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

February 2, 2024

MEMORANDUM TO: Andrea D. Veil, Director
Office of Nuclear Reactor Regulation

FROM: Eric Benner, Director
Division of Engineering and External Hazards
Office of Nuclear Reactor Regulation

Tania Martinez Navedo
Digitally signed by Tania Martinez Navedo
Date: 2024.02.02 12:55:20 -05'00'

SUBJECT: PROCESS FOR THE ONGOING ASSESSMENT OF NATURAL HAZARDS INFORMATION PERIODIC REPORT

This memorandum provides an overview of the status and progress of the Process for the Ongoing Assessment of Natural Hazards Information (POANHI) as reflected in the enclosed periodic report. The U.S. Nuclear Regulatory Commission (NRC) staff developed the POANHI framework in response to Japan Near-Term Task Force Recommendation 2.2, which recommended periodic evaluations of natural hazards at U.S. nuclear power plants. The staff proposed, and the Commission approved, a framework that uses current NRC processes to enhance its collection and analysis of external hazard data as documented in SECY-16-0144, "Proposed Resolution of Remaining Tier 2 and 3 Recommendations Resulting from the Fukushima Dai-ichi Accident," dated December 29, 2016, and the associated staff requirements memorandum dated May 3, 2017. To implement the POANHI framework, the staff issued NRC Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-208, "Process for the Ongoing Assessment of Natural Hazards Information," on November 20, 2019, and developed the Natural Hazards Information Digest, an online tool used by the NRC staff to document and organize natural hazards information related to nuclear power plants in the United States.

The enclosed periodic report documents the activities undertaken by the NRC staff since the last report was issued in February 2022 (Agencywide Documents Access and Management System Accession No. ML22039A273). The report specifically discusses knowledge base activities, the NRC staff's engagement with the broader technical community, recent staff public communication, and the staff's assessment of new natural hazards information. During the period covered by this report, the staff did not identify any needed regulatory actions in response to the new natural hazards information assessed under the POANHI framework.

Enclosure:
As stated

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SUBJECT: PROCESS FOR THE ONGOING ASSESSMENT OF NATURAL HAZARDS PERIODIC REPORT DATED: February 2, 2024

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ADAMS ACCESSION No.: ML24025A135 ***via email** **NRR-106**

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2024 POANHI Periodic Report

I. Background

The staff of the U.S. Nuclear Regulatory Commission (NRC) developed the Process for the Ongoing Assessment of Natural Hazards Information (POANHI) framework in response to Japan Near-Term Task Force Recommendation 2.2, which called for periodic evaluation of natural hazards at nuclear power plants in the United States. In SECY-16-0144, "Proposed Resolution of Remaining Tier 2 and 3 Recommendations Resulting from the Fukushima Dai-Ichi Accident," dated December 29, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16286A586), the staff proposed a framework for reviewing new natural hazards information that uses existing NRC regulatory processes to enhance its collection and analysis of external hazards data. In the staff requirements memorandum for SECY-16-0144, dated May 3, 2017 (ML17123A453), the Commission approved the staff's proposal and provided resources to undertake POANHI development. To implement the POANHI framework, the staff developed the guidance documented in NRC Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-208, "Process for Ongoing Assessment of Natural Hazards Information," dated November 20, 2019 (ML19210C288), and developed the Natural Hazards Information Digest (NHID), an internal tool the NRC staff uses to document and organize natural hazards information related to U.S. nuclear power plants.

