



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

July 12, 2018

Ms. Francis Pimentel  
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Washington, DC 20004

**SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION STAFF CHECKLIST TO SUPPORT REVIEW OF SEISMIC PROBABILISTIC RISK ASSESSMENT REPORTS PROVIDED IN RESPONSE TO TITLE 10 OF THE *CODE OF FEDERAL REGULATIONS* 50.54(f) RELATING TO SEISMIC HAZARD REEVLAUTIONS FOR RECOMMENDATION 2.1 OF THE NEAR-TERM TASK FORCE REVIEW OF INSIGHTS FROM THE FUKUSHIMA DAI-ICHI ACCIDENT**

Dear Ms. Pimentel:

The purpose of this letter is to provide a checklist that the U.S. Nuclear Regulatory Commission (NRC) will use in support of its review of seismic probabilistic risk assessment (SPRA) reports provided in response to the March 12, 2012, request for information that was issued pursuant to Title 10 of the *Code of Federal Regulations*, Part 50 (10 CFR), Section 50.54(f) (hereafter referred to as the 50.54(f) letter). The March 12, 2012, 50.54(f) letter can be found in the Agencywide Documents Access and Management System (ADAMS) at Accession No. ML12053A340. The SPRA reports are being prepared according to the guidance found in "Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," Electric Power Research Institute (EPRI) report 1025287, dated November 2012 (ADAMS Accession No. ML12333A170). The NRC endorsed the EPRI guidance in a letter dated February 15, 2013 (ADAMS Accession No. ML12319A074).

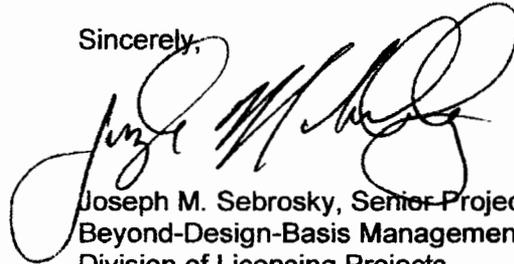
The enclosed checklist will be used by the NRC staff for licensees that choose to reference American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) RA-S Case 1 (hereafter referred to as the Code Case Standard). The enclosed checklist is a standalone document; however, it relies heavily on the checklist document developed for SPRA 50.54(f) report submittals that do not reference the Code Case Standard. As you are aware, the non-Code Case Standard SPRA report review checklist (available at ADAMS Accession No. ML17041A327) has been used to document the Vogtle Electric Generating Plant, Units 1 and 2 (Vogtle) SPRA 50.54(f) report review dated March 7, 2018 (ADAMS Accession No. ML17293A427), and the Beaver Valley Power Station, Units 1 and 2 (Beaver Valley) SPRA 50.54(f) report review dated June 6, 2018 (ADAMS Accession No. ML18092A837). The staff envisions using the enclosed checklist, as applicable, similar to how the checklist was used to document the Vogtle and Beaver Valley SPRA 50.54(f) report reviews.

F. Pimentel

- 2 -

If you have any questions regarding this letter, please contact me, at (301) 415-1132, or via e-mail at [Joseph.Sebrosky@nrc.gov](mailto:Joseph.Sebrosky@nrc.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "Joseph M. Sebrosky". The signature is fluid and cursive, with a large initial "J" and "S".

Joseph M. Sebrosky, Senior Project Manager  
Beyond-Design-Basis Management Branch  
Division of Licensing Projects  
Office of Nuclear Reactor Regulation

Enclosure:  
NRC Staff SPRA Submittal Technical  
Review Checklist for Submittals Using  
the "Code Case" Version of the ASME-ANS  
PRA Standard's Requirements for SPRA

**NRC Staff SPRA Submittal Technical Review Checklist for Submittals Using the “Code Case” Version of the ASME-ANS PRA Standard’s Requirements for Seismic PRA**

Several nuclear power plant licensees are performing seismic probabilistic risk assessments (SPRAs) as part of their required submittals to satisfy Near-Term Task Force (NTTF) Recommendation 2.1: Seismic. These submittals are being prepared according to the guidance in the Electric Power Research Institute – Nuclear Energy Institute (EPRI-NEI) Screening, Prioritization, and Implementation Details (SPID) document (EPRI-SPID, 2012), which was endorsed by the staff for this purpose. The SPRA peer reviews are also expected to follow the guidance in NEI 12-13 (NEI, 2012) as supplemented by NRC staff comments in its acceptance letter dated March 7, 2018 (NRC, 2018a, 2018b).

