



NRC Staff Feedback on NEI 25-08

“Graded Approach to Seismic Hazard Analysis and
Corresponding Site Investigations for Licensing Power Plants”

NEI 25-08 Overview ([ML25335A211](#))

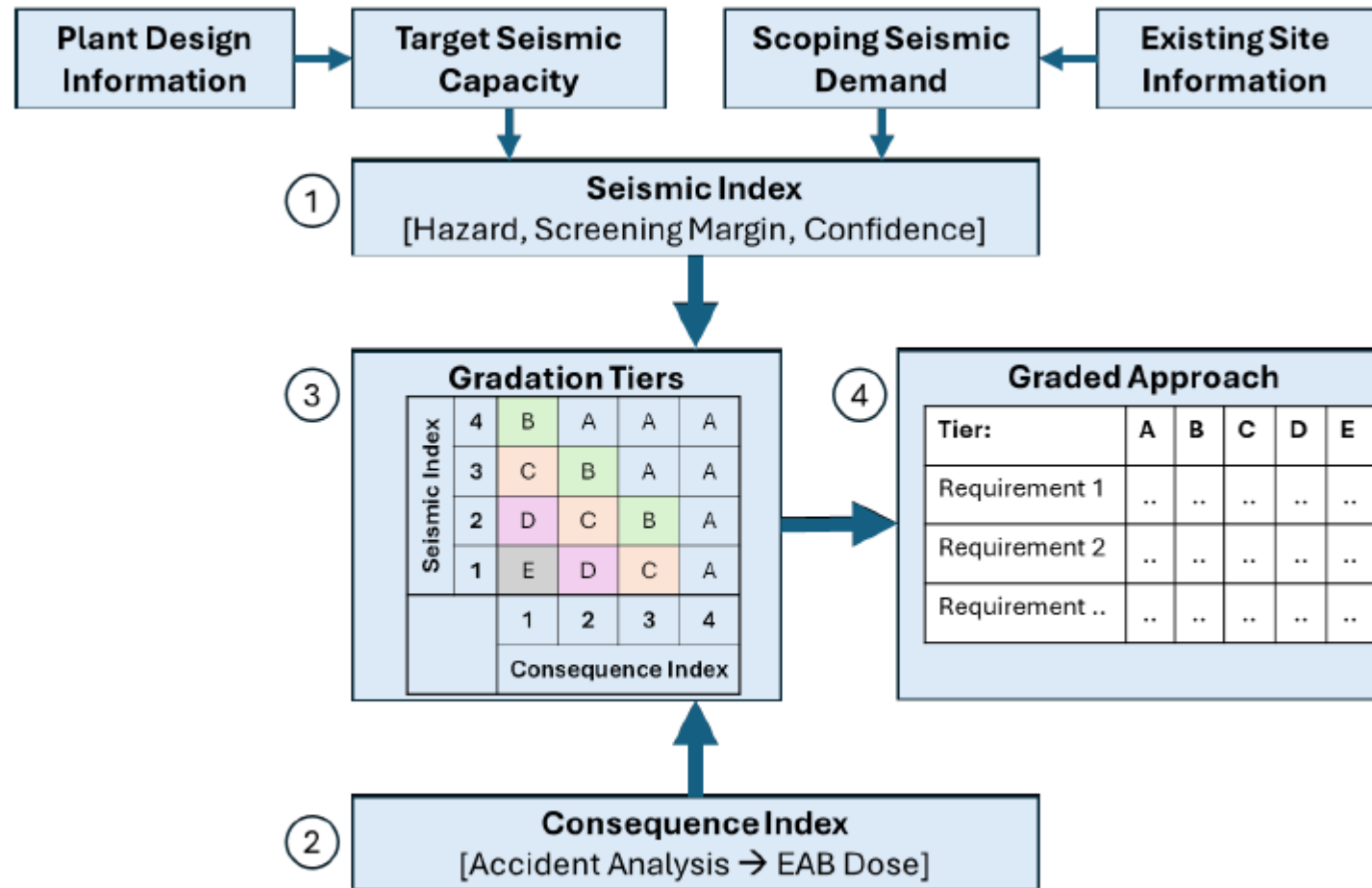


Figure 1: Framework for Graded Seismic Hazard and Site Characterization

Hazard Thresholds and Hazard Level

NEI Hazard Parameter Thresholds

Hazard	S_{MS} Threshold	S_{M1} Threshold
H	$S_{MS} > 0.50$	$S_{M1} > 0.2$
M	$0.25 < S_{MS} < 0.5$	$0.1 < S_{M1} < 0.2$
L	$S_{MS} < 0.25$	$S_{M1} < 0.1$