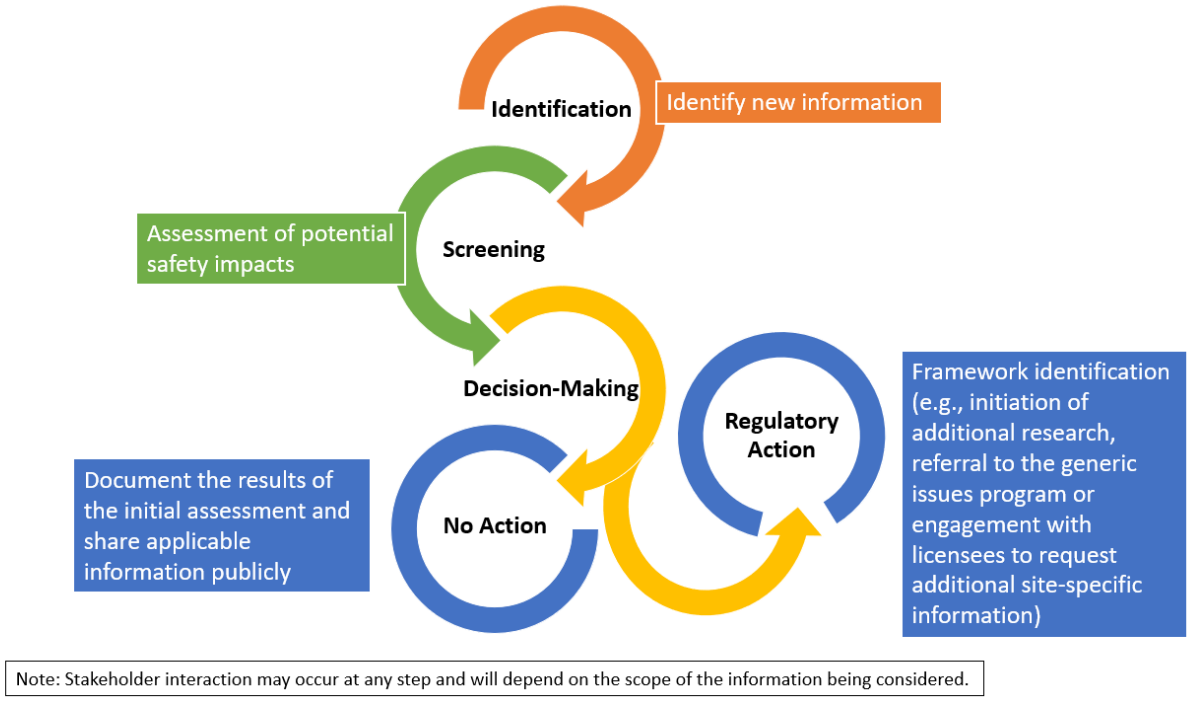

Figure 1 Process for the ongoing assessment of natural hazards information

Figure 1 illustrates POANHI activities, beginning with the identification of new information, followed by an assessment of potential safety impacts at the screening stage. At the screening stage, the NRC staff will assess the potential safety impact of the new information. This assessment may be considered generically across an entire class of licensed facilities or more specifically to individual facilities, depending on the hazard and scope of information. Finally, the staff will decide to either take no further action or to pursue a regulatory action. If no action is

needed, the NRC staff will document the results of the assessment and share applicable information publicly. If regulatory action is needed, the staff will identify the appropriate framework, such as the initiation of additional research, referral to the generic issues program, or engagement with licensees to request additional site-specific information. Stakeholder interactions may occur at any step in the process, and the level of stakeholder engagement will depend on the scope of the information being considered.

II. Knowledge Base Activities

Knowledge base activities provide the foundation for the POANHI framework.

a. Natural Hazards Information Digest

The NRC collects and archives natural hazards information in the NHID. The staff of the NRC Office of Nuclear Regulatory Research (RES) designed the NHID to provide a digital infrastructure for compiling and storing natural hazards information related to nuclear power plant sites. The NHID was developed by and is hosted by Idaho National Laboratory. It provides a single digital repository of natural hazards licensing basis information (e.g., licensing basis flood elevations, safe-shutdown earthquakes, wind loads). The NRC staff updates the NHID with new information as it becomes available.

