

# **NRC Staff Review Guidance for Seismic PRA Submittals and Technical Review Checklist**

## **A. PURPOSE OF THE STAFF GUIDANCE:**

Many NPP licensees will be performing seismic PRAs (SPRAs) as part of their required submittals to satisfy NTTF 2.1 (seismic.) These submittals will be done according to the guidance in the EPRI-NEI SPID document (Ref. EPRI-SPID, 2012), which was endorsed by the staff for this purpose. Peer reviews are to follow the guidance in NEI 12-13 (Ref. NEI, 2012), which was commented on by the staff. Please note that the staff comments are supplemented by 5 qualifications and comments that were added in a staff letter to NEI dated 12 November 2012 (Ref. NRC, 2012).

The staff will be reviewing these SPRA submittals. The purpose of this Review Guidance is to provide specific information so that the staff SPRA reviews will have an appropriate scope, will be more uniform, and will focus on the most important technical topics. The Guidance uses a check-list type of format.

## **B. BACKGROUND:**

The SPID requires that a Seismic PRA submitted for the purpose of satisfying NTTF 2.1 (seismic) must meet the requirements in the ASME-ANS PRA Methodology Standard (called "the Standard" herein.) Either the so-called "Addendum A version" (Ref. ASME/ANS Addendum A, 2009) or the "Addendum B version" (Ref. ASME/ANS Addendum B, 2013) of that Standard can be used. The SPID contains an extensive table, Table 6-4, discussing each technical requirement in the seismic-PRA sections of both of these Addenda, comparing them where they differ, and offering commentary on each of them.

However, according to the SPID it is not necessary that an SPRA developed for the purpose of satisfying NTTF 2.1 (seismic) meet all of the Standard's requirements. Specifically,

- (i) The SPID allows an SPRA not to meet certain of the requirements in the Standard while still being acceptable for the purpose of satisfying NTTF 2.1 (seismic.). The reason that some of the SPID's requirements are not in the Standard is that, in a few technical areas, the SPID's requirements tell the SPRA analyst "how to perform" one aspect of the SPRA analysis, whereas the 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 Standard.
- (iii) The SPID has some requirements that are not in the Standard.

All of the technical positions in the SPID have been endorsed by the NRC staff, subject to the 5 modifying conditions concerning peer review in the staff letter to NEI that is cited above (Ref. NRC, 2012).

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### Technical review checklist for \_\_\_\_\_ (NAME OF PLANT)

This Technical Review Guidance consists of two parts:

1) There are 16 “Topics” that require specific staff guidance because the SPID contains specific guidance that differs from the Standard or expands on it. Each is covered below, one by one, under its own heading, “Topic #1,” “#2,” etc.

2) There is guidance herein for the staff review of each Supporting Requirement in the Standard. The format for this is that Table 6-4 of the SPID has been reproduced, but with the addition of an extra column on the right side containing staff guidance or commentary. For most SRs, the SPID guidance does not differ from the requirement in the Standard, and if so, that is noted in this Table by an entry that says, “*This SR governs.*” For those SRs for which the SPID guidance differs from the SR, or for which the SPID states that the SR need not be followed, the guidance points the staff reviewer to one or more of the “Topics” covered in the body of this Guidance.

The approach to be used by the staff reviewers will be to begin with the submittal itself, including not only the SPRA itself but also the documentation about the SPRA peer review that will also be submitted. The intent of this Review Guidance is to direct the staff reviewer to the governing review basis, be it the Standard (Addendum A or B) or the SPID. The reviewer can then use the governing review basis, and the relevant “Topic” from the checklist, if directed there, to review the substance of the peer-review Finding, the licensee’s resolution, and determine the need for any further action.

