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

September 29, 2015

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: DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3 - REQUEST FOR ADDITIONAL INFORMATION RELATED TO THE LICENSE AMENDMENT REQUEST REGARDING SPENT FUEL STORAGE POOL CRITICALITY METHODOLOGY AND PROPOSED CHANGE TO TECHNICAL SPECIFICATION 4.3.1, "CRITICALITY" (TAC NOS. MF5734 AND MF5735)

Dear Mr. Hanson:

By application to the U. S. Nuclear Regulatory Commission (NRC) dated December 30, 2014, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14364A100), supplemented by letter dated May 8, 2015 (ADAMS Accession No. ML15128A305), Exelon Generation Company, LLC (the licensee) submitted a license amendment request for Dresden Nuclear Power Station (DNPS), Units 2 and 3, to change the criticality safety analysis methodology for the spent fuel pools. Additionally, the licensee's submittal proposes a change to the DNPS Technical Specification (TS) 4.3.1, "Criticality," in support of the new criticality safety analysis.

The NRC staff is reviewing the submittals and has determined that additional information is required to complete the review. The specific information requested is addressed in the enclosure to this letter. During a discussion with Mr. Tim Byam of your staff on September 1, 2015, it was agreed that you would provide responses to the enclosure by close of business on October 15, 2015.

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

If circumstances result in the need to revise the requested response date, please contact Russell Haskell at (301) 415-1129, or by email at Russell.Haskell@nrc.gov.

Sincerely,

Blake A. Purnell, Project Manager
Plant Licensing III-2 and
Planning and Analysis Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-237 and 50-249

Enclosure:
Request for Additional Information

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REQUEST FOR ADDITIONAL INFORMATION

RELATED TO THE LICENSE AMENDMENT REQUEST REGARDING

SPENT FUEL POOL CRITICALITY METHODOLOGY

AND PROPOSED CHANGE TO TECHNICAL SPECIFICATION 4.3.1

EXELON GENERATION COMPANY, LLC

DRESDEN NUCLEAR POWER STATION (DNPS), UNITS 2 AND 3

DOCKET NOS. 50-237 AND 50-249

Section 50.68 to Title 10 of the *Code of Federal Regulations* (10 CFR) states that the K-effective (K_{eff}) of the spent fuel pool (SFP) storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with unborated water. Holtec International Report No. HI-2146153, Revision 1, "Licensing Report for the Criticality Analysis of the Dresden Unit 2 and 3 SFP for ATRIUM 10XM Fuel Design", Attachment 6 of the licensee's submittal dated December 30, 2014 (Agencywide Document Access and Management System (ADAMS) Accession No. ML14364A100), documents a criticality analysis performed to demonstrate that this regulatory limit is met. The U.S. Nuclear Regulatory Commission (NRC) staff has identified some instances where it is not clear if the reactivity impact due to specific conditions was adequately addressed in the criticality analysis. The potential reactivity impacts may be positive, therefore, the staff requires additional information to verify the regulatory limit will not be challenged by these potential impacts.

1. Attachment 1 to the submittal dated December 30, 2015, "Evaluation of Proposed Changes" (ADAMS Accession No. ML14364A100), states that blisters have been identified as part of the licensee's BORAL monitoring program. Blisters displace water in the spent fuel pool (SFP), reducing moderation of neutrons, resulting in a harder neutron spectrum. Since the absorption cross section of Boron-10 decreases for neutrons with higher energies, the neutron attenuation effectiveness of the BORAL may be reduced. Therefore, the reactivity may be higher in the SFP when blisters exist on the BORAL.

   Provide information demonstrating that any blisters on BORAL installed in the SFP, being credited for sub-criticality, will not result in the regulatory limit being challenged.

2. The neutron-absorbing core of a BORAL panel is composed of a mixture of aluminum and boron carbide. The two constituents initially exist in powdered form and are mixed together prior to heating and rolling. The resulting product does not appear to be homogeneous, since the boron carbide particles remain discrete. Section 3.b.ii of DSS-ISG-2010-01, "Interim Staff Guidance, "Staff Guidance Regarding the Nuclear Criticality Safety Analysis for Spent Fuel Pools Introduction" (ADAMS Accession No. ML110620086), indicates that the effect of neutron streaming or Boron-10 self-shielding

Enclosure

effects should be considered when establishing the efficiency of the neutron-absorbing material credited in criticality analyses. The BORAL material appears to be modeled in the HI-2146153 analysis as a homogeneous material.

Provide the technical justification for concluding that the neutron absorption of the BORAL material will be bounded by the neutron absorption as modeled in the criticality analysis.