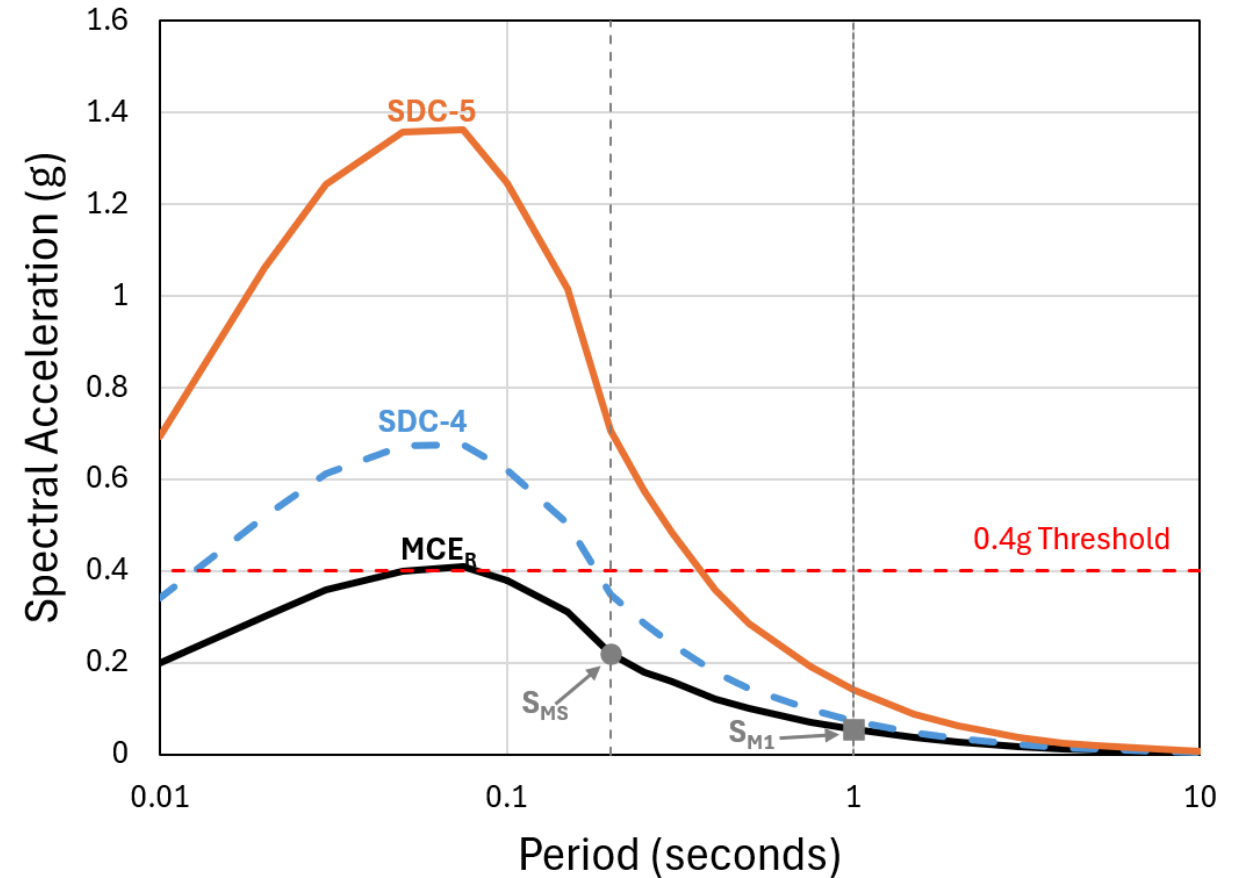
Example Site Hazard Level

	MCE_R
S_{MS}	0.22
S_{M1}	0.06
Hazard	Low

SDC-4 and SDC-5 spectra exceed 0.4g EPRI low hazard threshold (**Medium or High Hazard Level**)

