



**The Central and Eastern United States
Seismic Source Characterization for
Nuclear Facilities Project (CEUS-SSC):
Updating Seismic Source Models for the
Next Generation of Critical Facilities**

Jon Ake
U.S. NRC Office of Nuclear Regulatory Research
Regulatory Information Conference
March 11, 2009

1



Outline

- Regulatory Background
- Existing Seismic Hazard Models
- Senior Seismic Hazard Analysis Committee (SSHAC) Report
- Need for a new study
- Scope and Status
- Summary

2



**Seismic Hazards-Safe Shutdown
Earthquake (SSE)**

• **Deterministic**
The earthquake which would cause the maximum vibratory ground motion at the site. Defined by peak ground acceleration (*pga*) and standardized response spectra.
(10 CFR Part 100 Appendix A)

• **Probabilistic**
Probabilistic seismic hazard analysis (PSHA) incorporates the effects of all earthquakes capable of affecting the site including uncertainty.
(10 CFR Part 100.23, 1997-present)

3



Current Regulatory Guidance

- Regulatory Guide 1.208 provides general guidance on procedures acceptable to NRC staff to satisfy 10 CFR 100.23.
 - Perform a PSHA (incorporating uncertainty)
 - Conduct site and region specific geoscience/geotechnical investigations
 - Allows use of EPR or LLNL probabilistic seismic hazard models as a starting point

4



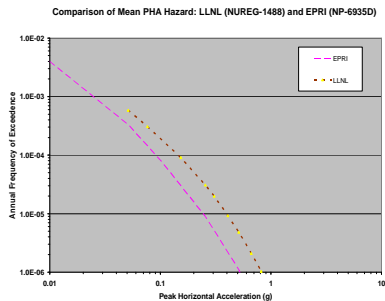
Previous PSHA Studies

- The NRC began using PSHA in the early 1980's as a tool to better understand deterministic seismic hazard assessments (and associated uncertainties) and input for risk-informed and performance-based safety evaluations.
- Two major PSHA regional-scale studies were performed in the 1980's and early 1990's, EPR-SOG (1986,1989) and LLNL (1985, 1993).
- Both were *multi-studies* (multiple years, multiple millions of \$, multiple experts, multiple feet of bookshelf space for documentation).
- Defined the state of the art at the time.

5



However,



6



Senior Seismic Hazard Analysis Committee (SSHAC)

- A group of senior experts assembled to evaluate the differences between the EPRI and LLNL studies and provide guidance on the conduct of PSHA.
- Concluded the differences in the results were primarily procedural rather than technical. The report focused on the appropriate use of experts (NUREG/CR-6372).
- The guidance has now been used for several major studies (Yucca Mountain (2), Swiss PEGASOS study, EPRI ground motion update, BC Hydro).

7



SSHAC Methodology

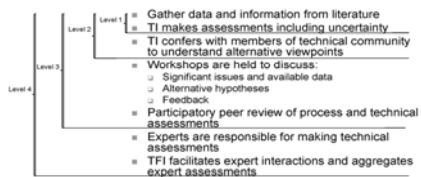
- Provides a framework for incorporating scientific assessments
 - > The views of the larger scientific community are fundamental (Goal to incorporate the center, body and range of the Informed Technical Community (ITC))
 - > Competing scientific hypotheses can be compared and uncertainties captured
 - > Leads to defined expert roles (Focus on evaluation and integration) and an emphasis on expert interaction
 - > Results represent a snapshot in time

8



SSHAC Framework

SSHAC Study Levels



Courtesy of K. Coppersmith

TI: Technical Integrator
TFI: Technical Facilitator Integrator

9



The Need for a New CEUS-SSC Model

- A need exists for a fully updated generic seismic source model for the CEUS that post dates issuance of 10 CFR 100.23.
- More than 20 years have past and significant new research results exist that are not represented in the original EPRI/LLNL models.
- Recent COL applications have used the EPRI model with updates. Expense and consistency of updates to the existing PSHA source model is an issue.
- The existence of multiple hazard models (LLNL, EPRI, USGS) is problematic.
- A model that meets the needs of multiple users/sponsors/regulators would be of great value.

