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

April 27, 2021

Mr. Fadi Diya
Senior Vice President and
Chief Nuclear Officer
Ameren Missouri
Callaway Energy Center
8315 County Road 459
Steedman, MO 65077

SUBJECT: CALLAWAY PLANT, UNIT NO. 1 – AUDIT QUESTIONS FOR LICENSE AMENDMENT REQUEST TO ADOPT 10 CFR 50.69, "RISK-INFORMED CATEGORIZATION AND TREATMENT OF STRUCTURES, SYSTEMS AND COMPONENTS FOR NUCLEAR POWER REACTORS" (EPID L-2020-LLA-0235)

Dear Mr. Diya:

By application dated October 30, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20304A454), Union Electric Company, dba Ameren Missouri (the licensee), submitted a license amendment request for Callaway Plant, Unit No. 1 (Callaway). The proposed amendment would modify the Callaway licensing basis by the addition of a license condition (i.e., License Condition 2.C.(19)), to allow for the implementation of the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.69, "Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors."

On February 18, 2021 (ADAMS Accession No. ML21039A222), the U.S. Nuclear Regulatory Commission (NRC) staff issued an audit plan that conveyed intent to conduct a regulatory audit to support its review of the subject license amendment. In the audit plan the NRC staff requested an electronic portal setup and provided a list of documents to be added to the portal. The NRC staff has performed an initial review of these documents and developed a list of audit questions. The proposed date for the audit is from May 11, 2021, through May 13, 2021. The proposed agenda for the audit is provided as Enclosure 1, and the list of Audit questions are provided as Enclosure 2 to this letter.

If you have any questions, please contact me at (301) 415-8371 or by e-mail at Mahesh.Chawla@nrc.gov.

Sincerely,

/RA/

Mahesh L. Chawla, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosures:
1. Audit Agenda
2. Audit Questions

cc: Listserv

AUDIT AGENDA

REGARDING LICENSE AMENDMENT REQUEST TO ADOPT

10 CFR 50.69, ““RISK-INFORMED CATEGORIZATION AND TREATMENT OF STRUCTURES,

SYSTEMS AND COMPONENTS FOR NUCLEAR POWER REACTORS”

UNION ELECTRIC COMPANY dba AMEREN MISSOURI

CALLAWAY PLANT, UNIT NO. 1

DOCKET NO. 50-483

Day 1 – Tuesday, May 11, 2021

9:00 AM to 12:00 PM Eastern Time (ET)

- Entrance Meeting
    - Opening comments by U.S. Nuclear Regulatory Commission (NRC) and Ameren Missouri
    - Introductions and logistics
- Discuss internal events probabilistic risk assessment (PRA) technical acceptability (APLA Questions 01 thru 03)
    - Dialog regarding the site-specific implementation of Pressurized Water Reactor Owners Group (PWROG)-18027-NP
- Discuss total risk consideration (APLA Question 06)

1:00 PM to 4:00 PM ET

- Discuss key assumptions and uncertainties process (APLA/APLC Questions 04 and 05)
    - Dialog summarizing recent changes implemented in PRA update 9
- Credit for Diverse and Flexible Coping Strategies (FLEX) equipment and actions (APLA/APLC Question 07)
- Dialog regarding the use of Nuclear Energy Institute (NEI) 16-09 in the implementation of Title 10 of the *Code of Federal Regulations* Section 50.69 (10 CFR 50.69)
- Summary of the day (3:00 PM)[1]

Day 2 – Wednesday, May 12, 2021

9:00 AM to 12:00 PM ET

- Discuss fire PRA technical acceptability (APLB Questions 01 and 02)

1:00 PM to 4:00 PM ET

[1] If discussion topics are completed early, additional discussions for Day 1 may be on the next day’s agenda items.

- Seismic PRA technical acceptability (APLC questions 03 thru 05)
- Integrated PRA hazards model (APLC question 01)
- Summary of the day (3:00 PM)[1]

Day 3 – Thursday, May 13th, 2021

9:00 AM to 12:00 PM ET

- Overall use of Nuclear Energy Institute (NEI) 00-04 and use for external floods (see APLC question 02)
- High winds PRA technical acceptability (see ALPC question 06 and 07)

1:00 PM to 4:00 PM ET

- Follow up on any remaining or new open action items
- Technical summary meeting with Ameren's audit team (1:00 PM)
- Formal exit meeting (4:00 PM)

AUDIT QUESTIONS

REGARDING LICENSE AMENDMENT REQUEST TO ADOPT

10 CFR 50.69, "RISK-INFORMED CATEGORIZATION AND TREATMENT OF STRUCTURES,

SYSTEMS AND COMPONENTS FOR NUCLEAR POWER REACTORS"

UNION ELECTRIC COMPANY dba AMEREN MISSOURI

CALLAWAY PLANT, UNIT NO. 1

DOCKET NO. 50-483

By letter dated October 30, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20304A454), Union Electric Company, dba Ameren Missouri (Ameren, the licensee) submitted a license amendment request (LAR, the application) for the use of a risk-informed process for the categorization and treatment of structures, systems, and components (SSCs) at Callaway Plant, Unit No. 1 (Callaway). The proposed license amendment would modify the Callaway licensing basis, by the addition of a license condition, to allow for the implementation of the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.69, "Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors." The U.S. Nuclear Regulatory Commission (NRC) staff from the Division of Risk Assessment, Probabilistic Risk Assessment (PRA) Licensing Branch A (APLA), Branch B (APLB) and Branch C (APLC) have reviewed the LAR and provided the following questions to discuss during the audit.

INTERNAL EVENTS PRA QUESTIONS

APLA Question 01 – PRA Upgrades

The American Society of Mechanical Engineers/American Nuclear Society(ASME/ANS) PRA Standard ASME/ANS RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," dated February 2009, defines PRA upgrade as the incorporation into a PRA model of a new methodology or significant changes in scope or capability that impact the significant accident sequences or the significant accident progression sequences. Section 1–5 of Part 1 of the ASME/ANS RA-Sa-2009 PRA Standard states that upgrades of a PRA shall receive a peer review in accordance with the requirements specified in the peer review section of each respective part of this standard. Criteria presented to identify PRA upgrades are: (1) use of new methodology, (2) change in scope that impacts the significant accident sequences or the significant accident progression sequences, and (3) change in capability that impacts the significant accident sequences or the significant accident progression sequences.

