC and published by November
- Some elements of SPID are applicable to the draft ISG and are incorporated and referenced in staff positions

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Proposed Key Positions

RLE:	The RLE to be used in the SMA is the envelope of the SSE and the Ground Motion Response Spectra (GMRS) over the entire frequency range.
Initiating events:	Transient and small LOCA with unrecoverable loss of offsite power Mission time: Extended to 72 hrs. or stable state,
Scope of functions:	Group A functions (Shutdown chain reaction plus injection-phase early core cooling) + emergency core cooling late involving recirculation and switchover phase + containment heat removal + containment over-pressure protection (early) + containment integrity (penetration and isolation).

Containment structural failure modes: Need not be included

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Proposed Key Positions

Non-seismic failures:	To be included explicitly
Human actions:	To be included explicitly
Screening of SSCs*:*	EPRI-NP-6041-SL Rev.1, other recent refs. SPID position
Plant walkdown:	EPRI NP-6041- SL Rev.1, ASME/ANS Part 10, HLR-SM-D
Responses:	ASME/ANS Part 10, SM-C1 to SM-C4 and SPID
Seismic margin (SSCs):	Fragility method: Section 5-2.2 of Part 5 of the ASME/ANS Part PRA Standard, also SPID provision of using CDFM with generic β
	CDFM method: Section 10-2 of ASME/ANS Part 10, EPRI Guidance

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Key Positions Under Consideration

High-frequency components :	Treated through test program
Soil failure modes:	To be included as applicable
Sequence/Plant HCLPF:	Convolution approach
	Min-Max method acceptable with justification
Documentation:	As per ISG-20 and position of SPID on sequences before screening of components
	HCLPFs for leading sequences separately for core damage and large release
	HCLPFs for sequences separately with and without non-seismic failures
Peer review:	Participatory review

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Next Steps

- Draft ISG for public comments issued on _____
- Receive public comments after 30 days
- Issue final ISG by November