



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001  
June 29, 2017

Mr. Bryan C. Hanson  
Senior Vice President  
Exelon Generation Company, LLC  
President and Chief Nuclear Officer (CNO)  
Exelon Nuclear  
4300 Winfield Road  
Warrenville, IL 60555

SUBJECT: QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2 – REQUEST FOR ADDITIONAL INFORMATION CONCERNING PERMANENT EXTENSION OF TYPE A AND TYPE C LEAK RATE TEST FREQUENCIES (CAC. NOS. MF9675 AND MF9676) (RS-17-051)

Dear Mr. Hanson:

By letter dated April 27, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17121A449), Exelon Generation Company, LLC (EGC) submitted a license amendment request for Quad Cities Nuclear Power Station, Units 1 and 2. The proposed amendment would modify Technical Specification 5.5.12, "Primary Containment Leakage Rate Testing Program," to allow for the permanent extension of the Type A Integrated Leak Rate Testing (ILRT) and Type C Leak Rate Testing frequencies.

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing your submittal and has determined that additional information is required to complete the review. The specific information requested is addressed in the enclosure to this letter. A draft request for additional (RAI) was transmitted by email to Mr. Mitch Mathews on June 16, 2017. A clarification call was held between members of your staff and NRC staff on June 22, 2017. As a result of the call, the staff revised RAIs 1b, 1e, and 3c to reduce ambiguity and more clearly state the NRC staff's request. Based on a discussion with Mr. Mathews, it was agreed that EGC will provide a response to the RAI within 30 days from the date of this letter.

The NRC staff considers that timely responses to requests for additional information help ensure sufficient time is available for staff review and contribute toward the goal of efficient and effective use of staff resources.

B. Hanson

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If circumstances result in the need to revise the requested response date, please contact me at (301) 415-1627.

Sincerely,

A handwritten signature in black ink, appearing to read "Kimberly J. Green". The signature is fluid and cursive, with a long horizontal stroke at the end.

Kimberly J. Green, Senior Project Manager  
Plant Licensing Branch III  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-254 and 50-265

Enclosure: As stated

cc w/encl: Distribution via Listserv

REQUEST FOR ADDITIONAL INFORMATION

EXELON GENERATION COMPANY, LLC

QUAD CITIES NUCLEAR POWER STATION (QCNPS), UNITS 1 AND 2

DOCKET NOS. 50-254 and 50-265

By letter dated April 27, 2017, Exelon Generation Company, LLC (EGC), submitted a license amendment request (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17121A449). The proposed amendment would modify Technical Specification 5.5.12, "Primary Containment Leakage Rate Testing Program," to allow for the permanent extension of the Type A integrated leak rate testing (ILRT) and Type C leak rate testing frequencies. The additional information below is needed to support the NRC staff's continued technical review of the license amendment request (LAR).

1. EGC conducted a peer review of the internal events probabilistic risk assessment (PRA) in February 2017. EGC stated that the Facts and Observations (F&Os) from the 2017 peer review have not yet been resolved. With regard to the impact of the F&Os, provided in Table A-2 of Attachment 3 to the LAR, on the ILRT application address the following:
  - a) F&O 1-9 identifies seven pre-initiator Human Failure Events potentially lacking documentation or detailed human reliability analysis (HRA). Confirm that detailed HRA was performed for each of the listed pre-initiators, or alternatively, describe each pre-initiator and provide justification of its assumed failure probability estimate provided in the resolution to this F&O.
  - b) F&O 1-18 found that significant accident sequences were not reviewed to support equipment operation or operator actions during accident progression to reduce large early release frequency (LERF). EGC stated that it performed a review of the top 10 sequences, which constitute 90 percent of LERF. EGC dispositioned three of the sequences by stating that they have no impact on the application because they don't impact Class 3b frequency, being assigned to Electric Power Research Institute (EPRI) Class 7 or 8. EGC further stated that the "remaining LERF sequences would also have an insignificant impact on this application as the ILRT methodology is sensitive to changes in [core damage frequency] CDF, not LERF." The NRC staff notes that the internal events CDF to LERF ratio is used in the application to estimate the LERF from external hazards, including seismic and fire, and, therefore, the internal events LERF has more than a minimal impact on the estimated total LERF. Address the impact of this F&O on total LERF.
  - c) F&O 2-10 found that supporting requirement QU-B3 was not met because the truncation limit of  $1E-12$  used in the LERF quantification did not show that the model results converged. Based on a sensitivity study on truncation levels cited by EGC in response to this F&O, the LERF would converge to  $2.19E-7$ /year, instead of the LERF of  $1.97E-7$ /year that was provided in the LAR (an increase of 11 percent). EGC stated that this F&O would contribute only to a small change to total LERF only. The NRC staff notes that the internal events CDF to LERF ratio is used in the application to estimate the LERF from external hazards, including seismic and fire, and, therefore, the internal

events LERF has more than a minimal impact on the estimated total LERF. Provide a quantitative estimate of impact on total LERF from this F&O.

