DRAFT REQUEST FOR ADDITIONAL INFORMATION

REGARDING LICENSE AMENDMENT REQUEST

TO REVISE TECHNICAL SPECIFICATION 4.3.1.1.A

CONCERNING K-INFINITY

PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3

DOCKET NOS. 50-277 AND 50-278

By letter to the Nuclear Regulatory Commission (NRC) dated June 25, 2008[1], as supplemented by letters dated November 6, 2008[2], March 9, 2009[3], June 12, 2009[4], and December 18, 2009[5], Exelon Generation Company, LLC, (Exelon) submitted a license amendment request (LAR) for Peach Bottom Atomic Power Station, (PBAPS) Units 2 and 3. The LAR seeks to revise Technical Specification (TS) 4.3.1.1.a concerning the spent fuel pool (SFP) k_{∞} value. The Nuclear Regulatory Commission (NRC) staff has reviewed the LAR and determined that in order for the NRC staff to complete its evaluation, response to the following request for additional information (RAI) questions is required.

Steam Generator Tube Integrity and Chemical Engineering Branch RAI Questions:

In the December 18, 2009, supplement, the licensee is proposing to lower the k-infinity value from 1.362 to 1.270. As part of the analysis to support this change, the licensee performed an analysis to predict the degradation of Boraflex in the spent fuel pool. In order for the NRC staff to have reasonable assurance that this analysis will conservatively predict the degradation of Boraflex, the NRC staff requires additional information.

RAI 26 - Discussion
NET-264-02, Revision 4[5], describes an algorithm to predict Boraflex degradation. The NRC staff has the following questions regarding the algorithm:

RAI 26.1: Please discuss if the NET-264-03, Revision 1, Appendix A[6], algorithm or a similar algorithm, was used in the current, NET-264-02, Revision 4, analysis.

RAI 26.2: Discuss whether NET-264-03, Revision 1, Appendix A, is still applicable to the Licensing Amendment Request.

RAI 26.3: Describe the methodology, conservatisms, and assumptions of the current, NET-264-02, Revision 4, algorithm to predict Boraflex degradation.

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1 Agencywide Documents Access and Management System (ADAMS) Accession No. ML081820302.
2 ADAMS Accession No. ML083190840.
3 ADAMS Accession No. ML090690804.
4 ADAMS Accession No. ML091740446.
5 ADAMS Accession No. ML093521435.
6 ADAMS Accession No. ML091740445.

Enclosure

RAI 26.4: Describe the limitations, such as upper limits on % Boraflex loss, of the current, NET-264-02, Revision 4, algorithm.

RAI 26.5: Describe the differences, such as geometric considerations, of the current, NET-264-02, Revision 4, algorithm to the one described in NET-264-03 Revision 1 Appendix A.

RAI 26.6: Discuss how the current, NET-264-02, Revision 4, algorithm was validated.

RAI 27 - Discussion

NET-264-02, Revision 4, mentions that the Peach Bottom Unit 2 RACKLIFE model was verified by BADGER campaigns; however, the verification of the RACKLIFE model for Unit 3 is not mentioned.

RAI 27.1: Please provide all of the BADGER results and RACKLIFE predictions for Unit 2 and Unit 3 racks.

RAI 27.2: Discuss the validation and verification of the RACKLIFE predictions by the BADGER results for the Unit 2 and Unit 3 racks.

RAI 28: The NET-264-02, Revision 4, analyses is based on Unit 2 with the assertion that Unit 2 bounds Unit 3. The NRC staff is unaware of the bases that justify that Unit 2 bounds Unit 3. Please discuss the similarities and differences of the Unit 2 and 3 spent fuel pools, spent fuel pool racks, and Boraflex material.

RAI 29: NET-264-02, Revision 4, correlates the peak panel loss to an average panel boron carbide loss. The NRC staff is uncertain how this correlation was obtained. Please discuss the correlation methodology.

RAI 30: NET-264-02, Revision 4, states, “The original (RACKLIFE) model was updated by Exelon every 6 months to reflect actual fuel discharges into the spent fuel racks through 2008.” Discuss whether the RACKLIFE model was updated in 2009 and if there are future plans to update the RACKLIFE model at a 6 month frequency. In addition, please describe plans for future BADGER testing for Units 2 and 3 to verify the RACKLIFE predictions.

Reactor Systems Branch Questions:

RAI questions 31 through 35 pertain to the area of the applicability of the validation as discussed in NET-901-02-05, Revision 4.

