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Subject:	Limerick 50.69 license amendment request application: Request for Information (RAI)
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In a letter dated June 28, 2017 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML17179A161), Exelon Generation Company, LLC (EGC) requested an amendment to the facility operating license for Limerick Generating Station Units 1 and 2 to adopt 10 CFR 50.69 for Risk-informed Categorization and Treatment of Structures, Systems and Components.

The NRC staff has reviewed the information provided in the license amendment request and determined that additional information is required in order to complete its review. Upon a technical clarification call held on December 6, 2017, please find the attached final RAIs. Please submit your responses by January 19, 2018.

Please contact me if you have any questions.

Attachment (1)

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REQUEST FOR ADDITIONAL INFORMATION

LICENSE AMENDMENT REQUEST TO ADOPT 10 CFR 50.69 RISK-INFORMED CATEGORIZATION OF STRUCTURES, SYSTEMS, AND COMPONENTS

EXELON GENERATION COMPANY, LLC

LIMERICK GENERATING STATION, UNITS 1 AND 2

DOCKET NOS. 50-352 AND 50-353

RAI 01 – Internal Events and Internal Flooding Probabilistic Risk Assessment (PRA) Facts and Observations (F&Os)

a. F&O HR-A1-01 – Review of Procedures and Practices for Test and Maintenance Pre-Initiators

   Open F&O HR-A1-01 appears to indicate that the test and maintenance pre-initiators were not derived from a review of procedures and practices as prescribed by PRA standard supporting requirement (SR) HR-A1. The disposition to the F&O in license amendment request (LAR) Attachment 3.a, "Open and Partially Resolved Peer Review Findings," states that the risk-significant pre-initiators are included in the model without explaining how the test and maintenance pre-initiators were identified. Explain how the test and maintenance pre-initiators were derived (e.g., through a review of procedures) and explain how the conclusion that the risk-significant pre-initiators have been included was reached.

b. F&O IF-B3-01 – Water Volume Not Considered

   Open F&O IF-B3-01 indicates that internal flooding scenarios may have been inappropriately screened out because the full volume of water that could drain from the cited cooling water systems was not considered. The disposition to this F&O in LAR Attachment 3.a, "Open and Partially Resolved Peer Review Findings," states that flood scenarios need to be reviewed in the next update to determine if revisions or additional scenarios are needed. However, any changes are expected to have "no material impact" on the Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.69 application. Given the acknowledgement that scenarios may need to be added, it is not clear why these exclusions can have no material impact on the 10 CFR 50.69 application. Justify why the excluded scenarios cannot have a material impact on the 10 CFR 50.69 application, or alternatively, incorporate the additional water volumes cited in the F&O into the internal flooding PRA.

c. F&O SC-SY-B1-01 – Fire Water Makeup

   Resolved F&O SC-SY-B1-01 stated that "a high probability was used for failure of fire water makeup to the vessel to prevent core damage"… "to include the uncertainty as to whether or not the fire protection system can actually prevent core damage after depressurizing the reactor and within four hours after an initiating event." The reported resolution in Attachment 3.b, "Resolved Peer Review Findings," was that a "detailed HRA [human reliability analysis] calculation was performed for aligning fire water makeup to the reactor vessel." Performing a "detailed HRA calculation" provides confidence that the alignment is

feasible and that failure to align is properly quantified, but not necessary, as to whether the flow and amount of water is sufficient to prevent core damage. Confirm that sufficient flow and amount of water was determined as part of the HRA calculation, or alternatively, provide justification that the fire protection system can successfully prevent core damage as credited in the PRA model.

d. Closed F&Os DA-C14-01 and QU-A4-01, related to credit for repair, stated that credit for repair had been removed for some listed systems but implied that credit was retained for the instrument air system.

   The internal events gap assessment results and resolutions have previously been provided for an inservice inspection relief request dated April 13, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16104A122), as supplemented by request for additional information (RAI) response dated September 19, 2016 (ADAMS Accession No. ML16263A218). In the September 19, 2016, RAI response, the licensee stated that "repair is not credited in the current model."

   Identify any structures, systems, and components (SSCs) for which repair is credited in the current internal events PRA and justify how the applicable SRs (e.g., SY-A24, DA-C1, LE-C3, and CA-C15) are met.

