NRR-PMDAPEm Resource

From:	DiFrancesco, Nicholas
Sent:	Wednesday, March 30, 2016 11:27 AM
To:	Laur, Steven; Fong, CJ; Reisifard, Mehdi; Lyons, Sara; Chokshi, Nilesh; Li, Yong; Heeszel, David; Harrison, Donnie; Ng, Ching
Cc:	Marshall, Michael; Shams, Mohamed; McCoppin, Michael; 50.54f_Seismic Resource; Manoly, Kamal
Subject:	Summary of March 16 Licensing Discussion Regarding the SPRA Submittal Template
Attachments:	DRAFT 50_54(f) SPRA Submittal Template 15 March 2016.docx

Folks,

Appreciate staff comments received.

This email summarizes a discussion between NRC staff and Nuclear Energy Institute (NEI) representatives regarding licensing plans on the attached SPRA Submittal Template which occurred on March 16.

Consistent with documentation requirements contained in MD 3.53, “Records and Document Management Program,” and COM-203, “Interfacing with Owners Groups, Vendors and NEI,” the staff completed a discussion with NEI and EPRI representatives regarding information needs associated with the development of planned SPRA submittal guidance. This discussion supported preparations for a future R2.1 Seismic public meeting. The general discussions were as follows:

1. NEI representatives discussed how the planned submittal will provide information consistent with the 50.54(f) letter and the SPID standard. NEI developed a crosswalk to confirm SPRA template content is met.
2. NRC and NEI representatives discussed aligning the submittal conclusions to support NRC review and decision making.
3. NEI representatives discussed emphasis on documenting the peer review effort. NRC staff expressed interest in attending future licensee peer reviews to observe the process. It was generally, agreed observations could support the review effort.
4. NRC staff suggested including a regulatory commitment section to support awareness of completed plant changes. Specifically, the staff discussed examples of how regulatory commitments support R2.1 Seismic closure and alignment with future licensing reviews.
5. NRC staff discussed that revised seismic hazard information could be presented in a format similar to the March 2014/2015 seismic hazard submittals. Separately, NRC staff acknowledged that changes to hazard information would be reviewed by the licensee peer review team.
6. NRC staff discussed the importance of explaining fragility and PRA models used. NRC staff encouraged providing high-level of information with emphasis on the use of new or current methods, and discussion any deviations. NEI representatives noted that the fragility methodologies are generally well established.
7. NRC staff encouraged template clarity in identifying peer review results separately from internal plant review results.
8. NRC staff noted limited development of soil failure review or discussion of results.
9. NRC staff was interested in seeing additional information on component risk measures (FV, RRW, RAW). Summary tables should provide failure model information. NRC staff suggested providing a review of top structural failures to ensure risk insights are not masked.
10. NRC staff discuss how the review conclusions are not directly link to quantitative health objectives.
11. NRC and NEI representatives discussed the desire to have a consistent definition of potential ‘vulnerabilities’.

NRC Attendees:	**NEI/**

	<u>Electric Power Research Institute (EPRI) / Jensen Hughes</u>
CJ Fong	Andrew Mauer, NEI
Steven Laur	Barry Sloane, Jensen Hughes
Mehdi Reisfard	Bret Tegeler, Jensen Hughes
Ng Ching	John Richards, EPRI
Sara Lyons	
Donnie Harrison	
Mohamed Shams	
Michael Marshall	
Nicholas DiFrancesco	
Kamal Manoly	
Yong Li	
Nilesh Chokshi	
David Heeszel	

Thanks,

Nick

Sr. Project Manager - Seismic Reevaluations
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Japan Lesson Learned Project Division
nicholas.difrancesco@nrc.gov | Tel: (301) 415-1115

Hearing Identifier: NRR_PMDA
Email Number: 2744

Mail Envelope Properties (Nicholas.DiFrancesco@nrc.gov20160330112600)

Subject: Summary of March 16 Licensing Discussion Regarding the SPRA Submittal Template
Sent Date: 3/30/2016 11:26:53 AM
Received Date: 3/30/2016 11:26:00 AM
From: DiFrancesco, Nicholas

Created By: Nicholas.DiFrancesco@nrc.gov

Recipients:
"Marshall, Michael" <Michael.Marshall@nrc.gov>
Tracking Status: None
"Shams, Mohamed" <Mohamed.Shams@nrc.gov>
Tracking Status: None
"McCoppin, Michael" <Michael.McCoppin@nrc.gov>
Tracking Status: None
"50.54f_Seismic Resource" <50.54f_Seismic.Resource@nrc.gov>
Tracking Status: None
"Manoly, Kamal" <Kamal.Manoly@nrc.gov>
Tracking Status: None
"Laur, Steven" <Steven.Laur@nrc.gov>
Tracking Status: None
"Fong, CJ" <CJ.Fong@nrc.gov>
Tracking Status: None
"Reisifard, Mehdi" <Mehdi.Reisifard@nrc.gov>
Tracking Status: None
"Lyons, Sara" <Sara.Lyons@nrc.gov>
Tracking Status: None
"Chokshi, Nilesh" <Nilesh.Chokshi@nrc.gov>
Tracking Status: None
"Li, Yong" <Yong.Li@nrc.gov>
Tracking Status: None
"Heeszel, David" <David.Heeszel@nrc.gov>
Tracking Status: None
"Harrison, Donnie" <Donnie.Harrison@nrc.gov>
Tracking Status: None
"Ng, Ching" <Ching.Ng@nrc.gov>
Tracking Status: None

Post Office:

Files	**Size**	**Date & Time**
MESSAGE	3558	3/30/2016 11:26:00 AM
DRAFT 50_54(f) SPRA Submittal Template 15 March 2016.docx	96453	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal

Expiration Date:
Recipients Received:

{Plant} Seismic Probabilistic Risk Assessment in Response to 50.54(f) Letter with Regard to NTTF 2.1 Seismic Example REPORT

March 2016

Notes for the example:

This document is intended to provide an example of a plant Seismic PRA (SPRA) Report. The primary purpose of this example is to demonstrate the level of detail expected to be provided in the SPRA submittals. This template is not intended to address Spent Fuel Pool evaluations.

This example reflects a combined submittal for a two unit site; however, sites can choose to create a separate submittal for each unit at a site.

Normal text	Typical text showing the amount of detail expected in each section
{brackets}	Specific to the plant submittal, e.g., {Plant}
<italic text>	Optional / plant-specific information or text options that may not apply to all
Highlighted italic text	Generic submittal guidance, not expected to be included in the actual plant submittals. In some cases for the current draft, issues to be addressed generically for the template are also highlighted.
Highlighted italic text	Temporary notations requesting input from subject matter experts

{PLANT} SEISMIC PROBABILISTIC RISK ASSESSMENT SUMMARY REPORT

TABLE OF CONTENTS (OPTIONAL)

1.0 Purpose and Objective

This section explains the criteria (EPRI SPID) used to determine the need for a seismic PRA in response to the 50.54(f) letter and defines the purpose of the submittal. The philosophy for the submittal is that the SPID should be viewed as defining what is expected to be done in developing the SPRA, but does not define what needs to be submitted, so this template provides guidance in that regard.