The SPID indicates that an SPRA submitted for the purpose of satisfying NTTF Recommendation 2.1: Seismic (hereafter referred to as NTTF Recommendation 2.1) must meet the requirements in the ASME-ANS PRA Methodology Standard (the ASME-ANS Standard). According to the SPID, either the “Addendum A version” (ASME/ANS Addendum A, 2009) or the “Addendum B version” (ASME/ANS Addendum B, 2013) of the ASME-ANS Standard can be used.

Recently, the ASME-ANS Joint Committee on Nuclear Risk Management (JCNRM), which develops and maintains the PRA standards at issue, has issued a new set of requirements for Seismic PRA, ASME/ANS RA-S Case 1 (ASME/ANS, 2017), herein the “Code Case Standard.” The Code Case Standard contains alternative requirements to Addenda A and B for Part 5 (seismic PRA) of the PRA Standard. The reasons for developing the Code Case version were to make the SPRA requirements more consistent in some areas with the rest of the standard, and also to respond to comments from users concerning the scope or the level of detail of some of the requirements.

The use of the Code Case Standard by a licensee is voluntary, but it is the NRC staff’s understanding that some nuclear power plant licensees will be developing and subsequently submitting their SPRAs in response to NTTF Recommendation 2.1 using the Code Case Standard instead of either the Addendum A or the Addendum B version.

The NRC staff wrote a letter to the JCNRM on March 12, 2018 (NRC, 2018), which states in part that, “*The NRC staff finds the process for developing a PRA for seismic events proposed in the ASME/ANS RA-S Case 1 acceptable,*” while also setting forth some conditions that must be met by a licensee’s submittal if the Code Case Standard is used. Specifically, an attachment to that letter contains detailed staff comments on the Code Case Standard that need to be addressed by any submittal that references the Code Case Standard. As stated in the staff’s March 2018 letter “[l]icensees may choose to retain their facility’s current SPRA approach, or revise it consistent with the Code Case. Any licensee use of the Code Case is voluntary.”

The purpose of this staff guidance document (checklist) is to provide guidance and a checklist to the staff for the review of prospective licensee submittals using the Code Case, similar to the earlier guidance and checklist (NRC, 2017) covering submittals using either the 2009 Addendum A version or the 2013 Addendum B version of the Standard.

This new staff guidance document (and checklist) is a stand-alone document. It does, however, rely heavily on the guidance material in the earlier staff guidance and checklist document, and uses a vast majority of the material in the earlier document directly.

The table provides a checklist covering each of the Supporting Requirements (SRs) in the Code Case Standard. For most SRs, the SPID guidance does not differ from the requirement in the Code Case Standard. However, because the guidance in the SPID and the criteria of the Code Case Standard differ in some areas, or the SPID does not explicitly address an SR, the staff has developed the checklist, to help NRC reviewers to address and evaluate the differences, as well as to determine the appropriate technical requirement (Code Case Standard or SPID) against which the SPRA for NTTF Recommendation 2.1 submittals should be reviewed.

In general, the SPID allows departures or differs from the ASME-ANS Standard in the following ways:

- (i) In some technical areas, the SPID's requirements tell the SPRA analyst "how to perform" one aspect of the SPRA analysis, whereas the Code Case Standard's requirements generally cover "what to do" rather than "how to do it".
- (ii) For some technical areas and issues the requirements in the SPID differ from those in the Code Case Standard.
- (iii) The SPID has some requirements that are not in the Code Case Standard.

All of the technical positions in the SPID have been endorsed by the NRC staff for NTTF Recommendation 2.1 submittals, subject to certain conditions concerning peer review outlined in the staff's letter to NEI dated March 7, 2018 (NRC, 2018a, 2018b), which supersedes the staff's November 12, 2012, letter to NEI (NRC, 2012).

The checklist in this document is comprised of the 16 "Topics" that require additional staff guidance because the SPID contains specific guidance that differs from the Code Case Standard or expands on it. Each is covered below under its own heading, "Topic 1," "2," etc. The checklist also includes the SR table at the end that was cited earlier.

The earlier checklist covering staff review of submittals using Addendum A or Addendum B of the ASME-ANS Standard was discussed during a public meeting on December 7, 2016 (ADAMS Accession No. ML16350A181).