RAI 02 – Fire PRA Facts and Observations

a. F&O 2-8 against SR PRM-B6 New Success Criteria

   Open F&O 2-8 is stated to be a "documentation issue with no impact on the application"; however, this F&O appears to identify potential modeling issues in the PRA model. Both the finding and the disposition to this F&O state that "the characterization of a MSIV [main steam isolation valve] spurious opening as a LLOCA [large loss-of-coolant accident] above TAF [top of active fuel] was not supported by T/H [thermal-hydraulic]." Provide justification that appropriate success criteria have been used in the PRA model for scenarios that consider MSIV spurious opening as an LLOCA.

b. F&O 2-25 against SR FSS-D7 – Crediting Fire Detection and Suppression Systems

   The disposition to open F&O 2-25 only addresses the availability and/or reliability of the fire detection and suppression system(s). Both the standard and the finding state that fire detection and suppression systems may only be credited if they are installed and maintained in accordance with applicable codes and standards. Proper installation and maintenance is normally documented in a code compliance calculation. Verify that all credited fire detection and suppression systems have been reviewed for compliance to applicable codes and documented in a code compliance calculation. If not, evaluate all credited fire detection and suppression systems against the original code of construction, and upon completion, adjust credit in the PRA accordingly (remove credit for those systems not installed in accordance with the original code of construction or provide justification that any deviations from the code do not impact system effectiveness).

c. F&O 4-6 against SR HRA-A3– Undesired Operator Actions

   The disposition to open F&O 4-6 states that undesired operator actions, such as tripping or isolating equipment, were identified that could result from spurious signals, but such actions

were determined to have "no material impact" on the 10 CFR 50.69 application. The disposition explains that in such cases, there would be time for recovery if there is no damage to equipment from fire. Undesired operator actions based on spurious signal create additional risk. Moreover, the success of recovery actions can be hampered by fire or fire damage and the difficulty of diagnosing what is happening in the plant when spurious signals have occurred. In light of these observations:

i. Provide justification that the operators would recover from spurious signals (cues), since operators are trained to believe their instrumentation and procedural controls may dictate that the undesired action should be taken. Include discussion of procedural guidance that limits the possibility of undesired actions and the cognitive and execution challenges associated with recovering from undesired operator actions.

ii. Provide further justification that the risk from undesired operator actions is negligible and can be excluded from the fire PRA.

iii. If it cannot be justified that the risk from undesired operator actions is negligible, then incorporate undesired operator actions caused by spurious signals into the fire PRA.

d. F&O 4-23 against SR PRM-C1 – New Contributors Due to Spurious Operations

Closed F&O 4-23 identifies that "MCRAB [Main Control Room Abandonment] Event tree uses existing FPIE [full power internal events] success criteria and T-H [thermal-hydraulic] analysis," without the proper confirmation or justification of applicability. The reported resolution in Attachment 3.b, "Resolved Peer Review Findings," states, "In general, the use of internal events and/or fire non-abandonment T/H runs for MCRAB actions is appropriate when the scenario details match closely enough." The use of the terms "in general" and "closely enough" seems to imply that there are situations where the use of internal events and/or fire non-abandonment T/H runs are not appropriate. Provide a discussion of how the situations where the internal events and/or fire non-abandonment T/H runs are not appropriate were addressed.

e. F&O 4-30 against SR IGN-A7 – Exclusion of Junction Box Modelling

The disposition to open F&O 4-30 states that the risk contribution from junction boxes has not been included in the fire PRA, but that the fire PRA will be modeled consistent with guidance in FAQ 13-0006 during the next PRA update. It is not clear to the U.S. Nuclear Regulatory Commission (NRC) staff that the risk associated with junction boxes is negligible for the 10 CFR 50.69 application. Provide justification that the risk from junction boxes has negligible impact on the 10 CFR 50.69 application, or alternatively, incorporate the risk associated with junction boxes into the fire PRA model.

f. F&O 4-34 against SR FSS-G1 – Exclusion of Certain Transient Fire Modeling

Open F&O 4-34 cites examples of transient fires that were excluded from consideration without justification. The disposition to this F&O states that better documentation is needed for the basis of this screening but does not provide the basis for the exclusion. Identify the guidance used, or explain why transient fires are excluded in specific scenarios such as those cited in the F&O, or alternatively, incorporate the excluded transient fires into the fire PRA model.

g. F&O N/A against FSS-C6 – Focused-Scope F&Os against THIEF Model

The disposition for the open self-identified F&O associated with PRA standard SR FSS-C6 explains that a focused-scope peer review was performed on the implementation of the thermally-induced electrical failure (THIEF) fire modelling tool, which resulted in two F&Os that "are being resolved in the current (2017) model update." The impact of the resolution of these two F&Os on the 10 CFR 50.69 program is unknown. Provide justification for why the two unresolved F&Os from the focused-scope peer review associated with a PRA upgrade of the fire modeling have minimal impact on the 10 CFR 50.69 application, or alternatively, incorporate resolution to these two focused-scope fire modeling F&Os into the fire PRA model.