#### D. ASSUMPTIONS OF THIS GUIDANCE:

The following 6 assumptions need to be understood by an NRC staff reviewer prior to beginning the review covered herein:

Assumption #1: It is assumed that the choice by an NPP licensee to use a Seismic PRA (SPRA) to satisfy NTTF 2.1 (seismic) was a decision either made voluntarily or made because it is required by the SPID and hence by the NRC staff. Either way, this Staff Review Guidance does not cover a review of the basis for the licensee’s decision to use SPRA.

Assumption #2: This Staff Review Guidance has been developed for a plant site located anywhere in the U.S., meaning either in the central or eastern U.S.(CEUS) or in the western U.S. (WUS). Although the technical details of the analysis can differ in some areas, the review guidance itself is applicable to seismic PRAs at all U.S. sites.

Assumption #3: It is assumed that the SPRA submittal:

- includes evidence of meeting the peer review requirements in the Standard and in the SPID;
- includes evidence that each peer-review finding or observation has been acceptably resolved, or provides a justified basis for not resolving any given finding or observation; and

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- includes a discussion and justification concerning any technical requirement(s) for which the SPRA does not meet Capability Category II of the Standard or does not meet the SPID guidance, whichever is appropriate.

**Assumption #4:** The probabilistic seismic hazard analysis (PSHA) aspect of a seismic PRA submitted for these purposes requires special discussion here, especially for NPP sites in the central and eastern U.S. (CEUS). This is one of the major topics where the Standard contains detailed technical requirements that are dealt with differently in the SPID. The reason is that the NRC has endorsed some recent seismic hazard studies for the entire CEUS that, if used by any CEUS plant, are acceptable according to the SPID. This is true for both the seismic-source-characterization aspect of the PSHA and the ground-motion-attenuation aspect, covered by different studies and endorsed by the NRC for use to satisfy NTTF 2.1 (seismic.). Relying on these relieves an NPP licensee from the corresponding requirements in the Standard.

However, given that an NPP licensee relies on these PSHA studies, which provide the “seismic input” to the site, certain important seismic response analyses must still be done, on a site-specific basis, to meet the Standard and to provide the seismic inputs to the SPRA’s analyses of the fragilities of the plant’s SSCs. Specifically, the SPRA must still perform site-specific analyses of soil-structure interaction (SSI) effects (for soil sites), of how the seismic energy enters the base of the structure, of how that energy propagates into the structure (the so-called in-structure-response-spectrum or ISRS analysis), and of how the ISRS leads to input seismic motion at the support of each relevant structure or component.

The SPID has some guidance on this complex set of analysis issues, but it is not highly specific. The Standard also has technical requirements on this broad set of topics, but the Standard’s requirements generally cover “what to do” rather than “how to do it,” so the Standard also does not have detailed guidance.

The above set of technical issues, ranging from the seismic sources and seismic energy propagation through to the structural model and the in-structure response analysis, is one broad area where the NRC staff’s technical review needs to concentrate, and the Technical Review Guidance herein provides some guidance for the staff review. Refer to Topics #1 through #7 below.

**Assumption #5:** It is assumed that the seismic-hazard input basis for the seismic PRA is the PSHA discussed in Assumption #4. It is also assumed that the PSHA is the starting point for the calculation of the UHRS (uniform hazard response spectra) from which the GMRS (ground motion response spectrum) is derived. Aside from the review of the ground-motion and site-response aspects of developing a site-specific seismic hazard for the purposes of supporting the SPRA (see Assumption #4 above), the review of these other aspects of the hazard analysis is not part of the Staff Review Guidance herein.

However, if a new site-specific PSHA has been developed, the aspects of the hazard analysis that are mentioned in Assumption #4 above are not part of the checklist and therefore will need to be reviewed by the staff separately. These aspects are the site-

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specific analyses of soil-structure interaction (SSI) effects (for soil sites), how the seismic energy enters the base of the structure, how that energy propagates into the structure (the so-called in-structure-response-spectrum or ISRS analysis), and how the ISRS leads to input seismic motion at the support of each relevant structure or component.