- Topic 1: Seismic Hazard (SPID Sections 2.1, 2.2, and 2.3)
- Topic 2: Site Seismic Response (SPID Section 2.4)
- Topic 3: Definition of the Control Point for the SSE-to-GMRS-Comparison Aspect of the Site Analysis (SPID Section 2.4.2)
- Topic 4: Adequacy of the Structural Model (SPID Section 6.3.1)
- Topic 5: Use of Fixed-Based Dynamic Seismic Analysis of Structures for Sites Previously Defined as "Rock" (SPID Section 6.3.3)

- Topic 6: Use of Seismic Response Scaling (SPID Section 6.3.2)
- Topic 7: Use of New Response Analysis for Building Response, ISRS, and Fragilities
- Topic 8: Screening by Capacity to Select SSCs for Seismic Fragility Analysis (SPID Section 6.4.3)
- Topic 9: Use of the CDFM/H Methodology for Fragility Analysis (SPID Section 6.4.1)
- Topic 10: Capacities of SSCs Sensitive to High-Frequencies (SPID Section 6.4.2)
- Topic 11: Capacities of Relays Sensitive to High-Frequencies (SPID Section 6.4.2)
- Topic 12: Selection of Dominant Risk Contributors that Require Fragility Analysis Using the Separation of Variables Methodology (SPID Section 6.4.1)
- Topic 13: Evaluation of LERF (SPID Section 6.5.1)
- Topic 14: Peer Review of the SPRA, Accounting for NEI 12-13 (SPID Section 6.7)
- Topic 15: Documentation of the SPRA (SPID Section 6.8)
- Topic 16: Review of Plant Modifications and Licensee Actions

**TOPIC 1: Seismic Hazard (SPID Sections 2.1, 2.2, and 2.3)**

<p>The site under review has updated/revised its PSHA from what was submitted to NRC in response to the NTTF Recommendation 2.1: Seismic 50.54(f) letter.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"><li>• the peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The relevant peer review findings are those that relate to the SHA requirements in the Code Case Standard, as well as to the requirements in the SPID.</li><li>• although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• the guidance in the SPID was followed for developing the probabilistic seismic hazard for the site.</li><li>• an alternate approach was used, and is acceptable on a justified basis.</li></ul>	

**TOPIC 2: Site Seismic Response (SPID Section 2.4)**

<p>The site under review has updated/revised its site response analysis from what was submitted to NRC in response to the NTTF Recommendation 2.1: Seismic 50.54(f) letter.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"><li>• the peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The relevant peer review findings are those that relate to all SRs under HLR-SHA-E in the Code Case Standard, as well as to the requirements in the SPID.</li><li>• although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• the licensee's development of PSHA inputs and base rock hazard curves meets the intent of the SPID guidance or another acceptable approach.</li><li>• the licensee's development of a site profile for use in the analysis adequately meets the intent of the SPID guidance or another acceptable approach.</li><li>• although the licensee's development of a <math>V_s</math> velocity profile for use in the analysis does not meet the intent of the SPID guidance, it is acceptable on another justified basis.</li></ul>	

**TOPIC 3: Definition of the Control Point for the SSE-to-GMRS-Comparison Aspect of the Site Analysis (SPID Section 2.4.2)**

<p>The issue is establishing the control point where the safe shutdown earthquake (SSE) is defined. Most sites have only one SSE, but some sites have more than one SSE, for example one at rock and one at the top of the soil layer.</p> <p>This control point is needed because it is used as part of the input information for the development of the seismic site-response analysis, which in turn is an important input for analyzing seismic fragilities in the SPRA.</p> <p>The SPID (Section 2.4.1) recommends one of two approaches for establishing the control point for a logical SSE-to-GMRS comparison:</p>	
<p>A) If the SSE control point(s) is defined in the final safety analysis report (FSAR), it should be used as defined.</p> <p>B) If the SSE control point is not defined in the FSAR, one of three criteria in the SPID (Section 2.4.1) should be used.</p> <p>C) An alternative method has been used for this site.</p> <p>The control point used as input for the SPRA is identical to the control point used to establish the GMRS and previously accepted by the staff.</p> <p>If <u>yes</u>, the control point can be used in the SPRA and the NRC staff's earlier acceptance governs.</p> <p>If <u>no</u>, the NRC staff's previous reviews might not apply. The staff's review of the control point used in the SPRA is acceptable.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p>	
<p>Consequence(s):</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers.</li></ul>	

