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

April 26, 2010

Mr. Charles G. Pardee
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: LASALLE COUNTY STATION, UNITS 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION RELATED TO LICENSE AMENDMENT REQUEST REGARDING THE USE OF NEUTRON ABSORBING INSERTS IN UNIT 2 SPENT FUEL POOL STORAGE RACKS (TAC NOS. ME2376 AND ME2377)

Dear Mr. Pardee:

By letter to the Nuclear Regulatory Commission (NRC) dated October 5, 2009 (Agencywide Documents Access and Management Systems Package No. ML092810278), Exelon Generation Company, LLC submitted a request to revise Technical Specification (TS) Section 4.3.1, "Criticality," to address a non-conservative TS, for the LaSalle County Station, Units 1 and 2. The proposed change addresses the Boraflex degradation issue in the Unit 2 spent fuel storage racks by revising TS Section 4.3.1 to allow the use of NETCO-SNAP-IN® rack inserts in Unit 2 spent fuel storage rack cells as a replacement for the neutron absorbing properties of the existing Boraflex panels.

The 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. During a discussion with your staff on April 23, 2010, it was agreed that you would provide a response 45 days from the date of this letter.

Please note that if you do not respond to this letter within the prescribed response time or provide an acceptable alternate date in writing, we may reject your application for amendment under the provisions of 10 CFR Section 2.108.

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 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 me at (301) 415-3719.

Sincerely,

Cameron S. Goodwin, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-373 and 50-374

Enclosure:
Request for Additional Information

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REQUEST FOR ADDITIONAL INFORMATION

LASALLE COUNTY STATION, UNITS 1 AND 2

DOCKET NOS. 50-373 AND 50-374

In reviewing the Exelon Generation Company's (Exelon's) submittal dated October 5, 2009 (Agencywide Documents Access and Management Systems (ADAMS) Package No. ML092810278), related to the request to revise Technical Specification (TS) Section 4.3.1, "Criticality," to address a non-conservative TS, for the LaSalle County Station (LSCS), Units 1 and 2, the Nuclear Regulatory Commission (NRC) staff has determined that the following information is needed in order to complete its review:

1. Text from Attachment 1, "Evaluation of Proposed Change," Section 3.2, "Criticality," Page 10, 2nd paragraph after the bulleted list:

   As the rack inserts are installed, there will be interface conditions between spent fuel storage racks with credit for Boraflex and no credit for the NETCO-SNAP-IN® rack inserts, and spent fuel storage racks with no credit for Boraflex and credit for NETCO-SNAP-IN® rack inserts. The reactivity state of the two storage configurations both meet the 0.95 K_{eff} storage criteria and therefore, by definition, both configurations are acceptable for storage in the LSCS Unit 2 SFP.

   It is not clear that this statement is true. The criticality safety analyses for the NETCO insert and Boraflex regions likely have different fuel assembly acceptance criteria. Thus, an assembly might be acceptable for storage in one region and not the other. Further, due to the location of the inserts in the NETCO insert racks, the interface between Boraflex and NETCO insert rack modules may require further evaluation or additional controls, such as the commitment stated in the criticality safety analysis to install inserts in neighboring Boraflex racks.

   Provide clarification or additional justification for this statement.

2. Text from Attachment 1, Section 3.2, Page 10, 5th paragraph after the bulleted list:

   Finally, the criticality analysis provided in Attachment 3 has employed a less reactive fuel assembly than that used in the most recent LSCS Unit 1 BORAL® SFP criticality analysis, and the most recent LSCS Unit 2 Boraflex SFP criticality analysis. The proposed change also includes a revision to TS Section 4.3.1 to specify this less reactive fuel as the most reactive assembly allowed for storage in either the Unit 1 or Unit 2 SFPs.

   The potential impact on either the LSCS Unit 1 BORAL or LSCS Unit 2 Boraflex criticality analyses by the installation and use of the NETCO-SNAP-In® rack inserts in LSCS Unit 2 has not been evaluated in the AREVA SFP criticality analysis (ANP-2843P, proprietary). Such an evaluation should be performed and documented.

