Summary of Staff Comments on the American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) Seismic Probabilistic Risk Assessment (PRA) Code Case

Table 1 provides the U.S. Nuclear Regulatory Commission (NRC) staff's comments on requirements in the Code Case. Only those requirements where the staff has an objection is provided. A discussion of the staff's concern (issue) and the staff proposed resolution is provided. The staff clarification or qualification to the requirement is indicated in the proposed staff resolution where new text is represented in bold typeface (i.e., **bold**) and deleted text is represented with a strikeout (i.e., ~~strikeout~~). The proposed staff resolutions represent the changes that would need to be made to the requirement (as written in the ASME/ANS standard) for the staff to have no objection are provided.

NRC staff understand that the ASME/ANS Seismic PRA Code Case will not be revised or updated. However, the NRC expects the issues described in Table 1 to be:

- addressed in the next edition of the ASME/ANS Level1/Large Early Release Frequency (LERF) PRA standard,
- considered by a peer review team when a peer review of a licensee's seismic PRA is performed using the Code Case prior to the issuance of the next edition of the ASME/ANS Level1/LERF PRA standard,
- considered in a seismic PRA developed using the Code Case prior to the issuance of the next edition of the ASME/ANS Level1/LERF PRA standard

Table 1 – Staff Position on ASME/ANS Seismic PRA Code Case

ID	Index	Issue	Proposed Staff Resolution
1	Section 5-1.3	The last paragraph of the section states that the internal events PRA model is the starting point "…to which must be added a number of structures, systems, and components (SSCs) not included in the model but that could fail due to the external hazard." Failure modes caused by the external hazard for SSCs existing in the internal events PRA should also be included.	The approach to any external hazard PRA typically uses as its starting point the internal-events PRA model to which must be added a number of structures, systems, and components (SSCs) not included in the model but that could fail due to the external hazard **and new failure modes caused by the external hazard for SSCs already present in the model**. Both the part of the internal-events model dealing with CDF and the part dealing with LERF are used as starting points.

ID	Index	Issue	Proposed Staff Resolution
2	Section 5-1.6	The Part 5 Code Case does not include the language from Section 5-1.6 in ASME/ANS RA-Sb-2013, which discussed the usage of generic fragility information. Section 5-1.6 in ASME/ANS RA-Sb-2013 indicates that "(a) Analysts should apply caution in the use of generic fragilities and provide justification that the generic fragilities are applicable, and (b) Peer reviews should focus on the use of generic fragilities to ensure that their use is appropriate and justified. " These statements are important because they appropriately identify the scope of interest with respect to generic fragility for both the analysts and the peer-reviewers.	Include the language from Section 5-1.6 in ASME/ANS RA-Sb-2013.
3	Section 5-2, first sentence	The first sentence of the first paragraph in Section 5-2 states, "The technical requirements for seismic PRA … based on a wealth of experience of more than 30 years," while the same sentence in ASME/ANS RA-Sb-2013 states "…over the past 20 years." Given that the Nonmandatory Appendix 5-A is the basis for both statements, a there needs to be consistency regarding this chronology statement.	Make the code case chronically consistent with ASME/ANS RA-Sb-2013.
4	Section 5-2, third paragraph	Text was removed from Section 5-2 that helps set the context for the standard requirements.	Seismic PRA is an integrated activity requiring close interactions among specialists from different fields (e.g., seismic hazard analysis, systems analysis, and fragility evaluation). For this reason, it is important that all members of the seismic PRA team be cognizant of all of the SRs in this Part, not just those in their area of expertise, and understand the interactions required between the elements. **Although the methodology for seismic PRA and the supporting data have evolved and advanced over the past 30 years, the analysis still requires judgment and extrapolation beyond observed data. Therefore, the analyst is strongly urged to review published seismic PRA reports and to compare his/her plant-specific seismic PRA to the published studies of similar reactor types and system designs.** This understanding of the Standard **and other seismic PRAs** will promote consistency among similar PRAs and risk-informed applications and will also promote reasonableness in the numerical results and risk insights. The peer review is also directed in part toward this same objective.

ID	Index	Issue	Proposed Staff Resolution
5	Section 5-2.1, Bullet 1	The action verb “estimate” implies using judgement or qualitative measures which is inconsistent with the intent of the statement. The action verb “calculate” involves a mathematical process whereas the action verb “estimate” does not necessarily involve a calculation (e.g., quantification of a probability or frequency) and can be derived qualitatively.	1. ~~estimate~~ **calculate** the frequency of exceeding different levels of vibratory ground motion and
6	Section 5-2.1	The first full paragraph of Section 5-2.1 states in part, “The requirements described in Part 5-2.1 address these objectives in detail. A probabilistic seismic hazard analysis (PSHA), which may directly incorporate site response analyses, is used to assess horizontal ground motions at the site.” It does not seem appropriate to highlight a specific aspect of the PSHA, particularly in such an ambiguous manner.	The requirements described in Part 5-2.1 address these objectives in detail. A probabilistic seismic hazard analysis (PSHA)~~, which may directly incorporate site response analyses,~~ is used to assess horizontal ground motions at the site.
7	General Comments on the SHA Technical Element	The Code Case proposes definitions for the terms primary hazard and Secondary hazard. However, the Code Case only uses the term primary hazard in the definition of the term secondary hazard, which may not prompt a need to define the term primary hazard. The primary hazard described by the objectives in Section 5-2.1 seems to be the vibratory ground motion. However, in many instances, but not all, the text refers to secondary hazards from vibratory ground motions but not always. It is unclear whether there is a difference between the way vibratory ground motion is referred to or if these are intended to be synonymous. Consideration should be given to whether the definition be made more precise to the hazards, primary or secondary, that the Code Case intends to address. For example, does it intend to address tsunamis and seiches? If not, it should not be mentioned.	• Update the Definitions section for new terms that reflect current terminology (meaning may be somewhat different) • Ensure consistent use of the term secondary hazards with the definition. • To the extent possible express, which secondary seismic hazards are included or, alternatively, which are not. • Define terms such as Ground Motion Prediction Equations.