<p>The relevant peer review findings are those that relate to the requirements in the SPID. No requirements in the Code Case Standard specifically address this topic.</p> <ul style="list-style-type: none"> <li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li> <li>• The licensee’s definition of the control point for site response analysis adequately meets the intent of the SPID guidance.</li> <li>• The licensee’s definition of the control point for site response analysis does not meet the intent of the SPID guidance, but is acceptable on another justified basis.</li> </ul>	
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**TOPIC 4: Adequacy of the Structural Model (SPID Section 6.3.1)**

<p>The NRC staff review of the structural model finds an acceptable demonstration of its adequacy</p> <p>Used an existing structural model</p> <p>Used an enhancement of an existing model</p> <p>Used an entirely new model</p> <p>Criteria 1 through 7 (SPID Section 6.3.1) are all met.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"> <li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The relevant peer review findings are those that relate to the SR requirement SFR-B3 in the Code Case Standard, as well as to the requirements in the SPID.</li> <li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li> <li>• The licensee’s structural model meets the intent of the SPID guidance.</li> </ul> <p>The licensee’s structural model does not meet the intent of the SPID guidance, but is acceptable on another justified basis.</p>	

**TOPIC 5: Use of Fixed-Based Dynamic Seismic Analysis of Structures for Sites Previously Defined as “Rock” (SPID Section 6.3.3)**

<p>Fixed-based dynamic seismic analysis of structures was used, for sites previously defined as “rock.”</p> <p>If <u>no</u>, this issue is moot.</p> <p>If <u>yes</u>, on which structure(s)? Structure #1 name: Structure #2 name:</p> <p><u>Structure #1:</u> If used, is <math>V_s &gt;</math> about 5,000 feet (ft.)/second (sec.)?</p> <p>If <math>3,500 \text{ ft./sec.} &lt; V_s &lt; 5000</math>, was peak-broadening or peak shifting used?</p> <p><u>Potential Staff Finding:</u> The demonstration of the appropriateness of using this approach is adequate.</p>	
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<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The relevant peer review findings are those that relate to the requirements in the SPID. No requirements in the Code Case Standard specifically address this topic.</li><li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis</li><li>• The licensee’s use of fixed-based dynamic analysis of structures for a site previously defined as “rock” adequately meets the intent of the SPID guidance.</li><li>• The licensee’s use of fixed-based dynamic analysis of structures for a site previously defined as “rock” does not meet the intent of the SPID guidance, but is acceptable on another justified basis.</li></ul>	

**TOPIC 6: Use of Seismic Response Scaling (SPID Section 6.3.2)**

<p>Seismic response scaling was used.</p> <p>If <u>no</u>, this issue is moot.</p> <p>If <u>yes</u>, on which structure(s)? Nuclear Steam System (NSS) including reactor vessel, steam generators, coolant pumps, pressurizer and piping.</p> <p><u>Structure #1:</u> Scaling based on: Previously developed In-Structure Response Spectra (ISRS) Shapes of previous uniform hazard spectrum/review-level earthquake (UHS/RLE) Shapes of new UHS/RLE Structural natural frequencies, mode shapes, participation factors</p> <p><u>Potential Staff Findings:</u> If a new UHS or RLE is used, the shape is approximately similar to the spectral shape previously used for ISRS generation.</p> <p>If the shape is not similar, the justification for seismic response scaling is adequate.</p> <p>Consideration of non-linear effects is adequate.</p>	
<p>Notes from staff reviewer:</p>	
<p>Deviation(s) or deficiency(ies) and Resolution: None. Consequence(s): None.</p>	

<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The relevant peer review findings are those that relate to the SR requirement SFR-B2 in the Code Case Standard, as well as to the requirements in the SPID.</li><li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• The licensee's use of seismic response scaling adequately meets the intent of the SPID guidance.</li><li>• The licensee's use of seismic response scaling does not meet the intent of the SPID guidance but is acceptable on another justified basis.</li></ul>	
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**TOPIC 7: Use of New Response Analysis for Building Response, ISRS, and Fragilities**

<p>The SPID does not provide specific guidance on performing new response analysis for use in developing ISRS and fragilities. The new response analysis is generally conducted when the criteria for use of existing models are not met or more realistic estimates are deemed necessary. The requirements for new analysis are included in the standard. See all of the SR requirements under HLR-SFR-B in the Code Case Standard.</p> <p>One of the key areas of review is consistency between the hazard and response analyses. Specifically, this means that there must be consistency among the ground motion equations, the soil-structure-interaction analysis (for soil sites), the analysis of how the seismic energy enters the base level of a given building, and the in-structure-response-spectrum analysis. Said another way, an acceptable SPRA must use these analysis pieces together in a consistent way.</p> <p>The following are high-level key elements that should have been considered:</p>	
<p>1. Foundation Input Response Spectra (FIRS) site response developed with appropriate building specific soil velocity profiles.</p> <p>Structure #1 name: Structure #2 name: etc.</p>	
<p>Are all structures appropriately considered?</p> <p>2. Are models adequate to provide realistic structural loads and response spectra for use in the SPRA?</p>	