RAI 03 – PRA Maintenance versus PRA Upgrade

a. Attachment 3.b, "Resolved Peer Review Findings," of the LAR provides information regarding the disposition of fire PRA F&Os that were closed by the July 2016 F&O closure review. The disposition for the F&Os does not include a discussion about whether each change is PRA maintenance or a PRA upgrade. Inspection of the reported change indicates that some changes may use a new methodology and that the change could impact significant accident sequences or the significant accident progression sequences (i.e., the change was an upgrade that should be peer reviewed).

i. For each of the following changes, summarize the original method in the PRA and the new method to demonstrate that the change is not an upgrade because "a new methodology was not used and that the changes do not impact significant accident sequences or the significant accident progression sequences," or identify whether the change is determined to be an upgrade:

- changes to the fire PRA event trees to use of the fire initiating event decision tree, as indicated in closed F&Os 2-12 and 4-2;
- change to use of the "Fire Modeling Workbook" approach, as indicated in closed F&Os 2-24 and 4-17;
- change to replacement of Fire Modelling Treatment notebook-based reduced heat release rates for transient fires of 60 kilowatts (kW) and 140 kW with guidance endorsed by the June 21, 2012, letter from Joseph Giitter to Biff Bradley entitled, "Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993, 'Evaluation of Peak Heat Release Rates in Electrical Cabinets Fires'" (ADAMS Package Accession No. ML12172A406), as indicated in open F&O 4-35;
- change to use of the guidance in Frequently Asked Question (FAQ) 14-0009, "Treatment of Well Sealed MCC [Motor Control Center] Electrical Panels Greater than 440V [volts]," dated October 20, 2014 (ADAMS Accession No. ML15118A810), as indicated in closed F&O 4-26; and
- change to use of the guidance in FAQ 12-0064, "Hot work/transient fire frequency: influence factors," dated September 5, 2012 (ADAMS Accession No. ML122550050), as indicated in closed F&O 5-7.

ii. Identify any other changes to the fire PRA not listed above that constitute PRA upgrades.

iii. For each upgrade identified in items i. and ii. above, either provide the results of the focused-scope peer review(s) performed on these upgrades and disposition of any findings, or alternatively, commit to an implementation item in response to RAI 04 to perform a focused-scope peer review of the upgrade and to close all resulting F&Os through a new peer review or through the F&O closure process accepted by the NRC in its letter dated May 3, 2017 to Nuclear Energy Institute (NEI) (ADAMS Accession No. ML17079A427), prior to implementing the 10 CFR 50.69 categorization process.

b. A September 19, 2016, RAI response (ADAMS Accession No. ML16263A218), associated with an earlier relief request dated April 13, 2016 (ADAMS Accession No. ML16104A122), reported changes in the internal events PRA after the 2005 full scope peer review. The 2008 model LG108A and LG208A changes converted the HRA from a spreadsheet to the "EPRI [Electric Power Research Institute] HRA Calculator." The September 19, 2016, RAI response stated that the change was PRA maintenance because "the HRA Calculator uses the same HRA methodologies as were used in the spreadsheets."

i. Please briefly confirm that, or alternatively summarize how, the previous spreadsheets applied the following HRA methodologies used in the HRA calculator:

- included pre-initiator, post-initiator, and dependency analysis;
- quantified pre-initiators using the accident sequence evaluation program (ASEP) or technique for human error rate prediction (THERP);
- included a cognitive error and an execution error for each post-initiator HFE;
- analyzed the cognitive error using the EPRI cause-based decision tree method and human cognitive reliability/occupational radiation exposure, THERP, or SPAR-methods.
- selected the appropriate input value (i.e., median or mean) for THERP or ASEP;
- analyzed the execution error using THERP;
- included or excluded recovery actions; and
- included a dependency analysis that could identify combinations of HFEs in cutsets and analyzed combinations of pre-initiators, post-initiators, and both pre- and post-initiators.