10



The CEUS-SSC Project

- Multiple sponsors (Industry/EPRI, DOE, NRC)
- Conducted as a SSHAC Level 3 with a TI team, PPRP, and sponsor reviewers.
- Large pool of experience represented.
- Major emphasis on the compilation of a data base of relevant seismological, geological, geophysical, and tectonic information.
- SSC: where earthquakes will occur, how big will they be, and how often will they happen.

PPRP: Participatory Peer Review Panel

11



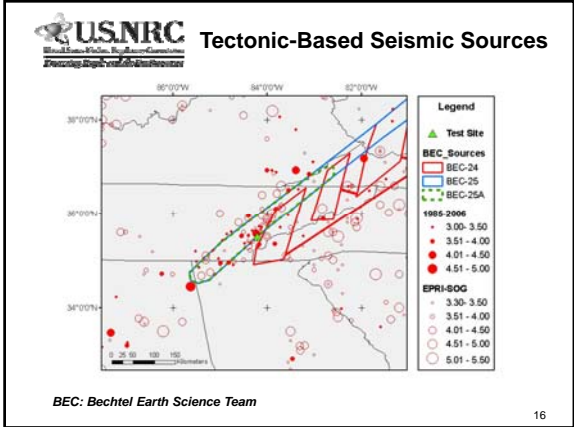
Earthquakes and NPPs

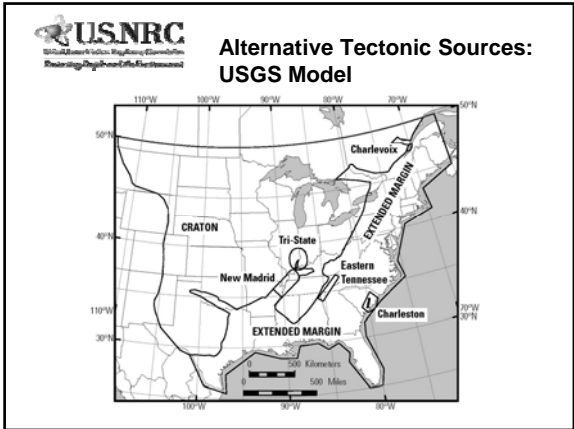
USGS Catalog of Felt/Damaging Earthquakes in the USA 1568 - 2004

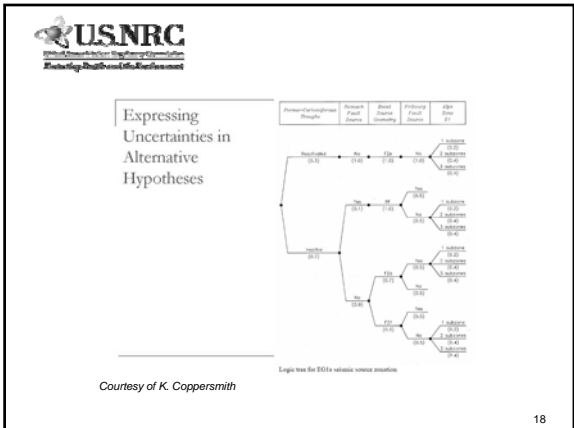


△ Nuclear power plant locations

12









CEUS-SSC Results

- Results will be a SSC Model (where, how big and how often). Must be used with Ground Motion Prediction Model to produce hazard estimates.
- To use for site licensing, applicable regulatory guidance (e.g. NRC R.G. 1.208) should be followed. Involves augmenting CEUS-SSC model with site specific evaluation within region (200 mile radius) and site vicinity (25 mile radius).

19



SUMMARY: CEUS-SSC for Nuclear Facilities Project

- A major multi-sponsor Seismic Source Characterization project is currently underway. The results will replace the existing EPRI-SOG and LLNL source models.
- The major objectives are to provide stability (public confidence that the views of the larger ITC have been represented) and longevity (technical framework remains valid in the future, even as new information becomes available).
- Broad participation from industry, NRC, DOE, USGS, academia.
- Target completion date of late-2010.

20