ID	Index	Issue	Proposed Staff Resolution
8	Table 5-2.1-1, HLR-SHA-A	The language of the high level requirement (HLR) HLR-SHA-A states, "The frequency of seismic ground motion at the site shall be based on a site-specific PSHA that represents the center, body, and range of the technically defensible interpretations. The level of analysis, as well as the level of updates when an existing study is the initial basis for the site-specific PSHA, shall be determined based on the intended application and on the technical viability of existing PSHA models." This language is too vague. In particular, the frequency of the ground motion is a natural process. It is their calculation that is based on a PSHA.	**The basis for the calculation of** ~~T~~**t**he frequencies of **exceeding different levels of vibratory** seismic ground motion at the site shall be ~~based on~~ a site-specific PSHA that represents the center, body, and range of the technically defensible interpretations. The level of analysis, as well as the level of updates when an existing study is the initial basis for the site-specific PSHA, shall be determined based on the intended application and on the technical viability of existing PSHA models.
9	Table 5-2.1-2, Note (1)	Note (1) of Table 5-2.1-2 provides references to NUREG/CR-6372 and NUREG-2117; however, the NRC has recently completed NUREG-2213, which supersedes both NUREG/CR-6372 and NUREG--2117. Publication of NUREG-2213 will occur prior to the publication of the next edition of the ASME/ANS PRA standard.	Revise the following language in Note (1) of Table 5-2.1-2: **NUREG-2213 [5-?]** ~~NUREG/CR=6372 [5-1] and NUREG-2117 [5-2]~~ **provides** ~~provide~~ the defined process for conducting a PSHA that produces a model that represents the center, body, and range of the technically defensible interpretations, as defined in **the** ~~those~~ **reference** ~~references~~. **NUREG-2213 [5-?]** ~~These references~~ **has** ~~have~~ identified and provided guidance for four levels of hazard analysis.
10	Table 5-2.1-2, Note (1)	Note (1) of Table 5-2.1-2 states in part, "The appropriate level of the hazard analysis will depend on project-specific factors and should include considerations such as the safety significance of the nuclear power plant, the technical complexity and uncertainties in hazard inputs, regulatory oversight and requirements, and the availability of resources." Although it is a note and not a requirement, citing the availability of resources as a means of determining the appropriate level of hazard analysis may be construed as a justification exclude consideration of a safety issue.	The appropriate level of the hazard analysis will depend on project-specific factors and should include considerations such as the safety significance of the nuclear power plant, the technical complexity and uncertainties in hazard inputs~~., regulatory oversight and requirements, and the availability of resources~~.

ID	Index	Issue	Proposed Staff Resolution
11	Table 5-2.1-2, Note (1)	Note (1) of Table 5-2.1-2 refers to Regulatory Guide (RG) 1.208 as providing an acceptable approach to establishing a lower-bound magnitude for use in the hazard analysis. However, the NRC staff has discouraged use of the damage parameter cumulative absolute velocity (CAV) filter in place of a lower-bound magnitude for the PSHA. Use of CAV has often been misapplied in PSHAs to improperly filter out larger magnitude events at larger source-to-site distances. Recently completed PSHAs for Near Term Task Force (NTTF) Recommendation 2.1 and combined operating license (COL) and early site permit (ESP) applications no longer use the CAV damage parameter in place of a lower-bound magnitude. NRC staff's related letter pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.54(f) specified use of *M*5 (moment magnitude 5) as an appropriate lower-bound magnitude.	Remove the following language in Note (1) of Table 5-2.1-2: ~~RG 1.208 [5-3] provides one acceptable approach to establishing a lower-bound magnitude for use in the hazard analysis.~~
12	Table 5-2.1-2, SHA-A5	Regarding supporting requirement SHA-A5 in Table 5-2.1-2, the NRC staff has discouraged use of the damage parameter cumulative absolute velocity (CAV) filter in place of a lower-bound magnitude for the PSHA. Use of CAV has often been misapplied in PSHAs to improperly filter out larger magnitude events at larger source-to-site distances. Recently completed PSHAs for Near Term Task Force (NTTF) Recommendation 2.1 and combined operating license (COL) and early site permit (ESP) applications no longer use the CAV damage parameter in place of a lower-bound magnitude. NRC staff's related letter pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.54(f) specified use of *M*5 (moment magnitude 5) as an appropriate lower-bound magnitude.	JUSTIFY the specified lower-bound magnitude ~~(or probabilistically defined characterization of magnitudes based on a damage parameter)~~ for use in the hazard analysis, such that earthquakes of magnitudes less than this value are not expected to cause significant damage to the engineered structures or equipment.
13	Table 5-2.1-3, SHA-B1	The term "subject matter experts/analysts" should be qualified (e.g., required trainings, certifications, etc.)	Add a note to Table 5-2.1-3 that references NUREG–2213 for the qualified meaning of this term.
14	Table 5-2.1-3, SHA-B3	Sole use of term "attenuation" in conjunction with modeling ground motions is unnecessarily limiting.	ENSURE that the data and information are sufficient to characterize attributes important for modeling both regional **propagation** ~~attenuation~~ of ground motions and local site effects including their associated uncertainties.