ii. Although the estimated human error probabilities (HEPs) are not expected to be identical between the spreadsheet and the EPRI calculator results, confirm that any significant differences were evaluated and are based on known differences between the implementation of the two tools.

iii. Alternatively, if item i. and ii. above cannot be confirmed, either provide the results of a focused-scope peer review of the HRA elements and disposition of any findings, or alternatively, commit to an implementation item in response to RAI 04 to perform a focused-scope peer review of the HRA and to close all resulting F&Os through a new peer review or through the F&O closure process accepted by the NRC in its letter dated May 3, 2017, to NEI prior to implementing the 10 CFR 50.69 categorization process.

RAI 04 – Implementation Items

Table 2 of the LAR supplement dated August 14, 2017, presents dispositions for assumptions and modeling uncertainties that include planned updates to the PRA models after the 10 CFR 50.69 amendment has been issued and before implementation of the 10 CFR 50.69

program. It appears that these future updates can have an impact on the 10 CFR 50.69 categorization. These updates include accounting for load shedding directed by procedure, updating the internal flooding pipe break frequencies, and removing credit for core melt arrest in vessel.

a. Justify why the updates listed above have no impact on the 10 CFR 50.69 categorization results or include them in response to item b. below.

b. Provide a list of activities and PRA changes, including any items from RAI 01, RAI 02, RAI 03, and RAI 04.a, which will not be completed prior to issuing the amendment but must be completed prior to implementing the 10 CFR 50.69 categorization process (i.e., implementation items). Propose a mechanism that ensures these activities and changes will be completed and appropriately reviewed and any issues resolved prior to implementing the categorization process, such as a reference to the table of implementation items in a license condition.

RAI 05 – Overall Categorization Process

LAR Section 3.1.1, "Overall Categorization," process has two different sets of bulleted elements and concludes with an additional list of ten elements. Some of the elements discuss training that will be given, some discuss the different hazard models, and some discuss PRA model results. It is not clear from these discussions what the sequence of evaluations will be in the categorization process, what information will be developed and used, and what guidance on acceptable decisions by the Integrated Decisionmaking Panel (IDP) will be followed during the categorization of each system. Information on the training and expertise of the IDP team is provided in the LAR and need not be repeated in this RAI response.

a. Please summarize, in the order they will be performed, the sequence of elements or steps that will be followed for each system that will be categorized. A flow chart, such as that provided in the NEI presentation (ADAMS Accession No. ML17249A072) for the September 6, 2017, public meeting with NEI regarding 10 CFR 50.69 LARs (ADAMS Accession No. ML17265A020) may be provided instead of a description. The steps should include:

   i. the input from all PRA evaluations such as use of the results from the internal events, internal flooding, and fire PRAs;

   ii. the input from non-PRA approaches (seismic, other external events, and shutdown);

   iii. the input from the responses to the seven qualitative questions in Section 9.2 of NEI 00-04, "10 CFR 50.69 SSC Categorization Guideline";

   iv. the input from the defense-in-depth matrix; and

   v. the input from the passive categorization methodology.

b. In description to item a. above, please clarify the difference between "preliminary HSS [high safety significant]" and "assigned HSS," and identify which inputs can and which cannot be changed from preliminary HSS to low safety significant by the IDP, and confirm that the proposed approach is consistent with the guidance in NEI 00-04, as endorsed by Regulatory

Guide (RG) 1.201, "Guidelines for Categorizing Structures, Systems, and Components in Nuclear Reactor Power Plants According to Their Safety Significance."

c. In description to item a. above, please clarify which steps of the process are performed at the function level and which steps are performed at the component level. Describe how the categorization of the component impacts the categorization of the function and vice-versa. Describe instances in which the final safety significance of the function would differ from the safety significance of the component(s) that support the function, and confirm that the proposed approach is consistent with the guidance in NEI 00-04, as endorsed by RG 1.201.

d. Section 7 of NEI 00-04 states that "If any SSC is safety significant, from either the PRA-based component safety significance assessment (Section 5) or the defense-in-depth assessment (Section 6), then the associated system function is preliminary safety significant." The NRC staff interprets that the cited guidance applies to all aspects identified in Sections 5 and 6 of NEI 00-04, including Sections 5.3 through 5.5, dedicated to seismic, external hazards, or shutdown risk.

