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Subject: North Anna SPRA (Fukushima 50.54f) Audit (Clarification) Questions - Plant Response
Date: Friday, September 14, 2018 9:51:00 AM

Diane,

As part of the ongoing audit of the seismic probabilistic risk assessment (PRA) submittal (ADAMS Accession No. ML18093A445), here are clarification questions related to plant-response portion of the submittal. Each question is associated to a topic in the technical checklist (ADAMS accession No. ML17041A342) used for this review;

Question 1 - Topic #12 - Selection of Dominant Risk Contributors that Require Fragility Analysis Using the Separation of Variables Methodology (SPID Section 6.4.1)

Section 4.4.2 of the seismic PRA submittal states that the conservative deterministic failure margin (CDFM) approach was initially used for most structures, systems, and components (SSCs) in the seismic equipment list, but that a more refined fragility analyses using the separation of variables (SOV) approach was used for "the top risk-important SSCs." The submittal further states that the CDFM approach was performed in one of two ways, by using "variabilities" from the Seismic Evaluation Guidance (SPID) or by using detailed plant specific structural response "variabilities." Sections 5.4 and 5.5 and Tables 5.4-2 and 5.5-2 of seismic PRA submittal show this to be the case but also indicate that rather than the SOV approach, a third approach was used to determine the fragility of certain risk-significant SSCs based on guidance from the EPRI Seismic PRA Implementation Guide issued in 2013 (EPRI 30020000709). Describe the approach (or approaches) from the EPRI guidance document used to determine the fragility of certain risk-significant SSCs and justify that this substitute approach for the SOV approach provides a refined fragility determination compared to the CDFM approach.

Question 2 - Topic #14 - Peer Review of the Seismic PRA, Accounting for NEI 12-13 (SPID Section 6.7)

Topic 14 in the technical checklist has an item to verify that peer reviewers focusing on seismic response and fragility analysis have successfully completed the Seismic Qualification Utility Group (SQUG) training course or equivalent (SPID section 6.7). Please confirm that the seismic PRA peer reviewers who focused on the seismic response and fragility aspects of the review "have successfully completed the SQUG Walkdown and Seismic Evaluation Training Course or equivalent" available at EPRI from the SQUG. If equivalent training was completed, or if there is sufficient professional experience, demonstrate the equivalency.

Question 3 - Topic #15 - Documentation of the Seismic PRA (SPID Section 6.8)

Section 5.7 of the seismic PRA submittal describes the results of sensitivity studies performed on key PRA model uncertainties consistent with guidance from the SPID. Among these studies, there is a sensitivity study on FLEX diesel generator (DG) failure rates to determine the impact on seismic risk if the failure rates are

higher than they are assumed to be in the seismic PRA. The NRC staff notes that, while industry failure rates for portable FLEX equipment are not yet available, they are expected to be different from (e.g., greater than) the failure rates for permanently installed equipment. In addition, NRC staff notes that the failure rates for the safety related emergency diesel generators (EDGs) are less than the failure rates for the Station Blackout DGs, which are not safety related. The submittal indicates that the failure rates used in the seismic PRA for the FLEX DGs are based on industry failure rates for EDGs. In light of these observations:

- a) Justify that the sensitivity study is sufficient to show that the uncertainty caused by using EDG failure rates for the FLEX DGs does not affect the submittal conclusions regarding no seismic hazard vulnerabilities and no need for plant improvements.
- b) Explain why using a multiplication factor of 5 is sufficient for the sensitivity analysis, even though the FLEX DGs are neither safety related or permanently installed.
- c) Also, since the conclusions the submittal depends on the importance values generated from the seismic PRA, discuss how the sensitivity study (using an appropriate multiplication factor) impacts the importance values generated to identify risk-significant contributors.

Question 4 - Topic #16 - Review of Plant Modifications and Licensee Actions, If Any

Table 5.6-1 of the seismic PRA submittal presents the mean seismic core damage frequency (SCDF) and seismic large-early release frequency (SLERF) values for both reactor units showing there is a relatively significant level of seismic risk at the plant. The table indicates that the mean SCDF is 6.32E-5 and 6.34E-5 per year for Units 1 and 2, respectively; and the mean SLERF is 1.934E-05 and 1.94E-05 per year for Units 1 and 2, respectively. Sections 5.4 and 5.5 of seismic PRA submittal present importance values for the risk-significant SSC seismic fragility failure groups, random component failures, and operator failures. It appears to NRC staff, based on this information, that there may be cost-justified substantial safety improvements that could reduce the SCDF by 1E-05 per year or the SLERF by 1E-06 per year. The following failure events, or their combination, identified in the seismic PRA submittal appear to have the potential to significantly reduce seismic risk:

- SEIS-LOOP - Seismic-induced loss of offsite power
- SEIS-SSLOCA - Seismic-induced Small-Small loss of coolant accident (LOCA)
- SEIS-EE-BKR-HJ8-RLY - 4Kv to 480V bus breaker relay chatter
- SEIS-SW-P-IAB-RLY - Service Water pumps relay chatter
- SEIS-CH-P-IABC-RLY - Charging pumps relay chatter
- SEIS-SLOCA - Seismic-induced Small LOCA
- SEIS-VB-INV-1234 - 120 VAC Vital bus inverter (Unit 2 only)
- HEP-C-OSW-CHP-ALT - Restore cooling to the Charging Pumps from the Fire Protection or Primary Grade Water systems

- SEIS-RS-P-1AB-RLY - Inside RS pump relay chatter

In light of these observations:

- a) Explain whether event SEIS-LOOP separately represents the occurrence of seismically induced LOOP within and outside the plant's jurisdiction. Include information on whether separate fragilities can be assigned to seismically induced LOOP contributors within and outside the plant's jurisdiction. If SEIS-LOOP separately represents seismically induced LOOP that can occur due to failures within the plant's jurisdiction, explain whether cost-justified improvements associated with plant switchyard equipment can significantly reduce seismic risk (as defined above) either alone or in combination with other potential plant modifications.
- b) Explain whether cost-justified plant improvement possibilities exist that would reduce the SCDF contribution by 1E-05 per year or reduce the SLERF contribution by 1E-06 per year by eliminating or decreasing the risk associated with the following:
 - i. a single failure event (e.g., SEIS-LOOP, SEIS-SLOCA, or SEIS-RS-P-1AB-RLY)
 - ii. a combination of two failure events
 - iii. a combination of three or more of the failure events identified in the list above

In the response to item b, explain how combinations and cost of plant improvements were considered.

- c) Describe the evaluation performed for plant improvements (single or combined) considered to have the potential to significantly reduce seismic risk. Include identification of the plant improvements that were evaluated and the results of evaluating those improvements.
- d) Many failure modes are listed as "functional." Please describe what the functional failure mode is and what kind of improvements can be done to address the functional failure mode. Explain if any generic modifications could be made to address this failure mode.

Question 5 - Topic #14 - Related to NAPS SA.7 R2, Attachment 5 (Internal events PRA F&Os)

The following questions pertain to finding-level Facts and Observations (F&Os) presented in NAPS SA.7 R2, Attachment 5 provided on the document portal during the audit. The table in Attachment 5 presents the internal events PRA F&Os for Supporting Requirements (SRs) not met at Capability Category II along with dispositions of the F&Os for the seismic PRA submittal. The dispositions provided for the following F&Os were not sufficient for NRC staff to conclude that the F&Os either individually or in the aggregate did not have an impact on the conclusions of the submittal. The NRC staff notes that the seismic PRA incorporates the plant response model from the internal events and internal flooding PRAs and that the conclusions of the submittal depend on the importance values generated from the

seismic PRA.

- a) The table in Attachment 5 indicates that a number of PRA model updates were performed to resolve internal events PRA F&Os but the table does not indicate what additional modelling or assessment was performed. For each of the following F&Os, describe PRA model update, or assessment, that was performed and explain how does it resolves the F&O:
 - i. F&O AS-A10-1 regarding the impact of loss of condenser vacuum on the transient initiating event group
 - ii. F&O DA-B2-01 regarding including outliers in the definition of component groups
 - iii. F&O HR-G2-01 regarding inclusion of recovery actions in the dependency analysis of post-initiator Human Failure Events (HFEs)
 - iv. F&O SC-B1-01 regarding large break LOCA success criteria

- b) The table in Attachment 5 indicates that the resolutions for a number of F&Os only require updates to documentation, but remarks by the peer reviewers in the F&Os indicate that further review or evaluation was needed. The same remarks stated that some of these further review or evaluation might necessitate updating the PRA models. For each of the following F&Os, justify that the resolution only requires an update to the documentation or confirm that further review or evaluation was performed and it was determined that no model update was needed:
 - i. For F&O AS-B6-01, it appears that a review needs to be performed on plant configurations and maintenance practices for dependencies among system alignments.
 - ii. For F&O IFQU-A6-01, based on the peer reviewers' recommended resolution provided in the NAPS containment integrated leak rate test (ILRT) LAR (ADAMS Accession No. ML14183B318), it appears that a review was needed of the time-related inputs to the human reliability analysis (HRA) calculator for consistency with the PRA notebook.
 - iii. For F&O IFSN-A8-01, based on the peer reviewers' recommended resolution provided in the NAPS ILRT LAR, it appears that a more detailed investigation of door failure due to water accumulation is needed or that the beneficial assumption that the doors fail during flooding needs to be removed.
 - iv. For F&O IFSN-B2-02, based on the peer reviewers' recommended resolution provided in the NAPS ILRT LAR, it appears that evaluation was needed of the flow rates for a full-diameter pipe breaks and a comparison was needed of the rates against corresponding maximum pump runout rates.
 - v. For F&O IFSN-B2-02, based on the peer reviewers recommended resolution provided in the NAPS ILRT LAR, it appears that the identification of electrical dependencies may be incomplete.