Since the last report, the NRC staff conducted outreach sessions to areas of the agency that may find the information in the NHID useful. The staff continues to seek feedback from internal stakeholders to improve the functionality and usefulness of the NHID. As a result, the NRC modified the existing contract with Idaho National Laboratory. Planned updates over the next year include the addition of volcanic hazards and an expansion of scope beyond natural hazards associated with POANHI by including human-induced external hazards for sites where these hazards are applicable.

b. Knowledge Management NUREGs

Knowledge management NUREGs (NUREG/KMs), published using processes external to POANHI, are prepared by the NRC staff for knowledge management for future NRC staff and the regulated community by documenting lessons learned during the staff's review and preserving that knowledge for future regulatory reviews. The last report documented the issuance of NUREG/KM-0015, "Considerations for Estimating Site-Specific Probable Maximum Precipitation at Nuclear Power Plants in the United States of America: Final Report," in September 2021 (ML21245A418) and NUREG/KM-0017, "Seismic Hazard Evaluations for U.S. Nuclear Power Plants: Near-Term Task Force Recommendation 2.1 Results," in December 2021 (ML21344A126). Since the last report, the NRC staff continued work on developing NUREG/KMs related to flooding that are anticipated to be published in 2024.

c. Research Information Letters

Research Information Letters (RILs) are documents issued by the NRC's Office of Nuclear Regulatory Research to the NRC regulatory and regional offices that summarize, synthesize, and/or interpret significant research information relevant to a given technical area, provide new or revised information, and discuss how that information may be used in regulatory activities. RILs can improve regulatory efficiency and effectiveness by providing important, pertinent information in a timely, concise, and comprehensive summary. The NRC staff issued several

RILs related to POANHI activities since the last report; these are discussed in later sections of this report.

III. Active Technical Engagement

An essential element of the POANHI framework is active NRC staff engagement with external stakeholders and the broader natural hazards community. This engagement happens in a variety of forums, including public meetings, professional and academic conferences, the NRC's participation in the Interagency Committee on Dam Safety, and other governmental working groups.

a. Workshops and Public Meetings

During 2022 and 2023, the staff hosted and participated in technical conferences on various topics related to natural hazards. Table 1 lists RILs published to document the proceedings of the NRC-sponsored annual Probabilistic Flood Hazard Assessment Research Workshops. Table 2 lists the NRC staff's participation in external meetings and conferences during the time covered by this report. Conference attendance enables the staff to maintain awareness of the state of practice in external hazards assessment. In addition, the NRC staff presented at several meetings listed in table 2. Staff presentations in conference settings provide the public an opportunity to view the NRC staff's thinking on topics relevant to external hazards and offer feedback on these topics outside of specific licensing or inspection activities. These meetings also give opportunities for the staff, the regulated community, and outside researchers to gather, present research findings, and discuss areas of future research.

Table 1 NRC-Sponsored Annual Probabilistic Flood Hazard Assessment Research Workshops

RIL #	Title	Publication Date	ADAMS Accession Number
2023-05	Proceedings of the Eighth Annual Probabilistic Flood Hazard Assessment Research Workshop	10/19/2023	ML23276B456
2022-02	Proceedings of the Sixth Annual Probabilistic Flood Hazard Assessment Research Workshop	08/31/2022	ML22214B351
2022-10	Proceedings of the Seventh Annual Probabilistic Flood Hazard Assessment Research Workshop	09/30/2022	ML22257A136

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Table 2 List of External Meetings Participated in by the NRC Staff under POANHI

Hazard	Meeting	Dates
All	DOE/NRC Natural Phenomena Hazards Meeting	Oct-22
Geology	Association of Environmental & Engineering Geologists (AEG) Annual Meeting	Sep-20
Geology	AEG Annual Meeting	Sep-21
Geology	AEG Virtual Geologic and Seismic Hazards Symposium	Mar-22
Geology	Geological Society of America Annual Meeting	Oct-22
Hydrology	Interagency Committee for Dam Safety	Quarterly
Hydrology	National Dam Safety Review Board	Quarterly