Following the accident at the Fukushima Dai-ichi nuclear power plant resulting from the March 11, 2011, Great Tohoku Earthquake and subsequent tsunami, the Nuclear Regulatory Commission (NRC) established a Near Term Task Force (NTTF) to conduct a systematic review of NRC processes and regulations and to determine if the agency should make additional improvements to its regulatory system. The NTTF developed a set of recommendations intended to clarify and strengthen the regulatory framework for protection against natural phenomena. Subsequently, the NRC issued a 50.54(f) letter on March 12, 2012 [1], requesting information to assure that these recommendations are addressed by all U.S. nuclear power plants. The 50.54(f) letter requests that licensees and holders of construction permits under 10 CFR Part 50 reevaluate the seismic hazards at their sites against present-day NRC requirements and guidance.

A comparison between the reevaluated seismic hazard and the design basis for {Plant} has been performed, in accordance with the guidance in EPRI 1025287, "Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic" [2], and previously submitted to NRC [3]. That comparison concluded that a seismic PRA would be the approach used to perform the seismic reevaluation for {Plant} relative to the updated seismic hazard, in response to the 50.54(f) letter, specifically item (8) in Enclosure 1 of the 50.54(f) letter.

This report describes the seismic PRA (SPRA) developed for {Plant} and provides the information requested in item (8)(B) of Enclosure 1 of the 50.54(f) letter. The intent of the SPRA is to assess the seismic risk for {Plant}, identify which structures, systems, and components (SSCs) are important to seismic risk, and describe any seismic vulnerabilities.

The objective of this report is to provide summary information describing:

- the preparation of the SPRA,
- the assessment of SPRA technical adequacy for the seismic reevaluation as established through a process of self-assessment and independent peer review against the criteria in the SPID and the ASME/ANS PRA Standard [4],

- the key risk results and insights from the SPRA, including the relative risk significance of plant SSCs, and
- adverse conditions identified for {Plant} based on the above, and actions taken [or planned].

The level of detail provided in the report is intended to enable NRC to understand the inputs used, the evaluations performed, and the decisions made as a result of the insights gained from the {Plant} seismic PRA.

2.0 Information Provided in This Report

This section notes the types of information included consistent with the SPRA reporting requirements in the 50.54(f) letter and the need to limit details provided in docketed submittals, refers to the defining guidance in the SPID and PRA Standard, and provides a high level road-map for the remainder of the report.

The following information is provided, in accordance with the information request in the 50.54(f) letter [1] for plants performing a SPRA.

- A summary of the methodologies used to estimate the seismic core damage frequency (SCDF) and seismic large early release frequency (SLERF), including:
    - a summary of the {Plant} seismic ground motion used for the SPRA
    - method of characterization of site response to the seismic hazard, and definition of control points and foundation input response spectra (FIRS) for risk important structures
    - description of the methodologies used to quantify the seismic fragilities of SSCs, together with key assumptions
    - summary of plant walkdowns performed in support of the SPRA *<and any corrective actions taken>*
    - description of the process used in the seismic plant response analysis and quantification, including a summary of the types of adaptations made in the internal events PRA model to produce the seismic PRA model for SCDF and SLERF, including containment performance
- The SCDF and SLERF results, including fragility values, failure modes, and associated risk importance measures for the key contributors
- Description of the process used to ensure that the SPRA is technically adequate, including the dates and disposition of pertinent findings of the peer review conducted for the {Plant} SPRA.
- *<Identified plant-specific issues and corresponding actions that are planned or have been taken.>*

The SPID [2] defines the principal parts of an SPRA, and the {Plant} SPRA has been developed and documented in accordance with the SPID. The main elements of the SPRA performed for {Plant} in response to the 50.54(f) Seismic letter correspond to those described in Section 6.1.1 of the SPID, i.e.:

- Seismic hazard analysis
- Seismic structure response and SSC fragility analysis
- Systems/accident sequence (seismic plant response) analysis
- Risk quantification

The {Plant} SPRA and associated documentation has been peer reviewed against the PRA Standard in accordance with the process defined in NEI-12-13 [5] *<or other stated process, if used>*, as documented in the {Plant} SPRA Peer Review Report [6]. The {Plant} SPRA, complete SPRA documentation, and details of the peer review are available for NRC review. This submittal provides a summary of the SPRA development, results, and insights sufficient to meet the 50.54(f) information request in a manner intended to enable NRC to understand and determine the validity of key input data and calculation models used, and to assess the sensitivity of the results to key aspects of the analysis.

Section 3 provides information related to the {Plant} seismic hazard analysis, including a summary site description, and listing of seismic category I structures.

Section 4 provides information related to the determination of seismic fragilities for {Plant} SSCs included in the seismic plant response.

Section 5 provides information regarding the plant seismic response model (seismic accident sequence model) and quantification of results. For each of these main portions of the SPRA, an overview of the methodology, discussion of key assumptions used in performing the SPRA, and summary of the important results and insights is provided. A discussion of the assessment of technical adequacy of the analysis is also provided.

Section 6 summarizes the results and conclusions of the SPRA.

Section 7 provides references.

The Appendix sections provide additional information as follows:

- Appendix A: Seismic Hazard Analysis Additional Information
- Appendix B: Seismic Structural Response and SSI Additional Information
- Appendix C: SSC Seismic Fragility Analysis Additional Information
- Appendix D: SPRA Model and Results Additional Information
- Appendix E: Assessment of SPRA Technical Adequacy for Response to NTTF 2.1 Seismic 50.54(f) Letter
- Appendix F: Summary of {Plant} SPRA Peer Review

3.0 {Plant} Seismic Hazard and Plant Response

Section 3.0 provides a high level summary site description, listing pertinent features such as location, soil or rock site characterization, seismic category I structures, including structures whose failure could result in external flooding or loss of ultimate heat sink. The subsections provide brief summaries of the site hazard and plant response characterization.

For each element, provide a several-paragraph summary of the methodology and important results and conclusions.

3.1 General Site Description

{Plant} is a *[single/dual unit plant vendor and type]* plant located in *[plant location]*. The {Plant} structures considered in the seismic PRA are listed in Table 3-1. Onsite or nearby structures important to maintaining the {Plant} ultimate heat sink (UHS) that are addressed in the SPRA are: *[Structure X, Structure Y, Tank Z, …]*.

{Plant} is a *[soil site / hard rock site / indicate the site geologic setting, including a summary of significant features, e.g., backfill and type, features on which Category I structures are situated; refer to prior NTTF 2.1 or 2.3 Seismic submittal for details.]*

[Describe the composite profile development, referring to prior NTTF 2.1 or 2.3 Seismic submittal for details.]

