

the NRC by inhibiting needed latitude in judgment [and] [it] has inhibited the flexibility needed in applying basic principles to new situations.” This commenter asked for an explanation as to how and when latitude and flexibility in judgment and in applying basic principles to new situations because geoscience assessments were specified in detail in a regulation, were inhibited.

*Response:* The current regulation (§ 72.102) requires that for areas of known potential seismic activity, seismicity will be evaluated by the techniques of appendix A to part 100. appendix A contains both requirements and guidance on how to satisfy the requirements. For example, Section IV, “Required Investigations,” of appendix A, states that investigations are required for vibratory ground motion, surface faulting, and seismically induced floods and water waves. Appendix A then provides detailed guidance on what constitutes an acceptable investigation. Such investigations require considerable latitude in judgment. This latitude in judgment is needed because of limitations in data and rapidly evolving state-of-the-art geologic and seismic analyses.

However, having geoscience assessments detailed and cast in a regulation has created difficulty for applicants and the NRC in terms of inhibiting the use of needed latitude in judgment. Also, it has inhibited flexibility in applying basic principles to new situations and the use of evolving methods of analyses (for instance, probabilistic) in the licensing process.

As an example, a prescriptive requirement of applying the capable fault criteria (see part 100, appendix A, § III(g)) to sites in California meant conducting investigations and analyses for surface rupture potential. If a fault does not cause a surface rupture (blind fault), the fault would not be considered a capable fault under the appendix A criteria, and thus would not be considered in determining the DE. This would lead to seismic hazard at a facility which would be not conservative. This has been demonstrated by the occurrences of the 1989 Loma Prieta, 1992 Petrolia, and 1994 Northridge earthquakes during which the causative faults did not rupture ground surface. On the other hand, the young faults, the last movements of which may satisfy the appendix A criteria for classifying them as capable faults, may not be capable faults in the true meaning of the criteria because the most recent displacements on them may be related to non-tectonic natural phenomena. In this case, use of

the appendix A criteria would lead to a finding of seismic hazard at a facility which would be overly conservative. Inclusion of detailed criteria or specific numbers in the regulation prevents a scientific evaluation of methodologies and approaches that advance with the state of the art, and the rule eventually becomes a hindrance to the exercise of rational judgement.

#### *Address Uncertainties and Use Probabilistic Methods*

*Comment 15:* A commenter urged revision of § 72.103 to continue to allow an applicant located in the western U.S. or in areas of known seismic activity in the eastern U.S., and not co-located with an NPP, to use a deterministic analysis similar to the analysis specified in appendix A to 10 CFR part 100, for developing design earthquake ground motions because a utility may decide to perform seismic hazards analysis on deterministic bases that are more conservative than the proposed rule.

*Response:* In using the deterministic approach for determining a SSE for a nuclear reactor site embodied in appendix A to 10 CFR part 100, there have often been differences of opinion and differing interpretations among experts as to the largest earthquakes to be considered and ground-motion models to be used. This often makes the licensing process relatively unstable. Over the past decade, analysis methods for incorporating these different interpretations have been developed and used. These “probabilistic” methods have been designed to allow explicit incorporation of different models for zonation, earthquake size, ground motion, and other parameters. The advantage of using these probabilistic methods is the ability to incorporate different models and different data sets and weight them using judgments as to the validity of the different models and data sets. This process provides an explicit expression for the uncertainty in the ground motion estimates and a means of assessing sensitivity to various input parameters.

Section 72.103 explicitly recognizes that there are inherent uncertainties in establishing the seismic and geologic design parameters and requires the use of a probabilistic seismic hazard methodology capable of propagating uncertainties to address these uncertainties. The rule further recognizes that the nature of uncertainty and the appropriate approach to account for it depend greatly on the tectonic regime and parameters, such as the knowledge of seismic sources, the existence of historical and recorded data, and the understanding of

tectonics. Therefore, methods other than the probabilistic methods, such as sensitivity analyses, may be adequate for some sites to account for uncertainties.

Consistent with § 100.23 for an NPP, § 72.103 does not allow the use of the deterministic methods in appendix A to 10 CFR part 100, to determine the DE because the deterministic methods do not account for the uncertainties in the seismic hazard analysis. However, § 72.103 allows the applicant to use methods other than the probabilistic methods, such as sensitivity analyses, to account for uncertainties. Additionally, § 72.103 allows a utility applying for a specific license for an ISFSI co-located at an NPP, the option of using the seismic design criteria of the NPP, which may be based on the deterministic methods of appendix A to 10 CFR part 100.

For these reasons, the NRC declines to amend § 72.103 as suggested by the commenter. However, a utility applying for a specific license for an ISFSI co-located at an NPP has the option of using the seismic design criteria of the NPP.

*Comment 16:* A commenter stated that the use of the term “uncertainty” in the Background section of the proposed rule (67 FR 47746) is ambiguous, and suggested that the term be revised to “aleatory uncertainty”. The commenter stated that the report “Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts,” NUREG/CR-6372 (SSHAC), distinguishes between “aleatory” and “epistemic” uncertainties. The deterministic approach can explicitly recognize epistemic uncertainty just as in the probabilistic approach. The deterministic approach does not explicitly include all components of aleatory variability. The commenter noted that sensitivity analyses are generally intended for addressing epistemic uncertainty, not aleatory variability.

*Response:* Despite extensive advances in seismic knowledge in recent years by a large and active community of researchers around the world, there are still major gaps in the understanding of the mechanisms that cause earthquakes. These gaps in understanding mean that in any seismic hazard analysis, either deterministic or probabilistic, there are inevitably significant uncertainties in the numerical results. These uncertainties can be classified into two different categories: (1) epistemic uncertainty which is due to lack of knowledge because the scientific understanding is imperfect for the