Hazard	Meeting	Dates
Hydrology	Probabilistic Flood Hazard Analysis (PFHA) Research Workshop	Mar-23
Hydrology	Coastal Resilience in New Jersey—sponsored by the Society of American Military Engineers	Apr-23
Meteorology	International Atomic Energy Agency (IAEA) Technical Meeting on the Effects of Climate Change on Meteorological and Hydrological Hazards for Nuclear Installations	Nov-22
Meteorology	Nuclear Energy Agency Workshop on High Winds and Tornadoes: Hazard Assessment and Protection of Nuclear Installations	Mar-22
Seismology	U.S. Geologic Survey (USGS) Alaska National Seismic Hazard Mapping (NSHM) Workshop	Dec-22
Seismology	USGS NSHM Workshop on Gulf Coastal Plain	Dec-23
Seismology	Seismological Society of America Annual Meeting	Apr-23
Seismology	USGS NSHM Meeting on Central and Eastern United States (CEUS) Fault Model Updates	May-22
Seismology	IAEA Technical Meeting on the Protection of Nuclear Installations Against External Hazards	Annual
Multiple	IAEA Meeting on External Event Notification System	Dec-23
Multiple	IAEA Technical Meeting on the Site and External Events Design (SEED) Review Service and Capacity Building Activity Output Assessment	Oct-23
Multiple	IAEA Updates to SSG-18, “Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations”	Began July 2023

Over this past year, the NRR and RES staffs have also engaged with the USGS, through an interagency agreement, on a long-term research project devoted to seismic hazards. This research project focused on elements of seismic hazard characterization related to new and existing seismic sources, induced seismicity, earthquake recurrence rates, and the impact of ground motion model selection on seismic hazard results. Future staff evaluations of seismic hazard and guidance updates will apply the results of this research.

b. Public Website

In spring 2023, the NRC staff published the POANHI public website, which can be found at https://www.nrc.gov/reactors/operating/ops-experience/poanhi.html.

The POANHI public website provides updates on staff activities related to hydrology, meteorology, geology, and seismology and answers frequently asked questions about POANHI. This website also includes an email address where external stakeholders can submit any comments or feedback related to seismic hazards to the staff. Annex I to this report identifies the comments received and the staff’s responses.

c. U.S. Government Accountability Office Audit of Nuclear Power Plant Climate Resilience

In December 2022, the NRC received notice that the U.S. Government Accountability Office (GAO) would perform an audit of Federal agencies, including the NRC, on the topic of nuclear power plant climate resilience. The NRC staff continues to participate in this effort. At the

conclusion of the audit, the GAO will produce a summary report that could include recommendations to the NRC related to updates to NRC policies and practices.

IV. Assessment of Hazard Information

The final element of the POANHI framework assesses natural hazards information to determine whether new information should be submitted to other processes within the NRC for regulatory action. The assessment of new information is often straightforward. For example, licensee event reports concerning natural hazards are forwarded to the NRC staff. These event reports are also forwarded to relevant licensing and inspection groups within the NRC for evaluation against licensing bases and regulatory requirements and for inspection, if necessary. The NRC staff also receives custom ShakeMap products from the USGS that provide a map of estimated ground motion based on local reports of earthquake shaking intensity and community-developed ground motion models. The ShakeMap products that the NRC receives also include a point estimate of ground motion at U.S. nuclear power plants in the vicinity of earthquakes. These single events, and the documents that accompany them, do not drive POANHI decision-making. Rather, they provide individual data points to the NRC staff that can be used to determine future research directions. During the period covered by this report, the staff did not identify the need for potential regulatory actions in response to the new hazards information assessed under the POANHI framework.

In October 2022, the NRC staff considered the impact of potential low water conditions at six sites located along the Mississippi River. During this time, the Mississippi River was experiencing lower than normal water levels. The staff reviewed available information from the updated final safety analysis reports of the nuclear power plants. This review included minimum operating and shutdown flows during anticipated operational occurrences and emergency conditions. The staff compared the availability of water with the information in the UFSAR and determined that the low-water conditions on the Mississippi River did not need to be addressed via additional regulatory action.