The LAR does not specifically state that there are no PRA upgrades that have not been peer reviewed. Section 3.3, "PRA Review Process Results (10 CFR 50.69(b)(2)(iii))," of Enclosure 1 to the LAR, indicates that the last full-scope peer review for the fire PRA was conducted in October 2009, and that the independent assessment to close out facts and observations (F&Os) from that peer review (and F&Os from a concurrent focused-scope peer review) was conducted in June 2020. The LAR states that updates have been performed to address revised guidance, but it does not discuss the fire PRA model changes made since October 2009 to improve the model or to incorporate changes to reflect the as-built, as-operated plant. Given the lack of a definitive statement that there are no PRA upgrades that have not been peer reviewed and the significant length of time between the last full-scope peer review and the F&O closure reviews, address the following:

a. Confirm that there are no internal events, fire, seismic, or high winds PRA upgrades that have not been peer reviewed. Include clarification of whether the independent assessment teams performing F&O closure reviews ensured that no PRA upgrades were inadvertently incorporated into the PRA without a peer review in accordance with ASME/ANS RA-Sa-2009 PRA Standard as endorsed by NRC.

b. For the fire PRA, summarize the major model changes since August 2009, and for each change justify that the change does not meet the definition of a PRA upgrade as defined in the ASME/ANS RA-Sa-2009 PRA Standard.

c. If there are PRA upgrades that have not been peer reviewed, then propose a mechanism that ensures a focused-scope peer review is performed on these upgrades, and that all resulting F&Os are closed out using an NRC-approved approach.

APLA Question 02 – Use of Newly Developed Method from PWROG-18027-NP

Section B of Regulatory Guide (RG) 1.200, Revision 3, “Acceptability of Probabilistic Risk Assessment Results for Risk-Informed Activities,” dated December 2020 (ADAMS Accession No. ML20238B871), endorses Nuclear Energy Institute (NEI) 17-07, Revision 2, “Performance of PRA Peer Reviews Using the ASME/ANS PRA Standard,” dated August 2019 (ADAMS Accession No. ML19241A615). The guidance in NEI 17-07, Revision 2, establishes a newly developed method (NDM) peer review process. Section B of RG 1.200, Revision 3 also endorses the following portions from the Pressurized Water Reactor Owners Group (PWROG)-19027-NP, Revision 2, “Newly Developed Method Requirements and Peer Review,” dated July 2020 (part of ADAMS Accession No ML20213C660):

- Requirements for the peer review of NDMs (see Regulatory Positions C.2.2.2 through C.2.2.4).
- Process for determining whether a change to a PRA is classified as PRA maintenance or a PRA upgrade (see Appendix C).
- Definitions related to NDMs, PRA maintenance, and PRA upgrade.

Sections 3.2.1, “Internal Events and Internal Flooding,” and 3.3 of Enclosure 1 to the LAR, states that Callaway incorporated the NDM described in PWROG-18027-NP, Revision 0, “Loss of Room Cooling in PRA Modeling,” dated April 2020, into its internal events PRA. The licensee explains that in November 2019 an independent assessment was performed to close open F&Os, but that an F&O related to implementation of the PWROG-18027-NP methodology remained open. In Section 3.3, of the LAR, the licensee explains that in June 2020 an independent assessment to close open F&Os and a concurrent focused-scope peer review was performed to complete review of the use of the PWROG-18027-NP methodology. In the LAR, the licensee states that the PRA standard supporting requirements (SRs) associated with implementation of the guidance in PWROG-18027-NP, Revision 0, were found to meet Capability Category II. The licensee also explains, as part of an effort unrelated to the Callaway reviews, a peer review was performed in February and March of 2020 on the PWROG-18027-NP methodology following the guidance in

NEI 17-07, Revision 2, and PWROG-19027-NP, Revision 2, which contains the SRs for new methods. This NDM pilot review is documented in a letter to the NRC titled “For Information Only – PWROG-19020-NP Revision 1 Appendices B, C and E “Newly Developed Method Peer Review Pilot – General Screening Criteria for Loss of Room Cooling in PRA Modeling” per PA-RMSC-1647,” dated August 6, 2020 (ADAMS Accession Nos. ML20230A125 and ML20230A126). The NDM pilot review document states that the PWROG-18027-NP methodology was found to meet all SRs associated with the NDM without any open F&Os. However, Section E.4.2 of PWROG-19020-NP states that a peer review of this method is needed when it is implemented at a plant that includes evaluation of the following SRs: SY-A3, SY-A6, SY-A11, SY-A18, SY-A21, SY-A22, SY-B6, SY-B9, SY-B11, and SYB12 and hazard-specific SRs that reference back to these SRs. In light of these observations, address the following:

a. Confirm that the SRs cited above were included in the June 2020 Callaway internal events focused-scope peer review of the implementation of the PWROG-18027-NP methodology.

b. If in response to Part (a) above, it cannot be confirmed that the cited SRs were included in the June 2020 focused-scope peer review of the implementation of the PWROG-18027-NP methodology, then justify any exclusions. Alternatively, perform a focused-scope peer review of the method against the cited SRs and close any resulting F&Os using an NRC-approved process.

APLA Question 03 – Overlap of Functions and Components

Section 7.1, “Engineering Categorization,” of NEI 00-04, Revision 0, “10 CFR 50.69 SSC Categorization Guideline,” dated July 2005 (ADAMS Accession No. ML052910035), states, in part, “[d]ue to the overlap of functions and components, a significant number of components support multiple functions. In this case, the SSC, or part thereof, should be assigned the highest risk significance for any function that the SSC or part thereof supports.” Section 4, “System Engineering Assessment,” of NEI 00-04 states that a candidate low safety-significant SSC that supports an interfacing system should remain uncategorized until all interfacing systems are categorized. The LAR does not discuss consideration or implementation of the guidance in Section 7.1 of NEI 00-04.