ID	Index	Issue	Proposed Staff Resolution
15	Table 5-2.1-3, SHA-B5	The current language requires a demonstration that the updated earthquake catalog has been reviewed if an existing PSHA is used. However, this does not include accounting for the impact of the updated earthquake catalog on the existing PSHA.	If an existing PSHA is used, DEMONSTRATE that an updated catalog of earthquakes ~~was reviewed in the evaluation to determine if~~ does not make the existing PSHA ~~remains~~ **un**viable.
16	Table 5-2.1-3, Note (1)	Note (1) of Table 5-2.1-3 references NUREG-2117; however, the NRC has recently completed NUREG-2213, which supersedes NUREG-2117. Publication of NUREG-2213 will occur prior to the publication of the next edition of the ASME/ANS PRA standard.	Revise the following language in Note (1) of Table 5-2.1-3: Guidelines as to when an existing study should be refined or replaced are provided in **NUREG-2213 [5-?]** ~~NUREG 2117 [5-2]~~.
17	Table 5-2.1-4, Note (1)	Note (1) of Table 5-2.1-4 provides references to NUREG/CR-6372 and NUREG-2117; however, the NRC has recently completed NUREG-2213, which supersedes both NUREG/CR-6372 and NUREG-2117. Publication of NUREG-2213 will occur prior to the publication of the next edition of the ASME/ANS PRA standard.	Revise the following language in Note (1) of Table 5-2.1-4: **NUREG-2213 [5-?]** ~~NUREG/CR-6372 [5-1] and NUREG 2117 [5-2]~~ **provides** ~~provide~~ a structured approach for conducting the PSHA consistent with the level of analysis defined in HLR-SHA-A. **NUREG-2213 [5-?]** ~~These references~~ also provides provide a defined process for producing a seismic source model that represents the center, body, and range of the technically defensible interpretations.
18	Table 5-2.1-5, SHA-D1	The ground motion characterization model needs to include the interface with site response analysis in terms of a reference soil or rock horizon, as defined by shear wave velocity, density, and damping values.	In the ground motion characterization model that determines the range of seismic vibratory ground motion that can occur at a site, INCLUDE *(a)* credible mechanisms governing estimates of vibratory ground motion that can occur at a site, *(b)* a review of available historical and instrumental seismicity data (including strong motion data) to assess and calibrate the model, and *(c)* applicable (existing and/or newly developed) ground motion prediction equations for the ground motion estimates~~,~~ ***(d)* reference soil or rock horizon (defined by shear wave velocity, density, and damping values).**
19	Table 5-2.1-5, SHA-D3	The ground motion characterization model should include ground motion prediction equations (GMPEs) with alternative distance and magnitude scaling behaviors, not just a range of amplitudes.	ENSURE that uncertainties are included in the model that determine the range of seismic vibratory ground motion that can occur at a site **as well as alternative magnitude and distance scaling** ~~behaviors~~ in accordance with the level of analysis identified for HLR-SHA-A and the data and information in the update of the PSHA.

ID	Index	Issue	Proposed Staff Resolution
20	Table 5-2.1-5, Note (1)	Note (1) of Table 5-2.1-5 provides references to NUREG/CR-6372 and NUREG-2117; however, the NRC has recently completed NUREG-2213, which supersedes both NUREG/CR-6372 and NUREG-2117. Publication of NUREG-2213 will occur prior to the publication of the next edition of the ASME/ANS PRA standard.	Revise the following language in Note (1) of Table 5-2.1-5: **NUREG-2213 [5-?]** ~~NUREG/CR-6372 [5-1] and NUREG-2117 [5-2]~~ **provides** ~~provide~~ a structured approach for conducting the PSHA consistent with the level of analysis defined in HLR-SHA-A. **NUREG-2213 [5-?]** ~~These references~~ also provides provide a defined process for producing a seismic source model that represents the center, body, and range of the technically defensible interpretations.
21	Table 5-2.1-6, SHA-E3	The term “ENSURE” is not the appropriate action verb.	**JUSTIFY** ~~ENSURE that~~ the approach used to incorporate the site response analysis into the hazard analysis ~~is justified~~**(e.g., sources of soils and rock material properties used in the analysis, uncertainties in site characterization and material properties, data to identify the depth to bedrock, appropriateness of one- two- or three-dimensional analysis in relation to the site stratigraphy)**.
22	Table 5-2.1-7, Note (1)	The high level requirement talks about propagation of uncertainties, but the supporting requirements do not explicitly address attributes of the methods of uncertainty propagation. Additionally, the NRC has recently completed NUREG-2213, which supersedes both NUREG/CR-6372 and NUREG-2117. Publication of NUREG-2213 will occur prior to the publication of the next edition of the ASME/ANS PRA standard.	Revise the following language in Note (1) of Table 5-2.1-7: ~~NUREG/CR-6372 [5-1] and NUREG-2117 [5-2]~~ **NUREG-2213 [5-?]** ~~provide~~ **provides** a structured approach for conducting the PSHA consistent with the level of analysis defined in HLR-SHA-A**, including guidance on methods for propagation of uncertainties**.
23	Table 5-2.1-9, Notes (1) and (2)	Notes (1) and (2) of Table 5-2.1-9 reference NUREG-2117; however, the NRC has recently completed NUREG-2213, which supersedes NUREG-2117. Publication of NUREG-2213 will occur prior to the publication of the next edition of the ASME/ANS PRA standard.	Revise the following language in Notes (1) and (2) of Table 5-2.1-9: (1) Guidelines as to when an existing study should be refined or replaced are provided in **NUREG-2213 [5-?]** ~~NUREG-2217 [5-2]~~, which also provides guidelines on the methodology that can be used to evaluate the model against available data, models, methods, and interpretations. (2) **NUREG-2213 [5-?]** ~~NUREG-2217 [5-2]~~ provides a structured approach for updating the PSHA consistent with the level of analysis defined in HLR-SHA-A.
24	Table 5-2.1-10, SHA-I2	The supporting requirement uses the terms hazards and secondary hazard interchangeably, which is potentially confusing.	For those **secondary** hazards that are not screened out, INCLUDE their effect through assessment of the frequency of ~~hazard~~ occurrence and ~~the~~ magnitude**, when applicable,** of the secondary hazard.