In addition to individual reports related to single events, the NRC staff are responsible for assessing new natural hazards information (i.e., new data, models, and methods) to determine whether additional regulatory action may be warranted. These assessments include reviewing both domestic and international climate reports as they are published, reviewing and documenting extreme weather impacts, considering state-of-the-science reports, and determining whether updates to NRC guidance are warranted.

a. Site-Specific Seismic Evaluations

The Next Generation Attenuation for Central and Eastern North America (NGA-East) ground motion model (GMM) was a multidisciplinary research project to develop a new ground motion characterization model for central and eastern North America.[1] This GMM includes a set of new ground motion prediction equations and their associated weights in the logic trees for use in a probabilistic seismic hazard analysis. Consistent with the model found in NUREG-2115, “Central and Eastern United States Seismic Source Characterization for Nuclear Facilities,” issued January 2012, NGA-East was conducted using the Senior Seismic Hazard Analysis Committee (SSHAC) Level 3 guidelines in NUREG-2213, “Updated Implementation Guidelines for SSHAC

[1] Goulet, C.A., Y. Bozorgnia, N. Abrahamson, N. Kuehn, L. Al Atik, R. Youngs, R. Graves, and G. Atkinson. “Central and Eastern North America Ground-Motion Characterization—NGA-East Final Report.” PEER Report 2018-08. Pacific Earthquake Engineering Research Center. Berkeley, CA. 2018.

Hazard Studies," issued October 2018. The staff evaluated NGA-East and documented the results in RIL2020-011, "NRC Staff Evaluation of the Next Generation Attenuation for Central and Eastern North America Projects (NGA-EAST) Ground Motion Model Characterization," issued September 2020 (ML20255A115). RIL2021-15, "Documentation Report for SSHAC level 2: Site Response," issued November 2021 (ML21323A056), documents work sponsored by the NRC that applied the SSHAC process for systematically identifying and propagating epistemic uncertainties in the site response analysis, as has been applied previously to the seismic source characterization model and GMM developments for more than 20 years.

The staff is producing site-specific seismic hazard evaluation reports for an initial set of sites in the CEUS (see table 3) that implement both the NGA-East GMM and updates in site response analysis (RIL2021-15). These reports are being sent directly to the licensee and made publicly available in ADAMS. Table 3 provides issuance dates and links for the site-specific reports that have been issued, and a schedule for plants that will be evaluated in 2024.

Table 3 Site-Specific Seismic Hazard Evaluation Reports

Site	Issuance Date	Site	Issuance Date
Vogtle	May 15, 2023	Robinson	November 1, 2023
Sequoyah	July 31, 2023	Browns Ferry	July 31, 2023
Watts Bar	July 31, 2023	North Anna	September 5, 2023
Oconee	1st Quarter 2024 (estimated)	Peach Bottom	1st Quarter 2024 (estimated)
DC Cook	1st Quarter 2024 (estimated)	Dresden	2nd Quarter 2024 (estimated)
Summer	2nd Quarter 2024 (estimated)	Beaver Valley	2nd Quarter 2024 (estimated)
Callaway	3rd Quarter 2024 (estimated)		

V. Future Activities

During 2024, the NRC staff will review the recently finalized Fifth National Climate Assessment issued by the U.S. Global Change Research Program for new information or resources. The staff will update the NHID to include volcanic hazards at sites where this may be a hazard. The staff will also continue assessing NGA-East and any potential impacts on seismic hazards that could affect existing licensees and applicants. In addition, the staff will participate in upcoming PFHA and Natural Phenomena Hazards meetings and continue engaging with external stakeholders, including other government agencies and the broader technical communities. Based on recent interactions with the USGS, the NRC will investigate its currently approved seismic source models for the CEUS to determine whether any updates are warranted.

ANNEX I

Staff Responses to Public Comments

Members of the public and external stakeholders can submit any comments or feedback to the staff by emailing POANHI.Seismic@nrc.gov.