Explain how the categorization process will be implemented to ensure that the cited guidance in NEI 00-04 will be followed. Include confirmation that any functions/SSCs that serve as an interface between two or more systems will not be categorized until the categorization for all of the systems that they support is completed and confirmation that SSCs that support multiple functions will be assigned the highest risk significance for any of the functions they support.

APLA Question 04 – Key Assumptions and Sources of Uncertainties Identification Process

Paragraphs 50.69(c)(1)(i) and (c)(1)(ii) of 10 CFR require that a licensee’s PRA be of sufficient quality and level of detail to support the SSC categorization process, and that all aspects of the integrated, systematic process used to characterize SSC importance must reasonably reflect the current plant configuration and operating practices, and applicable plant and industry operational experience.

Section 5, “Component Safety Significance Assessment,” of NEI 00-04 provides guidance for performing sensitivity studies for each PRA model to address the uncertainty associated with those models. Specifically, Sections 5.1, “Internal Events Assessment,” 5.2, “Fire Assessment,” and 5.3, “Seismic Assessment,” provide guidance for such sensitivities for the internal events, fire, and seismic PRA, respectively. The sensitivity studies are performed to ensure that assumptions and sources of uncertainty (e.g., human error, common-cause failure, and maintenance probabilities) do not mask the importance of components.

Attachment 6, “Key Assumptions and Sources of Uncertainty,” to Enclosure 1 of the LAR, explains that a list of generic assumptions and sources of uncertainty from Electric Power Research Institute (EPRI) Topical Report (TR)-1016737, “Treatment of Parameter and Model Uncertainty for Probabilistic Risk Assessments,” and plant-specific assumptions and sources of uncertainty identified from the PRA notebooks were reviewed. The LAR states that if the PRA models “used a non-conservative treatment or methods not commonly accepted, the underlying assumption or source of uncertainty was reviewed to determine its impact on this application.” The LAR also states that only assumptions and sources of uncertainty with the potential to “challenge the risk ranking evaluation” are considered to be key uncertainties. The LAR further states that no assumptions or sources of uncertainty were found to challenge the “risk ranking evaluation guidelines of the 50.69 application,” and reported no key assumption or sources of uncertainty. The LAR states, therefore, that no additional sensitivity analyses are required to address Callaway PRA modeling assumptions or sources of uncertainty. The LAR does indicate how modeling choices and approximations were considered for this application, and whether they are included in the set of assumptions and sources of modeling uncertainty considered for the application. The LAR does not indicate how generic sources of modeling uncertainty for fire, seismic, or high winds events were considered. Additionally, it is not clear to NRC staff how it was determined that an assumption or source of uncertainty will not “challenge the risk ranking evaluation” performed as part of the 10 CFR 50.69 program.

In addition to EPRI TR-1016737, NUREG-1855, Revision 1, “Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decisionmaking,” dated March 2017 (ADAMS Accession No. ML17062A466), also cites EPRI TR-1026511, “Practical Guidance on the Use of Probabilistic Risk Assessment in Risk-Informed Applications with a Focus on the Treatment of Uncertainty,” dated December 2012, which provides generic sources of modeling uncertainty for fire, seismic, and Level 2 events. Furthermore, Section 1.3, “Scope and Limitations,” of NUREG-1855, Revision 1, states, in part:

> Although assumptions and approximations made on the level of detail in a PRA can influence the decisionmaking process, they are generally not considered to be model uncertainties because the level of detail in the PRA model could be enhanced, if necessary.
>
> Therefore, methods for identifying and characterizing issues associated with level of detail are not explicitly included in NUREG-1855; they are, however, addressed in EPRI TR-1016737 and TR-1026511.”

Additionally, Section 3.3.2, “Assessment of Assumptions and Approximations,” of RG 1.200, Revision 2, dated March 2009 (ADAMS Accession No. ML090410014), defines key assumptions and sources of uncertainty. Therefore, the NRC staff requests the following information to confirm the conclusion that there are no PRA assumptions or sources of uncertainty that can impact the 10 CFR 50.69 application, and to confirm that key assumptions and sources of uncertainty were properly assessed from the base PRAs:

a. Provide a description of the process used to compile or identify an initial comprehensive set of generic and plant-specific modeling assumptions and sources of uncertainty including those associated with modeling choices and approximations (e.g., level of detail choices). The description should be provided separately for the internal events, fire, seismic, and high winds PRAs. If modeling choices were not included as modeling assumptions or sources of uncertainty, then justify your approach

b. Include a discussion of how generic fire, seismic, and high winds PRA modeling assumptions and uncertainties were considered in compiling or identifying an initial comprehensive list. If generic fire, seismic, and high winds PRA modeling assumptions and uncertainties were not considered then justify your approach.

c. Discuss the specific criteria used to determine whether an assumption or source of modeling is key to the 10 CFR 50.59 application or can be screened:

    i. Besides use of non-conservative treatments and methods not commonly accepted, identify any other criteria used to evaluate uncertainties.

    ii. Explain how you determined that a modeling assumption or source of uncertainty will not "challenge the risk ranking evaluation" performed as part of the 10 CFR 50.69 program.

d. If the process of identifying "key" assumptions or sources of uncertainty for the PRA models used to support this application cannot be justified for use in the 10 CFR 50.69 categorization process based on the responses to part (a) and (b) above, then provide the results of an updated assessment that includes a description of each key assumption or source of uncertainty identified.

APLA/APLC Question 05 – PRA MODEL UNCERTAINTY DISPOSITIONS

Paragraphs 50.69(c)(1)(i) and (c)(1)(ii) of 10 CFR require that a licensee's PRA be of sufficient quality and level of detail to support the SSC categorization process, and that all aspects of the integrated, systematic process used to characterize SSC importance must reasonably reflect the current plant configuration and operating practices, and applicable plant and industry operational experience. The guidance in NEI 00-04 specifies sensitivity studies to be conducted for each PRA model to address uncertainty. The sensitivity studies are performed to ensure that assumptions and sources of uncertainty (e.g., human error, common-cause failure, and maintenance probabilities) do not mask importance of components. The guidance in NEI 00-04 states that additional "applicable sensitivity studies" from characterization of PRA adequacy should be considered.