- d) F&O 3-2 identified deficiencies regarding consideration of common cause failures (CCF) or maintenance activities for special initiators, which typically involve support system failures. The peer review stated that potential common cause and alignment are generally addressed in the fault tree supporting the initiating events, however, the effects of maintenance are not. The peer review provided few examples: maintenance events were not included for the service water and the component cooling water (CCW) initiating events, and CCF of heat exchangers and pumps was missing for CCW initiators. EGC stated that special initiator systems would also include circulating water and instrument air systems. For each risk-significant special initiator, confirm that maintenance activities and CCF are addressed, and reflect the as-operated plant, and if not, assess, preferably quantitatively, the impact on CDF and LERF.
  - e) F&O 3-9 found that the PRA data analysis spanned only 4 years of plant-specific experience and it did not justify exclusion of plants events that occurred prior to January 2010. This F&O appears to apply to initiating event frequencies, as well as to equipment failures probabilities and unavailabilities. EGC discussed the impact on the application of this F&O for two of the initiators, general transients and loss of offsite power. However, no discussion of impact on the application from not including plant operational experience for other initiating events or for equipment failure probabilities and unavailabilities was provided in the LAR. Assess and justify the impact of this F&O on the estimated CDF and LERF from any plant-specific operational experience related to other initiating event frequencies that were not discussed in the LAR, and from plant-specific operational experience related to equipment failure probabilities and unavailabilities.
2. Section 4.2 of Attachment 3 of the LAR indicates that there are no “substantive differences” between Unit 1 and Unit 2 that are judged to affect the conclusions of the PRA, and that the Unit 1 PRA results are judged representative for Unit 2. Provide a brief description of the differences between the units, particularly, those differences that might impact internal events and internal flooding risk, and provide justification for concluding that Unit 1 PRA results are representative of Unit 2.
  3. EPRI Technical Report (TR) 1009325, Revision 2-A (ADAMS Accession No. ML14024A045), states that “[w]here possible, the analysis should include a quantitative assessment of the contribution of external events (for example, fire and seismic) in the risk impact assessment for extended ILRT intervals. For example, where a licensee possesses a quantitative fire analysis and that analysis is of sufficient quality and detail to assess the impact, the methods used to obtain the impact from internal events should be applied for the external event.” EPRI TR-1009325, Revision 2-A, further states that the “assessment can be taken from existing, previously submitted and approved analyses or another alternate method of assessing an order of magnitude estimate for contribution of the external event to the impact of the changed interval.”

In Section 5.7 of Attachment 3 to the LAR, EGC performed an assessment of external event contribution. To assess the fire risk, EGC stated that “a quantifiable fire PRA model meeting an appropriate level of ASME/ANS [American Nuclear Society] Standard is under development for QCNPS.” It further stated that “[t]he QCNPS Fire PRA updated in 1999 as part of the revised QCNPS Individual plant Examination of External Events (IPEEE)

Submittal is judged to be adequate to support the ILRT External Events quantitative risk assessment.”