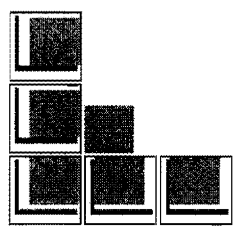
3. Text from Attachment 1, Section 3.3.2, "Areal Density of Boron," notes that lower limit for the areal density of boron (B) in the Rio Tinto Alcan composite is 0.0087 g Boron-10 per centimeter squared ($^{10}B/cm^2$). What is the uncertainty associated with the measurements used to confirm that the "manufacturing insert quality assurance testing lower limit for areal density" is met? Describe how the areal density assumed in the analysis accounts for the measurement uncertainty.

4. Text from Attachment 1, Section 3.4.2, "Mechanical Wear," notes that mechanical wear may occur. The text further states that minimal material loss is expected, but does not quantify how much material may be lost. Loss of material due to wear may occur in multiple, adjacent locations at the same time. Consequently, the increase in the effective multiplication factor (k_{eff}) may not be bounded by the loss of a single insert, which is evaluated in the criticality analysis.

   Provide estimates for how much the ^{10}B areal density may be reduced locally by mechanical wear. If appropriate, modify the criticality analysis to consider this additional potential failure mechanism.

5. Text from Attachment 1, Section 3.8.3, "Fuel Assembly Place Alongside Spent Fuel Storage Rack," describes an assembly placed outside the racks. From the description, it is not clear that the most reactive configuration was considered.

   Confirm that an assembly placed into an interior corner of three rack modules, with outer walls not covered by inserts (see figure), was evaluated. The analysis should also look at variations in spacing between the external assembly, with and without fuel channel, and the storage rack modules.



6. Text from Attachment 1, Section 3.9, "Rio Tinto Alcan Composite Surveillance Program," describes the proposed surveillance program. Describe how the surveillance program will detect loss of ^{10}B due to mechanical wear (e.g. due to friction as assemblies are inserted and withdrawn) and/or erosion of material (e.g. due to water flow) from the inserts. Describe the measurement uncertainty and acceptance criteria. Describe also how the surveillance program is factored into the criticality analysis.

7. Text from Attachment 1, Section 4.1, "Applicable Regulatory Requirements/Criteria," describes the applicable regulatory requirements and criteria. Noticeably absent from the list is GDC-5, "Sharing of Structures, Systems, and Components." Considering that fuel from either unit may be stored in either spent fuel storage pool, it would seem

appropriate to include consideration of GDC-5. Additionally, the applicable regulatory requirements of *Title 10 of the Code of Federal Regulation* (10 CFR) Section 50.68, "Criticality accident requirements," extend beyond 10 CFR 50.68(b)(4).

Provide the logic addressing compliance with GDC-5 and a commitment to meet the other requirements of 10 CFR 50.68, including the 5 weight percent (wt percent) uranium-235 (^{235}U) maximum nominal enrichment specified in 10 CFR 50.68(b)(7).

8. Report ANP-2843(P) (proprietary), Section 2.0, 5th paragraph provides guidance for evaluating the reactivity of lattices for comparison with the limiting rack infinite multiplication factor (k_∞) values. The reader is referred to the CASMO-4 models provided in Appendix A. Considering the nature of how these models will be used, the NRC staff will need to review them.

   Provide the CASMO-4 manual for use in the review. These input files inherently rely on several approximations and assumptions related to in-core depletion and in-rack k_∞ calculations.

   Consistent with the guidance provided in Standard Review Plan 9.1.1, "New Fuel Storage," identify and justify approximations and assumptions used. Where appropriate, quantify biases and uncertainties associated with approximations and assumptions used.

9. In ANP-2843(P) (proprietary), Section 2.0, the 3rd bulleted item includes the parenthetical phrase "no credit is taken for assembly burnup." This is incorrect and misleading. For assemblies with gadolinium (Gd), the peak-reactivity point takes credit for both fuel burnup and residual Gd. Uncertainties related to burnup-dependent fuel <u>and</u> Gd concentrations and reactivity worths should be applied to Gd lattices when they are compared to the bounding beginning of life (BOL) lattices.