ID	Index	Issue	Proposed Staff Resolution
25	Table 5-2.1-10, Note (2)	The last sentence of Note (2) in Table 5-2.1-10 is vague and unnecessary.	The appropriate approach used to justify the basis and methodology used for screening out secondary hazards is hazard- and site-specific. ~~Justification may be based on available public literature and prior hazard studies.~~
26	Table 5-2.1-11 Note (1)	Note (1) of Table 5-2.1-11 provides references to NUREG/CR-6372 and NUREG-2117; however, the NRC has recently completed NUREG-2213, which supersedes both NUREG/CR-6372 and NUREG-2117. Publication of NUREG-2213 will occur prior to the publication of the next edition of the ASME/ANS PRA standard.	Revise the following language in Note (1) of Table 5-2.1-11: **NUREG 2213 [5-?]** ~~NUREG/CR-6372 [5-1] and NUREG 2117 [5-2]~~ **provides** ~~provide~~ a structured approach for conducting the PSHA consistent with the level of analysis defined in HLR-SHA-A. **NUREG 2213 [5-?]** ~~These references~~ also provides provide a defined process for producing a seismic source model that represents the center, body, and range of the technically defensible interpretations.
27	Table 5-2.2-2, SFR-A1	The intent of supporting requirement SFR-A1 needs additional clarification.	Add a footnote to Table 5-2.2-2 that conveys the following: The fragility and the systems analysts should ensure consistency between the failure modes evaluated by each of them. The systems analyst defines the failure modes based on the PRA basic events. The seismic fragility analyst defines the failure mechanism induced by an earthquake to result in such a failure mode.
28	Table 5-2.2-2, SFR-A2	The information to be included should be such that it can justify the modeling of SSCs as correlated from a fragility perspective and not simply be relevant. Justification, more than the examples provided, will be necessary for any correlation other than 0 and 1. Additionally the phrase “fragility correlation” should be replaced with “fragility dependence”. Dependence between random variables characterize their interrelationship. Correlation (coefficient) is used to define the dependence structure between random variables. It is also lacking criteria for acceptability of a correlation model.	INCLUDE information ~~relevant to~~ **justifying the** modeling of fragility **dependency** ~~correlation~~ of SSCs (e.g., similarity of component construction and location, **and response spectra at the locations**) to support SPR-B4.

ID	Index	Issue	Proposed Staff Resolution
29	Table 5-2.2-3, SFR-B1, CC I	The action verb ESTIMATE implies using judgement or qualitative measures which are inconsistent with the intent of the SR. The action verb CALCULATE involves a mathematical process whereas the action verb ESTIMATE does not necessarily involve a calculation (e.g., quantification of a probability or frequency) and can be derived qualitatively.	~~ESTIMATE~~ **CALCULATE an** ~~the~~ approximate **but conservative** seismic response~~s~~ that the risk-significant SSCs experience at failure using the input earthquake response spectra (from HLR-SHA-G) in three orthogonal directions.
30	Table 5-2.2-3, SFR-B1, CC II	The action verb ESTIMATE implies using judgement or qualitative measures which are inconsistent with the intent of the SR. The action verb CALCULATE involves a mathematical process whereas the action verb ESTIMATE does not necessarily involve a calculation (e.g., quantification of a probability or frequency) and can be derived qualitatively.	~~ESTIMATE~~ **CALCULATE** the realistic seismic response that the risk-significant SSCs experience at failure using the input earthquake response spectra (from HLR-SHA-G) in three orthogonal directions.
31	Table 5-2.2-3, SFR-B1	The response evaluations for CC I and II are distinguished by the adjective “approximate” and “realistic”. However, to a fragility analyst, “realistic is just another level of approximation. As this would directly affect the cost and resources, clarifications with examples should be provided.	Add a note or examples in the non-mandatory appendix to provide clarification.
32	Table 5-2.2-3, SFR-B4	The action verb ESTIMATE implies using judgement or qualitative measures which are inconsistent with the intent of the SR. The action verb CALCULATE involves a mathematical process whereas the action verb ESTIMATE does not necessarily involve a calculation (e.g., quantification of a probability or frequency) and can be derived qualitatively.	If median-centered response analysis is performed, ~~ESTIMATE~~ **CALCULATE** the median response (i.e., structural loads and floor response spectra) and variability in the response.
33	Table 5-2.2-3, SFR-B4	Should explain whether “variability” means “composite” or “separate aleatory and epistemic”.	Add a note in the non-mandatory appendix to provide the clarification.
34	Table 5-2.2-3, SFR-B5	Part of the SR asked one to QUANTIFY uncertainties in the SSI analysis. In the 2009 version, there was an extensive discussion on how to calculate the uncertainty. But the provisions are removed in 2013 and in the code case. It is understood that the emphasis of the Code is to identify the WHAT but not the HOW	To aid the user, add a description of the uncertainties that are to be quantified and their purpose.