The NRC staff notes that assessment of uncertainty may identify the need for additional sensitivity studies, as presented in Table 5-2, "Sensitivity Studies for Internal Events PRA," and Table 5-3, "Sensitivity Studies for Fire PRA," of NEI 00-04. Attachment 6 to Enclosure 1 of the LAR identifies no key assumptions and sources of uncertainty for the internal events (including internal flood), fire, seismic, and high winds PRAs. However, the NRC staff reviewed the report on the uncertainty analyses performed for the 10 CFR 50.69 application and other PRA notebooks provided to NRC staff during the audit via document portal and noted a few sources of uncertainty that appeared to have the potential to impact the 10 CFR 50.69 risk-informed categorization. Therefore, address the following:

a. The uncertainty analysis performed in support of the 10 CFR 50.69 application (PRA-IE-UNCERT_APP6 – page 28 of 42) indicates that the electrical grid fragility, during high winds, is a source of uncertainty. The high winds PRA [PRA-HW-Analysis] presents the results of a sensitivity study indicating that a more "optimistic" estimate of the fragility of the electrical grid would result in a 29 percent decrease in core damage frequency (CDF) while a more "pessimistic" estimate of the fragility would result in an 81 percent increase in CDF demonstrating a high level of sensitivity to this assumption. The uncertainty analysis report states that the assumed failure probabilities are "pure assumptions." Though high winds risk is just one of several elements considered in 10 CFR 50.69 risk categorization, significant uncertainty in high wind risk could impact the application. Therefore, justify that the uncertainty associated with electrical grid fragility in high winds has an inconsequential impact on the 10 CFR 50.69 application.

b. The uncertainty analysis performed in support of the 10 CFR 50.69 application (PRA-IE-UNCERT_APP6 – page 14 of 42) indicates that the human reliability analysis (HRA) bin definitions (which were used to assign increased operator error probabilities for higher magnitude seismic events) are a source of "inherent" seismic PRA modeling uncertainty. The seismic PRA quantification report (PRA-SEISMIC-QUANT Rev 000), as well as the initial seismic PRA report transmitted in a letter dated August 12, 2019 (see ADAMS Accession No. ML19225D324), presents the results of a sensitivity study showing that the CDF could increase by a factor of 171.4 percent for one of the HRA bin cases (i.e., Case B). It is not clear to the NRC staff that the sensitivity study stipulated by the guidance in NEI 00-04 performed to address HRA uncertainty for the 10 CFR 50.69 program would be applied to the HRA bin definitions in the seismic PRA. Though seismic risk is just one of several elements considered in 10 CFR 50.69 risk categorization, it dominates the total plant risk, and a significant uncertainty in seismic risk could impact the application. Therefore, address the following:

   i. Confirm that the sensitivity study stipulated by the guidance in NEI 00-04 performed to address HRA uncertainty for the 10 CFR 50.69 program will be applied to the HRA bin definitions in the seismic PRA.

   ii. If the sensitivity study stipulated by the guidance in NEI 00-04 performed to address HRA uncertainty for the 10 CFR 50.69 program will not be applied to the HRA bin definitions in the seismic PRA, then justify that the uncertainty associated with seismic PRA HRA bin definitions has an inconsequential impact on the 10 CFR 50.69 application.

c. Attachment 2, "Description of PRA Models Used in Categorization," to Enclosure 1 of the LAR, and the PRA quantification report provided during the audit (PRA-SEISMIC-QUANT Rev 000) indicates that the point estimate CDF is 5.59E-05 per year and that the mean CDF is 7.26E-05 per year based on parametric uncertainty analysis (see page 89). Though seismic risk is just one of several elements considered in 10 CFR 50.69 risk categorization, it dominates the total plant risk and its mean value is high relative to the RG 1.200, Revision 2 threshold value of 1E-04 per year. Therefore, the uncertainty in seismic risk could impact the application.

   In light of the observation above, justify that the parametric uncertainty has an inconsequential impact on the 10 CFR 50.69 application.

d. The PRA quantification report provided during the audit (PRA-SEISMIC-QUANT Rev 000) presents the results of the seismic PRA truncation level convergence study. The NRC staff notes that the example criterion from SR QU-B3 of the ASME/ANS RA-Sa-2009 PRA Standard (i.e., "convergence can be considered sufficient when successive reductions in truncation value of one decade result in decreasing changes in CDF or LERF [large early release frequency], and the final change is less than 5%") is not met for several seismic hazard bins. For example, LERF increases 38.2 percent for Bin %G04 and 50.3 percent for Bin %G05 for the last decade decrease in truncation level (based on 100 percent of cutsets post-processed). Also, even though the report presents only an increase of 5.7 percent in CDF for Bin %G05 and an increase of 5.4 percent in CDF for Bin %G06 for the last decade decrease in truncation level these results are based on about 3 percent of the cutsets post-processed. The report indicates that challenges associated with using ACUBE for seismic PRA lead to this incomplete truncation study but that the risk insights from the seismic PRA should not change even if cutsets were added to reach a greater level of convergence. It is not clear to the NRC staff that this incomplete convergence has an inconsequential impact on the 10 CFR 50.69 application, and notes that adding cutsets to achieve a greater level of convergence could result in higher seismic CDF and LERF, which are already high. Therefore, address the following:

i. Justify that the truncation levels used in the seismic PRA model supporting the 10 CFR 50.69 application lead to sufficient convergence of the calculated CDF and LERFs results to support the 10 CFR 50.69 program. Provide the results of the truncation convergence study that support this justification and discuss the adequacy of how the seismic intervals are defined and the truncation levels used for each seismic hazard bin.

ii. As an alternative to part (i) above, demonstrate that the uncertainty associated with an incomplete truncation convergence study has an inconsequential impact on the 10 CFR 50.69 application.

iii. As an alternative to part (i) and (ii) above, propose a mechanism for ensuring that the truncation levels used in the seismic PRA model supporting the 10 CFR 50.69 program have resulted in less than about 5 percent for the last decade truncation level decrease.

APLA Question 06 – Total Risk Consideration

RG 1.174, Revision 3 , "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," dated January 2018 (ADAMS Accession No. ML17317A256), provides the risk acceptance guidance in terms of change-in-risk in combination with total CDF defined by regions, which in Figures 4 and 5 are shown as Region I (No Changes Allowed), Region II (Small Changes), and Region III (Very Small Changes and More Flexibility with Respect to Baseline CDF/LERF). NEI 00-04, Revision 0, includes an overall risk sensitivity study for all the low safety-significant components to assure that if the unreliability of the components was increased, the increase in risk would be small (i.e., meet the acceptance guidelines of RG 1.174, Revision 3).

