U.S. Regulatory Perspectives on Model Testing

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Seismic design for U.S. nuclear power plants is based on a safe shutdown earthquake (SSE), which currently is developed through a probabilistic seismic hazard analysis (PSHA). Confidence in the PSHA results is achieved by using a rigorous elicitation process, developed by the Senior Seismic Hazard Analysis Committee (SSHAC), to ensure the center, body, and range of available technical information is considered in the analysis (NUREG-2117). Extensive testing of PSHA models, however, currently appears impracticable and is not required by U.S. regulations to support development of the SSE.

In contrast, U.S. regulations for licensing a geologic repository for disposal of spent nuclear fuel (10 CFR Part 63) focus on a numerical analysis of repository performance through time. Probabilistic models used in this performance assessment have regulatory requirements to i) develop site-specific data and account for data uncertainty and variability; ii) evaluate alternative conceptual models that are consistent with current scientific understanding; iii) account for rare events that have $>10^{-8}$/yr likelihoods; and iv) provide the technical basis for models, such as comparisons made with outputs of detailed process-level models and/or empirical observations (e.g., laboratory testing, field investigations, and natural analogs). Although PSHAs include items i–ii and $>10^{-6}$/yr events typically are considered, a rigorous framework for model support (item iv) has yet to be developed for PSHAs. Nevertheless, U.S. NRC staff's 2011 review of the DOE license application for a proposed geologic repository (NUREG-2107) demonstrated that such regulatory requirements, including a clear framework to evaluate model support (item iv), can be implemented effectively and used to support safety decisions involving natural hazards. In this instance, support for natural hazard models relied heavily on comparisons to results from detailed process models, and comparison with empirical observations from reasonably analogous natural systems.

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