ID	Index	Issue	Proposed Staff Resolution
35	Table 5-2.2-3, SFR-B6	In the 2009 revision (SFR-C2), part of the SR asked one to ACCOUNT for the entire spectrum of input ground motion levels displayed in the seismic hazard curves. This sentence is removed in the code case. However, this sentence also ensures the quality of the results of the probabilities response analysis	If probabilistic response analysis is performed to calculate structural loads and floor response spectra, ENSURE that the number of simulations done (e.g., Monte Carlo simulation or Latin Hypercube Sampling) is large enough to calculate stable responses. **ACCOUNT for the entire spectrum of input ground motion levels displayed in the seismic hazard curves.**
36	Table 5-2.2-3, SFR-B6	This should include quantifying what constitutes “stable” response as this could have a significant impact on cost for the fragility analysis.	Add a note in the non-mandatory appendix to provide the clarification.
37	Table 5-2.2-4, SFR-C1	The intent is to provide the basis and methodology to justify that the capacity of the SSC exceeds the screening level.	SPECIFY the basis and methodologies established for the capacity-based screening for the level defined in SPR-B5 **(e.g., use of simplified fragility analysis, use of applicable generic fragility or qualification data or earthquake experience, and use and applicability of EPRI fragility screening guidance are examples)**.
38	Table 5-2.2-4, SFR-C1	The systems analysts specifies the screening level (SPR-B5). This screening level should be high enough that the contribution to seismic core damage frequency and seismic large early release frequency from the screened components is not significant. SFR-C1 requires that the SPRA provide the basis and methodology for justifying that the capacity of the SSC exceeds the screening level.	Add a footnote to Table 5-2.2-4 such as: The intent of the requirement is to provide the basis and methodology for justifying that the capacities of certain SSCs exceed the screening level specific in SPR-B5. SFR-E1 is the requirement to ESTIMATE those capacities and DEMONSTRATE the applicability of the data and methodologies used.
39	Table 5-2.2-4, SFR-C2	In ASME/ANS RA-Sa-2009, Note (2) of the corresponding supporting requirement (i.e., SFR-B2) indicates that the screening criteria do not apply to high-seismic regions such as coastal California. However, SFR-C2 in the Code Case does not discuss this note.	Add the language from Note (2) of supporting requirement SFR-B2 from ASME/ANS RA-Sa-2009 in the non-mandatory appendix of the Code Case for SFR-C2 to clarify whether those specific screening criteria are applicable to high seismic region or not.
40	Table 5-2.2-4, SFR-C2	The intent is to provide the basis to justify that the capacity of the SSC is inherently rugged.	~~SPECIFY~~ **JUSTIFY** the basis for screening of inherently rugged components **(e.g., applicability of fragility or qualification test data, earthquake experience, past fragility analysis for similar SSCs and seismic responses, applicable EPRI guidance)**.

ID	Index	Issue	Proposed Staff Resolution
41	Table 5-2.2-4, SFR-C2	Additional clarification is needed regarding what is meant by the term “inherently rugged component.”	Add language to the non-mandatory appendix indicating that the term inherently rugged refers to seismic capacities well beyond the risk-significant level. Typical items include manual valves, check valves, and small, in-line strainers. The SPID (guidance for NTTF Recommendation 2.1 response) includes extensive discussions on the meaning of inherently rugged and many other fragility topics.
42	Table 5-2.2-5, SFR-D3, CC I	In general, the walkdown AND the fragility evaluation provide the assurance. This requirement supports that assurance but may not always ensure. Also, “vulnerability” needs to be defined.	IDENTIFY seismic vulnerabilities ~~and~~ **to ensure** ~~ENSURE~~ that assumptions and the use of generic seismic fragilities are conservative.
43	Table 5-2.2-5, SFR-D3, CCII	The current language implies realistic and plant specific fragilities for all vulnerabilities, which is inconsistent with SFR-E3 and established practice.	IDENTIFY seismic vulnerabilities and ENSURE that the seismic fragilities **for SSCs that contribute significantly to seismic CDF or seismic LERF** are realistic and plant-specific.
44	Table 5-2.2-5, SFR-D4	The walkdown should also focus on operator pathways and potential unavailability of those pathways	FOCUS on potential functional and structural failure modes, equipment anchorage, ~~and~~ support load paths, **and pathways necessary for performing required ex-control room actions**.
45	Table 5-2.2-5, SFR-D5	The purpose of SFR-D5 is to identify. The assessment action is in SPR-B9. Therefore, it does not make sense to use the term ‘credible’ in SFR-D5 as the purpose of this supporting requirement is to identify any seismic–induced failure for the flood sources.	IDENTIFY ~~credible~~ seismic-induced failures (including spray) for the flood sources provided in SPR-C3.
46	Table 5-2.2-5, SFR-D6	The purpose of SFR-D6 is to identify. The assessment action is in SPR-B10. Therefore, it does not make sense to use the term ‘credible’ in SFR-D6 as the purpose of this supporting requirement is to identify any seismic–induced failure for the fire sources	IDENTIFY ~~credible~~ seismic-induced failures for the fire sources provided in SPR-C4.