   Describe how such uncertainties are included in the analysis or justify not including these uncertainties.

10. ANP-2843(P) (proprietary), footnote * states that 80 mil fuel channels are acceptable. The analysis should show this to be the case by presenting results for both the 80 and 100 mil fuel channels.

    Confirm that calculations were performed for both 80 and 100 mil channels.

11. ANP-2843(P) (proprietary), Section 2.0, bullet item on page 2-3. This claim is not substantiated. The uncertainties in k_{eff} will vary with things like assembly design, initial ^{235}U enrichment, burnup-dependent fuel and Gd compositions, initial Gd content, number of Gd rods, fuel enrichment, part-length versus full length rod lattices, etc.

    Strengthen the analysis supporting this claim.

12. ANP-2843(P) (proprietary), Table 2.1, Section 3. This part of Table 2.1 describes the parameters for lattice designs that are acceptable without further review. The description states minimum numbers of Gd rods and minimum Gd content in each rod, but does not

specify maximum values for either or the range of acceptable number of part-length rods or their permissible locations. The uncertainties associated with these design variations should be considered in the uncertainty analysis. The description should also describe where natural uranium blankets may be used.

Provide a more complete description of the acceptable range of lattice designs or justify not doing so.

13. ANP-2843(P) (proprietary), Table 2.1, Section 4. This part of Table 2.1 provides zone-dependent maximum in-rack k_∞ values. Use of this table with zone-dependent k_∞ values creates the potential for an abnormal condition that has not yet been analyzed in ANP-2843(P). What will be the impact on maximum in-rack k_∞ value if the zone 3 limit is erroneously applied to a zone 1 lattice for a group of fuel assemblies?

    Evaluate this additional abnormal condition or justify not doing so.

14. ANP-2843(P) (proprietary), Section 3.0 includes a listing of design criteria applicable to the spent fuel storage evaluation. GDC 5, GDC-62, "Prevention of Criticality in Fuel Storage and Handling," and 10 CFR 50.68(b)(7) are missing from the list.

    Confirm that the analysis documented in ANP-2843(P) is compliant with these requirement sources.

15. ANP-2843(P) (proprietary), Section 4.2, first paragraph. As is stated in this paragraph, the analysis assumes the Boraflex has been replaced with water. The gaps in the Boraflex may not be filled with water. To cover these areas, it may be more appropriate to replace the Boraflex with void, which may yield higher in-rack k_∞ values.

    Evaluate the impact of replacing the Boraflex with void rather than water or justify not doing so.

    Additionally, if Boraflex was utilized on the rack module perimeter locations, it was probably held in place by a steel "wrapper." It is not clear whether or not the steel wrapper is modeled. If it was not modeled, this modeling simplification should be described and justified. If it was modeled, the manufacturing tolerances on the Boraflex cavity dimensions and on the wrapper thickness, and width should be included in the uncertainty analysis.

16. ANP-2843(P) (proprietary), Table 4.1. The fuel rod description includes both a theoretical density and a pellet void volume percent. Is the effective pellet density the combination of the two (i.e., effective density is 95.10 percent of theoretical density)?

    Clarify how the pellet void volume percent is used.

17. ANP-2843(P) (proprietary), Table 4.1. The fuel channel description implies that the fuel channels are a uniform thickness. At some plants, a fuel channel may have multiple wall thicknesses. If the LSCS reactor uses fuel channels that have multiple wall thicknesses,

the modeling simplification should be stated and the impact of the simplification on the analysis should be quantified.

Confirm that the actual fuel channels have a uniform wall thickness.

18. ANP-2843(P) (proprietary), Table 4.2. No tolerance is provided for the insert wing length. A footnote is provided that implies that the wing length is modeled as longer than it really is. What is the tolerance on the wing length and what is the impact of the modeling simplification used?

    Provide the tolerance on the insert wing width. If appropriate, include this tolerance in the uncertainty analysis documented in Section 6 of ANP-2843(P). Evaluate the impact of the modeling simplification stated in the footnote on Page 4-4 of ANP-2843(P).

