

Establishing Seismic Design Criteria and Updating a Hazard Analysis for the 10 year Review

NPH Break-Out
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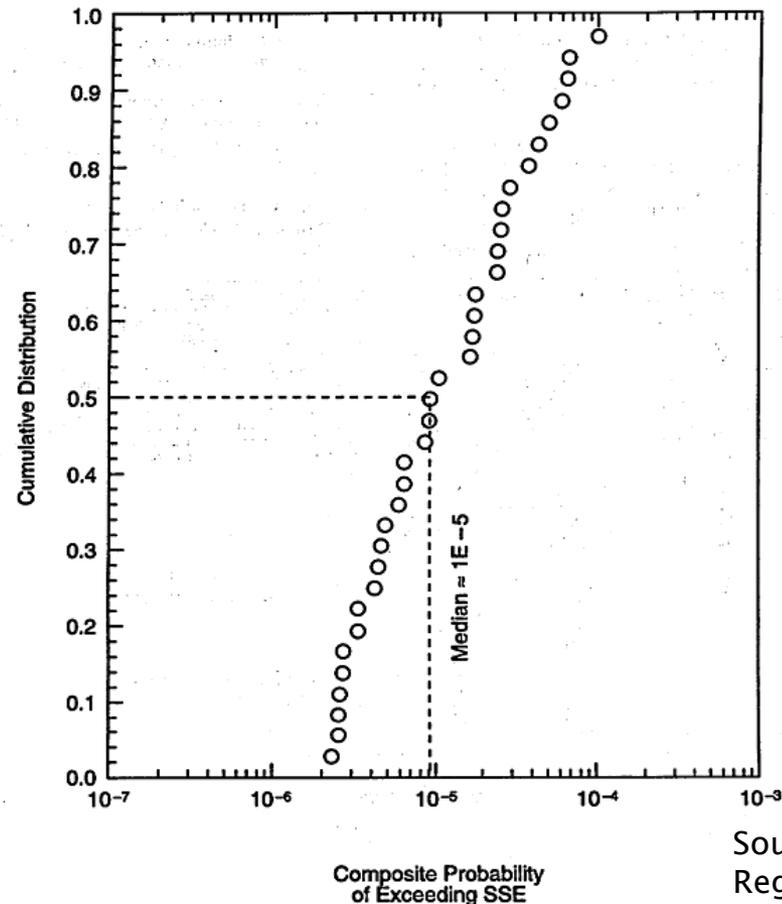
"Structurally, the building is fine. But sadly, the earthquake destroyed all of our art pieces."

Deterministic Hazard Ignores Rate

- ▶ Attempts to capture it awkwardly by calling it “maximum” or “worst case.”
- ▶ Intermixed with notions of conservatism, which are useful in design, not in hazard
- ▶ Leads to unequal risk for given deterministic hazard
 - Example: Fleet of existing NPPs in the US

Legacy of Deterministic Assessments of SSEs

- ▶ All SSEs defined deterministically
- ▶ Probabilistic seismic hazard carried out post-facto
- ▶ Annual probability of exceeding SSE varies by nearly two orders of magnitude
- ▶ Difficult to claim uniform risk across inventory of plants