RG 1.174 and Section 6.4, "Step D-3: Comparison of the Risk Results with the Application Acceptance Guidelines," of NUREG-1855, Revision 1, for a Capability Category II risk evaluation, indicate that the mean values of the risk metrics (total and incremental values) need to be compared against the risk acceptance guidelines. The mean values referred to are the means of the probability distributions that result from the propagation of the uncertainties on the PRA input parameters and model uncertainties explicitly reelected in the PRA models. In general, the point estimate CDF and LERF obtained by quantification of the cutset probabilities using mean values for each basic event probability does not produce a true mean of the CDF/LERF. Under certain circumstances, a formal propagation of uncertainty may not be required if it can be demonstrated that the state of knowledge correlation (SOKC) is unimportant (i.e., the risk results are well below the acceptance guidelines).

The NRC staff observes that the LAR does not indicate whether the total CDF and LERF values presented in Attachment 2 to Enclosure 1 of the LAR, are mean values and notes the small margin between the total Callaway CDF and the RG 1.174, Revision 3 CDF threshold of 1E-04 per year. The seismic CDF value, presented in LAR Attachment 2, of 5.59E-05 per year appears to be a point-estimate value because it is consistent with the seismic CDF point-estimate value presented in Section 6.0, "Conclusions," of the supplemental Callaway seismic PRA report dated July 10, 2020 (ADAMS Accession No ML20192A244). Section 5.6, "S-PRA Quantification Uncertainty Analysis," of that same report presents a mean seismic CDF value of 7.26E-05 per year and a mean LERF value of 8.267E-06 per year, which is significantly higher than CDF and LERF values presented in the LAR but could be somewhat overestimated based on the footnote to Table 5-8, "Uncertainty Quantification Results," of that seismic PRA report. Accordingly, the margin between the total Callaway CDF and the RG 1.174, Revision 3 LERF threshold of 1E-04 per year could be less than as presented in LAR Attachment 2. Moreover, the risk increase due to consideration of the SOKC for the internal events, fire, and high winds PRA could result in exceeding the RG 1.174 risk acceptance guidelines. In light of these observations, address the following:

a. Provide a summary of how the SOKC investigation was performed for the base Callaway PRA models used to support the 10 CFR 50.69 application. Include explanation and justification for the internal events, fire, and high winds PRAs of the parameters that were assumed to be correlated.

b. Provide a summary of how the SOKC will be addressed for the 10 CFR 50.69 application, and how this treatment is consistent with NUREG-1855, Revision 1 and the risk acceptance criteria in RG 1.174 when the risk increase associated with SOKC is considered.

APLA/C Question 07 – PRA Credit for Flex Strategies

The NRC memorandum dated May 30, 2017, "Assessment of the Nuclear Energy Institute 16-06, 'Crediting Mitigating Strategies in Risk-Informed Decision Making, 'Guidance for Risk-Informed Changes to Plants Licensing Basis" (ADAMS Accession No. ML17031A269), provides the NRC's staff assessment of identified challenges and strategies for incorporating Diverse and Flexible Coping Strategies (FLEX) equipment into a PRA model in support of risk-informed decisionmaking in accordance with the guidance of RG 1.200. The NRC staff specifically notes the challenges associated with determining appropriate failure rates for portable FLEX equipment and modeling operator errors to transport and startup portable FLEX equipment.

Section 3.2.9.2, "Discussion," of Enclosure 1 to the LAR, discusses three FLEX strategies credited in the internal events PRA and seismic PRA. The LAR states that the first two strategies, which consist using a portable FLEX Steam Generator Makeup Auxiliary Feedwater Pump and 480 Volt Alternating Current Portable Backup Generators, are credited in the seismic PRA. The third strategy, which consists of switching over to the hardened condensate storage tank, is credited in the internal events PRA model (and therefore, used in all other hazard models) and involves only permanently installed equipment. It is not completely clear whether the first two strategies are also credited in the internal events PRA.

Section 3.2.9.2 of Enclosure 1 to the LAR, explains that the first two FLEX strategies are each modeled as single events and assigned a total failure probability of 0.99. The LAR states that sensitivity studies for the first two FLEX strategies have been performed in the seismic PRA and that assuming a failure probability of 1.0 is expected to have “negligible” impact on the estimated seismic risk compared to the seismic risk given the current assumed failure probability of 0.99. The results of the cited sensitivity studies are not discussed in the LAR, but NRC finds that the current modeling is necessarily conservative until industry guidance is available to explicitly model FLEX component failure rates and human errors. The LAR also explains that it is licensee’s judgment that incorporation of FLEX strategies is not a PRA upgrade. The NRC staff interprets this statement to mean that regardless of the challenges associated with modeling FLEX, the licensee does intend to perform a focused-scope peer review on FLEX modeling should it be incorporated into one (e.g., the seismic PRA) or all the PRA models. It is not clear to NRC staff what impact the uncertainty associated with FLEX modeling would have on the 10 CFR 50.69 application after FLEX modeling is incorporated, and the first two FLEX strategies are fully credited.

ASME/ANS RA-Sa-2009 PRA Standard defines PRA upgrade as the incorporation into a PRA model of a new methodology or significant changes in scope or capability that impact the significant accident sequences or the significant accident progression sequences. Section 1-5 of Part 1, of the ASME/ANS RA-Sa-2009 PRA Standard states that upgrades of a PRA shall receive a peer review in accordance with the requirements specified in the peer review section of each respective part of this standard.