3. In the HI-2146153 analysis, the BORAL appears to be modeled as a homogeneous mixture that blends the BORAL core and the cladding into a single material. The thickness is then set equal to the minimum BORAL panel thickness (including cladding) with the remaining space between the rack wall and the sheathing filled with water. An increase in the BORAL thickness would displace the water in the gap between the BORAL and the rack/sheathing walls, which may or may not be less reactive. The results of the rack manufacturing tolerance calculations suggest that a reduction in moderator between the fuel and the BORAL will increase reactivity.

   Discuss the modeling of the BORAL core and cladding, and provide information demonstrating that this approach is appropriately conservative with respect to the calculated $K_{eff.}$

4. Based on the Updated Final Safety Analysis Report (UFSAR) for DNPS, the BORAL panels are enclosed by two square tubes, with the thickest tube on the outside. In the figures provided in HI-2146153, the rack cells appear to be modeled as a thick tube with BORAL panels attached to the outside surface using a thin sheathing. The material modeled at the corners of the cells, where the individual cells should be welded together, appears to be water. The geometry differences of the model as compared to the physical configuration in the SFP appear to result in an unevaluated reactivity deviation.

   Discuss how the model used in the criticality analysis differs from the physical configuration of the BORAL installed in the SFP, and why any differences bound the physical configuration.

5. In the HI-2146153 analysis the manufacturing tolerance associated with the SFP storage cell inside diameter is an assumed value. This value is used to evaluate the reactivity impact of the SFP storage cell inside diameter manufacturing tolerance. It appears the absolute value for the cell inside diameter manufacturing tolerance is the same as the manufacturing tolerance for the SFP cell pitch. However, the SFP cell pitch would be related to the dimensions of the outside tube, not the inside tube, so it is not clear what the basis for the assumed value is.

   Provide information demonstrating that the assumed value for the SFP storage cell inside diameter manufacturing tolerance is appropriate and acceptable.

6. The minimum Boron-10 areal density is one of the most important parameters affecting the neutron absorption effectiveness of the BORAL material.
   Provide the basis for the minimum Boron-10 areal density used in the HI-2146153

analysis and how it bounds the BORAL material installed in the SFP. In particular, discuss the following:

a) Whether this value is based on a pre-defined acceptance criterion or measured values;
b) Whether this value is validated based on the lower end of the 95/95 range for the measurements associated with each BORAL panel; and
c) Whether there are BORAL panels with a minimum as-built Boron-10 creates areal density near the minimum value used in the criticality analysis.

7. In Section 2.3.1.2 of the HI-2146153 analysis, the first step in the screening calculations documented is to remove all legacy fuel lattices with a "low" U [uranium]-235 enrichment from consideration. This screen-out criterion is based on the fact that they will be bounded by more recent fuel designs with much higher lattice average enrichments. The methodology being used to evaluate the reactivity of the stored fuel is a peak reactivity methodology, which means that the limiting reactivity for a lattice is a function of both U[uranium]-235 enrichment and Gd [gadolinium] content. The screen-out criterion does not appear to consider the Gd loading of the legacy fuel lattices. As a result, the NRC staff was unable to determine if there may be lower enrichment fuel with low Gd loadings that may have a reactivity that is comparable to the higher enrichment fuel with higher Gd loadings.

   Provide additional justification to support the conclusion that the unanalyzed legacy fuel will be bounded by this analysis.

8. In the HI-2146153 analysis, the calculations to identify the design basis lattice are performed at four different sets of core operating parameters. However, the individual parameters that make up each set do not appear to have been independently confirmed to be at their limiting values.

   Provide information demonstrating that the final set of core operating parameters used in the design basis calculations will bound all possible operating scenarios.

9. In the HI-2146153 analysis, the accident conditions analyzed do not appear to consider all potential SFP configurations. In particular, if a BORAL panel is lost for some reason, it may occur in one of the cells adjacent to the interface between rack modules, resulting in more than two face adjacent fuel assemblies with no BORAL between them. This represents a new configuration with a reactivity impact that may not adequately be evaluated by use of the interface bias.

   Provide information demonstrating that these SFP configurations would not result in a challenge to the regulatory limit.

10. In Table 7.2 of the HI-2146153 analysis, the biases and uncertainties applied to the calculations are from the normal condition calculations. The normal condition has a lower reactivity than the limiting accident condition, so the potential reactivity impact of changes in the SFP configuration may be larger for the latter condition.

Given the limited remaining margin to the regulatory limit, provide justification for considering the reactivity impact of the various biases and uncertainties to be essentially the same for the normal and the limiting abnormal/accident configurations.