<ol style="list-style-type: none"><li>1. Is the SSI analysis capable of capturing uncertainties and realistic?</li><li>2. Is the probabilistic response analysis capable of providing the full distribution of the responses?</li></ol>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	
<p>The NRC staff concludes:</p> <ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The relevant peer review findings are those that relate to all SRs under HLR-SFR-B in the Code Case Standard, as well as to the requirements in the SPID.</li><li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• The licensee's FIRS modeling is consistent with the prior NRC review of the GMRS and soil velocity information.</li><li>• The licensee's structural model meets the intent of the SPID guidance and the Standard's requirements.</li><li>• The response analysis accounts for uncertainties in accordance with the SPID guidance and the Standard's requirements.</li><li>• The NRC staff concludes that an acceptable consistency has been achieved among the various analysis pieces of the overall analysis of site response and structural response.</li><li>• The licensee's structural model does not meet the intent of the SPID guidance and the Standard's requirements, but is acceptable on another justified basis.</li></ul>	

**TOPIC 8: Screening by Capacity to Select SSCs for Seismic Fragility Analysis (SPID Section 6.4.3)**

<p>The selection of SSCs for seismic fragility analysis used a screening approach by capacity following Section 6.4.3 of the SPID.</p> <p>If <u>no</u>, see items D and E.</p> <p>If <u>yes</u>, see items A, B, and C.</p> <p><u>Potential Staff Findings:</u></p> <p>A) The recommendations in Section 6.4.3 of the SPID were followed for the screening aspect of the analysis, using the screening criteria therein.</p> <p>B) The approach for retaining certain SSCs in the model with a screening-level seismic capacity follows the recommendations in Section 6.4.3 of the SPID and has been appropriately justified.</p> <p>C) The approach for screening out certain SSCs from the model based on their inherent seismic ruggedness follows the recommendations in Section 6.4.3 of the SPID and has been appropriately justified.</p> <p>D) The Standard has been followed.</p> <p>E) An alternative method has been used and its use has been appropriately justified.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	
<p>The NRC staff concludes:</p> <ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The relevant peer review findings are those that relate to the SR requirements SFR-C1, SFR-C2, and SPR B-5 in the Code Case Standard, as well as to the requirements in the SPID.</li></ul>	

<ul style="list-style-type: none"><li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• The licensee's use of a screening approach for selecting SSCs for fragility analysis meets the intent of the SPID guidance.</li><li>• The licensee's use of a screening approach for selecting SSCs for fragility analysis does not meet the intent of the SPID guidance but is acceptable on another justified basis.</li></ul>	
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**TOPIC 9: Use of the CDFM/Hybrid Methodology for Fragility Analysis (SPID Section 6.4.1)**

<p>The Conservation Deterministic Failure Margin (CDFM)/Hybrid method was used for seismic fragility analysis.</p> <p>If <u>no</u>, See item C) below and next issue.</p> <p>If <u>yes</u>:</p> <p><u>Potential Staff Findings:</u></p> <p>A) The recommendations in Section 6.4.1 of the SPID were followed appropriately for developing the CDFM High Confidence Low Probability of Failure capacities.</p> <p>B) The Hybrid methodology in Section 6.4.1 and Table 6-2 of the SPID was used appropriately for developing the full seismic fragility curves.</p> <p>C) An alternative method has been used appropriately for developing full seismic fragility curves.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	

The NRC staff concludes that:

- The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The relevant peer review findings are those that relate to the requirements in the SPID. No requirements in the Code Case Standard specifically address this Topic.
- Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.
- The licensee's use of the CDFM/Hybrid method for seismic fragility analysis meets the intent of the SPID guidance.
- The licensee's use of the CDFM/Hybrid method for seismic fragility analysis does not meet the intent of the SPID guidance, but is acceptable on another justified basis