ID	Index	Issue	Proposed Staff Resolution
47	Table 5-2.2-5, SFR-D7	This supporting requirement appears to pre-judge which seismic interactions have the potential to be "risk-significant" prior to the walkdown. If the intent is that such information will be provided to the walkdown team by the plant-systems analyst it appears to be premature to expect such information to be available at the time of walkdown. Further, such an intent or appearance of intent can lead to an argument for excluding the plant-systems analyst from the walkdown. The second part of the SR starting with "EVALUATE the consequences…" is expected to capture the "risk-importance" of the identified interactions.	IDENTIFY ~~potential risk-significant~~ seismic interactions including proximity impacts, falling hazards, and differential displacements (e.g., failure and falling of masonry walls and nonseismically designed SSCs, impact between cabinets, differential building displacements) and EVALUATE the consequences of such interactions on SSC s contained in the systems model and on the credited operator actions. (See HLR-SPR-D.)
48	Table 5-2.2-5, HLR-SFR-D	In 2009 (SFR-E3) indicates that if component screened out during or following the walkdowns, document anchorage calculation and provide the basis. However, this statement is removed in the code case and it is not clear if screening out equipment during walkdowns is allowed.	Add the following or equivalent as a new SFR-D6: IDENTIFY credible seismic-induced failure for the fire sources provided in SPR-C4. **If components are screened out during or following the walkdown, DOCUMENT anchorage calculations and PROVIDE the basis justifying such a screening.**
49	Table 5-2.2-6, SFR-E2, CC I	The intent of the requirements should be to identify. In CCI conservative assumptions and data may be used.	For SSCs identified in ~~SPR-C4~~**SPR-C6** that significantly contribute to seismic core damage frequency and/or seismic large early release frequency, ~~conservatively~~ IDENTIFY relevant failure modes of structures, equipment, and soil. **ENSURE that the assumptions and data used in the identification are conservative.**
50	Table 5-2.2-6, SFR-E2, CC II	The examples listed in the requirement confuse the understanding of the differences between CCI and CCII. The only real difference is that CCI says 'conservatively IDENTIFY relevant' while CCII says 'IDENTIFY relevant and realistic'. This SR also references SPR-C4, but should reference SPR-C6.	For those SSCs identified in ~~SPR-C4~~**SPR-C6** that significantly contribute to seismic core damage frequency and/or seismic large early release frequency, IDENTIFY relevant and realistic failure modes of structures ~~(e.g., sliding, overturning, yielding, and excessive drift)~~, equipment ~~(e.g., anchorage failure, functional failure, impact with adjacent equipment or structures, and bracing failure)~~, and soil ~~(e.g., liquefaction, slope instability, and excessive differential settlement)~~. **For the other SSCs identified in SPR-C6, conservatively IDENTIFY relevant failure modes of structures, equipment, and soil.**
51	Table 5-2.2-6, SFR-E2, CC I and CC II	Listing of examples for CCII only but they seem to be applicable to CCI as well.	Remove the comments from the requirement. Comments in the parentheses in the original should go into the NMA.

ID	Index	Issue	Proposed Staff Resolution
52	Table 5-2.2-6, SFR-E4	The action verb ESTIMATE implies using judgement or qualitative measures which are inconsistent with the intent of the SR. The action verb CALCULATE involves a mathematical process whereas the action verb ESTIMATE does not necessarily involve a calculation (e.g., quantification of a probability or frequency) and can be derived qualitatively.	~~ESTIMATE~~ **CALCULATE** fragilities for the relevant failure modes for SSCs that are not screened out and do not significantly contribute to seismic core damage frequency and/or seismic large early release frequency.
53	Table 5-2.2-6, SFR-E5, CCI and II	The SR (CC I and II) refers to SPR-B6 for identification purposes. SPR-B6 discusses “relay or other similar devices”. This SR also needs to capture “or other similar devices” which is currently missing not only for consistency but also to prevent any implication that “other similar devices” need not be considered here. Additionally, the action verb for the second part of the CC II requirements needs to be capitalized to identify it.	For CCI: ESTIMATE contact-chatter seismic fragilities for relays **or other similar devices** that are identified in the systems analysis. (See SPR-B6.) For CCII: CALCULATE contact-chatter seismic fragilities for relays **or other similar devices** that are identified in the systems analysis (see SPR-B6) that significantly contribute to seismic core damage frequency and/or seismic large early release frequency. For those relays **or other similar devices** that do not significantly contribute to seismic core damage frequency and/or seismic large early release frequency, ~~estimate~~ **ESTIMATE** the seismic fragilities.
54	Table 5-2.2-6, SFR-E6, CCII	The action verb for the second part of the CC II requirements needs to be capitalized to identify it.	CALCULATE seismic fragilities for credible seismic-induced flood sources (see SFR-D5) and seismic-induced fire sources (see SFR-D6) that significantly contribute to seismic core damage frequency and/or seismic large early release frequency. For those flood and fire sources that do not significantly contribute to seismic core damage frequency and/or seismic large early release frequency, ~~estimate~~ **ESTIMATE** the seismic fragilities.
55	Table 5-2.2-5 SFR-D3, Table 5-2.2-6 HLR-SFR-E SFR-E1, -E2, and -E3	The use of word “conservative” is found in these requirements. Given that a goal of a PRA is to be as realistic as possible with display of uncertainties, the use of this term needs to be defined in context of this goal	The word “conservative’ needs to be defined or further explained in a note. The conservative fragilities when used should assure that the numerical results, such as CDF and LERF, are not under estimated: however, their use should not lead to mischaracterization of significant contributors or ranking of accident sequences or other risk insights.

ID	Index	Issue	Proposed Staff Resolution
56	Table 5-2.2-7, SFR-F2	Related Table 5-2.2-6 that provides supporting requirements associated with calculation of seismic-fragility parameters use distinct action verbs ESTIMATE and CALCULATE, respectively, for Capability Category I and Capability Category II. However, the related supporting requirement SFR-F2, item *(i)* associated with documentation of fragility parameter values only uses the word "estimation," but not "calculation." Therefore, the documentation supporting requirement item *(i)* is partly inconsistent with other related supporting requirements.	Regarding list item *(i)* in SFR-F2: *(i)* estimation **or calculation** of fragility parameter values for each SSC modeled (median capacity, logarithmic standard deviation reflecting the randomness in median capacity, and logarithmic standard deviation representing the uncertainty in median capacity), and
57	Section 5-2.3 Seismic Plant Response Analysis (SPR), Second list	The seismic PRA depends on both the capability and completeness of the internal events at-power PRA.	It is assumed: • Relative to the systems-analysis requirements contained herein, the seismic PRA analysis team possesses a full-scope internal events, at-power Level 1 and Level 2 LERF PRA, developed either before or concurrently with the seismic PRA. • The internal-events PRA is then used as the basis for the seismic PRA systems analysis. • It is recognized that the capability and completeness of the seismic PRA is a function of the capability **and completeness** of the internal events at-power PRA.
58	Section 5-2.3 Seismic Plant Response Analysis (SPR)	The sentence reads like a "how to" which is not the intent of the Standard. Further, none of the references cited in the Section are endorsed by the staff. Such references should be moved to the NMA portion of the Standard.	~~A general methodology for the modeling and quantification of a seismic PRA is documented in references such as EPRI-3002000709 [5-5], EPRI-1020756 [5-6], and EPRI-1025294 [5-7].~~
59	Section 5-2.3 Seismic Plant Response Analysis (SPR)	Cross-references in SFR to SPR (ensure that they also are in SPR). • SPR-B4 includes the reference to SFR-A2 • SPR-B5 includes the reference to SFR-C1 • SPR-C4 <u>does not</u> cross-reference SFR-D6 • SPR-D <u>does not</u> cross-reference SFR-D7	Include the missing cross-references either in the requirements or footnotes