Assumption #6: The SPID states in several places that “existing PSHA studies will not be used to characterize seismic hazard at any site.” (See SPID Table 6.4 at entries SHA-B2, SHA-C4, SHA-D4, SHA-H1, and SHA-J2.) However, if any element of an existing PSHA is used in the SPRA under review, then the corresponding SR in the Standard will govern.

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**E. TECHNICAL STAFF GUIDANCE, TOPIC-BY-TOPIC**

The 16 topics covered individually below are as follows:

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 Seismic PRA, Accounting for NEI 12-13 (SPID Section 6.7)

Topic #15: Documentation of the Seismic PRA (SPID Section 6.8)

Topic #16: Review of Plant Modifications and Licensee Actions

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

The site under review has updated/revised its PSHA from what was submitted to NRC in response to the NTTF 2.1 (seismic) 50.54(f) letter. Yes / No

If no, this issue is moot, and the existing PSHA must meet the SHA requirements in the Standard.

If yes

The guidance in the SPID was followed for developing the site's probabilistic seismic hazard. Yes / No

An alternate approach was used. Yes / No / NA

Notes from staff reviewer:

*[NOTE: This staff review is only necessary if the site under review has updated/revised its PSHA from what was submitted to the NRC in response to the NTTF 2.1 (Seismic) 50.54(f) letter.]*

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes that:

- the peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SHA requirements in the Standard as well as to the requirements in the SPID. Yes / No
- although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis. Yes / No / NA
- the guidance in the SPID was followed for developing the probabilistic seismic hazard for the site. Yes / No
- An alternate approach was used, and is acceptable on a justified basis. Yes / No / NA

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

The site under review has updated/revised its site response analysis from what was submitted to NRC in response to the NTTF 2.1 (seismic) 50.54(f) letter.. Yes / No

If no, this issue is moot, and the existing PSHA must meet the SHA requirements in the Standard.

If yes

The guidance in the SPID was followed for developing a site profile for use in the analysis to develop control point seismic hazard curves (site response). Yes / No

An alternate approach was used. Yes / No / NA

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes that:

- the peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirements SHA-E1 and E2 in the Standard as well as to the requirements in the SPID. Yes / No
- although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis. Yes / No / NA
- the licensee's development of PSHA inputs and base rock hazard curves meets the intent of the SPID guidance or another acceptable approach. Yes / No / NA
- 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. Yes / No / NA
- although the licensee's development of a  $V_s$  velocity profile for use in the analysis does not meet the intent of the SPID guidance, it is acceptable on another justified basis. Yes / No / NA

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

The issue is establishing the control point where the 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.

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 seismic PRA.

The SPID (section 2.4.1) recommends one of two criteria for establishing the control point for a logical SSE-to-GMRS comparison:

A) If the SSE control point(s) is defined in the FSAR, it should be used as defined.

Yes / No / NA

B) If the SSE control point is not defined in the FSAR, one of 3 criteria in the SPID (section 2.4.1) should be used.

Yes / No / NA

C) An alternative method has been used for this site.

Yes / No / NA

Yes / No

The control point used as input for the SPRA is identical to the control point used to establish the GMRS.

If yes, the control point can be used in the SPRA and the NRC staff's earlier acceptance governs.

Yes / No / NA

If no, the NRC staff's previous reviews might not apply. The staff's review of the control point used in the SPRA is acceptable.

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes that:

- The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the requirements in the SPID. No requirements in the Standard specifically address this Topic.
- Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.