**TOPIC 10: Capacities of SSCs Sensitive to High-Frequencies (SPID Section 6.4.2)**

<p>The SPID requires that certain SSCs that are sensitive to high-frequency seismic motion must be analyzed in the SPRA for their seismic fragility using a methodology described in Section 6.4.2 of the SPID.</p> <p><u>Potential Staff Findings:</u> The NRC staff review of the SPRA's fragility analysis of SSCs sensitive to high frequency seismic motion finds that the analysis is acceptable.</p> <p>The flow chart in Figure 6-7 of the SPID was followed.</p> <p>The flow chart was not followed but the analysis is acceptable on another justified basis.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p>	
<p>Consequence(s):</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The relevant peer review findings are those that relate to the SR requirement SFR-E5 in the Code Case Standard, as well as to the requirements in the SPID.</li><li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• The licensee's fragility analysis of SSCs sensitive to high frequency seismic motion meets the intent of the SPID guidance.</li><li>• The licensee's fragility analysis of SSCs sensitive to high-frequency motion does not meet the intent of the SPID guidance but is acceptable on another justified basis.</li></ul>	

**TOPIC 11: Capacities of Relays Sensitive to High-Frequencies (SPID Section 6.4.2)**

<p>The SPID requires that certain relays and related devices (generically, "relays") that are sensitive to high-frequency seismic motion must be analyzed in the SPRA for their seismic fragility. Although following the Standard is generally acceptable for the fragility analysis of these components, the SPID (Section 6.4.2) contains additional guidance when either circuit analysis or operator-action analysis is used as part of the SPRA to understand a given relay's role in plant safety. When one or both of these are used, the NRC reviewer should use the following elements of the checklist.</p>	
<p>i) <u>Circuit analysis</u>: The seismic relay-chatter analysis of some relays relies on circuit analysis to assure that safety is maintained.          (A) If <u>no</u>, then (B) is moot.           (B) If <u>yes</u>:   <u>Potential Staff Finding</u>:          The approach to circuit analysis for maintaining safety after seismic relay chatter is acceptable.</p>	
<p>ii) <u>Operator actions</u>: The relay-chatter analysis of some relays relies on operator actions to assure that safety is maintained.           (A) If <u>no</u>, then (B) is moot.           (B) If <u>yes</u>:   <u>Potential Staff Finding</u>:          The approach to analyzing operator actions for maintaining safety after seismic relay chatter is acceptable.</p>	
<p>Notes from staff reviewer:          Deviation(s) or deficiency(ies) and Resolution:          Consequence(s):</p>	
<p>The NRC staff concludes that:</p>	

<ul style="list-style-type: none"><li>• the peer review findings have been addressed and the analysis approach has been accepted by the staff for the purposes of this evaluation. The relevant peer review findings are those that relate to SR requirement SPR-B6 in the Code Case Standard, as well as to the requirements in the SPID.</li><li>• although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• the licensee's analysis of seismic relay-chatter effects meets the intent of the SPID guidance.</li><li>• the licensee's analysis of seismic relay-chatter effects does not meet the intent of the SPID guidance, but is acceptable on another justified basis.</li></ul>	
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**TOPIC 12: Selection of Dominant Risk Contributors that Require Fragility Analysis Using the Separation of Variables Methodology (SPID Section 6.4.1)**

<p>The CDFM methodology has been used in the SPRA for analysis of the bulk of the SSCs requiring seismic fragility analysis.</p> <p>If <u>no</u>, the staff review will concentrate on how the fragility analysis was performed, to support one or the other of the “potential staff findings” noted just below.</p> <p>If <u>yes</u>, significant risk contributors for which use of separation of variables (SOV) fragility calculations would make a significant difference in the SPRA results have been selected for SOV calculations.”</p> <p><u>Potential Staff Findings:</u>  A) The recommendations in Section 6.4.1 of the SPID were followed concerning the selection of the “dominant risk contributors” that require additional seismic fragility analysis using the separation-of-variables methodology.</p> <p>B) The recommendations in Section 6.4.1 were not followed, but the analysis is acceptable on another justified basis.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	
<p>The NRC staff concludes:</p> <ul style="list-style-type: none"> <li>• the peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The relevant peer review findings are those that relate to SFR-E3 and the requirements in the SPID. No requirements in the Standard specifically address this Topic.</li> <li>• although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li> <li>• the licensee’s method for selecting the “dominant risk contributors” for further seismic fragilities analysis using the separation-of-variables methodology meets the intent of the SPID guidance.</li> <li>• the licensee’s method for selecting the “dominant risk contributors” for further seismic fragilities analysis using the separation-of-variables methodology does not meet the intent</li> </ul>	

of the SPID guidance, but is acceptable on another justified basis.	
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**TOPIC 13: Evaluation of LERF (SPID Section 6.5.1)**