ID	Index	Issue	Proposed Staff Resolution
60	Table 5-2.3-2 SPR-A2	It is unclear whether the SR is seeking to identify all possible initiating events from secondary hazards or if the intent is to identification and screen such initiators for inclusion in the plant-systems model.	Using a systematic process, IDENTIFY seismically induced initiating events caused by secondary hazards (e.g., seismically induced internal flooding, external flooding, and fire) including those identified in SHA-I2 **for retention in the seismic PRA plant-response model**.
61	Table 5-2.3-2 SPR-A2	Additional clarity is needed regarding secondary hazards: SPR-A2 – Seems to imply that there are secondary hazards other than those in SHA-A2.	Additional clarification is needed regarding what other secondary hazards are to be considered besides those in SHA-I2. If there are no others, delete the words “including those” from the supporting requirement.
62	Table 5-2.3-2 SPR-A3	The verb “encompasses” is overly severe and cannot reasonably be achieved in practice. The wording of this SR should be similar to IE-A3 and IE-A4.	REVIEW plant-specific response to past seismic events, as well as other available seismic risk evaluations for nuclear plants, to ensure that the list of initiating events included in the evaluation ~~encompasses~~ **accounts for** industry experience.
63	Table 5-2.3-2 SPR-A4	The plant-response analysis should include all identified events.	INCLUDE in the plant-response analysis the events identified in SPR-A1~~, and~~ SPR-A2**, and SPR-A3** above.
64	Table 5-2.3-1 HLR-SPR-B	XSLOCA was called out specifically in 2009 (SPR-B10) and 2013 (SPR-B8) to be evaluated. Not clear if the current SRs in Table 5.2.3-3 are sufficient.	Add the equivalent of the supporting requirement SPR-B10 from the 2009 version of Part 5 to the note for SPR-A1 in the Code Case, to account for the consideration, and unless appropriately justified, the inclusion of an earthquake-caused “very small loss-of-coolant accident” in the seismic-PRA accident sequences as an additional fault within each sequence in the seismic-PRA model.
65	Table 5-2.3-3 SPR-B2	Due to the input from the fire and internal flooding PRAs, and possibly other hazard PRAs, in addition to internal events the findings from all relevant PRAs should be appropriately dispositioned. Additionally, it is not clear what is intended by the latter part of this SR (“…does not adversely affect…”).	ENSURE that the peer review findings for the internal-events **and other hazard** PRA**s** that are relevant to the seismic PRA are resolved and ~~that the disposition does not adversely affect~~ **incorporated into** the development of the seismic PRA plant-response model.
66	Table 5-2.3-3 SPR-B3	Incorrect reference to SPR-C4 instead of SPR-C6.	INCLUDE seismically induced failures representing the failure modes of interest in the seismic PRA plant-response model (e.g., tank rupture, pump failure to start/run, etc.). (See ~~SPR-C4~~**SPR-C6**.)

ID	Index	Issue	Proposed Staff Resolution
67	Table 5-2.3-3 SPR-B5	The justification for the appropriate capacity based screening level needs to be provided. Neither the action verb for this SR nor that used for SFR-C1 achieves that purpose.	~~SPECIFY~~ **JUSTIFY (e.g. based on the contribution to the risk quantification)** ~~an appropriate~~ **the** set of criteria to be used in support of the screening of SSC failure modes on the basis of fragility. (See SFR-C1.)
68	Table 5-2.3-3 SPR-B6	The term "with a significant contributor to CDF or LERF" is not defined. How can one determine the significance without performing the calculation?	USE a systematic approach to INCLUDE in the system analysis the effects of those relays or similar devices whose contact chatter results in the unavailability or spurious actuation of SSCs~~ with a significant contribution to CDF or LERF~~.
69	Table 5-2.3-3 SPR-B9	The seismic induced flood events are expected to be identified in SPR-A2 and this SR should refer to SPR-A2 for consistency and to highlight the inter-dependence.	For any seismic-induced internal flood retained in the seismic PRA **(see SPR-A2)**, ENSURE the model is consistent with HLR-IFSN-A, IFQU-A1, A2, A3, and A4.
70	Table 5-2.3-3 SPR-B10	The seismic induced fire events are expected to be identified in SPR-A2 and this SR should refer to SPR-A2 for consistency and to highlight the inter-dependence.	For any seismic-induced internal fire retained in the seismic PRA **(see SPR-A2)**, ENSURE the model is consistent with HLR-PRM-A and B.
71	Table 5-2.3-3 SPR-B11	The secondary hazards are expected to be identified in SPR-A2 and this SR should refer to SPR-A2 for consistency and to highlight the inter-dependence.	For all other secondary hazards explicitly retained in the seismic PRA **(see SPR-A2)**, USE Part 8 or Part 9 in this Standard for applicable supporting requirements.
72	Table 5-2.3-3 SPR-B11	Additional clarity is needed regarding secondary hazards: SPR-B11 – It is not clear if it refers to secondary hazards in addition to those identified in SHA-A2.	Additional clarification is needed regarding what other secondary hazards are to be considered besides those in SHA-I2. If there are no others, replace "explicitly retained in the seismic PRA" with "identified in SHA-I2 and explicitly retained in the seismic PRA".
73	Table 5-2.3-4 SPR-C6	The term "failure mode(s) of interest for the fragility analysis" is not well-defined here. Use 2009 version SFR-D1 definition.	For the SSCs identified in SPR-C1, SPR-C2, SPR-C3, SPR-C4, and SPR-C5, IDENTIFY the failure mode(s) of interest **that interfere with the operability of equipment during or after the earthquake through a review of the plant design document and the walkdown** for the fragility analysis to be performed.