Use of proposed thresholds do not seem consistent and conservative across all consequence indices

Example Site Response Spectra



Seismic Margin

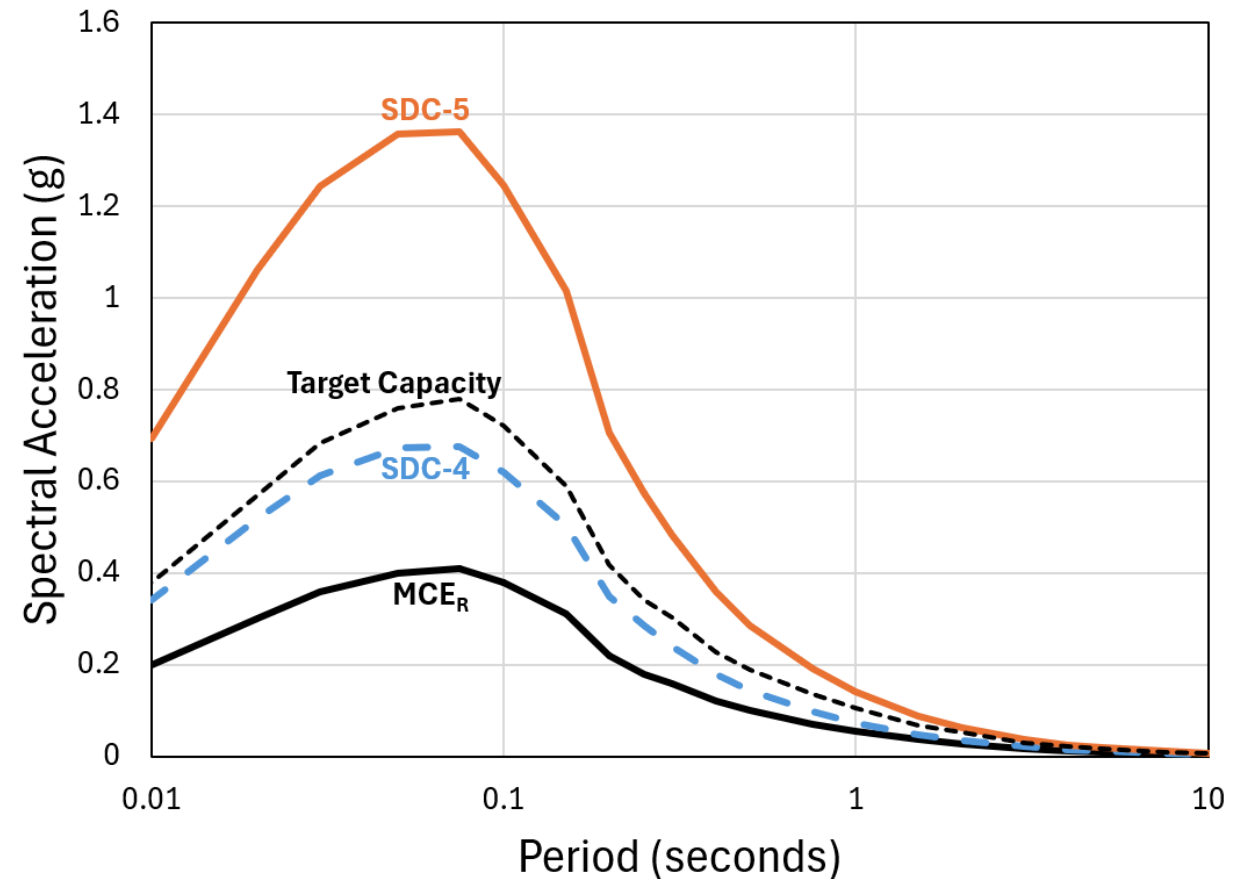
NEI Seismic Margin Thresholds

Seismic Margin	M_p Threshold
H	$M_p > 1.87$
M	$1.87 < M_p < 1.5$
L	$1.25 < M_p < 1.5$