- a) If an estimate of fire CDF and LERF is available for the current fire PRA under development, provide those values with a summary description of the status of the fire PRA under development.
  - b) In Section 5.7.1 of Attachment 3, EGC uses the Unit 1 fire CDF results to estimate the risk from the external hazards for the ILRT extension application for both Unit 1 and Unit 2, but no justification was provided. As cited in the original IPEEE (Section 4.2 of “Technical Evaluation Report on the Review of the Individual Plant Examination of External Events at Quad Cities Nuclear Power Station, Units 1 and 2,” dated January 2001, ADAMS Accession No. ML011410547), the Unit 2 fire CDF was 7.13E-5/year, which is higher than the Unit 1 fire CDF of 6.6E-5/year. Justify the applicability of the Unit 1 fire CDF to estimate Unit 2 risk or provide an updated estimate for Unit 2.
  - c) In the LAR, EGC provided an estimate of 6.6E-5/year for the fire CDF from the IPEEE. To estimate the change in LERF due to the ILRT, the calculation of the Class 3b frequency used a reduced frequency of 1.56E-5/year by eliminating 95 percent of the fire-induced loss of decay heat removal (DHR) scenarios, based on an assumption that these scenarios would have the general emergency declared “early,” such that the release would be considered non-LERF. The NRC staff notes that some of these non-LERF scenarios could become LERF if the containment had an undetected leak, and that EGC’s assumption seems to be inconsistent with the guidance in EPRI TR 1009325 Revision 2-A, which allows removing only “sequences that either may already (independently) cause a LERF or could never cause a LERF.” Additionally, this discussion on fire-induced loss of DHR scenarios appears to be based on internal events LERF scenarios, and may not be directly applicable in the context of fire scenarios. Justify the reduction in fire CDF in the calculation of the Class 3b frequency and explain how it is consistent with the guidance in EPRI TR 1009325 Revision 2-A, or remove this credit and provide an updated estimate of risk from external hazards.
4. Section 5.7 of Attachment 3 of the LAR states that high winds, tornadoes, external floods, transportation accidents, nearby facility accidents and other external hazards were not considered because of their negligible contribution to overall plant risk. This conclusion was reached based on the QCNPS IPEEE analysis performed in 1999, based on the fact that the plant met the applicable Standard Review Plan requirement.
- a) Given that the external hazard information has not been updated since the IPEEE studies, discuss the applicability of the IPEEE conclusions to the current plant and its environs, considering each of the external hazards screened from this application and taking into account any updated risk studies and insights.
  - b) In light of recent external flooding re-evaluation performed in response to Near-Term Task Force recommendations, provide technical justification for why the risk from external flooding is negligible, or provide, with justification, a conservative or bounding estimate of the impact of external flooding risk for the current application.
5. Section 4.2.6 of EPRI TR-1009325, Revision 2-A states that, “[p]lants that rely on containment overpressure for net positive suction head (NPSH) for emergency core cooling

system (ECCS) injection for certain accident sequences may experience an increase in CDF,” therefore, requiring a risk assessment.

- a) Section 5.2.4 of EPRI TR-1009325, Revision 2-A includes guidance on performing this risk assessment and provides the following examples of accident scenarios to be considered:
- LOCA [loss-of-coolant accident] scenarios where the initial containment pressurization helps to satisfy the NPSH requirements for early injection in BWRs or PWR [pressurized-water reactor] sump recirculation
  - Total loss of containment heat removal scenarios where gradual containment pressurization helps to satisfy the NPSH requirements for long term use of an injection system from a source inside of containment.

The NRC staff notes that the EPRI guidance cited above refers to all LOCA scenarios, not limited to LOCA initiators only. LOCA initiators are a relatively small contributor to the internal events CDF. However, other internal events initiators (e.g., transients) or conditions (e.g., station blackout) could result in a consequential LOCA.

Explain and justify how all the initiating events or conditions which correspond to the two EPRI guidance general event categories were considered in the  $\Delta$ CDF estimate of  $7.2E-8$ /year provided in the LAR for the loss of containment overpressure.

- b) Describe and justify the PRA modeling and methodology used in the LAR to estimate  $\Delta$ CDF due to loss of containment overpressure. The LAR states that the containment isolation failure was increased by the frequency of Class 3b in order to derive  $\Delta$ CDF. Containment isolation failure is typically linked to LERF, so it is not immediately clear to the NRC staff how increasing containment isolation failure probability would produce a change in CDF.
- c) If a new estimate of  $\Delta$ CDF results from items a) and b) above, estimate the contribution to  $\Delta$ LERF resulting from loss of containment overpressure impact on the ECCS pump performance, including the contribution from loss of containment overpressure to the risk from external hazards. Describe and justify the method used for estimating  $\Delta$ LERF.
6. Subsequent to resolving the requests above, confirm that the total change in LERF and total LERF are still within the “small” risk increase regions of Regulatory Guide 1.174. If necessary, re-perform the calculations in the LAR using any updated CDF or LERF values provided in response to the requests above.

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**ADAMS Accession No. ML17180A153**

**NRR-106**

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