Table 3-1 {Plant} Structures Considered in the SPRA (1)

Structure
Containment
Auxiliary Building
Control Building
Fuel Handling Building
…

1. Refer to prior NTTF 2.1 or 2.3 Seismic Submittal for Structure details

3.2 Seismic Hazard Analysis

This section discusses the seismic hazard methodology, presents the final seismic hazard results used in the SPRA, discusses important assumptions and important sources of uncertainty, and describes any particular hazard-related insights identified.

This section will typically consist of several pages. Refer to prior NTTF 2.1 and 2.3 Seismic submittals as appropriate.

The seismic hazard analysis determines the annual frequency of exceedance for selected ground motion parameters. The analysis involves use of earthquake source models, ground motion attenuation models, characterization of the site response (e.g. soil column), and accounts for the uncertainties and randomness of these parameters to arrive at the site seismic hazard. Detailed information regarding the {Plant} site hazard was provided to NRC in the seismic hazard information submitted to NRC in response to the NTTF 2.1 Seismic information request [3].

3.2.1 Seismic Hazard Analysis Methodology

For the {Plant} SPRA, the following method was used:

If the Plant-specific hazard analysis methodology is the same as was described in the NTTF 2.1 Seismic hazard submittal (March 2014 / March 2015 submittal), provide a brief (several paragraphs) summary and refer to that submittal. Information should include note the ground motion used for the SPRA, e.g., GMRS, mean 1E-04 ground motion, confirmation that the previously-submitted sources have been used and that the control point information applies.

If the PSHA for the SPRA has been significantly revised, explain the significant differences in inputs or methodologies from what as submitted previously under the 2.1 Seismic (March 2014, March 2015) submittal. Refer to Appendix A as appropriate for details.

For example, Appendix A may include:

- *the site Soil Profile and/or the site GMRS used for the SPRA if different.*
- *If additional control points and FIRS (i.e., beyond what was addressed in the previous hazard submittal) have been defined for specific structures modeled in the SPRA, describe these for each such structure, with its associated soil column.*
- *If changes were made, e.g. to the site profile and amplification analysis, the new profile and amplification results should be described in Appendix A.*
- *If a new source was added to the SHS Report, that source should be described in Appendix A.*
- *If any changes were made, the new hazard curves and GMRS should be described in Appendix A, along with relevant sensitivity studies.*
- *If changes have been made, provide one or two paragraphs summarizing each of the following in Appendix A:*
  - Rock Hazard Calculation
  - Rock Hazard Deaggregation and Sensitivities
  - Amplification Factor Calculation
  - Soil Hazard Calculation
  - Soil Hazard Deaggregation and Sensitivities
  - UHRS and FIRS development
  - Vertical spectra
  - Time history development
  - Hazard-consistent strain-compatible properties
  - Comparison of GMRS and each FIRS]

3.2.2 Seismic Hazard Analysis Technical Adequacy

The {Plant} SPRA hazard methodology and analysis were subjected to an independent peer review against the pertinent requirements in the SPID [2].

Generic Note: It is assumed that definition of which requirements are "pertinent" will be addressed in Appendix E (PRA Technical Adequacy) and Appendix F (Peer Review). If the SPRA was peer reviewed relative to Capability Category II for the full set of requirements in the Standard and judged acceptable for this submittal on the basis that this subsumes the requirements in the SPID, that should be discussed in Appendix E (with reference to Appendix F) and stated here. Similarly, if the peer review was performed with a somewhat more narrow focus on the requirements in the SPID, that should be noted in Appendix F. So, for example, if the criteria for the set of SFR SRs listed in SPID Table 6-5 were reviewed, that information would be provided in Appendix F. This note also applies to the similar statements in other sections.

The peer review assessment, and subsequent disposition of peer review findings, is described in Appendix F, and establishes that the {Plant} SPRA hazard analysis is suitable for this SPRA application.

3.2.3 Seismic Hazard Analysis Results and Insights

This section provides the final seismic hazard results used in the {Plant} SPRA, discusses important assumptions and important sources of uncertainty, and describes any particular hazard-related insights.

Summarize key contributors to hazard uncertainty, either from the previously-submitted SHS Report or, if the hazard analysis was revised, from information provided in Appendix A. If the seismic hazard has been calculated for several profiles (for different structures), summarize differences among profiles (e.g. a stiff, shallow profile may amplify high frequencies). [This section would typically consist of several pages and figures plus Appendix A as needed]

Insights from the seismic hazard analysis should be provided and should summarize the dominant seismic sources for 10 Hz and 1 Hz spectral frequency, the dominant contributors to uncertainty in rock hazard, the dominant earthquakes for rock hazard by M, R, and ε, the effect of site amplification uncertainty on site hazard, and provide an explanation of characteristics of the UHRS and GMRS (e.g. presence or lack of high frequencies, change in UHRS shape from hard rock to site characteristics). [See Appendix A for additional detail.]

4.0 Determination of Seismic Fragilities for the SPRA

This section provides a summary of the process for identifying and developing fragilities for SSCs that participate in the plant response to a seismic event for the {Plant} SPRA. The subsections provide brief summaries of these elements.

For each element, provide a several-paragraph summary of the methodology and important results and conclusions.

4.1 Seismic Equipment List and Seismic Walkdowns

For the {Plant} SPRA, a seismic equipment list (SEL) was developed that includes those SSCs that are important to achieving safe shutdown following a seismic event, and to mitigating radioactivity release if core damage occurs, and that are included in the SPRA model.

[The methodology used to develop the SEL is generally consistent with the guidance provided in [16] [or other reference if appropriate]].

Walkdowns of those SSCs included on the seismic equipment list were performed, to assess the as-installed condition of these SSCs for use in determining their seismic capacity and performing initial screening. The walkdowns were conducted in accordance with the criteria provided in EPRI NP 6041 [7] [and *insert other criteria as appropriate]. [If applicable: For some SEL SSCs walkdowns had recently been performed in support of resolution of NTTF 2.3 seismic [8] or the Expedited Seismic Evaluation Program (ESEP) [9], and the information from those walkdowns was used where it provided the necessary detail.]*

4.1.1 SEL Development

Provide a general description of how the SEL was developed, e.g., starting with the list of SSCs related to core damage and large early release mitigation from the Internal Events PRA, IPEEE, Fire PRA, Internal Flood PRA, etc.; adding SSCs identified via walkdowns, high frequency (HF) component reviews, etc. Summarize the approach used to evaluate HF components/relay chatter and screen such components from the SEL. Also indicate if/how any IPEEE, NTTF 2.3 or ESEP walkdown information was incorporated.

It is not intended that the full SEL be included with the submittal. It is suggested to include a list of plant systems considered for the SEL.

