

US NRC Approach for Seismic Hazard Assessments

INTERNATIONAL WORKSHOP ON LESSONS LEARNED
FROM STRONG EARTHQUAKES

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Overview

- NRC Framework
- Key NRC documents on Probabilistic Seismic Hazard Assessment (PSHA) methods
- New NRC initiatives to update PSHA tools for Central and Eastern US



NRC Framework

- In 1998, the Commission issued a policy decision to move towards a risk-informed and performance-based regulatory framework
- Risk-informed frameworks use probabilistic methods and require not only a specification of “what can go wrong”, but also “how likely is it”. Deterministic methods provide no explicit information about how likely the events are.
- The overall goal is hazard assessments that are accurate, defensible, and lead to regulatory stability



US NRC Objectives for PSHA

- The NRC objective is to produce a defensible, unbiased estimate of the mean seismic hazard at a specified site.
- Because the mean seismic hazard is sensitive to uncertainties in the component pieces that together form the hazard model, as secondary objective is to reduce uncertainties through strong scientific research.



US NRC Objectives for PSHA

- A modern, detailed PSHA includes:
 - All relevant uncertainties
 - The range of diverse technical interpretations that are consistent with the available data
 - Any site-specific data and knowledge
 - Clear and complete documentation
 - A detailed peer review process



US NRC Key Guidance on PSHA

- Regulatory Guide 1.208 (March 2007)
 - Guidance on undertaking site-specific PSHA
- NUREG/CR-6372
 - Provides a framework for undertaking large, complex, or regional PSHA
- NUREG/CR-6728
 - Integrates site response into PSHA methods
- Publically available at www.nrc.gov



US NRC Key Guidance on PSHA

- Regulatory Guide 1.208 (March 2007)
 - “A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion”
 - Basis of NRC risk-informed, performance-based approach for analysis and design
 - Probabilistic framework for development of site-specific ground motion response spectra with the 10^{-4} to 10^{-6} annual probabilities of exceedance
 - Clarifies and defines various response spectra related to framework for Certified Designs



US NRC Key Guidance on PSHA

- NUREG/CR-6372
 - “Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts”
 - Commonly called the “SSHAC guidelines”
 - Provides framework for undertaking large PSHA
 - Used in recent large assessment projects
 - Yucca Mountain PSHA
 - Yucca Mountain PVHA
 - PEGASOS study in Switzerland
 - Currently developing additional recommendations for application of the guidelines



US NRC Key Guidance on PSHA

- NUREG/CR-6728
 - “Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-consistent Ground Motion Spectra Guidelines”
 - Discusses framework for developing ground motions spectra; including for sites that must consider site response
 - NRC Currently undertaking research on various methods to incorporate site response directly into PSHA (implementation of framework)



New US NRC Projects to Assess Seismic Hazard in Central and Eastern US

Source Characterization →

Central and Eastern US Seismic Source Characterization project for Nuclear Facilities (CEUS SSC)

Ground motion prediction equations →

Next Generation Attenuation Relationships for the Central and Eastern (NGA-East)

Framework for large PSHA studies →

Recommendations for Application of the SSHAC Guidelines



Recommendations for Application of the SSHAC Guidelines

- Developing companion document to NUREG/CR-6372
- Provides framework for undertaking large PSHA using multiple levels of complexity
- Provides unbiased representation of the informed scientific community's view of the technically supportable interpretations of the important input components (both data and models), as well as the site-specific hazard.
- Incorporates uncertainty to provide an unbiased estimate of the mean and range of hazard levels.
- Leads to long-term regulatory stability by assessing and weighting all scientifically supportable interpretations



Recommendations for Application of the SSHAC Guidelines

- New project created to develop practical recommendations for application of the SSHAC guidelines
 - Lessons learned
 - How and when to update
 - Understanding and characterizing uncertainties (epistemic and aleatory)
- Will develop a NUREG document to accompany the SSHAC guidelines



Central and Eastern US Seismic Source Characterization project for Nuclear Facilities

- Major study with participation from NRC, DOE, EPRI, USGS, and other US specialists
- NRC SSHAC guidelines level-3 study
- 3 year project starting summer 2008
- Project to develop a seismic source database for the CEUS to be used as a baseline for all PSHA
- NPP applications will still study local sources
- Coordinating a CEUS SSC “International Observers Program” to allow international specialists to observe the US project firsthand



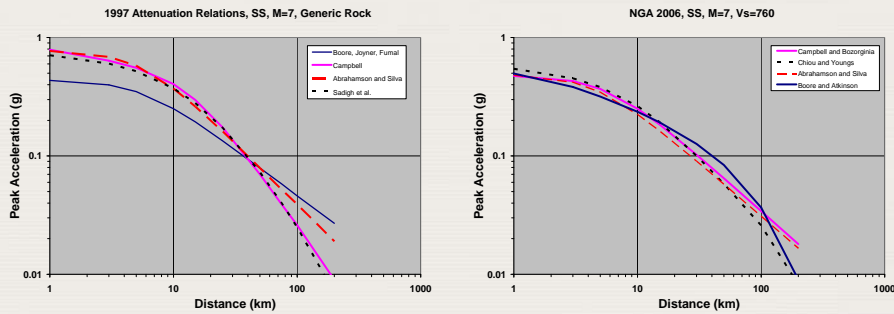
Next Generation Attenuation Relationships for the Central and Eastern US (NGA-East)

- Follows and expands the framework of the successful NGA project recently completed for California
- Will develop a set of state-of-the-art ground motion prediction equations (attenuation relationships) for the CEUS
- Sponsored by multiple US agencies, led by the NRC
- Combined with the source database of the CEUS SSC project, will allow for highly advanced state-of-the-art PSHA to be undertaken in the CEUS and will bring long-term regulatory stability



Next Generation Attenuation Relationships for the Central and Eastern US (NGA-East)

Before NGA-West After



Significant reduction in uncertainty



CONCLUSIONS

- US NRC uses a probabilistic risk-informed performance-based framework for assessing seismic hazard
- Several publically-available documents are in use currently and more are in development
- The NRC has initiated several large integrated multi-year, multi-agency projects to create the next generation of state-of-the-art seismic hazard assessment tools for the CEUS