RAI 31: Is Table 4-1 intended to state the ranges of parameters that the safety analysis fits within? If so, what is the basis for applying the bias and bias uncertainty up to 5 w/o U-235 when the CASMO validation only goes up to 4.31 w/o U-235? Similarly, H/U and EALF ranges in Table 4-1 are not substantiated by the CASMO validation ranges. Provide the basis for the extrapolation.

RAI 32: Similar to RAI 31 above, H/U and EALF ranges in Table 4-1 are not substantiated by the SCALE validation ranges. Provide the basis for the extrapolation.

RAI 33: In Table 4-1, there seems to be an omission for the absorber plate poison loading. Please provide the missing data.

RAI 34: Why were experiments with soluble boron used when the analyzed system does not contain any soluble boron? What is the effect of soluble boron on the code bias and bias uncertainty? Justify your approach.

RAI 35: Discuss validation gaps (e.g., fission product validation) and, if appropriate, additional margin adopted to cover validation gaps.

RAI questions 36 through 37 pertain to the normality test performed for the CASMO validation as discussed in NET-901-02-05, Revision 4.

RAI 36: Section 5.2 states that the normality tests were performed for the Δk values. This approach seems to deviate from NUREG-6698 which uses the calculated k_{eff} values. Please justify your approach.

RAI 37: Section 5.2 states that Δk values were tested for normality and the data passed all tests. The staff could not confirm the normality of the Δk values based on the Shapiro-Wilk test described in NUREG-6698. In addition, the normality of the calculated k_{eff} values could not be confirmed. Re-evaluate the CASMO bias and bias uncertainty using the appropriate methods to handle non-normal data or justify not doing so.

RAI questions 38 through 39 pertain to the method used to determine the bias and bias uncertainty as discussed in NET-901-02-05, Revision 4.

RAI 38: The 3-dimensional SCALE bias was determined by comparing SCALE to critical experiments. The 2-dimensional SCALE models simulate a fictitious set of experiments used to validate CASMO. Justify using the SCALE bias determined in the 3D model to correct 2D SCALE models.

RAI 39: The CASMO validation was performed in two steps. SCALE was validated against 103 critical experiments resulting in a SCALE bias and bias uncertainty. Then 24 of the 103 critical experiments were represented using the 2-dimensional SCALE models which were used to determine the CASMO bias and bias uncertainty. The 2-dimensional SCALE representation of the experiments corrects for the SCALE bias, but it does not seem to account for the SCALE bias uncertainty. Please explain how the SCALE bias uncertainty is accounted for in the maximum k_{eff} determination. Presently, it is not clear how the analysis links to the critical experiments.

RAI questions 40 through 43 pertain to the trend analysis of the validation as discussed in NET-901-02-05, Revision 4.

RAI 40: Please discuss what is to be concluded from the low “p” values of <1E-4 in Tables 5-2 and 5-5. Does this indicate that the association between the response and predictor is statistically significant?

RAI 41: Please explain what is meant by “maybe” in Table 5-5. Does this indicate that a statistically significant trend exists? If so, justify its impact on the bias.

RAI 42: The NRC staff could not confirm the r^2 value for enrichment in Table 5-5. Please confirm that the correct value was determined in the submittal.

RAI 43: The trending analysis data provided in the submittal is not sufficient for the staff to independently verify that no statistically significant trends exist for CASMO. This is especially the case for enrichment and EALF. Please provide additional information to substantiate your claim that no trends exist for CASMO.

RAI questions 44 through 59 pertain to NET-264-02, Revision 4.

RAI 44: Provide 2-dimensional plots of the CASMO-4 and KENO V.a models used in the analysis.

RAI 45: Describe how the asymmetries of the Peach Bottom spent fuel pool (SFP) racks are modeled in CASMO-4.

<u>RAI 46 - Discussion</u>
The following questions pertain to how the gamma dose to an individual Boraflex panel was determined:

RAI 46.1: Explain the use of the end of cycle relative power in calculating the gamma dose.

RAI 46.2: Explain why the use of a weighted average end of cycle relative power is appropriate versus a bounding end of cycle relative power.

RAI 46.3: What is the basis for the gamma source term?

RAI 46.4: The analysis assumes a 0.8 weighted average end of cycle relative power; describe the effect a higher weighted average end of cycle relative power would have on the analysis.

RAI 47: How are the KENO bias and bias uncertainty applied in the methodology for assessing the reactivity effects of Boraflex degradation? Justify the approach used and explain how it ensures the Boraflex degradation prediction meets a at a 95 percent probability, 95 percent confidence level.