The U.S. Nuclear Regulatory Commission (NRC) has received a total of six comments from four organizations and individuals to date. The staff provided individual responses to the sender for each inquiry received. The comments and responses are summarized below.

Comment 1: A commenter asked the following questions related to NUREG/KM-0017, "Seismic Hazard Evaluations for U.S. Nuclear Power Plants: Near-Term Task Force Recommendation 2.1 Results," issued December 2021, and Research Information Letter 2021-15, "Documentation Report for SSHAC level 2: Site Response," issued November 2021:

(1) What definition of reference rock is the NRC planning to use in its upcoming site response re-evaluations for the CEUS nuclear power plant fleet?

(2) Will it be necessary to introduce epistemic uncertainty in depth to reference rock (explicitly in site response logic tree) if this depth is not well known?

(3) How will this be determined and how will various depths to bedrock be weighted in the site response logic trees?

Response: In response to question 1, the staff indicated that NRC is using the NGA-East definition of reference rock (shear-wave velocity (Vs) = 3,000 meters per second) and a site kappa of 6 miliiseconds. In response to question 2, the staff noted that where the reference rock horizon is not well established, alternative lower and upper median Vs profiles have been developed. In some cases, six median profiles have been developed (i.e., two sets of lower, best estimate, and upper profiles). In response to question 3, the staff responded that generally the two sets of profiles will be equally weighted unless otherwise justified; the report will discuss the rationale for the weighting.

Comment 2: A commenter referred to the site-specific data in NUREG/KM-0017 and noted the following errors in the response spectra data for Sequoyah (Agencywide Documents Access and Management System Accession No. ML21133A363) and Watts Bar (ML21133A375): there are no data points for frequencies above about 2 hertz (Hz) and the ground motion response spectra were not calculated in accordance with Regulatory Guide 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion."

Response: The NRC acknowledged in a response that there are some mismatches between the table of subsurface layers and the figure in NUREG/KM-0017. However, these errors do not change the results for any of the sites.

Comment 3: A commenter referred to the NRC's screening process under the Process for the Ongoing Assessment of Natural Hazards Information (POANHI), as outlined in the flow chart on the NRC POANHI public website. Specifically, the staff was asked what the NRC was using to develop its seismic risk before it acquired the new information (such as NGA-East) being used

for the new estimate of the seismic risk?

The question noted the following potential options that could be used to develop the prior seismic risk estimate:

(1) Use the seismic hazard and control point location documented in the Japan Near-Term Task Force (NTTF) Recommendation 2.1 screening submittals that the NRC approved.

(2) Use the seismic hazard and control point location that were used in the submitted NTTF Recommendation 2.1 seismic probabilistic risk assessment (SPRA) that the NRC approved.

(3) For some plants, the hazard and control point location could have been updated following the submittal of the SPRA for NTTF Recommendation 2.1 by virtue of updating that occurred subsequent to NTTF Recommendation 2.1 ending.

The commenter also asked, if the NRC used option 2 for the screening, how were the seismic hazards for 1 Hz, 5 Hz, and 10 Hz estimated given that the zero period acceleration hazard is typically the only frequency that was submitted?

Response: The staff responded that, for its site response analysis, the NRC is using the latest control point elevation established by the licensees for their NTTF Recommendation 2.1 SPRA submittals, or, if the control point has been subsequently updated after that SPRA, then the NRC will use the latest control point elevation. To the extent that the 1 Hz, 5 Hz, and 10 Hz control point hazard curves are needed to finalize the risk portion of the POANHI screening evaluation, the staff will contact the licensees through the NRC project office to obtain this information.

Comment 4: A commenter asked questions related to the Vogtle POANHI letter dated March 31, 2003. The first question requested the data provided in this letter in digital format. The second question noted that the nonlinear aleatory variability, associated with the Vogtle site amplifications that the NRC developed, is missing. Specifically, this information is plotted as the red markers in the lower half of figure 8; the digitized values were not provided in appendix A, as they were for the total aleatory variability.