    Provide a description of the wing material model. Justify any modeling simplifications made.

19. ANP-2843(P) (proprietary), Figure 4.2. Due to the off-center location of the water hole, assembly rotations should have been evaluated in conjunction with assembly groupings.

    Provide more detailed discussion of assembly rotation studies performed so that the NRC staff may confirm that this issue was fully studied. What rotations and assembly locations were evaluated?

20. ANP-2843(P) (proprietary), Section 5.0. This section presents the calculation methodology. From reading the rest of the report, it looks like all CSAS25 calculations were for models with fresh fuel that had no Gd rods. All variations from these conditions were evaluated using CASMO-4. Additionally, some uncertainties documented in Section 6 were evaluated using CASMO-4.

    Confirm the NRC staff understanding of the calculation methodology.

21. ANP-2843(P) (proprietary), Section 5.0, page 5-2, 1st bulleted item. This item states that in-core depletions were performed at certain void percentages. As is noted near the top of page 6-2, the limiting in-rack k_∞ values were calculated for each lattice using a particular percent void history during depletion. It is not clear that some other value would not result in a higher value. Consequently, there is some uncertainty associated with this simplified analytical approach that has not yet been quantified.

    Justify the use of only the particular void histories. Note that while these values may be sufficient for reactor safety analysis, additional calculations may be needed for criticality safety analysis.

22. ANP-2843(P) (proprietary), Section 5.0, page 5-2, 4th bulleted item. This item states that a 0.01 Δk margin is built into the REBOL lattices to account for calculational and depletion uncertainties. It is not clear that this 0.01 Δk margin is adequate. This margin needs to cover bias and bias uncertainty associated with:

- fuel actinide composition calculations,
- fission product composition calculations,
- Gd depletion calculations, and
- k_{eff} calculations (nuclear data errors)

The "depletion" uncertainty (discussed in Section D.3.3) extracted from Table 2.2 of EMF-2158(P)(A) is for boiling-water reactor (BWR) simulator code (i.e. CASMO-4+MICROBURN-B2) validation. It is not clear that this uncertainty is applicable to stand-alone CASMO-4 models used to calculate in-rack k_∞.

Provide additional justification for the 0.01 Δk margin used to account for calculational and depletion uncertainties.

23. ANP-2843(P) (proprietary), Section 5.1, page 5-3, last paragraph. This text concludes that the CASMO-4 calculations performed for the evaluation are within the area of applicability (AOA) of the comparisons shown in Appendix D. All comparisons shown in Appendix D involve fresh fuel without Gd rods. The CASMO-4 depletion calculations, which involve burned fuel compositions and Gd rods, are clearly not within the AOA of the comparisons shown in Appendix D.

    Revise the report to (1) more accurately and clearly describe the verification and validation of computational methods used and (2) to justify the extension of the AOA.

24. ANP-2843(P) (proprietary), Section 6.5 covers abnormal and accident conditions. One condition evaluated was the placement of an assembly next to the side of a fuel storage rack module. The analysis of this configuration should have been for an assembly placed in a corner formed by three rack modules. Further, the analysis should have optimized the "normal" conditions to maximize the k_{eff} value for the accident condition. For example, k_{eff} might be increased if the three assemblies are moved toward the assembly that is placed next to the racks, or if some or all of the four assemblies involved are not installed in fuel channels.

    Another condition evaluated was a missing insert. Again, the normal conditions should have been revisited to maximize the impact of the missing insert. This might include moving some of the surrounding assemblies toward the cell with the missing insert.

    Confirm that the normal conditions were re-optimized to maximize k_{eff} for the abnormal and accident conditions.

    In addition to a missing insert, the abnormal conditions discussion should address:

    - The potential for and, if appropriate, the impact of loss of boron due to corrosion, erosion, and mechanical wear.
    - Misassignment or miscalculation of lattice k_∞ value.
    - Comparison of lattice k_∞ value with the wrong zone-dependent limit.
    - Placement of an assembly in the wrong fuel storage rack region.