4.1.2 Relay Evaluation

During a seismic event, vibratory ground motion can cause relays to chatter. The chattering of relays potentially can result in spurious signals to equipment. Most relay chatter is either acceptable (does not impact the associated equipment), is self-correcting, or can be recovered by operator action. An extensive relay chatter evaluation was performed for the {Plant} SPRA, in accordance with SPID, Section 6.4.2 and ASME/ANS PRA Standard, Section 5-2.2. The evaluation resulted in most relay chatter scenarios screened from further evaluation based on no impact to component function. The relays that were not screened were reviewed for potential operator actions and seismic capacity.

Describe the process used to evaluate unscreened relays and other high frequency sensitive components for response that required evaluation in the SPRA.

4.1.3 Walkdown Approach

This section provides a summary of the methodology and scope of the seismic walkdowns performed for the SPRA.

Licensees should discuss the extent and basis of use of previous seismic walkdowns performed at the plant for USI A-46, IPEEE, NTTF 2.3, ESEP, or other initiatives, if these were used in support of the SPRA. [This section would typically consist of several pages]

Walkdowns were performed in accordance with guidance in SPID Section 6.5 and the associated requirements in the PRA Standard. Detailed fragility walkdowns were performed on *[Dates]* in accordance with the criteria provided in EPRI NP-6041 [7] and SQUG guidance by appropriately qualified personnel whose qualifications were evaluated as part of the SPRA peer review (see Appendix F). *[Additional walkdown criteria were developed in accordance with [insert other criteria as appropriate].*

[If use was made of prior walkdown information, that should be described briefly here, with reference to the prior walkdown information if submitted to NRC and a summary of applicability of the previous walkdown approach to the SPRA.] [For some SEL SSCs walkdowns had recently been performed in support of resolution of NTTF 2.3 seismic [8] or the Expedited Seismic Evaluation Program (ESEP) [9], and information from those walkdowns was used where the appropriate level of detail needed for the SPRA was available.]

Insert summary level Plant-specific discussion of which plant walkdowns were performed [several paragraphs, e.g., including general walkdown purpose and scope (e.g., SEL development, fragilities development, seismic-fire-flood interactions, other consequential hazards), walkdown dates, summary of walk

down team qualifications and experience, and general process used. Refer to Appendix B as appropriate for additional details].

This should be very simplified summary, indicating which walkdown were performed and for what purpose, in accordance with requirements in the PRA standard. It is not intended that a detailed walkdown report be included with the submittal.

4.1.4 Significant Walkdown Results and Insights

Consistent with the guidance from NP-6041 [7], no significant findings were noted during the {Plant} seismic walkdowns. *[Or provide a table of any specific walkdown observations involving adverse conditions and (planned) disposition.]*

Components on the SEL were evaluated for seismic anchorage and interaction effects in accordance with SPID guidance and ASME/ANS PRA Standard requirements. The walkdowns also assessed the effects of component degradation, such as corrosion and concrete cracking, for consideration in the development of SEL fragilities. In addition, seismic-induced fire and flooding scenarios were assessed, and potential internal flood scenarios were incorporated into the {Plant} SPRA model. The walkdown observations were adequate for use in developing the SSC fragilities for the SPRA.

4.1.5 Seismic Equipment List and Seismic Walkdowns Technical Adequacy

The {Plant} SPRA SEL development and walkdowns were subjected to an independent peer review against the pertinent requirements (i.e., the relevant SFR and SPR requirements) in Table 6-5 of the SPID [2].

See Generic Note in Section 3.1.2 regarding definition of which requirements are “pertinent”, and considerations regarding peer review relative to the SPID vs. Capability Category II for all supporting requirements in the ASME/ANS PRA Standard.

The peer review assessment, and subsequent disposition of peer review findings, is described in Appendix F, and establishes that the {Plant} SPRA SEL and seismic walkdowns are suitable for this SPRA application.

4.2 Seismic Structure Response

This section summarizes the Seismic Structure Response and Soil Structure Interaction Analysis methodology used, discusses significant / limiting seismic structure response and structure fragility results for the SSCs modeled in the SPRA, discusses important assumptions and important sources of uncertainty, and describes any particular fragility-related insights identified.

The seismic structure response analysis considers the impact of seismic events on the response of site structures containing systems and components important to achieving a safe shutdown.

[provide additional / alternative bases as appropriate].

Describe the development of floor response spectra.

4.2.1 Soil Structure Interaction

[Since {Plant} site is a hard rock site, i.e., all structures are founded on hard rock, incoherence of input motion did not need to be considered, and it was concluded that SSI analyses were not required to determine the necessary building responses needed for determination of SSC fragilities for the SPRA.]

[Since {Plant} site is a soil site [or certain structures are situated on soil], it was concluded that SSI analyses should be performed for the following structures: …]

[Several pages] – Provide a summary discussion of key information and discuss the effects of uncertainties in the SSI analysis; provide, in Appendix B, a tabulation, for each structure, of the foundation elevation, embedment condition, FIRS, the soil column used to determine the FIRS, and the frequencies used in generating the response.]

4.2.2 Structure Response Models

Summary of how the modeling was done.

[Several pages] – State, for each structure analyzed, whether existing plant structure response models have been used, or enhanced, or if finite element models have been developed

- State the rationale for electing to use FEM vs. stick models.

- State whether structural damping was used in the structural response.

- State whether the analysis was performed at median or 84th percentile.

- Address concrete cracking modeling methodology and structural damping.

If existing plant structure response models have been used or enhanced for the SPRA, include statements to confirm (or provide in Appendix B) information regarding the following as outlined in SPID Section 6.3.1:

- *The ability of the structural models to capture the overall structural responses for both the horizontal and vertical components of ground motion.*
- *If there is significant coupling between the horizontal and the vertical responses, the approach used to analyze all three directions of the earthquake (e.g., SPID states that one combined structural model should be used per ASCE 4-98 Section 3.1.1.1 "Models for Horizontal and Vertical Motions").*
- *Appropriate treatment of total mass as well as center of gravity (SPID states to lump total structural, major components, and appropriate portion of live load, and inclusion of rotational inertia if it affects response*

in the frequency range of interest, per ASCE 4-98 Section 3.1.4.1 "Discretization of Mass" Part (b) 1).

- *Use of a sufficient number of nodal or dynamic degrees of freedom to represent significant structural modes, including all modes up to structural natural frequencies of about 20 Hz in all directions, to ensure that the seismic responses and in-structure response spectra (ISRS) developed in the 1 to 10 Hz frequency range are reasonably accurate, per ASCE 4-98 Section 3.1.4.1 "Discretization of Mass" Part (b) 2. SPID notes that structural engineer should verify that vertical floor slab flexibility has frequencies above 15 Hz so that this need not be considered.*
- *The approach taken to address torsional effects resulting from eccentricities between the center of mass and the center of rigidity.*
- *The criteria used to determine the adequacy of a "one-stick" model to represents the structure or the need for a two-stick model, if applicable.*
- *The approach used to address in-plane floor flexibility (and subsequent amplified seismic response) for developing accurate seismic response up to 15 Hz (see guidance in the SPID).*

For FEM, indicate the approach to verification of the models.