Source: USNRC
Reg Guide
1.165

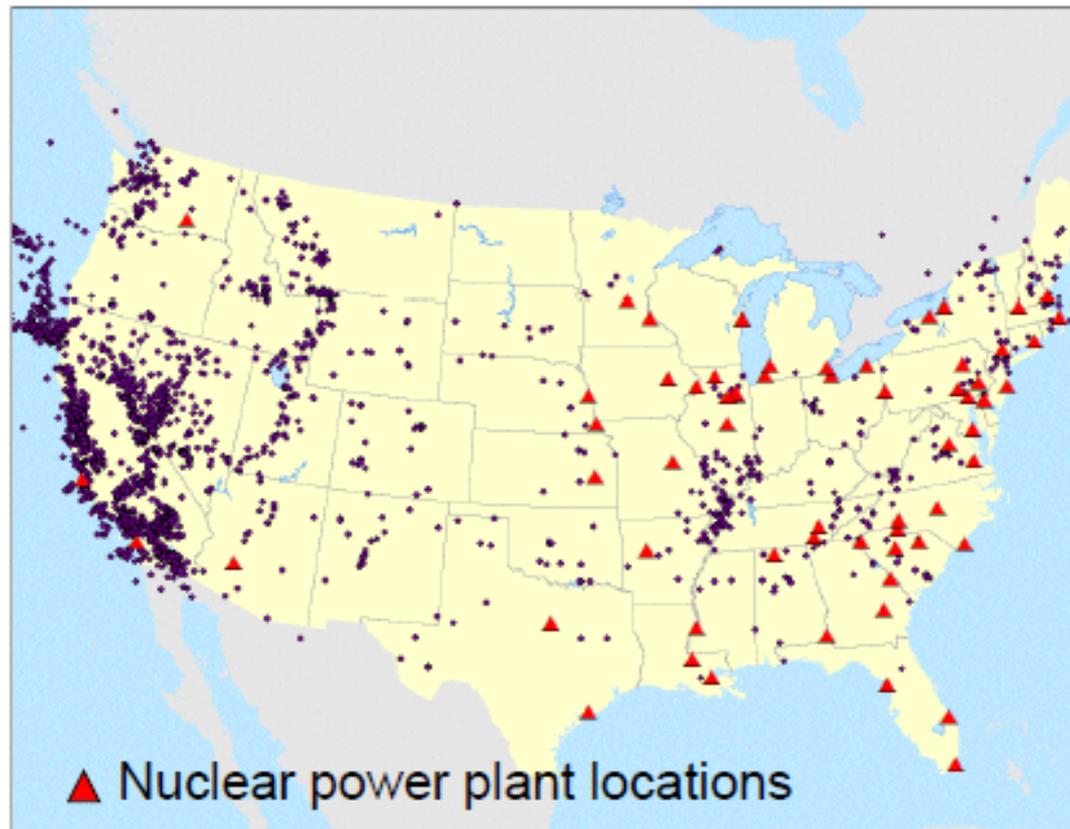
Figure B.2 Probability of Exceeding SSE
Using Median LLNL Hazard Estimates

Safety/Risk Assessment for GI-199

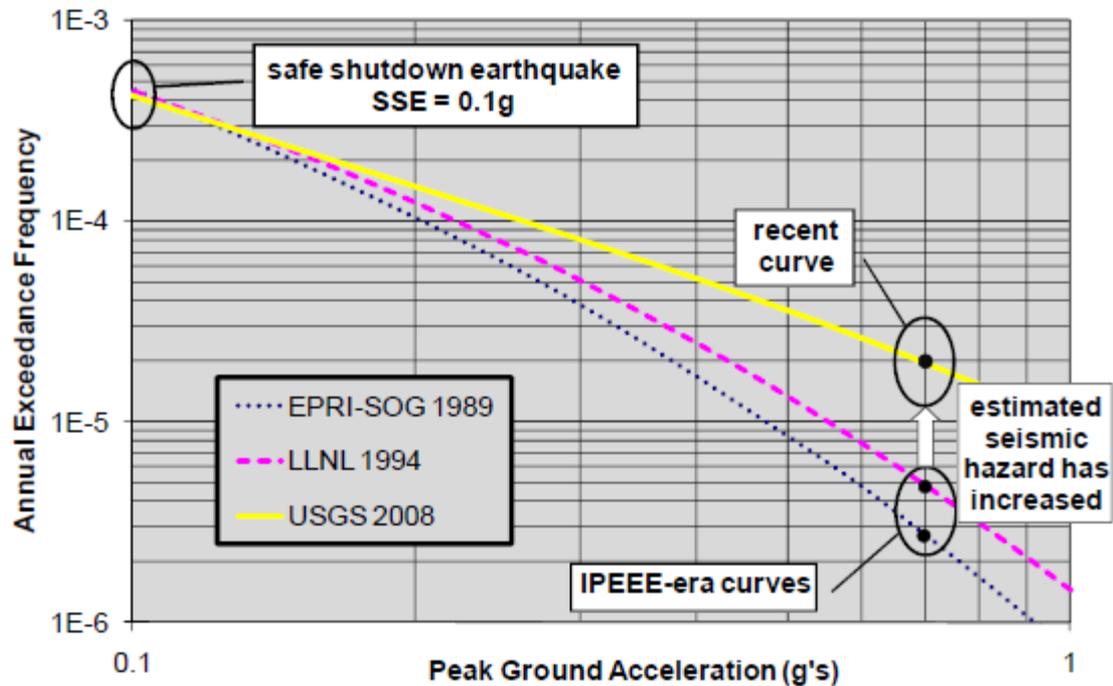
“Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants”

● Felt and Damaging Earthquakes In the U.S.