ID	Index	Issue	Proposed Staff Resolution
74	Table 5-2.3-1 HLR-SPR-D	The term “operator performance” can be interpreted in a narrow context to mean only in-control room actions and performance. However, the HLR and the corresponding SRs are applicable to all human actions included in the SPRA.	Human actions credited in the seismic PRA shall consider seismic-specific challenges to ~~operator performance~~ **credited human actions**.
75	Table 5-2.3-5 SPR-D3	Cue availability as well as dependencies are integral part of HRA analyses and maybe affected by seismic events	For CCI: CALCULATE the HEPs for all HFEs taking into account relevant seismic-related effects on control room and ex-control room post-initiator actions in accordance with the SRs for HLR-HR-G in Part 2 of this Standard as set forth under Capability Category I. In addressing influencing factors and the timing considerations covered in SRs HR-G3, HR-G4, and HR-G5 in Part 2, attention is to be given to how the seismic event alters any previous assessments in nonseismic analyses including: additional workload and stress; effects of the seismic event on mitigation, **cue availability**, **dependencies,** required response, timing, accessibility, and potential for physical harm; and seismic-specific job aids and training. For CCII: CALCULATE the HEPs for all HFEs taking into account relevant seismic-related effects on control room and ex-control room post-initiator actions in accordance with the SRs for HLR-HR-G in Part 2 of this Standard as set forth under Capability Category II. In addressing influencing factors and the timing considerations covered in SRs HR-G3, HR-G4, and HR-G5 in Part 2, attention is to be given to how the seismic event alters any previous assessments in nonseismic analyses including: additional workload and stress; effects of the seismic event on mitigation, **cue availability**, **dependencies,** required response, timing, accessibility, and potential for physical harm; and seismic-specific job aids and training.

ID	Index	Issue	Proposed Staff Resolution
76	Table 5-2.3-5 SPR-D4	The action verb ESTIMATE implies using judgement or qualitative measures only which are inconsistent with the intent of the SR. Some of the examples of approaches provide more information than an estimate.	For significant HFEs, ~~ESTIMATE~~ **DETERMINE** the timing aspects of the response actions (i.e., time of relevant indication, time available to complete action, and time required to complete action) recognizing the sequence of events and expected seismic conditions based on one or a combination of the following approaches: *(a)* Walk-throughs or talk-throughs of procedures with plant operations or training personnel *(b)* Simulator observations *(c)* Plant-specific thermal-hydraulic analyses *(d)* Realistic and applicable generic or similar plant thermal-hydraulic analyses. Based on a review of procedures with plant operations or training personnel and recognizing the sequence of events and expected seismic conditions, CONFIRM for nonsignificant HFEs the timing aspects of the response actions.
77	Table 5-2.3-6 SPR-E3	For CCII, QU-D4 indicated that one should compare results to those from similar plants and IDENTIFY causes for significant differences.	QUANTIFY the seismic sequences in accordance with the following supporting requirements from Part 2 of this Standard, which are applicable to the seismic hazard for CCII: QU-A2, A3, A4, and A5; QU-B1, B2, B3, B5, B6, B7, B8, B9, and B10; QU-C1, C2, and C3; QU-D1, D2, D3,**[D4],** D5, D6, and D7.
78	Table 5-2.3-6 SPR-E4	The phrase “dominant sequence insights” is not defined in either Addendum A or Addendum B. Use of the term “dominant” was decided not to be used anywhere in the standard.	USE the quantification process to ensure that the components screened out, based on the screening level defined in SPR-B5, do not become a significant contributor or do not invalidate the ~~dominant~~ **significant** sequence insights of the seismic PRA.
79	Table 5-2.3-6 SPR-E5, CC-II	It is not possible or necessary to quantify all uncertainties.	QUANTIFY the mean core damage frequency and large early release frequency and propagate the **parameter** uncertainty that results from each input (i.e., the seismic hazard, the seismic fragilities, and the systems analysis).

ID	Index	Issue	Proposed Staff Resolution
80	Table 5-2.3-6 SPR-E7	The reference to Part 2 is missing for HLR-QU-E for CCII.	For CC II: PERFORM the uncertainty analysis consistent with HLR-QU-E **of Part 2** addressing key assumptions in the hazard analysis (see SHA-J2), fragility analysis (see SFR-F3), and system modeling for Capability Category II.
81	Table 5-2.3-1 HLR-SPR-F	This HLR is overly broad since HLR-SHA-J and HLR-SFR-F already address documentation of the seismic hazard evaluation and the seismic-fragility evaluation, respectively.	Documentation of the seismic ~~PRA analysis~~ **plant-response model** shall be consistent with the applicable supporting requirements.
82	Table 5-2.3-7 SPR-F2	The Code Case needs to specify the type of documentation to be provided, rather than relying on the discretion of the user.	DOCUMENT the process used in the seismic plant-response analysis and quantification**, including**~~. For example, this documentation typically includes a description of~~