Yes / No

Yes / No / NA



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- The licensee's definition of the control point for site response analysis adequately meets the intent of the SPID guidance. Yes / No

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. Yes / No / NA

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**TOPIC #4: Adequacy of the Structural Model (SPID Section 6.3.1)**

The NRC staff review of the structural model finds an acceptable demonstration of its adequacy Yes / No

Used an existing structural model Yes / No

Used an enhancement of an existing model Yes / No

Used an entirely new model Yes / No

Criteria 1 through 7 (SPID section 6.3.1) are all met. Yes / No

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes that:

- The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirements SFR-C1 through C6 in the Standard as well as to the requirements in the SPID. Yes / No
- Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis. Yes / No / NA
- The licensee's structural model meets the intent of the SPID guidance. Yes / No
- The licensee's structural model does not meet the intent of the SPID guidance but is acceptable on another justified basis. Yes / No / NA

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

Fixed-based dynamic seismic analysis of structures was used, for sites previously defined as “rock.” Yes / No

If no, this issue is moot.

If yes, on which structure(s)?

Structure #1 name:

Structure #2 name:

etc.

Structure #1:

If used, is  $V_s > \text{about } 5000 \text{ ft/sec}$ ? Yes / No / NA

If  $3500 \text{ ft/sec} < V_s < 5000$ , was peak-broadening or peak shifting used? Yes / No / NA

Potential Staff Finding:

The demonstration of the appropriateness of using this approach is adequate. Yes / No

REPEAT ABOVE FOR STRUCTURE #2, STRUCTURE #3, etc.

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes that:

- The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the requirements in the SPID. No requirements in the Standard specifically address this Topic. Yes / No
- Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis Yes / No / NA
- 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. Yes / No
- 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. Yes / No / NA

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

Seismic response scaling was used. Yes / No

If no, this issue is moot.

If yes, on which structure(s)?

Structure #1 name:

Structure #2 name:

etc.

Structure #1:

Scaling based on:

Previously developed ISRS Yes / No

Shapes of previous UHS/RLE Yes / No

Shapes of new UHS/RLE Yes / No

Structural natural frequencies, mode shapes, participation factors Yes / No

Potential Staff Findings:

If a new UHS or RLE is used, the shape is approximately similar to the spectral shape previously used for ISRS generation. Yes / No / NA

If the shape is not similar, the justification for seismic response scaling is adequate. Yes / No / NA

Consideration of non-linear effects is adequate. Yes / No / NA

REPEAT ABOVE FOR STRUCTURE #2, STRUCTURE #3, etc.

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes that:

- The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirement SFR-C3 in the Standard as well as to the requirements in the SPID. Yes / No
- Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis. Yes / No / NA
- The licensee's use of seismic response scaling adequately meets the intent of the SPID guidance. Yes / No / NA

Yes / No / NA

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The licensee's use of seismic response scaling does not meet the intent of the SPID guidance but is acceptable on another justified basis.

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**TOPIC #7: Use of New Response Analysis for Building Response, ISRS, and Fragilities**

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 SR requirements SFR-C2, C4, C5, and C6.

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.

The following are high-level key elements that should have been considered:

1. FIRS site response developed with appropriate building specific soil velocity profiles.

Structure #1 name:  
Structure #2 name:  
etc.

Are all structures appropriately considered? Yes / No

2. Are models adequate to provide realistic structural loads and response spectra for use in the seismic PRA? Yes / No

1. Is the SSI analysis capable of capturing uncertainties and realistic? Yes / No

Is the probabilistic response analysis capable of providing the full distribution of the responses? Yes / No

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes:

Yes / No

- The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR

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requirements SFR-C2, C4, C5, and C6 in the Standard as well as to the requirements in the SPID.

Yes / No / NA

- Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.
- The licensee's FIRS modeling is consistent with the prior NRC review of the GMRS and soil velocity information.
- The licensee's structural model meets the intent of the SPID guidance and the standard's requirements.
- The response analysis accounts for uncertainties in accordance with the SPID guidance and the standard's requirements.
- 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.
- 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.

Yes / No

Yes / No / NA

Yes / No / NA

Yes / No / NA

Yes / No / NA



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

The selection of SSCs for seismic fragility analysis used a screening approach by capacity following Section 6.4.3 of the SPID. Yes / No

If no, see items D and E.