RAI 48: Provide the data that is plotted in Figure 4-2.

RAI 49: What trend analyses were performed on the data plotted in Figure 4-2 to reach the conclusion that no non-normal behavior was observed?

RAI 50: Provide plots of the Boraflex degradation being modeled in the data in Figure 4-2 so that it is clear how the Boraflex degradation changes from one case to the next.

RAI 51: What are the Boraflex loading reference points for Table 4-3?

RAI 52: Provide the depletion parameters used in determining the limiting peak reactivity of the lattices evaluated. Justify those depletion parameters and Identify how deviations from those parameters would affect the peak reactivity.

RAI 53 - Discussion
With respect to the determination of the reactivity equivalent fresh fuel enrichment (REFFE) fuel assembly, the cross-section bias and CASMO/KENO geometric bias, please provide the following information:

RAI 53.1: How were the CASMO-4 and KENO biases and bias uncertainties applied?

RAI 53.2: How was xenon treated?

RAI 53.3: How were the lumped fission products in CASMO-4 treated? Please provide the following information concerning those lumped fission products:
- i) What actual fission products are represented in each lumped fission product?
- ii) What are the cross sections for each lumped fission product? What are the decay constants for each lumped fission product?
- iii) Are there any neutron absorbers represented in the lumped fission products? What are the cross sections for those neutron absorbers? What are the decay constants for those neutron absorbers?
- iv) Are there any neutron sources represented in the lumped fission products? What are the source terms? What are the decay constants for those neutron sources?
- v) What is the basis for the cross section for each lumped fission product?
- vi) How do the cross sections of the lumped fission products respond to changes in temperature and spectral hardening?

RAI 53.4: Explain how normalizing KENO to CASMO-4 in determining the REFFE affects the determination of the cross-section bias and CASMO/KENO geometric bias.

RAI 54 - Discussion
The following questions pertain to Table 5-2. This table compares CASMO-4 and KENO V.a in a standard cold core geometry (SCCG) configuration, which both codes are capable of modeling.

RAI 54.1: Explain the differences in the information contained in the third and fourth columns and the differences in the information contained in the fifth and sixth columns of the table.

RAI 54.2: The number of examples provided is insufficient to draw conclusions; provide additional examples and include depleted fuel.

RAI 55 - Discussion
The following questions pertain to Table 5-3, which compares CASMO-4 and KENO V.a in cold SFP rack geometry.

RAI 55.1: Since CASMO-4 cannot model the asymmetries associated with the Peach Bottom SFP rack design, explain what is being done in CASMO-4 to model the SFP rack geometry.

RAI 55.2: Explain the differences in the information contained in the third and fourth columns and the differences in the information contained in the fifth and sixth columns of the table.

RAI 55.3: The number of examples provided is insufficient to draw conclusions, provide additional examples and include depleted fuel.

RAI 56: Explain why the information provided in Table 5-3 doesn't match the information provided in Figure 5-1.

RAI 57: Justify not using the KENO V.a uncertainty in the calculation of K_{eff} as stated on page 39.

RAI 58: Please provide the applicable sections of Reference 25, Doub, W.B., "Particle Self-Shielding in Plates Loaded with Spherical Poison Particles," Part B of Section 4.2, Naval Reactors Physics Handbook, Volume 1: Selected Basic Techniques, Naval Reactors, Division of Reactor Development, United States Atomic Energy Commission: Washington, D.C.; 1964. Justify why this reference is applicable to the Peach Bottom SFP.

RAI 59: Please explain the large change in the fuel assembly miss placement accident from the previously supplied information.

RAI questions 60 through 62 pertain to GNF-0000-0110-5796, Revision 0.

RAI 60: GNF-0000-0110-5796, Revision 0, states, "For fuel pool storage evaluations, the 95/95 bias uncertainty is used as a bias applied to the TGBLA in-core peak cold reactivity." This is the effect of an uncertainty when it is the only uncertainty considered. Please provide the justification for not considering the other uncertainties.

RAI 61: GNF-0000-0110-5796 indicates that the TGBLA06 bias and the 95/95 bias uncertainty are extracted from NEDE-240II-P-A-16, "General Electric Standard Application for Reactor Fuel (GESTAR II)", October 2007 (ADAMS Accession No. ML091340075). However, the NRC staff could not locate the TGBLA06 bias and the 95/95 bias uncertainty in NEDE-240II-P-A-16. Please provide clarification regarding the location of the TGBLA06 bias and the 95/95 bias uncertainty in a document currently on the NRC docket, or provide the information for the NRC staff's review.