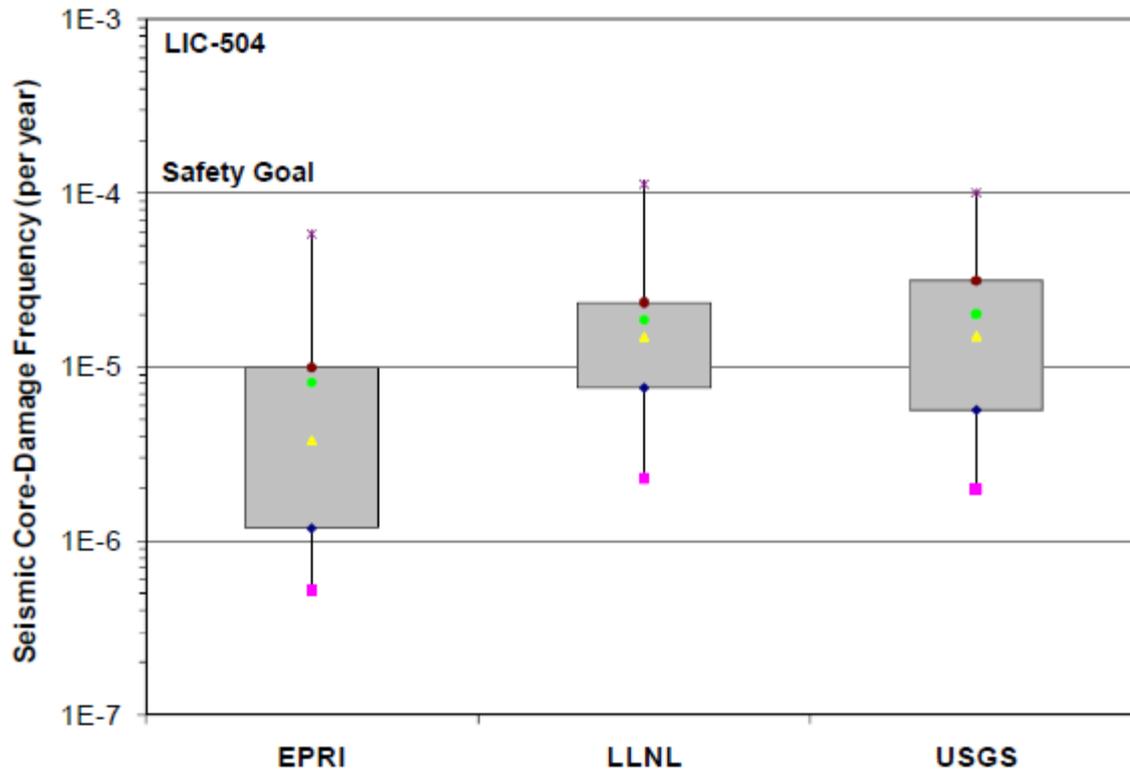
Source: USGS



What is GI-199 About?



Fleetwide SCDF Variability





GI-199 Key Points

- Operating power plants are safe
- Seismic hazard estimates have increased at some sites
- Assessment of GI-199 will continue
 - Information is needed to perform regulatory assessments
 - NRC will request the needed information

ASCE/SEI Standard 43-05

- ▶ Performance-based approach to ensure facility achieves desired performance
- ▶ Function of Target Performance Goal (P_F), Probability Ratio (R_p), and Hazard Exceedance Probability (H_D) criteria
- ▶ Tells us where to enter the mean hazard curve to achieve a desired performance objective and, in turn, to mitigate defined dose consequence

ASCE/SEI Standard 43-05 (cont'd.)

Table 2-1 Seismic Design Basis (SDB)

SDC	Limit State			
	A Large Permanent Distortion (Short of Collapse)	B Moderate Permanent Distortion	C Limited Permanent Distortion	D Essentially Elastic
1	SDB-1A	SDB-1B	SDB-1C	SDB-1D
2	SDB-2A	SDB-2B	SDB-2C	SDB-2D
3	SDB-3A	SDB-3B	SDB-3C	SDB-3D
4	SDB-4A	SDB-4B	SDB-4C	SDB-4D
5	SDB-5A	SDB-5B	SDB-5C	SDB-5D

SDC is the Seismic Design Category

Nuclear Power Plants

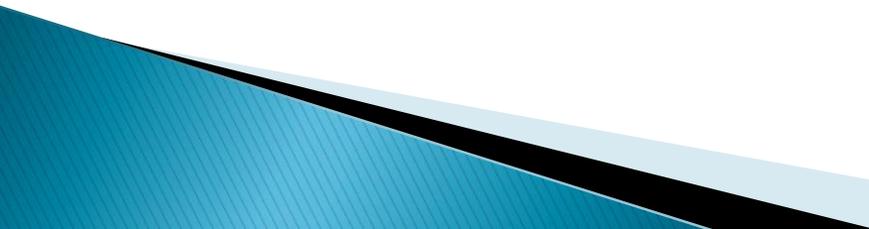
ASCE/SEI Standard 43-05 (cont'd.)

