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Central and Eastern United States Seismic Source Characterization Project
Frequently Asked Questions

What were the roles of the three project sponsors?

The Central and Eastern United States (CEUS) Seismic Source Characterization study was sponsored by the Electric Power Research Institute (EPRI), the U.S. Department of Energy (DOE), and the U.S. Nuclear Regulatory Commission (NRC). The joint sponsorship of the study by both public and private sector representatives is unique for regional seismic hazard assessments in the United States. It signifies the recognition by the participants that they have common needs – a rigorous seismic source model that can be used for nuclear facility sites throughout the CEUS – and common goals of seismic hazard inputs that are stable and long-lived.

Technical experts from EPRI, DOE, NRC, U.S. Geological Survey (USGS), Defense Nuclear Facility Safety Board (DNFSB), nuclear power industry and academia participated in the study as part of the Technical Integration Team or as members of the Participatory Peer Review Panel. The sponsors also provided financial and technical reviewers who took part in project workshops and briefings.

How much did it cost to develop this model and how was that cost shared among the listed partners?

The cost of the Central and Eastern United States Seismic Source Characterization Project was approximately $7 million over four years. The cost was shared among EPRI, DOE and the NRC.

How was the model developed?

The Central and Eastern United States Seismic Source Characterization model was developed in accordance with the Senior Seismic Hazard Analysis Committee (SSHAC) process, which is described in detail in NUREG/CR-6372, *Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty in Use of Experts*. The SSHAC process ensures compliance with seismic regulations and properly quantifies uncertainties in seismic design basis for nuclear facilities. The fundamental goal of a SSHAC process is to effectively execute and completely document the activities of evaluation and integration, which are defined as:

- Evaluation: The consideration of the complete set of data, models and methods proposed by the larger technical community that are relevant to the hazard analysis.
- Integration: Representation of the center, body, and range of technically sound interpretations in light of the evaluation process, informed by the assessment of existing data, models, and methods.

How much additional data was used in developing the updated model versus the previous model? Was this simply new seismic data over the past 20 years or does it include additional historical data?

A major component of the project involved the updating of data, models, and methods for characterizing seismic sources in the Central and Eastern United States. This included development of a comprehensive project database and the participation of the seismic technical community. Also, considerable effort was

devoted to the development and incorporation of new methods for assessing key seismic source characterization parameters, such as maximum earthquakes, and for quantifying the spatial distribution of those parameters, such as spatial smoothing of activity rates. In addition to an updated seismic source characterization model that can be used for conducting seismic hazard analyses anywhere within the study region, the project resulted in a number of other products that have value for future users:

- Data Evaluation and Data Summary Tables that document the data considered by the project team and the team's views of the quality of the data and the degree of reliance placed on any given data set
- Database of Geologic, Geophysical, and Seismological Data
- Earthquake Catalog with Uniform Moment Magnitudes
- Updated Paleoseismicity Data and Guidance
- Recommendations for Future Applications of Seismic Source Characterization Model

Was this project undertaken as a result of the Fukushima incident or the recent East Coast earthquakes?

The Central and Eastern United States Seismic Source Characterization Project was not undertaken as a result of Fukushima or the 2011 East Coast earthquake. The project was conducted from April 2008 to December 2011 to replace the 1988 EPRI-Seismicity Owners Group (EPRI-SOG) seismic source characterization model and the 1989 Lawrence Livermore National Laboratory seismic source characterization model.

Will the model be updated again to reflect the seismic events since 2008, including the March 2011 Tohoku, Japan, earthquake and the August 2011 East Coast earthquake?

The catalog of earthquakes used in the Central and Eastern United States Seismic Source Characterization model covers the study region for the period from 1568 through the end of 2008. Should the model be updated again, the August 2011 Virginia earthquake will be included. The March 2011 Tohoku earthquake is not in the study region and occurred within a very different tectonic environment, so it does not have implications to the Central and Eastern United States Seismic Source Characterization model.