Example Site Seismic Margin

Response Spectrum	M_p	Seismic Margin
MCE_R	1.9	High
SDC-4 GMRS	1.2	Low
SDC-5 GMRS	0.6	Low

Example Site Response Spectra



Confidence



- Site class per ASCE 7 with use of measured shear wave velocity data may not be sufficient for medium confidence
 - V_{s30} may not capture effects of large impedance contrast that significantly affect site response
- Seismic Source and Ground Motion Model Characterization Considerations
 - RIL 2025-10 demonstrates that the USGS NSHM may not incorporate all faults that significantly contribute to hazard in the western United States
- Explanation and justification of seismic index grading within each confidence level is needed

Consequence Index: Target Performance Goal

Seismic Index	4	B	A	A	A
	3	C	B	A	A
	2	D	C	B	A
	1	E	D	C	A
		1	2	3	4
		Consequence Index			

Tier	Target Performance Goal
A	2×10^{-4} per year
B through D	4×10^{-5} per year

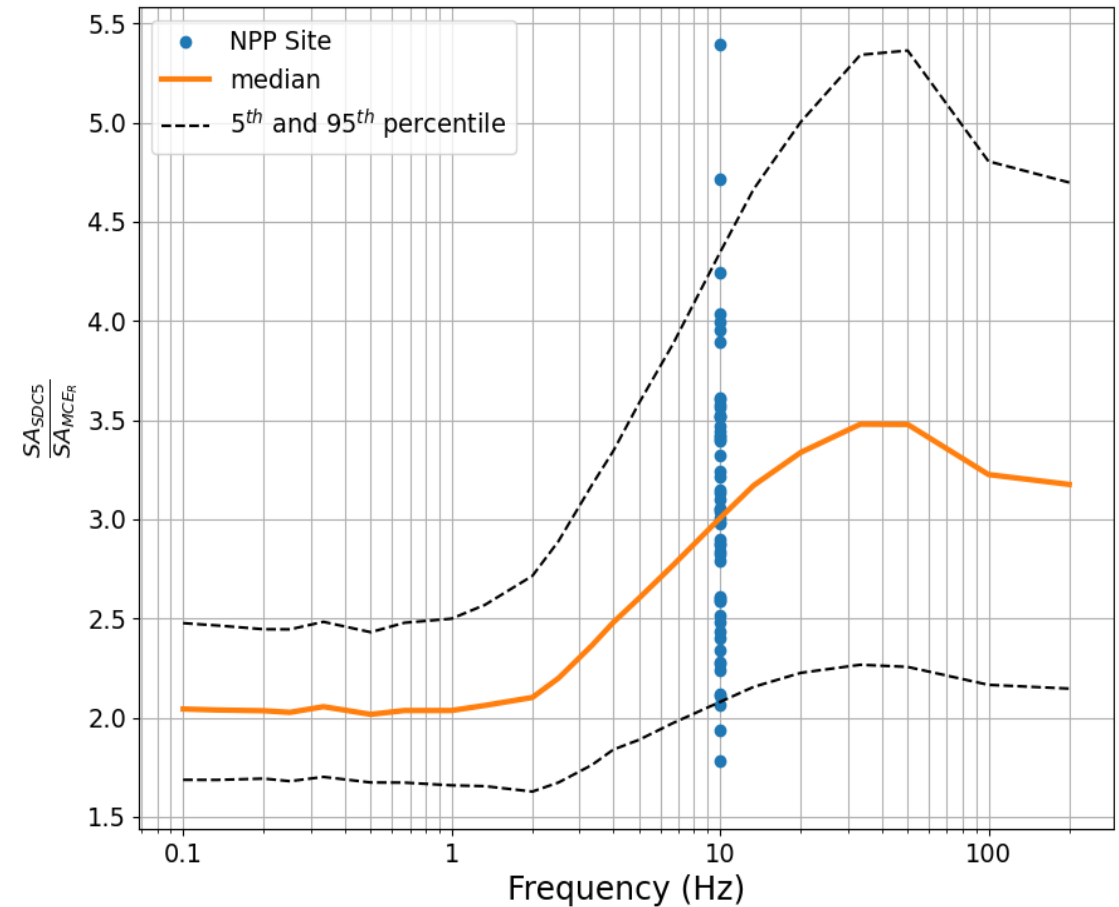
- Changing target performance goal based on seismic index does not seem consistent with ANS and ASCE standards
- Tier A may only be appropriate for the lowest consequence (highest consequence index) and where a target performance goal of 2×10^{-4} per year is acceptable