In light of the observations above, address the following:

a. Confirm that the first two strategies are only modeled in the seismic PRA, not in other hazard models (e.g., internal events PRA, internal flooding, fire PRA, and high winds PRA) and that the third strategy is modeled in all plant PRAs.

b. Provide sensitivity studies for lowering the event failure probabilities from 0.99 to 0.01 for the two portable FLEX equipment strategies only modeled in the seismic PRA and any other PRAs where the portable FLEX strategies are modeled.

c. If the licensee does not intend to perform a focused-scope peer review on incorporation of future modeling of FLEX strategies that will be incorporated to support 10 CFR 50.69 risk categorization, then provide an evaluation of the changes associated with incorporating FLEX strategies into the different PRA models that demonstrate the following criteria from the PRA standard is satisfied: (1) the FLEX strategy incorporation does not use a new methodology, (2) the FLEX strategy incorporation does not result in a change in scope that impacts the significant accident sequences or the significant accident progression sequences, and (3) the FLEX strategy incorporation does not result in a change in capability that impacts the significant accident sequences or the significant accident progression sequences.

d. If the licensee does intend to perform a focused-scope peer review on future modeling of FLEX strategies that will be incorporated into the PRAs to support 10 CFR 50.69 risk categorization, then to ensure that FLEX modeling uncertainties are addressed, propose a mechanism to ensure that a focused-scope peer review is performed on the model changes associated with incorporating FLEX, and any resulting F&Os are closed using an NRC approved process to Capability Category II prior to implementation of the 10 CFR 50.69 categorization program.

FIRE PRA QUESTIONS

APLB Question 01 – Focused-Scope Peer Review of Fire PRA HRA for Main Control Room (MCR) Abandonment Performed After LAR Submittal

RG 1.200, Revision 2, provides guidance for addressing PRA acceptability. RG 1.200, Revision 2, describes a peer review process using the ASME/ANS-RA-Sa-2009 PRA Standard as one acceptable approach for determining the technical acceptability of the PRA. The primary results of peer review are the F&Os recorded by the peer review team and the subsequent resolution of these F&Os. A process to close finding-level F&Os is documented in Appendix X to the NEI guidance document, "NEI 05-04/07-12/12-06 Appendix X: Close-out of Facts and Observations (F&Os)" (ADAMS Package Accession No. ML17086A431), which was accepted by the NRC in a letter dated May 3, 2017 (ADAMS Accession No. ML 17079A427).

During the audit, access was provided for NRC staff to the following reports on reviews that occurred subsequent to the submittal of the 10 CFR 50.69 LAR: (1) a fire PRA focused-scope peer review performed in November 2020, and (2) the subsequent F&O closure review performed in February 2021. These reviews appear to fulfill the commitment presented in LAR Enclosure 4, "Commitment," to implement the following item prior to using the fire PRA to support implementation of any alternative treatments under the 10 CFR 50.69 application:

> The resolution of Fire PRA Suggestion F&O FSS-BI-03 was determined to be an upgrade during F&O closure review. The upgrade was not reviewed at the time of identification and has not yet been reviewed by an independent peer review. To resolve FSS-BI-03 and also close [National Fire Protection Association] NFPA-805 LAR Table S-3 Implementation item 13-805-001, the Fire PRA was updated to perform the Human Reliability Analysis (HRA) evaluations for MCR abandonment using detailed assessments within HRA Calculator rather than the screening values discussed in this F&O. This change was determined by a recent independent peer review team to be an upgrade. PRA scope and technical adequacy guidance requires upgrades to be independently peer reviewed and Finding F&Os to be closed, or dispositioned for a given application. Therefore, Ameren Missouri will conduct a focused scope peer review on this upgrade and close any new Finding F&Os using an endorsed closure process.

The focused-scope peer review performed in November 2020 was performed on an upgrade to the HRA modeling for the MCR abandonment scenarios from using screening values as indicated in the LAR commitment cited above. The focused-scope peer review resulted in one Finding and four suggestion-level F&Os. The February 2021 F&O closure review closed out the five F&Os from the 2020 focused-scope peer review (plus two additional suggestion-level F&Os.) In light of the observations above, address the following:

a. Confirm that the cited November 2020 focused-scope peer review and subsequent February 2021 F&O closure review fulfill the commitment made in LAR Enclosure 4. Also, update the status of the commitment as appropriate.

b. If the cited December 2020 focused-scope peer review and subsequent February 2021 F&O closure review do not fulfill the commitment made in LAR Enclosure 4, then explain what further actions are necessary and update the commitment made in LAR Enclosure 4 if appropriate.

APLB Question 02 – Fire PRA Methods

The guidance in RG 1.200, Revision 2, states “NRC reviewers, [will] focus their review on key assumptions and areas identified by peer reviewers as being of concern and relevant to the application.” The relatively extensive and detailed reviews of fire PRAs undertaken in support of LARs to transition to NFPA-805 determined that implementation of some of the complex fire PRA methods often used non-conservative and over-simplified assumptions to apply the method to specific plant configurations. Some of these issues were not always identified in F&Os by the peer review teams but are considered potential key assumptions by the NRC staff because using more defensible and less simplified assumptions could substantively affect the fire risk and fire risk profile of the plant. The NRC staff evaluates the acceptability of the PRA for each new risk-informed application and, as discussed in RG 1.174, Revision 3, recognizes that the acceptable technical adequacy of risk analyses necessary to support regulatory decision-making may vary with the relative weight given to the risk assessment element of the decisionmaking process.

Section 3.2.2, “Fire Hazards,” of Enclosure 1 to the LAR, states that Callaway was approved to implement NFPA-805 in January 2014, and acknowledges that since then, there have been “numerous” updates to the approved fire PRA methods through the issuance of fire PRA frequently asked questions and new or revised guidance documents, which are addressing through the PRA maintenance and update process. Therefore, justify that there are no key assumptions or sources of modeling uncertainties in the fire PRA associated with the updated fire PRA guidance issued since the NFPA-805 program was approved in 2014 that would impact 10 CFR 50.69 risk-informed categorization. Include discussion of the updates that have been performed to incorporate updated fire PRA guidance and justify that the fire PRA and any associated uncertainties you considered for its impact on the 10 CFR 50.69 application.