The Central and Eastern United States Seismic Source Characterization model represents the center, body and range of technical interpretations of existing data, models and methods. Because the range of uncertainties have been included in the model, it is unlikely that new earth sciences information will fall outside of that range. For example, the Virginia earthquake occurred within a region that had been recognized from past seismicity as being capable of future earthquakes (the region is called the "Central Virginia Seismic Zone") and the size of the earthquake was smaller than the maximum earthquake magnitudes assessed for this region. It is anticipated that new information will continue to be developed by the seismic community in the future and this information can be compared with the Central and Eastern United States Seismic Source Characterization model to assess whether there is any significance.

How does the model predict future seismic activity?

The Central and Eastern United States Seismic Source Characterization Project provides a regional seismic source model for use in Probabilistic Seismic Hazard Analyses (PSHAs) for nuclear facilities. A PSHA is an analytical methodology that estimates the likelihood that various levels of earthquake-caused ground motions will be exceeded at a given location in a future time period.

What Central and Eastern United States areas face the greatest seismic risk?

Demonstration hazard calculations were made at seven geographical test sites in different hazard environments to illustrate the effects that the seismic sources have on calculated seismic hazard. See Figure 8.1-1 for a map of the test sites. As noted above, a seismic hazard calculation determines the likelihood that various levels of earthquake-caused ground motions will be exceeded at a given location in a future time period. Chapter 8 presents the results from the demonstration hazard calculations.
A review of a Central and Eastern United States seismic hazard map would show that the largest predicted ground motions could occur in the vicinity of repeated large magnitude earthquake (RLME) sources, such as New Madrid, Missouri and Charleston, South Carolina. Other RLME sources are Charlevoix (lower St. Lawrence), Cheraw Fault (High Plains in southeastern Colorado), Meers Fault (southwestern Oklahoma), Reelfoot Rift – Marianna (Marianna, Arkansas; 75 km southwest of Memphis, Tennessee), Reelfoot Rift – Commerce Fault Zone (Tamms, Illinois to Qulin, Missouri) and Wabash Valley (Indiana and Illinois). See Figure 6.1-1 for locations and geometry of the RLME source zone.

How does this report relate to regulatory efforts underway?

The Central and Eastern United States Seismic Source Characterization model has been cited in the Draft NRC Generic Letter 2011-XX: Seismic Risk Evaluations for Operating Reactors, and the NRC Tier 1 Fukushima Response Draft Section 50.54(f) Letter for Recommendation 2.1 as a potential resource for reevaluation of the seismic hazards.

How can other (non-nuclear) parts of society use this new model?

Products from the Central and Eastern United States Seismic Source Characterization Project will benefit the U.S. National Seismic Hazard Maps developed by the U.S. Geological Survey. These maps are used by the building community to guide building design and by the insurance industry to conduct risk assessments. Those involved in the evaluation of dam safety can also benefit from the products of the Central and Eastern United States Seismic Source Characterization Project.

Which nuclear plants are included in the Central and Eastern United States region?
The Central and Eastern United States region encompasses those portions of the United States east of longitude 105°W (which passes through Denver, Colorado). This region is home to 62 existing sites with 96 commercial nuclear reactors, 22 potential new nuclear sites, and five Department of Energy nuclear facilities.

Why the Central and Eastern U.S. as opposed to the whole country?

The central and eastern United States (CEUS) is considered a stable continental region. This enables the CEUS Seismic Source Characterization model to be applied as a regional model to the nuclear reactors and facilities in this region. Sites in the western United States will need to develop site-specific seismic source characterization models for their use.

About EPRI
The Electric Power Research Institute, Inc. (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together experts from academia and industry as well as its own scientists and engineers to help address challenges in electricity generation, delivery and use, including health, safety and the environment. EPRI's members represent more than 90 percent of the electricity

generated and delivered in the United States, and international participation extends to 40 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

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