4.2.3 Seismic Structure Response Results Summary

[Several pages]

Include discussion of :

- Impact of effects of response combination from different directions.

- Impact of treatment of peak broadening or clipping

4.2.4 Seismic Structure Response Analysis Technical Adequacy

The {Plant} SPRA Seismic Structure Response and Soil Structure Interaction Analysis were subjected to an independent peer review against the pertinent requirements in Section 6.7 of the SPID [2].

See Generic Note in Section 3.1.2 regarding definition of which requirements are "pertinent", and considerations regarding peer review relative to the SPID vs. Capability Category II for all supporting requirements in the PRA Standard.

The peer review assessment, and subsequent disposition of peer review findings, is described in Appendix F, and establishes that the {Plant} SPRA Seismic Structure Response and Soil Structure Interaction Analysis are suitable for this SPRA application.

4.3 SSC Fragility Analysis

The SSC seismic fragility analysis considers the impact of seismic events on the probability of SSC failures at a given value of a seismic motion parameter, such as peak ground acceleration (PGA), peak spectral acceleration, floor spectral acceleration, etc. The fragilities of the SSCs that participate in the SPRA accident sequences, i.e., those included on the seismic equipment list (SEL) are addressed in the model. Seismic fragilities for the significant risk contributors, i.e., those which have an important contribution to plant risk, are intended to be generally realistic and plant-specific based on actual current conditions of the SSCs in the plant, as confirmed through the detailed walkdown of the plant.

This section summarizes the fragility analysis methodology, presents a tabulation of the fragilities (with appropriate parameters *(e.g., A_m, βr, βu)*, and the calculation method and failure modes) for those SSCs determined to be sufficiently risk important, based on the final SPRA quantification (as summarized in Section 5). Important assumptions and important sources of uncertainty, and any particular fragility-related insights identified, are also discussed.

4.3.1 SSC Screening Approach

[Discuss the approach to screening and subsequent sensitivity analyses to determine the risk significant contributors, and explain when separation of variables was used to finalize the item fragility. Discuss any sensitivity studies performed to assess the screening results.]

4.3.2 SSC Fragility Analysis Methodology

For the {Plant} SPRA, the following methods were used to determine seismic fragilities for SSCs included in the SPRA:

Insert Plant-specific discussion of the structure response and SSC fragility analysis methodology. The following topics should be noted:
- outcome of screening, indicating which SSCs were determined to require which type of analysis, e.g., separation of variables, CDFM, hybrid, for fragility calculations
- methodology used in computing fragilities for buildings,
- approach to determination of fragilities for NSSS components,
- important assumptions made in the calculation of SSC fragilities,
- treatment of SSC correlation, and component groupings and correlation

[This section would typically consist of several paragraphs, referring to Appendix C as appropriate for additional details]

4.3.3 SSC Fragility Analysis Results and Insights

Present a tabulation of the fragilities for those SSCs determined to be sufficiently risk important, based on the final SPRA quantification. Provide, for each listed fragility, appropriate parameters (e.g., A_m, βr, βu), the calculation method, and the failure mode(s) addressed in the model.

4.3.4 SSC Fragility Analysis Technical Adequacy

The {Plant} SPRA SSC Fragility Analysis was subjected to an independent peer review against the pertinent requirements the SPID [2].

See Generic Note in Section 3.1.1 regarding definition of which requirements are "pertinent", and considerations regarding peer review relative to the SPID vs. Capability Category II for all supporting requirements in the PRA Standard.

The peer review assessment, and subsequent disposition of peer review findings, is described in Appendix F, and establishes that the {Plant} SPRA SSC Fragility Analysis is suitable for this SPRA application.

5.0 Plant Seismic Logic Model

This section summarizes the adaptation of the {Plant} internal events at power PRA model to create the seismic PRA plant response (logic) model. It should be a brief discussion that includes a summary of: which elements of the internal events model were changed (e.g., addition of a seismic initiating event tree and integration with appropriate plant response event trees), what portions of the model were removed as not applicable for the SPRA (e.g., removal of random initiating events), assumptions regarding correlation of seismic impacts on similar SSCs, approach to incorporating seismic failures into the system fault trees and PRA model database, and note the PRA software used..

[This section would typically consist of several pages, with details included in Appendix D as needed. The intent is to summarize the pertinent aspects of the PRA model, not submit the model.]

The seismic plant response analysis models the various combinations of structural, equipment, and human failures given the occurrence of a seismic event that could initiate and propagate a seismic core damage or large early release sequence. This model is quantified to determine the overall SCDF and SLERF and to identify the important contributors, e.g., important accident sequences, SSC failures, and human actions. The quantification process also includes an evaluation of sources of uncertainty and provides a perspective on how such sources of uncertainty affect SPRA insights.

5.1 Development of the SPRA Plant Seismic Logic Model

The {Plant} seismic response model was developed by starting with the {Plant} internal events at power PRA model of record as of *[date]*, and adapting the model in accordance with guidance in the SPID [2] and PRA Standard [4], including adding seismic fragility-related basic events to the appropriate portions of the internal events PRA, eliminating some parts of the internal events model that do not apply or that were screened-out, and adjusting the internal events PRA model human reliability analysis to account for response during and following a seismic event. For the {Plant} SPRA, the following methods were used to develop the seismic plant response model:

Insert Plant-specific discussion of the SPR methodology [several paragraphs]. The approach(es) used for the following topics should be noted:

- General approach used; e.g., adaptation of internal events PRA large fault tree model, discretization of seismic hazard into x intervals treated as seismic initiators with assignment of interval-specific seismic fragilities, and summation of solution over the intervals]

- Confirm use of {Plant} internal events model of record as basis for the SPRA accident sequences, fault trees, modeled non-seismic human actions, and non-seismic data [or summarize differences and rationale], PRA software used. Refer to Appendix E.2 for assessment of plant changes that are not reflected in the PRA model.

- Selection of seismic initiating events and consequential events

- Assumptions regarding loss of offsite power, other important PRA modeling assumptions

- Treatment of random failures

- SSC response correlation: e.g., [Fully correlated response of same or very similar equipment in the same structure and elevation is assumed; partial correlation is not modeled [or is modeled for the following types of SSCs: …]

- HRA methodology used for the SPRA model

- Approach to evaluation of seismically-induced internal fires and internal floods

5.2 SPRA Plant Seismic Logic Model Technical Adequacy

The {Plant} SPRA seismic plant response methodology and analysis were subjected to an independent peer review against the pertinent requirements the SPID [2].

See Generic Note in Section 3.1.1 regarding definition of which requirements are "pertinent", and considerations regarding peer review relative to the SPID vs. Capability Category II for all supporting requirements in the PRA Standard.