11. Sections 2.3.11.1.1 and 2.3.11.1.2 of the HI-2146153 analysis explain that fuel rod growth, cladding creep, and crud buildup do not need to be evaluated because these factors are not expected to be significant at the peak reactivity burnup of the design basis lattice. Changes to the fuel rod geometry as a result of irradiation may result in a positive reactivity impact.

    Provide information regarding the expected fuel rod growth, cladding creep, and crud buildup at this burnup, and explain why the reactivity impact would not be significant.

12. Section 2.3.11.1.3 of the HI-2146153 analysis does not describe clearly how the Monte Carlo N-Particle (MCNP) Transport Code, Version 5, geometry is changed to evaluate bowing of fuel rods. The text states that "the reactivity impact of this geometry change to the fuel in the SFP is evaluated using the depletion related fuel rod pitch positive tolerance provided in Table 5.1(h)." This appears to refer to the "Fuel rod pitch exposed" entry.

    Provide clarification to indicate if the staff's inference is correct with respect to the data being referenced in Table 5.1(h), and describe how the MCNP model was altered for Case 2.3.11.1.3.2. Also, discuss how this tolerance was determined and how it bounds any expected ATRIUM 10XM fuel rod bowing.

13. Section 2.3.11.2 of the HL-2146153 analysis does not describe clearly how the geometry is changed to evaluate fuel channel bulging and bowing. The text refers to the "channel outer exposed width tolerance," but it is not clear if the outer exposed width is changed by varying the channel inner width or the channel wall thickness.

    Describe how the MCNP model was altered for Case 2.3.11.1.3.2. Also, discuss how the channel bowing tolerance was determined and how it bounds any expected ATRIUM 10XM channel bulging/bowing.

14. Section 2.3.16 of the HI-2146153 analysis dispositions all reconstituted fuel assemblies currently stored in the SFP based on the fact that none of them would exceed the criteria for initial screening of fuel discussed in the first paragraph of Section 2.3.1.2. It also states that all future reconstituted fuel will need to be evaluated to determine if they are bounded by this analysis.

    Provide details on how reconstituted fuel would be evaluated, including any relevant assumptions, uncertainties, and/or biases.

15. Section 2.3.15.4 of the HI-2146153 analysis explains that the "Missing BORAL Panel" analysis is intended to cover the potential that a BORAL panel was inadvertently not installed during construction of the rack. A missing BORAL panel would increase the local reactivity in the SFP for the area surrounding the missing BORAL. If this is expected to have occurred, then it would be part of the normal condition for the SFP.

    Provide information demonstrating how inadvertent non-installment of a BORAL panel was precluded from occurring.

16. Table 2.1(a) of the HI-2146153 analysis indicates that the analysis includes Uranium Oxide (UO_2) and Mixed Oxide (MOX) fuel. The report does not discuss MOX fuel at DNPS at any other point. The higher plutonium content in MOX fuel may result in unique reactivity impacts that are not considered for UO_2 fuel.

    Clarify if this analysis is intended to cover MOX fuel, and if so, provide further information about the MOX fuel.

17. Provide the number of coupons currently available in each DNPS SFP and discuss whether the ambient conditions of the coupon tree (i.e., radiation exposure, flow, temperature) are bounding or representative of the neutron-absorbing material in SFP racks. Also, discuss whether coupons are returned to the SFP after inspection. If so, provide the technical justification for this approach.

18. The DNPS Technical Specification (TS) 4.3.1.1(a) requires a K_{eff} of < 0.95. The NRC staff notes the calculated K_{eff} found in the SFP criticality safety analysis (CSA) is determined, in part, from the minimum Boron-10 areal density of BORAL provided in the CSA. The calculated K_{eff} is used to demonstrate compliance with the K_{eff} TS requirement. In Section 9.1.2.3.1 of the UFSAR, and in information provided in the supplement dated May 8, 2015, it is stated that the corrosion sampling program (coupon surveillance program) is used as an essential long-term monitoring program to ensure the Boron-10 areal density of the BORAL remains at or above its minimum credited value during both normal operating conditions and design basis events.

    Discuss what controls the licensee will implement to ensure that the actual Boron-10 areal density of the BORAL remains at or above its minimum credited value and that the regulatory requirement to maintain the TS value of K_{eff} < 0.95 continues to be met.

If circumstances result in the need to revise the requested response date, please contact Russell Haskell at (301) 415-1129, or by email at Russell.Haskell@nrc.gov.

Sincerely,

/RA EBrown For/

Blake A. Purnell, Project Manager
Plant Licensing III-2 and
Planning and Analysis Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-237 and 50-249

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