   If the licensee's categorization process differs from the guidance in Section 7 of NEI 00-04 cited above where functions supported by any HSS component(s) will be assigned HSS, describe and justify the approach.

e. The industry flow chart presented at the September 6, 2017, public meeting shows that the passive categorization would be undertaken separately from the active categorization.

   i. Explain how the results from the passive categorization will be integrated with the overall categorization results.

   ii. If the results from the passive categorization can be changed by the IDP, explain and justify the proposed approach.

RAI 06 – SSCs Categorization Based on Other External Hazards

NEI 00-04 provides guidance on including external events in the categorization of each SSC to be categorized. Fire (Section 5.2) and seismic (Section 5.3) hazards are discussed in Sections 5.2 and 5.3, respectively. All other hazards are discussed in Section 5.4, "Assessment of Other External Hazards." Figure 5-6 in Section 5.4 illustrates the process that begins with the SSC selected for categorization and then proceeds through the flow chart for each external hazard.

LAR Section 3.2.4 states that the "Limerick [Limerick Generating Station] categorization process will use screening results from the Individual Plant Evaluation of External Events (IPEEE) in response to GL [Generic Letter] 88-20 for evaluation of safety significance related to the [following] other external hazards." LAR Section 3.2.4 continues that "[a]ll SSCs credited in other IPEEE external hazards are considered HSS." The use of "other" instead of a more precise description does not allow the NRC staff to compare the licensee's proposed process with the guidance.

a. Identify the external hazards that will be evaluated according to the flow chart in Figure 5-6 of NEI 00-04.

b. Identify which hazards will have "[a]ll SSCs credited […] considered HSS" instead of using the flow chart.

c. Describe and justify any additional method(s) different from (a) or (b) that will be used to evaluate individual SSCs against external hazards and identify the hazards that will be evaluated with these methods.

d. Confirm that all hazards not included in the categorization process (a), (b), or (c) above will be considered insignificant for every SSC and, therefore, will not be considered during the categorization process.

e. Attachment 4 of the LAR indicates that external flooding and extreme wind or tornado hazards are screened. Justify the basis for screening and explain how the guidance in Figure 5-6 of NEI 00-04 will apply to these hazards and whether these hazards will or will not be considered during the categorization process.

RAI 07 – Shutdown Risk

LAR Section 3.2.5 states the Limerick categorization process will use the shutdown safety management plan described in NUMARC 91-06, "Guidelines for Industry Actions to Assess Shutdown Management," for categorization of safety significance related to low power shutdown conditions. However, the LAR does not cite the other criteria specified in NEI 00-04, Section 5.5, pertaining to low power shutdown events (i.e., includes defense-in-depth attributes and failures that would initiate a shutdown event). Clarify and provide a basis for how the categorization of SSCs will be performed for shutdown events and how it is consistent with the guidance in NEI 00-04, as endorsed by RG 1.201.

RAI 08 – Passive Component Categorization

LAR Section 3.1.2 states that for the categorization of passive components and the passive function of active components, Limerick will use the method for risk-informed repair/replacement activities consistent with the safety evaluation issued by the Office of Nuclear Reactor Regulation, "Request for Alternative ANO2-R&R-004, Revision 1, Request to Use Risk-informed Safety Classification and Treatment for Repair/Replacement Activities in Class 2 and 3 Moderate and High Energy Systems, Third and Fourth 10-Year Inservice Inspection Intervals," for Arkansas Nuclear One, Unit 2, dated April 22, 2009 (ADAMS Accession No. ML090930246).

The safety evaluation for this methodology states that the "methodology is only applied to Class 2 and Class 3 piping". This methodology is a modification to the American Society of Mechanical Engineers Code Case N-660, "Risk-Informed Safety Classification for Use in Risk-Informed Repair/Replacement Activities, Section XI, Division 1," and deleted one question from it (Section I-3.1.3(a)(2)), requiring that all Class 1 items (except for some Class 1 parts defined in 10 CFR 50.55a(c)(2)(i) and (ii)) should be classified as HSS.

Pease confirm that only Class 2 and Class 3 equipment will be categorized using this methodology or explain and justify how the methodology will be modified to include Class 1 equipment.