<u>SEISMIC AND HIGH WINDS PRA QUESTIONS</u>

APLC Question 01 – Integrated PRA Hazards Model

Paragraph 50.69(c)(1)(ii) of 10 CFR requires that the SSC functional importance be determined using an integrated, systematic process. The categorization of SSCs, including those categorized using the seismic PRA, is based on importance measures and corresponding numerical criteria, as described in Section 5.1, “Internal Events Assessment,” of NEI 00-04. Section 5.6, “Integral Assessment,” of NEI 00-04, discusses the need for an integrated computation using available importance measures. Section 5.6 states that the “integrated importance measure essentially [weighs] the importance from each risk contributor (e.g., internal events, fire, seismic PRAs) by the fraction of the total core damage frequency [or large early release frequency] contributed by that contributor.” The guidance provides formulas to compute the integrated Fussell-Vesely (F-V) and integrated Risk Achievement Worth (RAW).

LAR Section 3.2.9.2 refers to a “one-top all hazards model,” but does not describe how the licensee will address the integration of importance measures across all PRAs (i.e., internal events, internal flooding, fire, seismic, and high winds PRAs). The NRC staff recognizes that there are technical challenges associated with integrating importance measures across the PRA models for different hazards. For example, for the fire, seismic, and high winds PRAs, both hazard-induced failures and random failures exist in the PRA for the same components. Moreover, the basic events in these PRAs may not align with the basic events from the internal events PRA (e.g., the seismic and high winds PRA produce structural failures of SSCs not included in the internal events PRA). Therefore, address the following:

a. Concerning integration of importance measures across seismic bins:

   i. Describe how the importance measures (i.e., F-V and RAW) are derived from the seismic PRA considering that the seismic hazard is discretized into “bins.” The discussion should include how the same basic events, which were discretized by binning during the development of the seismic PRA, are then combined (i.e., combined across ‘bins’ as well as across failure modes such as seismic and random failures) to develop representative importance measures. As described in the seismic PRA model, the “bins” are different for seismic CDF (SCDF) and seismic LERF (SLERF). Describe how this process will be performed specifically for SCDF and SLERF.

   ii. Discuss how F-V and RAW are compared to the importance measure thresholds in NEI 00-04. Provide justification to support the determined impact on the categorization results and describe how the approach is consistent with the guidance in NEI 00-04.

b. Concerning integration of importance measures across different hazards:

   i. Explain how the integration of importance measures across different hazards for the 10 CFR 50.69 categorization process will be performed. Provide details and justification to support how the integrated importance measures will be calculated for the seismic PRA modeled basic events that may not align directly with basic events modeled in other PRAs.

   ii. If the practice or method used to generate the integrated importance measures is determined to deviate from the NEI 00-04 guidance, then provide justification to support why the integrated importance measures computed are appropriate for use in the categorization process.

c. Concerning random and hazard-induced failure events that impact the same components:

   i. Explain how the impact of failure events such as structural failures and other hazard-induced failures that do not have a one-to-one correlation with random failure events are considered in the determination of integrated importance measures.

   ii. Describe whether and how random and hazard-induced failure events that impact the same components are combined to develop representative importance measures.

iii. Explain how the importance measures are compared to the importance measure thresholds in NEI 00-04. Include explanation of whether the importance measures for the random and hazard-induced failures are compared to the importance measure thresholds in NEI 00-04 before or after they are combined.

iv. Provide justification to support the determined impact on the categorization results and describe how the approach is consistent with the guidance in NEI 00-04.

APLC Question 02 – Overall use of NEI 00-04 Figure 5-6 and use for External Floods

Figure 5-6, "Other External Hazards," in NEI 00-04, Revision 0, illustrates the process that begins with the SSC selected for categorization and then proceeds through the flow chart for each external hazard. The guidance in NEI 00-04 states, in part, that "[i]f it can be shown that the component either did not participate in any screened scenarios or, even if credit for the component was removed, the screened scenario would not become unscreened, then it is considered a candidate for the low safety-significant category."

Section 3.2.5, "Other External Hazards," of Enclosure 1 to the LAR, explains that besides seismic and high winds, which are modeled in separate PRAs, "[a]ll remaining hazards not explicitly modeled were screened from applicability and considered insignificant for every SSC. Therefore, they will not be considered during the categorization process." Attachment 4, "External Hazards Screening," of Enclosure 1 to the LAR, lists hazards as screened except internal events, internal flooding, internal fire, seismic events, and high winds for which there are PRA models. Based on this description, it appears to NRC staff that at the time an SSC is categorized it will not be evaluated using the guidance in NEI 00-04, Figure 5-6. The NRC staff notes that plant changes, plant and industry operational experience, and identified errors or limitations in the PRA models could potentially impact the conclusion that an SSC is not needed to screen an external hazard. Therefore, address the following:

a. Clarify whether or not an SSC will be evaluated during categorization of the SSC using the guidance in NEI 00-04, Figure 5-6, to confirm that the SSC is not credited in screening an external hazard.

b. If an SSC will not be evaluated using the guidance in NEI 00-04, Figure 5-6, to confirm that the SSC is not credited in screening an external hazard at the time of categorization because that evaluation has already been made, then explain how plant changes, plant or industry operational experience, and identified errors or limitations that could change that decision are addressed.

APLC Question 03 – Seismic PRA Modeling

RG 1.174, Revision 3, states that the plant-specific PRA supporting the licensee's proposals has been demonstrated to be acceptable.

In Attachment 2, "Description of PRA Models Used in Categorization," of Enclosure 1 to the LAR, the licensee provided the seismic CDF of 5.59E-05/yr and LERF of 2.82E-06/yr, which are based on the licensee's calculation PRA-SEISMIC-QUANT Rev 000, or its vendor calculation PRA-SPRA-002 Rev 001. The values of SCDF and SLERF in the LAR are almost the same as the

SCDF of 5.59E-05/yr and SLERF of 2.90E-06/yr, listed in the licensee's seismic PRA supplement dated July 10, 2020. Review of these documents indicate the following issues:

1. The licensee used different interval bins to calculate SCDF and SLERF.
2. The last bin for SCDF represents 0.88 g covering seismic hazard ranging from 0.8 to 10 g.
3. Truncation limits increase with seismic hazard peak ground acceleration increase and seismic hazard frequency decrease, which causes the truncation limit to be in the same order of magnitude as the last few bins for SCDF and SLERF.