Table 2-2 Earthquake Design Parameters for SDC 3, 4 & 5

	SDC		
	3	4	5
Target Performance Goal (P_F)	1×10^{-4}	4×10^{-5}	1×10^{-5}
Probability Ratio (R_P)	4	10	10
Hazard Exceedance Probability (H_D) $H_D = R_P \times P_F$	4×10^{-4}	4×10^{-4}	1×10^{-4}

FOSID Criterion in RG 1.208
Achieves CDF of 1×10^{-6}

Strawmen for Discussion

- ▶ Deterministic assessments of seismic design bases are not risk-informed and can lead to variable levels of risk
 - ▶ Probabilistic hazard assessments for design should have an explicit connection with risk or performance goal
 - ▶ A graded approach to design bases leads to reasonable risk decisions
 - ▶ Approach to hazard analysis and design bases should be consistent for all US nuclear facilities
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Fixed Term Review of Need to Update

- ▶ DOE Order 420.1B
 - *3. REQUIREMENTS.*
 - *c. NPH Assessment.*
 - (4) An NPH assessment review must be conducted at least every 10 years and must include recommendations to DOE for updating the existing assessments based on significant changes found in methods or data. If no change is warranted from the earlier assessment, then this only needs to be documented.
- ▶ Note:
 - Review is required, not reassessment
 - “Significant change” is not defined

ANSI/ANS- 2.29-2008 on Updating Existing study

- ▶ 4.1 High Level Requirements
- ▶ “...in the second case, the PSHA analyst may have the option to use an existing seismic study as a starting point for a site-specific assessment.”
- ▶ HLR-A: Scope
 - “The assessment of the frequency of earthquake ground motions at a site shall be based on a PSHA that considers the epistemic uncertainty in the analysis inputs and that reflects the composite distribution of the informed technical community. The level of the analysis shall be determined based on the intended application of the PSHA results and on site-specific complexity (see Sec. 4.3). For PSHA levels 3 and 4, the analysis shall include a site-specific detailed analysis.”
- ▶ HLR-B: Data collection
 - [develop a comprehensive up-to-date database per ANSI/ANS-2.27-2008]

ANSI/ANS- 2.29-2008 on Updating Existing study (cont'd.)

- ▶ HLR-C: Seismic source source characterization
- ▶ HLR-D: Ground motion characterization
- ▶ HLR-E: Local site effects
- ▶ HLR-F: Quantification
 - [Epistemic and aleatory uncertainties including in each element of PSHA]
- ▶ HLR-G: Use of existing studies
 - “When use is made of an existing study for PSHA purposes, it shall be confirmed that the basic data and scientific interpretations in the original analysis are still valid in light of current information, the study meets the requirements outlined in HLR-A through HLR-F above, and the study is suitable for the intended application.”

NRC Approach to Updating

- ▶ In the past, relied on updates related to new licensing, regional studies (e.g., EPRI-SOG, LLNL) conducted in the 1980s
- ▶ Recent COLAs have highlighted the need for updating
- ▶ CEUS SSC project and NGA-East projects will update Eastern US using SSHAC Level 3
- ▶ GI-199 may lead to updates of western site seismic hazard assessments
- ▶ Guidance being developed: defines when to
 - Replace, revise, refine, accept existing study

NRC Recommendations Regarding Updating Hazard Assessments for Nuclear Facilities

Existing Study	Condition of Existing Study	Hazard Assessment Needed	Recommendation	SSHAC Level for New Study
No study, or previous studies conducted at lower SSHAC Levels (2 or 1), or non-SSHAC studies	Not adequate for nuclear/critical facilities	Regional and/or site-specific	Conduct new study	3 or 4
Regional or site-specific	Not viable <u>and</u> hazard results expected to be significantly different	Regional and/or site-specific	Replace existing study	3 or 4
Regional or site-specific	Not viable <u>but</u> hazard results not expected to be significantly different	Regional and/or site-specific	Revise existing study	2, 3, or 4
Regional, no site-specific	Viable	Site-specific	Refine regional study locally consistent with RG 1.208 and ANSI/ANC-2.27-2008	2, 3, or 4

^[1] “Viable” is defined as: (1) based on a consideration of data, models, and methods in the larger technical community, and (2) representative of the center, body, and range of technically defensible interpretations.

Strawman Conclusion

- ▶ ANSI/ANS-2.29-2008 provides a list of attributes for an existing hazard study to assess whether or not it provides a sufficient starting point for a new hazard study (Section 4.1 High Level Requirements)
- ▶ These attributes can be used as criteria during a 10 year review for evaluating whether or not a hazard study needs to be updated
- ▶ The criteria track closely with the criteria for updating given in the upcoming NUREG on implementation of SSHAC Level 3 and 4 projects