The peer review assessment, and subsequent disposition of peer review findings, is described in Appendix F, and establishes that the {Plant} SPRA seismic plant response analysis is suitable for this SPRA application.

5.3 Seismic Risk Quantification

In the SPRA risk quantification the seismic hazard is integrated with the seismic response analysis model to calculate the frequencies of severe core damage and large early release of radioactivity to the environment. This section describes the SPRA quantification methodology and important modeling assumptions.

[Several pages as needed to adequately describe the seismic risk quantification methodology and important assumptions.]

5.3.1 SPRA Quantification Methodology

For the {Plant} SPRA, the following approach was used to quantify the seismic plant response model and determine seismic CDF and LERF:

Insert Plant-specific discussion of the SPR quantification methodology [several paragraphs]

5.3.2 SPRA Model and Quantification Assumptions

The following assumptions were made as part of the seismic PRA quantification:

Insert plant-specific model assumptions important to understanding the modeling approach and results. Any assumptions made in the hazard analysis, structures/fragilities analysis, and plant response modeling that are key to the SCDF or SLERF results (i.e., assumptions for which the use of an alternative consensus method or hypothesis would significantly alter the results or insights) should be noted and justification provided for their use. [several paragraphs]

5.4 SCDF Results

This section presents the SCDF results, a list of the SSCs that are significant contributors, including risk importance measures, a discussion of significant sequences and/or cutsets and their relative SCDF contributions, and any other characterization of the results deemed insightful (e.g., SCDF as a function of hazard interval if a discretized hazard binning approach is used). Include, for example:

- *overall SCDF;*
- *listing and summary of the top SCDF accident sequences and/or cutsets;*
- *summary of SSCs with significant seismic failure contribution to SCDF and associated failure mode and fragility information*

- *summary of SSCs with significant non-seismic failure contribution to SCDF and associated failure mode*
- *summary of important human errors and scenarios*

The seismic PRA performed for {Plant} shows that the seismic CDF is *n.n*x10^{-y}. *Recommend that results be reported to only 2 significant figures.* The results show that … ___________.

5.4.1 SCDF Cutset Summary

The top SCDF accident sequences *[cutsets]*, contributing approximately *xx*% of total SCDF, are summarized in Table 5.4-1.

5.4.2 Top SCDF Contributors

SSCs with significant seismic failure contribution to SCDF are listed in Table 5.4-2. The results show that … __________. Among the top SCDF contributors are: *[Summarize the top SCDF contributors]*

A listing of the risk significant SCDF SSCs is provided in Appendix D.

Important human actions for SCDF are described in Table 5.4-3.

Important non-seismic SSC failures are listed in Table 5.4-4.

5.5 SLERF Results

This section presents the SLERF results, a list of the SSCs that are significant contributors, including risk importance measures, a discussion of significant sequences and/or cutsets and their relative SLERF contributions, and any other characterization of the results deemed insightful (e.g., SLERF as a function of hazard interval if a discretized hazard binning approach is used). Include, for example:

- *overall SLERF;*
- *listing and summary of the top SLERF accident sequences and/or cutsets;*
- *summary of SSCs with significant seismic failure contribution to SLERF and associated failure mode and fragility information*
- *summary of SSCs with significant non-seismic failure contribution to SLERF and associated failure mode*
- *summary of important human errors and scenarios*

The seismic PRA performed for {Plant} shows that the seismic LERF is *m.m*x10^{-z}. *Recommend that results be reported to only 2 significant figures.* The results show that … __________.

5.5.1 SLERF Cutset Summary

The top SLERF accident sequences, contributing approximately *xx*% of total SLERF, are summarized in Table 5.5-1.

5.5.2 Top SLERF Contributors

SSCs with significant seismic failure contribution to SLERF are listed in Table 5.5-2. The results show that …

Important human actions for SLERF are described in Table 5.5-3.

Important non-seismic SSC failures are listed in Table 5.5-4.

5.6 SPRA Quantification Uncertainty Analysis

The method for quantification of parametric uncertainty in the result should be summarized. Provide the parametric uncertainty analysis results and a discussion of the implications relative to the reported mean SCDF and SLERF.

Provide a discussion of identified sources of model uncertainty, along with the set of assumptions and sources of model uncertainty selected for sensitivity study.

5.6.1 SPRA Quantification Sensitivity Analysis

List and describe the set of SCDF and SLERF sensitivity studies performed, and summarized significant results and insights, including any actions taken in response to the sensitivity results (e.g., to modify the SPRA, or to recommend actions for plant or procedure changes).

5.6.2 SPRA Quantification Technical Adequacy

The {Plant} SPRA risk quantification and results interpretation methodology were subjected to an independent peer review against the pertinent requirements the SPID [2].

See Generic Note in Section 3.1.1 regarding definition of which requirements are "pertinent", and considerations regarding peer review relative to the SPID vs. Capability Category II for all supporting requirements in the PRA Standard.

The peer review assessment, and subsequent disposition of peer review findings, is described in Appendix B, and establishes that the {Plant} SPRA seismic risk quantification and results analysis is suitable for this SPRA application.

5.7 SPRA Quantification Sensitivity Analysis

[Describe the approach to determining which sensitivity studies to perform, the results of the studies performed, and important insights.]

5.8 SPRA Logic Model and Quantification Technical Adequacy

The {Plant} SPRA risk quantification and results interpretation methodology were subjected to an independent peer review against the pertinent requirements the ASME/ANS PRA Standard [4].

The peer review assessment, and subsequent disposition of peer review findings, is described in Appendix B, and establishes that the {Plant} SPRA seismic risk quantification and results analysis is suitable for this SPRA application, and therefore meets the requirements in the SPID [2].

6.0 Conclusions

The conclusions and results of the SPRA evaluation are summarized in this section, including the identification of any planned plant modifications and schedules for any follow up actions.

The seismic PRA performed for {Plant} shows that the seismic CDF is *n.n*x10^{-y} and the seismic LERF is *m.m*x10^{-z}. *Recommend that results be reported to only 2 significant figures.*

Further, no seismic hazard vulnerabilities were identified. *[Or describe any particular vulnerabilities that were identified and the actions taken (or planned to be taken) to address.]*

Additional consensus is needed regarding what to present here and in what manner. It is expected that the SPRA submittal will reflect the as-built/as-operated plant as of the SPRA freeze date, including an assessment (in Appendix E.2) of the impact of subsequent plant changes on the results. This may not include mods that might be under consideration to reduce SCDF/SLERF. The intent is that such actions would be utility-driven, at least until such time as NRC establishes "target acceptance" risk metric values. However, if specific plant mods are actually planned, reporting the projected post-mod SCDF/SLERF may be worthwhile, to inform NRC about what {Plant} seismic risk may ultimately be.