Response: The staff responded that the data in digital format will not be provided. In addition, the staff noted that a column with site amplification factor aleatory variability has subsequently been added to all the reports.

Comment 5: This comment referred to the NRC's screening process under POANHI, as outlined in the flow chart on the NRC POANHI public website, asking whether the agency has changed its screening process and, if so, what is the new screening process being used?

The commenter asked the following additional questions with respect to the ground motion response spectra developed by the NRC for both Vogtle and Browns Ferry, for which the flow chart leads to performing a computation of the average change in seismic core damage frequency (delta SCDF):

(1) Was the delta SCDF calculated for these two plants in alignment with the flow chart?

(2) If yes, did the NRC get the new seismic hazard at 5 Hz, 10 Hz, and 100 Hz from the

utility or some other source? If no, then what was the basis to screen out these plants from further review?

(3) What plant-level fragilities were used for this seismic risk estimation?

(4) Were the frequencies of the dominant risk contributors and structures driving those responses considered in the risk evaluation?

Response: The staff confirmed that the screening process has not changed; it remains the same as that presented in the public meetings and documented on the POANHI website.

In response to question 1, the staff indicated that the delta SCDF calculated for the Vogtle and Browns Ferry plants were in alignment with the flowchart on the NRC POANHI public website. Furthermore, in response to question 2, the staff noted that the NRC uses the POANHI seismic hazard ("new hazard") developed by its subject matter experts for the evaluation. The staff did not get the 1 Hz, 5 Hz, 10 Hz, and 100 Hz hazard curves used by the licensee for its SPRA. For plants that submitted SPRA reports in response to the NRC's post-Fukushima actions, the staff performs a check to determine whether the 100 Hz hazard used for the licensee's SPRA is the same as that reported in the licensee's NTTF Recommendation 2.1 report that the NRC staff reviewed and accepted. In case of no or minimal difference, the staff uses 1 Hz, 5 Hz, 10 Hz, and 100 Hz information from the licensee's NTFF Recommendation 2.1 report for its evaluation. The staff handles any instance with differences between that report and SPRA hazard on a case-by-case basis, including implementing workarounds to address the differences. For plants that did not submit SPRA reports in response to the NRC's post-Fukushima actions, the staff plans to use the 1 Hz, 5 Hz, 10 Hz, and 100 Hz information from the licensee's post-Fukushima hazard reevaluation report for its evaluation. In response to question 3, the staff noted that for plants that submitted SPRA reports in response to the NRC's post-Fukushima actions, the plant-level fragility parameters are determined using the results from the SPRA report (i.e., the conditional core damage probability). The staff performs sensitivity analyses, as necessary, to determine the impact of variations in plant-level fragility parameters on its decision. For plants that were not required to submit SPRA reports, the staff plans to use plant-level fragility from the best available source, including recent risk-informed license amendment requests. In response to question 4, the staff indicated that the NRC will use this information if it needs to review additional risk insights to determine the path forward (identified by "Further Risk Analysis" in the flowchart).

Comment 6: A commenter requested clarification on the use of the 2013 Electric Power Research Institute (EPRI) GMM in NUREG/KM-0017, specifically the Gulf Coast and Midcontinent regions, for a given source. The commenter posed the following questions:

(1) How was the travel path determined for a source when investigating which GMM (Gulf Coast or Midcontinent) to apply?

(2) Which option was used when the travel path was through both the Gulf Coast and Midcontinent regions?

(3) If proration was used, how were distances/fractional travel paths calculated, and how were the different GMMs proportioned?

Response: The staff responded that for the probabilistic seismic hazard analyses in NUREG/KM-0017 for the South Texas, River Bend, and Grand Gulf sites in the Gulf Coast

region, the NRC implemented the Gulf Coast EPRI GMMs for ECC, GC, and GHEX. For the other seismotectonic zones and all the magnitude of the largest possible earthquake (Mmax) zones for these three sites, the staff ran the Midcontinent EPRI GMMs. No proration of the travel path was implemented.