<p>The NRC staff review of the SPRA's analysis of LERF finds an acceptable demonstration of its adequacy.</p> <p><u>Potential Staff Findings:</u></p> <p>A) The analysis follows each of the elements of guidance for LERF analysis in Section 6.5.1 of the SPID, including in Table 6-3.</p> <p>B) The LERF analysis does not follow the guidance in Table 6-3 but the analysis is acceptable on another justified basis.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"><li>• the peer review findings have been addressed and the analysis approach has been accepted by the staff for the purposes of this evaluation. The relevant peer review findings are those that relate to the SR requirements SPR-E1, E5, and E6 in the Code Case Standard, as well as to the requirements in the SPID.</li><li>• although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• the licensee's analysis of LERF meets the intent of the SPID guidance.</li><li>• the licensee's analysis of LERF does not meet the intent of the SPID guidance but is acceptable on another justified basis.</li></ul>	

**TOPIC 14: Peer Review of the SPRA, Accounting for NEI 12-13 (SPID Section 6.7)**

<p>The NRC staff review of the SPRA's peer review findings, observations, and their resolution finds an acceptable demonstration of the peer review's adequacy.</p> <p><u>Potential Staff Findings:</u></p> <p>A) The analysis follows each of the elements of the peer review guidance in Section 6.7 of the SPID as supplemented by NRC staff comments in the NRC letter dated March 7, 2018 (NRC 2018a, 2018b).</p> <p>B) The composition of the peer review team meets the SPID guidance as supplemented by NRC staff comments in the NRC letter dated March 7, 2018 (NRC 2018a, 2018b).</p> <p>C) The peer reviewers focusing on seismic response and fragility analysis have successfully completed the Seismic Qualifications Utility Group training course or equivalent (see SPID Section 6.7).</p> <p>In what follows, a distinction is made between an "in-process" peer review and an "end-of-process" peer review of the completed SPRA report. If an in-process peer review is used, go to (D) and then skip (E). If an end-of-process peer review is used, skip (D) and go to (E).</p> <p>D) The "in process" peer-review process followed the "in process" peer review guidance in the SPID (Section 6.7), including the three "bullets" and the guidance related to NRC's additional input in the paragraph immediately following those three bullets. These three bullets are:</p> <ul style="list-style-type: none"><li>• the SPRA findings should be based on a consensus process, and not based on a single peer review team member</li><li>• a final review by the entire peer review team must occur after the completion of the SPRA project</li></ul> <p>an "in-process" peer review must assure that peer reviewers remain independent throughout the SPRA development activity.</p>	
<p>If <u>no</u>, go to (F).</p> <p>If <u>yes</u>, the "in process" peer review approach is acceptable. Go to (G).</p>	

<p>E) The “end-of-process” peer review process followed the peer review guidance in the SPID (Section 6.7) as supplemented by NRC staff comments in the NRC letter dated March 7, 2018 (NRC 2018a, 2018b).</p> <p>If <u>no</u>, go to (F).</p> <p>If <u>yes</u>, the “end-of-process” peer review approach is acceptable. Go to (G).</p> <p>F) The peer-review process does not follow the guidance in the SPID as supplemented by NRC staff comments in the NRC letter dated March 7, 2018 (NRC 2018a, 2018b) but is acceptable on another justified basis.</p> <p>G) The licensee peer-review Findings and Observations were satisfactorily resolved or were determined not to be significant to the SPRA conclusions for this review application.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	
<p>The NRC staff concludes:</p> <ul style="list-style-type: none"><li>• the licensee’s peer-review process meets the intent of the SPID guidance as supplemented by NRC staff comments in the NRC letter dated March 7, 2018 (NRC 2018a, 2018b).</li><li>• the licensee’s peer-review process does not meet the intent of the SPID guidance as supplemented by NRC staff comments in the NRC letter dated March 7, 2018 (NRC 2018a, 2018b), but is acceptable on another justified basis.</li></ul>	

**TOPIC 15: Documentation of the SPRA (SPID Section 6.8)**

<p>The NRC staff review of the SPRA's documentation as submitted finds an acceptable demonstration of its adequacy.</p> <p>The documentation should include all of the items of specific information contained in the 50.54(f) letter as described in Section 6.8 of the SPID.</p>	
<p>Notes from staff reviewer:</p> <p>Deviation(s) or deficiency(ies) and Resolution:</p> <p>Consequence(s):</p>	
<p>The NRC staff concludes:</p> <ul style="list-style-type: none"><li>• The licensee's documentation meets the intent of the SPID guidance. The documentation requirements in the Code Case Standard can be found in HLR-SHA-J, HLR-SFR-F, and HLR-SPR-F.</li><li>• The licensee's documentation does not meet the intent of the SPID guidance but is acceptable on another justified basis.</li></ul>	