[Insert applicable {Plant}-specific discussion from results/action matrix paper]

***NOTE**: The following are some possible suggestions under consideration regarding additional information that might be included in the discussion of conclusions of the SPRA.*

The {Plant} SPRA *<did not identify any significant SSC seismic capacity deficiencies relative to the new seismic hazard and demonstrates that, accounting for the realistically-assessed existing capacity of systems important to safety and viability of required operator actions, the entirety of the set of existing plant protective features is available to respond to the seismic hazard in a manner that is adequate to maintain plant risk within the NRC quantitative health objectives.>*

OR

The {Plant} SPRA *<identified the following SSCs [or operator actions] as having a significant contribution to seismic risk for the new seismic hazard: … . However, the results, accounting for the realistically-assessed existing capacity of xxx and other systems important to safety, demonstrate that the entirety of the set of existing plant protective features is available to respond to the seismic hazard in a manner that is adequate to maintain plant risk within the NRC quantitative health objectives.>*

OR

The {Plant} SPRA *<identified the following SSCs [or operator actions] as having a significant contribution to seismic risk for the new seismic hazard: … . The following actions / commitments have been / will be taken to address this. Once addressed, the results, accounting for the realistically-assessed existing capacity of xxx and other systems important to safety, the entirety of the set of existing plant protective features is available to respond to the seismic hazard in a manner that is adequate to maintain plant risk within the NRC quantitative health objectives.>*

7.0 References (typical)

[References are place-holders for this version of the draft template]

1) NRC (E Leeds and M Johnson) Letter to All Power Reactor Licensees et al., "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3 and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident," March 12, 2012.

2) EPRI 1025287, *Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic*. Electric Power Research Institute, Palo Alto, CA: February 2013.

3) {Plant} Seismic Hazard and GMRS submittal, dated March 31, 2014.

4) ASME/ANS RA-S-2008, *Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications*, including Addenda *[specify Addenda A, 2009 or Addenda B, 2013 as appropriate]*, American Society of Mechanical Engineers, New York, *[February 2, 2009]* or *[September 30, 2013]*

5) NEI-12-13, *External Hazards PRA Peer Review Process Guidelines*, Revision 0, Nuclear Energy Institute, Washington, DC, August 2012

6) {Plant} SPRA Peer Review Report

7) EPRI NP 6041-SL, *A Methodology for Assessment of Nuclear Power Plant Seismic Margin*, Rev. 1. , Electric Power Research Institute, Palo Alto, CA, August 1991.

8) {Plant} Walkdown performed for NTTF 2.3

9) {Plant} Walkdown performed for ESEP

10) NUREG-1407 , *Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities*, Nuclear Regulatory Commission, June 1991

11) Generic Letter No. 88-20 Supplement 4, *Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities - 10CFR 50.54(f)*, Nuclear Regulatory Commission, June 1991

12) EPRI TR-103959, *Methodology for Developing Seismic Fragilities*, Electric Power Research Institute, Palo Alto, CA. June 1994,

13) NUREG/CR-0098, *Development of Criteria for Seismic Review of Selected Nuclear Power Plants*, Nuclear Regulatory Commission, May 1978

14) NRC (E Leeds) Letter to All Power Reactor Licensees et al., "Screening and Prioritization Results Regarding Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(F) Regarding Seismic Hazard Re-Evaluations for

Recommendation 2.1 of the Near-Term Task Force Review of Insights From the Fukushima Dai-Ichi Accident," May 9, 2014.

15) {Plant} NTTF 2.3 Seismic Walkdown Submittal dated xxxxx

16) EPRI 30020007091, *Seismic PRA Implementation Guide,* Electric Power Research Institute, Palo Alto, CA, December 2013

Appendix A

Seismic Hazard Analysis Additional Information

This section would present information deemed pertinent to the characterization of the site seismic hazard.

The discussion of the Seismic Hazard Analysis Methodology (submittal Section 3.1.1) in this Appendix should refer to the "Seismic Hazard and Screening" (SHS) Report if the seismic hazard analysis and control point are the same as submitted in that report, and little additional detail should be required.

Otherwise, if changes were made from the SHS Report hazard, a description of the changes should be provided.

The following is a list of possible components of input and output; this should not be considered a list of requirements. The actual information to be presented is a function of the degree to which changes were made from the SHS submittal.

- <u>Seismic sources</u> – Provide a paragraph or two summary of the following, with pointers to the generic CEUS SSC and other references. The level of detail should be about the same as was provided in the March 2014 utility seismic hazard submittals.
    - how the sources were chosen;
    - the source characteristics;
    - how epistemic uncertainty is characterized by alternative interpretations with weights;
    - citations for any use of previous studies;
    - details regarding any site-specific changes or additions to seismic source interpretations made starting from a previous study;
    - the level of technical review used to develop the seismic source model (e.g. SSHAC level);
    - a table of significant contributors.

- <u>Rock ground motion model</u> – Provide a paragraph or two summary of the following, with pointers to the generic ground motion models and other references. The level of detail should be about the same as was provided in the March 2014 utility seismic hazard submittals.
    - how the hard rock ground motion model was developed;
    - alternative median ground motion equations;

  - the weights on each model;
  - how aleatory uncertainty is characterized;
  - spectral frequencies represented by the rock ground motion model;
  - how a smooth rock spectrum is developed for a broad spectral frequency range (e.g. 100 Hz – 0.1 Hz);
  - citations for use of any previous studies of rock ground motion;
  - detailed description of any site-specific changes or additions to rock ground motion interpretations are made starting from a previous study;
  - the level of technical review used to develop the rock ground motion model (e.g. SSHAC level).

- <u>Site amplification model</u> – Provide a paragraph or two summary of the following. The amount of information here should be similar to what was provided in the March 2014 submittals. To the extent that a plant uses multiple FIRS for the SPRA, some information identifying the different FIRS elevations within a soil column or the different applicable soil columns would be necessary.
  - how this model was developed;
  - specific definition of the control point (including reason for selection and general description, e.g. soft, rock, deep soil);
  - the site-specific data used as input;
  - how shear-wave velocities were measured or estimated at the site;
  - the range of alternative shear-wave velocities (with weights) used to characterize epistemic uncertainty in the profile;
  - the alternative soil/soft rock properties used (alternative stiffness and damping curves, kappa values, Poisson's ratio, density, and weights);
  - the basis for assumptions on parameters should be stated (e.g. laboratory tests, adoption of SPID assumptions);
  - description of the recommended spectral shape to be used to develop a smooth site spectrum for a broad spectral frequency range (e.g. 100 Hz – 0.1 Hz);
  - the level of technical review used to develop the site amplification model (e.g. SSHAC level).

The discussion of the Seismic Hazard Analysis should include the following results and sensitivity studies. Most of the information in the following bullets are plots that should be available from the PSHA information provided to the utility as a normal part of the SPRA seismic hazard assessment.