   In light of the observations above, please address the following:

a. SLERF is normally calculated based on SCDF using the same interval bins, or same initiating events. What is the SCDF value when it is calculated using the SLERF bins, and what is the SLERF value when it is calculated using the SCDF bins? Do the different bins have any impact on the calculation of importance measures? Explain why or why not.

b. The last bin for SCDF represents 0.88g peak ground acceleration, covering a seismic hazard from 0.8 to 10g. This bin has a conditional core damage probability of about 0.9. Provide a sensitivity study to demonstrate no impact on the final SCDF when this bin is divided into several sub-bins (for example, 0.8-1.0 g, 1.0-1.2 g, 1.2-1.4 g, 1.4-1.6 g, 1.6-2.0 g and 2.0-10 g).

c. The truncation limit of the last bin for SLERF was set to 2E-07, while the calculated SLERF in that bin is 3.2E-07/yr. This indicates that the truncation limit is about the same as the calculated SLERF. A high truncation limit may cause loss of risk information. Provide a sensitivity study to demonstrate no impact on the final SLERF when the truncation limit is set to one-decade lower.

APLC Question 04 – Seismic Site-Specific Inputs

Many fragilities with highly ranked F-V values were based on the generic values in Table 5-3, "SCDF Importance Measures Ranked by Fussell-Vesely," for SCDF and Table 5-7, "SLERF Importance Measures Ranked by Fussell-Vesely," for SLERF of the seismic PRA supplement, or Table 4-14 and Table 4-15, respectively, of the calculation PRA-SPRA-002 Rev 001. These generic conservative estimates may not represent site-specific SSCs. When these generic fragilities values are used for 10 CFR 50.69 categorization, the calculated F-V and RAW values may not represent actual plant-specific values for these SSCs.

Will a state-of-practice approach (the so-called hybrid approach or separation of variables) be used to develop, and use refined fragilities prior to implementation of 10 CFR 50.69? Explain how this will be accomplished.

APLC Question 05 – Seismic PRA Model Uncertainties

Section 3.3.2 of RG 1.200, Revision 2, states "[f]or each application that calls upon this regulatory guide, the applicant identifies the key assumptions and approximations relevant to that application. This will be used to identify sensitivity studies as input to the decision-making associated with the application."

Calculation PRA-SPRA-002 Rev 001 provides uncertainty analysis in Section 4.6 (similarly in Section 5.6 of seismic PRA supplement dated July 10, 2020. Table 4-24 of PRA-SPRA-002 Rev 001 shows base model SLERF of 2.90E-6 with point estimate of 4.72E-6, mean of 8.27E-6, 95th percentile value of 2.16E-5 and 5th percentile value of 2.20E-06/yr. It is not clear what is the difference between the base model SLERF of 2.90E-6 and point estimate SLERF of 4.72E-6. It is also noted that the mean SLERF of 8.27E-6 is about three times higher than the base model SLERF of 2.90E-6, which is reported in the 10 CFR 50.69 LAR.

a. Explain the difference between the base model SLERF of 2.90E-6 and point estimate SLERF of 4.72E-6.

b. Discuss the parametric uncertainties that cause the mean SLERF to be about three times higher than the base model SLERF.

c. Provide a sensitivity analysis, which compares some example categorizations of SSCs, by performing an uncertainty run based on the mean SLERF and a point estimate run based on the base model SLERF to demonstrate that there is no impact on the categorization by these two methods. If this cannot be demonstrated, explain what method will be used with justification.

APLC Question 06 – High Winds and their Generated Missiles Hazards Development

RG 1.200, Revision 2, endorses, with staff clarifications and qualifications, the ASME/ANS RA-Sa-2009 PRA Standard. High level requirement (HLRs) in Part 7 of the ASME/ANS RA-Sa-2009 PRA Standard, related to the high winds technical element, specifically HLR-WHA-A, calls for the use of site-specific probabilistic wind hazard analysis to develop the hazard frequency and for the propagation of model uncertainties and parameter values to develop a family of hazard curves.

Section 3.2.4 “High Winds Hazards” of Enclosure 1 to the LAR, does not discuss the hazards development of high winds and their generated missiles. To better understand Callaway’s high winds and their generated missile hazards development, please address the following:

a. Discuss the approach followed for the development of hazard curves for high winds and tornadoes used in the Callaway high winds PRA. For each hazard, the discussion should include information on (1) the sources of data, (2) the process used to develop the corresponding non-exceedance curves, (3) the consideration of uncertainties in parameter values, and (4) the sources of model uncertainty and key assumptions.

b. Discuss the approach followed for the evaluation and development of wind-generated missile hazards for inclusion in the Callaway high winds PRA. The discussion should include the approach used (1) to identify and assess the number, type and location of potential missiles, and (2) to determine the frequency of damage on individual SSCs from high winds and tornado generated missiles. Justify any deviation(s) from using a plant-specific high wind missile analysis methodology for determining the frequency of damage resulting from missiles generated by high winds and tornadoes on individual SSCs and demonstrate the impact of identified deviation(s) on this application.

APLC Question 07 – High Winds PRA Modeling

RG 1.174, Revision 3, states that the plant-specific PRA supporting the licensee's proposals has been demonstrated to be acceptable.

In Section 3.2.4 of Enclosure 1 to the LAR, the licensee did not provide the detailed description of the Callaway's high winds PRA model. To better understand the Callaway's high winds PRA model, please address the following:

a. Describe the systematic process that was followed to determine the initiating events from the internal events PRA that would be included in the Callaway high winds PRA. Include discussion on consideration of SSC failures that can result in initiators, spatial and environmental dependencies, multiple-unit impacts, and feedback from plant walkdowns as well as the outcome of the process.

b. The Callaway high winds PRA model includes a loss of offsite power, which is typically modeled in the internal events PRA. How does the licensee address the loss of offsite power event without double counting in both PRAs for this 10 CFR 50.69 categorization?

SUBJECT: CALLAWAY PLANT, UNIT NO. 1 – AUDIT QUESTIONS FOR LICENSE AMENDMENT REQUEST TO ADOPT 10 CFR 50.69, “RISK-INFORMED CATEGORIZATION AND TREATMENT OF STRUCTURES, SYSTEMS AND COMPONENTS FOR NUCLEAR POWER REACTORS” (EPID L-2020-LLA-0235) DATED APRIL 27, 2021

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