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NRC Perspective on PSHA Model Updates

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Overview

- Background
- Recent updates to EPRI-SOG PSHA model
- Relevant NRC guidance
- NRC perspective on PSHA updates
- Summary

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Background

- EPRI-SOG seismic source model has been used extensively for CEUS sites
- Model developed by six earth-science teams during mid 1980s
  - Source Interpretations were equally weighted in EPRI-SOG PSHA
- Final report for EPRI-SOG model stated that source interpretations are:
  - "considered suitable, with appropriate site-specific consideration, for application of the SOG methodology during the next five to ten years"
- NRC's Safety Evaluation Report endorsing the EPRI-SOG model indicated it should be updated every 10 years

Background (Continued)

- Since the EPRI-SOG PSHA, there have been no major EPRI-coordinated updates to the model
  - Exception: EPRI 2003 ground motion attenuation model update
- Updates to EPRI-SOG source model have been performed as part of several recent ESP and COL applications
- Many RAIs and open items during NRC review of ESP applications have been related to EPRI-SOG PSHA source characterization

Recent Updates to EPRI-SOG PSHA Model

- EPRI 2003 ground motion attenuation model update (SSHAC Level 3) based on:
  - New data and ground motion models available for ENA
  - Recent developments related to uncertainty assessment
- Clinton ESP (SSHAC Level 1)
  - Overlapped the characteristic New Madrid Seismic Zone (NMSZ) model on original EPRI-SOG aerial source model
  - Maximum magnitudes for Wabash Valley and Central Illinois Seismic Sources

Updates to EPRI-SOG PSHA Model (Continued)

- Grand Gulf ESP (SSHAC Level 1)
  - Added Saline River Source Zone to EPRI-SOG model
  - Overlapped the characteristic NMSZ model on original EPRI-SOG aerial source model
- Vogtle ESP (SSHAC Level 2)
  - Replaced existing EPRI Charleston seismic source zone interpretations with new source zone (geometry, maximum earthquake magnitude, earthquake recurrence)
- North Anna ESP (SSHAC Level 1)
  - Adopted USGS Charleston Seismic Source Model

Relevant NRC Guidance

- RG 1.208 states the following regarding performing updates:
  - PSHA models accepted by the NRC in past licensing decisions may be used as a starting point
  - New information related to a seismic source that impacts the hazard calculations must be evaluated
  - Evaluation may need to include (but not limited to) seismic source characterization, ground motion attenuation relationships and other PSHA-related contents

Relevant NRC Guidance (Continued)

- Characteristics to be evaluated for seismic sources (Appendix C to RG 1.208):
  - Seismic source location and geometry
  - Earthquake recurrence for each seismic source
  - Maximum earthquake for each seismic source
- Evaluation of new information (RG 1.208):
  - Determine whether new information is consistent with range of previous EPRI-SOG interpretations
  - PSHA should be updated if new information indicates current version of seismic source model underestimates hazard or if new attenuation relationships are available
  - Perform sensitivity studies to demonstrate existing PSHA database envelops the new information

Relevant NRC Guidance (Continued)

- Updating seismic sources (RG 1.208):
  - Updates should follow the guidance of NUREG/CR-6372 (SSHAC)
    - "However, if an outlier interpretation persists, it is our firm belief—in agreement with the SSHAC—that the approaches outlined will allow for essential downweighting of that interpretation. This is preferable to the stiff adherence to an equal weighting scheme, which can result in the final seismic hazard being driven by a single outlier input." (Sponsor's Perspective)

Relevant NRC Guidance (Continued)

- Updating seismic sources (RG 1.208) (continued):
  - More specific guidance for identification and characterization of seismic sources (Regulatory Position 2.2, 2.3, & Appendix C)
    - 2.2: Use of Alternative Seismic Sources
    - 2.3: Characterizing Seismic Potential
    - Appendix C: Investigations to Characterize Site Geology, Seismology & Geophysics
  - Currently, no detailed guidance on acceptable approaches to modify existing PSHA models

NRC Perspective Related to Updates

- Types of new information:
  - Paleoliquefaction data & interpretations, new earthquakes, etc.
  - PSHA studies (including seismic source characterization and ground motion models)
  - Re-interpretations of existing data
  - Methods to determine seismic source parameters
  - Guidance related to uncertainty and use of experts (e.g. SSHAC studies)
- Evaluation of new information
  - Comparison of new information with relevant seismic source parameter (M_{max}, P_A, geometry, recurrence) with each EPRI team
  - Important to also consider parameter distributions (weighting) as part of the comparison

NRC Perspective Related to Updates (Continued)

- Evaluation of new information (continued)
  - Outlier interpretations in any of the EPRI-SOG EST interpretations should be carefully evaluated in terms of impact on rock UHS
  - Examples of types of sensitivity calculations:
    - Comparison of hazard curves by source for each team to evaluate total contribution to the hazard
    - PSHA sensitivity calculations with modified seismic source parameters or ground motion models
      - E.g. Clinton ESP application

NRC Perspective Related to Updates (Continued)

- Updating existing seismic sources
  - Updates to PSHA model are necessary if incorporation of new information would result in a significant impact on rock UHS
  - Updated PSHA model should represent the range of current understanding of seismic source parameters (and ground motion models) of the informed technical community
  - Acceptable approaches (with adequate justification):
    - Down-weight existing team's interpretations (if outlier interpretation)
    - Addition of new teams (e.g. new PSHA studies)
    - Modify or replace individual source zones of existing teams

Summary

- RG 1.208 provides some guidance regarding evaluation of new information in context of PSHA database
- Additional guidance is needed related to evaluating new information and performing updates to existing PSHA models
- Outlier interpretations in existing PSHA models (e.g. EPRI-SOG EST interpretations) should be carefully evaluated
- New or updated PSHA models should represent a composite understanding of the present-day informed scientific community