**Topic 16: Review of Plant Modifications and Licensee Actions, If Any**

<p>The licensee:</p> <ul style="list-style-type: none"><li>• identified modifications necessary to achieve seismic risk improvements</li><li>• provided a schedule to implement such modifications (if any), consistent with the intent of the guidance</li><li>• provided Regulatory Commitment to complete modifications</li><li>• provided Regulatory Commitment to report completion of modifications.</li></ul>	
<p>Plant will:</p> <ul style="list-style-type: none"><li>• complete modifications by</li><li>• report completion of modifications by</li></ul>	
<p>Notes from the Reviewer:</p> <p>Deviation(s) or Deficiency(ies), and Resolution:</p>	
<p>The NRC staff concludes that the licensee:</p> <ul style="list-style-type: none"><li>• identified plant modifications necessary to achieve the appropriate risk profile</li><li>• provided a schedule to implement the modifications (if any) with appropriate consideration of plant risk and outage scheduling</li></ul>	

## **REFERENCES**

**ASME/ANS Addendum A, 2009:** Standard ASME/ANS RA-Sa-2009, Addenda A to ASME/ANS RA-S-2008, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," American Society of Mechanical Engineers and American Nuclear Society, 2009

**ASME/ANS Addendum B, 2013:** Standard ASME/ANS RA-Sb-2013, Addenda B to ASME/ANS RA-S-2008, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," American Society of Mechanical Engineers and American Nuclear Society, 2013

**ASME/ANS, 2017:** Case 1 for Standard ASME/ANS RA-Sb-2013 Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," American Society of Mechanical Engineers and American Nuclear Society, 2017

**EPRI-SPID, 2012:** "Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," Electric Power Research Institute, EPRI report 1025287, November 2012 (ADAMS Accession No. ML12333A170) as endorsed by the NRC in a February 15, 2013, letter (ADAMS Accession No. ML12319A074).

**NEI, 2012:** NEI 12-13 "External Hazards PRA Peer Review Process Guidelines," Nuclear Energy Institute, August 2012

**NRC, 2012:** "U.S. Nuclear Regulatory Commission Comments on NEI 12-13, 'External Hazards PRA Peer Review Process Guidelines' Dated August 2012," NRC letter to Nuclear Energy Institute, November 16, 2012 (ADAMS Accession No. ML12321A280)

**NRC, 2017:** "NRC Staff Review Guidance for Seismic PRA Submittals and Technical Review Checklist," February 10, 2017 (ADAMS Accession No. ML17041A342)

**NRC, 2018:** "US Nuclear Regulatory Commission Acceptance of ASME/ANS RA-S Case 1," NRC letter from Brian Thomas (NRC Standards Executive) to C.R. Grantom and R.J. Budnitz, March 12, 2018 (ADAMS Accession No. ML18017A963)

**NRC, 2018a:** "US Nuclear Regulatory Commission Acceptance of Nuclear Energy Institute (NEI) Guidance NEI 12-13, "External Hazards PRA Peer Review Process Guidelines" (August 2102" NRC letter to Nuclear Energy Institute, March 7, 2018 (ADAMS Accession No. ML18025C025)

**NRC, 2018b:** "US Nuclear Regulatory Commission Acceptance of Nuclear Energy Institute (NEI) Guidance NEI 12-13, "External Hazards PRA Peer Review Process Guidelines" (August 2102," tabular compilation of NRC staff comments, appended to (NRC, 2018a), (ADAMS Accession No. ML18025C022)

**SUBJECT:** U.S. NUCLEAR REGULATORY COMMISSION STAFF CHECKLIST TO SUPPORT REVIEW OF SEISMIC PROBABILISTIC RISK ASSESSMENT REPORTS PROVIDED IN RESPONSE TO TITLE 10 OF THE *CODE OF FEDERAL REGULATIONS* 50.54(f) RELATING TO SEISMIC HAZARD REEVLATIONS FOR RECOMMENDATION 2.1 OF THE NEAR-TERM TASK FORCE REVIEW OF INSIGHTS FROM THE FUKUSHIMA DAI-ICHI ACCIDENT DATED July 12, 2018

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