If yes, see items A, B, and C.

Potential Staff Findings:

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. Yes / No / NA

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. Yes / No / NA

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. Yes / No / NA

D) The Standard has been followed. Yes / No / NA

E) An alternative method has been used and its use has been appropriately justified. Yes / No / NA

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes:

- The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirements SFR-B1 and B2 in the Standard as well as to the requirements in the SPID. Yes / No
- Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis. Yes / No / NA

Yes / No

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- The licensee's use of a screening approach for selecting SSCs for fragility analysis meets the intent of the SPID guidance. Yes / No / NA

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.

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**TOPIC #9: Use of the CDFM/Hybrid Methodology for Fragility Analysis (SPID Section 6.4.1)**

The CDFM/Hybrid method was used for seismic fragility analysis. Yes / No

If no, See item C) below and next issue.

If yes:

Potential Staff Findings:

A) The recommendations in Section 6.4.1 of the SPID were followed appropriately for developing the CDFM HCLPF capacities. Yes / No / NA

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. Yes / No / NA

C) An alternative method has been used appropriately for developing full seismic fragility curves. Yes / No / NA

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes that:

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

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

The SPID requires that certain SSCs that are sensitive to high-frequency seismic motion must be analyzed in the seismic PRA for their seismic fragility using a methodology described in Section 6.4.2 of the SPID. Yes / No

Potential Staff Findings:

The NRC staff review of the seismic PRA's fragility analysis of SSCs sensitive to high frequency seismic motion finds that the analysis is acceptable. Yes / No / NA

The flow chart in Figure 6-7 of the SPID was followed. Yes / No

The flow chart was not followed but the analysis is acceptable on another justified basis. Yes / No / NA

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes that:

- The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirement SFR-F3 in the Standard as well as to the requirements in the SPID. Yes / No
- Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis. Yes / No / NA
- The licensee's fragility analysis of SSCs sensitive to high frequency seismic motion meets the intent of the SPID guidance. Yes / No
- 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. Yes / No / NA

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

The SPID requires that certain relays and related devices (generically, “relays”) that are sensitive to high-frequency seismic motion must be analyzed in the seismic PRA 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.

i) Circuit analysis: The seismic relay-chatter analysis of some relays relies on circuit analysis to assure that safety is maintained. Yes / No

(A) If no, then (B) is moot.

(B) If yes:

Potential Staff Finding:

The approach to circuit analysis for maintaining safety after seismic relay chatter is acceptable. Yes / No / NA

ii) Operator actions: The relay-chatter analysis of some relays relies on operator actions to assure that safety is maintained. Yes / No

(A) If no, then (B) is moot.

(B) If yes:

Potential Staff Finding:

The approach to analyzing operator actions for maintaining safety after seismic relay chatter is acceptable. Yes / No / NA

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes that:

- the peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirements SPR-B6 (Addendum A) or SPR-B4 (Addendum B) in the Standard as well as to the requirements in the SPID. Yes / No

Yes / No / NA

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- although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis. Yes / No
- The licensee's analysis of seismic relay-chatter effects meets the intent of the SPID guidance.
- 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. Yes / No / NA

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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)**

The CDFM methodology has been used in the seismic PRA for analysis of the bulk of the SSCs requiring seismic fragility analysis. Yes / No

If no, 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.,

If yes, 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.” Yes / No

Potential Staff Findings:

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. Yes / No

B) The recommendations in Section 6.4.1 were not followed but the analysis is acceptable on another justified basis. Yes / No / NA

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes:

- The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the requirements in the SPID. No requirements in the Standard specifically address this Topic. Yes / No
- Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis. Yes / No / NA
- 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. Yes / No
- 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 Yes / No / NA

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intent 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)**

The NRC staff review of the seismic PRA's analysis of LERF finds an acceptable demonstration of its adequacy. Yes / No

Potential Staff Findings:

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. Yes / No

B) The LERF analysis does not follow the guidance in Table 6-3 but the analysis is acceptable on another justified basis. Yes / No / NA

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes that:

- the peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirements SFR-F4, SPR-E1, SPR-E2, and SPR-E6 (Addendum B only) in the Standard as well as to the requirements in the SPID. Yes / No
- although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis. Yes / No / NA
- The licensee's analysis of LERF meets the intent of the SPID guidance. Yes / No
- The licensee's analysis of LERF does not meet the intent of the SPID guidance but is acceptable on another justified basis Yes / No / NA

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

The NRC staff review of the seismic PRA's peer review findings, observations, and their resolution finds an acceptable demonstration of the peer review's adequacy. Yes / No

Potential Staff Findings:

A) The analysis follows each of the elements of the peer review guidance in Section 6.7 of the SPID. Yes / No

B) The composition of the peer review team meets the SPID guidance. Yes / No

C) The peer reviewers focusing on seismic response and fragility analysis have successfully completed the SQUG training course or equivalent (see SPID section 6.7). Yes / No

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).

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 3 bullets. These 3 bullets are: Yes / No

- o The SPRA findings should be based on a consensus process, and not based on a single peer review team member
- o A final review by the entire peer review team must occur after the completion of the SPRA project
- o An "in-process" peer review must assure that peer reviewers remain independent throughout the SPRA development activity.

If no, go to (F).

If yes, the "in process" peer review approach is acceptable. Go to (G). Yes / No

E) The "end-of-process" peer review process followed the peer review guidance in the SPID (Section 6.7).

If no, go to (F).

Yes / No

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If yes, the “end-of-process” peer review approach is acceptable. Go to (G).

F) The peer-review process does not follow the guidance in the SPID but is acceptable on another justified basis. Yes / No / NA

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.

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes:

- The licensee’s peer-review process meets the intent of the SPID guidance. Yes / No
- The licensee’s peer-review process does not meet the intent of the SPID guidance but is acceptable on another justified basis. Yes / No / NA

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**TOPIC #15: Documentation of the Seismic PRA (SPID Section 6.8)**

The NRC staff review of the seismic PRA's documentation as submitted finds an acceptable demonstration of its adequacy. Yes / No

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. Yes / No

Notes from staff reviewer:

Deviation(s) or deficiency(ies) and Resolution:

Consequence(s):

The NRC staff concludes:

- The licensee's documentation meets the intent of the SPID guidance. The documentation requirements in the Standard can be found in HLR-SHA-J, HLR-SPR-G, and HLR-SPR-F. Yes / No
- The licensee's documentation does not meet the intent of the SPID guidance but is acceptable on another justified basis. Yes / No / NA

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

The licensee:

- |  |               |
|--|---------------|
| • identified modifications necessary to achieve seismic risk improvements                                  | Yes / No / NA |
| • provided a schedule to implement such modifications (if any), consistent with the intent of the guidance | Yes / No / NA |
| • provided Regulatory Commitment to complete modifications   | Yes / No / NA |
| • provided Regulatory Commitment to report completion of modifications.                                    | Yes / No / NA |

[Plant] will:

- complete modifications by N/A or Date
- report completion of modifications by N/A or Date

**Notes from the Reviewer:**

None

**Deviation(s) or Deficiency(ies), and Resolution:**

No deviations or deficiencies were identified.

The NRC staff concludes that the licensee:

- |  |               |
|--|---------------|
| • identified plant modifications necessary to achieve the appropriate risk profile   | Yes / No / NA |
| • provided a schedule to implement the modifications (if any) with appropriate consideration of plant risk and outage scheduling | Yes / No / NA |

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**REFERENCES**

1. 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
2. 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
3. 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
4. NEI, 2012: NEI 12-13 "External Hazards PRA Peer Review Process Guidelines," Nuclear Energy Institute, August 2012
5. 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