- Overall mean and fractile rock hazard curves for spectral frequencies at which the rock hazard was calculated;

- Dominant seismic sources to rock hazard for 10 Hz and 1 Hz spectral frequency;
- Dominant contributors to rock hazard curve epistemic uncertainty for 10 Hz and 1 Hz (e.g. maximum magnitude in the dominant source, alternative source geometry configuration);
- Contribution to epistemic uncertainty in rock hazard by rock ground motion equation, for 10 Hz and 1 Hz spectral frequency;
- Deaggregation of rock hazard for 10 Hz and 1 Hz spectral frequency by magnitude, distance, and aleatory uncertainty ε;
- Contribution to epistemic uncertainty in site hazard by site amplification model (e.g. alternative profiles, alternative properties);
- Overall mean and fractile site hazard curves for spectral frequencies at which rock hazard was calculated;
- Mean UHRS site spectra for annual frequencies of 10^{-4}, 10^{-5}, and 10^{-6};
- Fractile UHRS site spectra (16%, median, 84%) for annual frequencies of 10^{-4}, 10^{-5}, and 10^{-6}.

Insights from the seismic hazard analysis, accompanied by a modest amount of text and a few plots with the sensitivity studies, should be provided, and should include:

- the dominant seismic sources for 10 Hz and 1 Hz spectral frequency,
- the dominant contributors to uncertainty in rock hazard,
- the dominant earthquakes for rock hazard by M, R, and ε,
- the effect of site amplification uncertainty on site hazard, and
- an explanation of characteristics of the UHRS and GMRS (e.g. presence or lack of high frequencies, change in UHRS shape from hard rock to site characteristics).

This information should be available from the PSHA information provided to the utility as a normal part of the SPRA seismic hard assessment.

Appendix B

Seismic Structural Response and SSI Additional Information

This section would present information deemed pertinent to the soil and structure response analysis.

Appendix C

SSC Seismic Fragility Analysis Additional Information

This section would present information deemed pertinent to the SSC fragilities analysis and a table listing pertinent information regarding the seismic fragilities for significant SPRA contributors.

Appendix E

Assessment of PRA Technical Adequacy for Response to NTTF 2.1 Seismic 50.54(f) Letter

This section establishes that the SPRA used meets the expectations for a PRA of adequate scope and technical capability as defined in RG 1.200 R2. The presentation here should:

(a) Establish that the SPRA has the appropriate scope and reflects the current plant
(b) Establish that the SPRA has been performed in accordance with the requirements in the SPID and the PRA Standard deemed to be applicable for this submittal
(c) Identify important modeling assumptions and limitations and explain how their impact has been considered
(d) Summarize how important peer review issues have been accounted for in the model and results

NOTE FOR DRAFT TEMPLATE REVIEW: *It may be possible to combine Appendix E with Appendix F, since the "application" is (at this point) response to a request for information rather than to support a risk-informed plant change in accordance with RG1.200.*

E.1. Introduction

This Appendix provides a summary of the methodology used to develop the {Plant} seismic PRA and establishes that the SPRA meets the expectations for adequate scope and technical capability for assessing {Plant} seismic risk resulting from the updated seismic hazard, for response to the 50.54(f) letter.

E.2. Summary of the risk assessment methodology used to assess the seismic risk, including how the base PRA model was modified to appropriately model seismic risk and results.

- Statement that more detailed archival information consistent with the listing in Section 4.1 of RG 1.200 Rev. 2 is available for NRC audit if required to facilitate the NRC staff's review of the submittal
- Brief description of the methodology *[several pages]*, including:
    - Summary of the seismic hazard analysis
    - Summary of the structures and fragilities analysis
    - Summary of the seismic walkdowns performed
    - Brief description of the internal events at power PRA model on which the SPRA is based, for CDF and LERF
    - specific adaptations made in the internal events PRA model to produce the seismic PRA model and bases for the adaptations
- Statement regarding SPRA model reflecting the as-built and as-operated plant
- Listing of any permanent plant changes that have not been reflected in the SPRA model and why the change does not impact the PRA results used to support the application

  - Justification of why it is acceptable that the change has not been modeled, including appropriate sensitivity studies that demonstrate the significant SPRA accident sequences and contributors are not significantly impacted

E.3. Summary of Peer Review Results and Statement that the SPRA meets the capability as defined in Table 6-5 of the SPID.

- Table of any requirements of the standard that have not been met relative to capability noted in Table 6-5 of the SPID
  - Justification of why it is acceptable that the requirement has not been met, including appropriate sensitivity studies that demonstrate the significant SPRA accident sequences and contributors are not significantly impacted
- Table of any requirements of the standard that have been met at capability categories lower than defined in Table 6-5 of the SPID
  - Justification of why it is acceptable that the requirement has been met at the lower capability category, including appropriate sensitivity studies that demonstrate the significant SPRA accident sequences and contributors are not significantly impacted

E.4. Identification of the key assumptions and uncertainties relevant to the SPRA results.

- Table of key assumptions sources of uncertainty, and assessment of potential impact on the results.
  - Summary of any sensitivity studies performed to support the conclusions regarding impact of assumptions and sources of uncertainty.
- Summary of the peer reviewers' assessment of the key assumptions and sources of uncertainty.

E.5. Discussion of resolution of peer review findings that may have a significant impact on the SPRA results and conclusions.

- Table of peer review findings and affected PRA standard supporting requirements
  - Discussion of how the peer review issue has been addressed in the SPRA model; or
  - Justification that the issue does not significantly affect the SCDF or SLERF results, or the significant SPRA accident sequences and contributors (e.g., per the assessment for E.3).

E.6. Identification of Plant Changes Not Reflected in the SPRA

The {Plant} SPRA reflects the plant as of the cutoff date for the SPRA, which was *[date]*. Table E-4 lists those plant changes subsequent to this date and provides a qualitative assessment of the likely impact of those changes on the SPRA results and insights.

Appendix F

Summary of SPRA Peer Review

This is expected to be largely excerpts from the end-of-project peer review report. The presentation here should:

(a) Establish that the SPRA has been peer reviewed by a team with adequate credentials to perform the assessment
(b) Establish that the peer review process followed meets the intent of the peer review characteristics and attributes in Table 16 of RG1.200 R2
(c) Present the significant results of the peer review

F.1. Introduction

- Date of the end-of-process peer review, scope of the review, peer review participants
- *<Discussion of in-process peer review if used, and how in-process peer review feedback was addressed in the SPRA development, shared with the end-of-project peer reviewers, etc.>*

F.2. Summary of the Peer Review Process

F.3. Peer Review Team Qualifications

F.4. Summary of the Peer Review Conclusions

- Conclusions of Peer Review Team relative to each High Level Requirement
- Listing of any Supporting Requirements judged to be Not Met or Met at a capability category lower than that specified in Table 6-5 of the SPID
- Listing of Findings reported by the peer review team and manner in which the findings have been dispositioned for the SPRA