- c) For certain F&Os, the sixth column of the table in Attachment 5 indicates that resolution of the F&O pertains only to documentation, but the eighth column indicates that a PRA model update was performed. For each of the following F&Os, describe the PRA model update that was performed and explain how it resolves the F&O:
- i. For F&O DA-C14-01, it appears that an evaluation of historical maintenance schedules was needed and based on this an update of the PRA model may be needed.
 - ii. For F&Os DA-D8-01 and DA-D8-02, it appears that an evaluation of the impact of plant modifications on the data and possible update of the failure rates used in the PRA model is needed.
 - iii. For F&O QU-B8-01, it appears that a review and possible correction is needed for the cited mutually exclusive logic.
- d) The table states that plugging of manual valves will not impact the seismic PRA and, because they are seismically rugged, they are not modeled in the seismic PRA. It is not clear how this assertion resolves F&O SY-A14-01. F&O SY-A14-01 concerns the plugging of manual valves in standby trains that may have a long exposure rate between tests or alignments. Justify why the exclusion of this failure mode cannot have an impact on the seismic PRA.

Question 6 - Topic #14 - Related to Appendix A of the Seismic PRA Submittal (Seismic events PRA F&Os)

The following questions pertain to finding-level F&Os documented in Appendix A of the Seismic PRA submittal, which presents the seismic event PRA F&Os for SRs not met at Capability Category II along with dispositions of the F&Os for the SPRA submittal.

- a) F&O 25-9 states that the seismic PRA model includes modeling of the low-leakage reactor coolant pump (RCP) Flowserve seals but also cites the internal events PRA notebook which states “the logic for the Flowserve seals is disabled until the seals are replaced in all of the RCPs.” Based on these statements, it is not clear whether the seismic PRA model credits the Flowserve RCP seals. The disposition also states that North Anna Flowserve RCP seal modeling has not been peer reviewed, but that the “Flowserve seal in the North Anna PRA (and SPRA) is nearly identical to the Flowserve model in the Surry PRA, which had undergone a peer review in 2013.” In light of these observations:
- i. Confirm whether the low-leakage RCP Flowserve seals have been completely installed and whether they are credited in the seismic PRA.
 - ii. If the RCP seals are credited in the seismic PRA, then perform a

sensitivity study that removes credit for the Flowserve low leakage RCP seals and discuss whether exclusion of credit for these seals affects the conclusions of the submittal. The discussion should include the effect on the importance values generated by the seismic PRA for the risk significant contributors.

- iii. If the inclusion of credit for the Flowserve RCP seals can affect the conclusions of the submittal, then justify that the updated modeling to reflect the new seals does not constitute a PRA upgrade as defined by the ASME/ANS SA-Ra-2009 PRA standard.
 - iv. If the updated modeling to reflect the new seals constitutes a PRA upgrade as defined by the ASME/ANS SA-Ra-2009 PRA standard, then provide the results of a focused-scope peer review on the RCP seal modeling that justifies its use in the NAPS seismic PRA.
- b) F&O 25-13 states that “surrogate values are used to capture the contribution for the unique nature of the actions taken in FLEX that are outside the scope of the HRA calculator.” Based on this brief explanation, it is not clear how FLEX Human Error Probabilities (HEPs) were estimated. Section 5.7.4 of the seismic PRA submittal explains that a sensitivity study was performed in which the FLEX HEPs were raised by a factor of 5, but it is unclear whether the sensitivity study was sufficient to justify the finding to address the “surrogate approach”. In light of these observations:
- a. Describe the surrogate approach, include discussion of the parameters for which “surrogates” were used and what values were assigned.
 - b. Justify that the sensitivity study (i.e., the factor of 5 increase) is sufficient to show that the uncertainty associated with surrogate values used for failure of FLEX actions does not affect the conclusions of the submittal. Justifications should discuss how the sensitivity study affects the importance values generated by the seismic PRA for the risk significant contributors.

Document request via ePortal:

In addition, please make the following documents available for audit:

- NAPS PRA Model Notebook MC.1, Rev.2
- NOTEBK-PRA-NAPS-SA.4, Rev 2, PRA Model Notebook Volume SA.4
- PRA Model Notebook SA.1, “Seismic PRA Quantification Results”

We are available to discuss our questions.
Please give me a call to discuss further.

Respectfully,

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