Design Basis Accident as a Consequence Index

- DBA analyses do not generally account for common cause failure caused by seismic events
- Seismic DBAs can be useful in identifying which SSCs need to operate during or following a seismic event, but it does not provide information on the appropriate level of seismic event to design to

Emergency Planning Zone as a Consequence Index

- Approach requires event sequences and fragilities that may be difficult to define in the early design stage
- Estimating EPZ seismic scenario from the MCE_R proxy is challenging
 - Large uncertainty in factor to obtain SDC-5 GMRS
 - Site specific details not captured in MCE_R may significantly impact GMRS
- PEP EPZ set at 10 miles for CI 1 may result in inconsistencies in SDC



Unmitigated Accident Release as a Consequence Index

Seismic Design Category	ANSI/ANS 2.26-2004 (R2021) Unmitigated Dose Consequence	NEI Unmitigated Dose Consequence	ASCE Target Performance Goal
SDC-1	No Consequence		2×10^{-4}
SDC-2	dose $\leq$ 5 rem	< 25 rem (CI 4)	2×10^{-4}
SDC-3	5 rem < dose < 25 rem	25 – 100 rem (CI 3)	1×10^{-4}
SDC-4	25 rem < dose < 100 rem	100 – 500 rem (CI 2)	4×10^{-5}
SDC-5	dose > 100 rem	> 500 rem (CI 1)	1×10^{-5}

Technical basis for NEI unmitigated doses has not been provided

Gradation Tiers

- **Tiers A, B, and C:** In-situ and/or laboratory testing of soils is needed for Subsurface Characterization-Foundations
- **Tier B:** Justification needed for using surface geophysics. Staff have not yet concluded when surface geophysics alone is sufficient for determining the shear wave velocity profile.
- **Tier B:** All SSHAC studies need to demonstrate that the center, body, and range of technically defensible interpretations of data and models have been captured. Relying wholly or in part on the USGS NHSM will need to be justified by the TI Team.
- **Tier B:** $V_{s30} > 1100$ m/s may not be sufficient to justify using ASCE 7 site class amplification
- **Tiers B and C:** The maximum spacing between boreholes has been provided in other standards. NRC staff assume the intent was to state that boreholes should be spaced no more than 100 ft apart (maximum spacing between boreholes).

Gradation Tiers

- **Tiers B, C, D, and E:** Dynamic site profile characterization should be included as part of the site response analysis SSHAC level study
- **Tier C:** SSHAC level may depend on the complexity of the SSC model, availability of existing SSHAC level studies, and any proposed changes to existing SSHAC level SSC and GMC models.
- **Tiers D and E:** SSHAC Level 3 may not be necessary for site response analysis for Tiers D or E. In some cases, a SSHAC Level 1 site response analysis could be justified.

Abbreviations and Acronyms

ANS	American Nuclear Society
ASCE	American Society of Civil Engineers
CI	Consequence Index
DBA	Design Basis Accident
EAB	Exclusion Area Boundary
EPZ	Emergency Planning Zone
GMC	Ground Motion Characterization
GMRS	Ground Motion Response Spectrum
MCE_R	Risk-Targeted Maximum Considered Earthquake
M_p	Primary Margin
NSHM	National Seismic Hazard Model
PEP	Plume Exposure Pathway
RIL	Research Information Letter
SDC	Seismic Design Category
S_{M1}	MCE_R , 5% damped, spectral response acceleration parameter at a period of 1 s adjusted for site class effects as determined in accordance with Section 11.4.3 of ASCE 7 (ASCE 7-22)
S_{MS}	MCE_R , 5% damped, spectral response acceleration parameter at short periods adjusted for site class effects as determined in accordance with Section 11.4.3 of ASCE 7 (ASCE 7-22)
SSC	Seismic Source Characterization
SSHAC	Senior Seismic Hazard Analysis Committee
USGS	United States Geological Survey
V_{S30}	Time averaged shear wave velocity in the top 30 meters