Address the potential for these abnormal conditions and, where appropriate, incorporate into the criticality analysis.

25. ANP-2843(P) (proprietary), footnote at the bottom of page 6-6 – Provide a reference supporting this claim or perform the analysis.

26. ANP-2843(P) (proprietary), Section 6.6, last paragraph, last sentence. The bias and bias uncertainty associated with burned fuel calculations has not been adequately incorporated into the calculation of $k_{95/95}$. Consequently, direct comparison of REBOL lattice k_∞ values with bounding lattice k_∞ values is not sufficient to reach the stated conclusion.

    Incorporate the bias and bias uncertainty associated with burned fuel calculations into the analysis.

27. ANP-2843(P) (proprietary), Section 6.7 includes a statement that uniform rod enrichment distributions are more reactive than actual rod enrichment distributions by 0.005 to 0.007 Δk.

    Provide a reference or describe what was done to support this claim. In particular, was the increased reactivity checked in fuel storage rack geometry? Is this statement true for assemblies with Gd rods burned to peak reactivity?

28. ANP-2843(P) (proprietary), Section 6.8 – It is not clear how the conclusion reached in this section will be used. Does the applicant intend to assume all fuel already stored in the Unit 1 and Unit 2 spent fuel storage racks is bounded by the ATRIUM-10 lattices without checking the lattice k_∞ values? The text claims that the ATRIUM-10 lattices used in the evaluation can reasonably represent past assembly fuel types. It is not clear how the term "reasonably represent" can be consistent with the 10 CFR 50.68 requirement that the k_{eff} of the spent fuel 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.

    Describe the process, consistent with the 10 CFR 50.68(b)(4) requirement, that will be used to determine that the current inventory of spent fuel is acceptable for storage in the modified racks.

29. In ANP 2843(P) (proprietary), Section 6.8 it states, "The assembly enrichment and gadolinia limitations defined in Table 2.1 will be applied to all future ATRIUM-10 fuel assemblies that are built for LaSalle Unit 1 and Unit 2." How is this requirement captured and controlled in the LaSalle TS?

30. ANP-2843(P) (proprietary), Section 6.9 addresses inaccessible storage locations. Is it credible that the spent fuel pool configuration might change, making previously inaccessible cells, which will not have inserts, accessible? If so, the lack of inserts might be overlooked for multiple adjacent cells and fuel erroneously stored there.

Confirm that such spent fuel pool configuration changes are not credible or incorporate into the analysis an abnormal condition wherein multiple assemblies are stored in cells without inserts.

31. ANP-2843(P) (proprietary), Section 6.9, second paragraph, last sentence - The existence of accessible empty cell locations without an insert creates the potential for erroneous placement of fuel assemblies in multiple unpoisoned locations. Confirm that this configuration is acceptable only for inaccessible storage locations.

32. ANP-2843(P) (proprietary), Section 6.10 covers the interface between racks where inserts are credited and racks where degraded Boraflex is credited. The text in this section commits to placement of inserts into the degraded Boraflex racks such that there will be an insert between adjacent assemblies in the new and old regions.

    From a technical point of view, doing this makes sense. However, the original criticality analysis should be reviewed to determine whether or not the coexistence of another storage rack region creates any new normal or credible abnormal conditions.

    Confirm that the original criticality analysis is not impacted by the proposed changes. If necessary, update the analysis and implement any resulting modified or new controls.

33. In ANP-2843(P) (proprietary), Section 6.10 it states, "*Exelon commits to expand the placement of inserts into one row and one column of the adjacent region as necessary to completely surround all assemblies that are part of the insert region with four wings of the NETCO-SNAP-IN inserts.*" How is this requirement captured and controlled in the LSCS TS?

34. ANP-2843(P) (proprietary), Table 6.3 covers fuel and storage rack manufacturing uncertainty analysis. The following observations are made concerning the uncertainty analysis:

    a. The Gd rod pellet density and tolerance should be evaluated.
    b. The insert wing width and tolerance should be evaluated.
    c. The fuel channel manufacturing tolerances should be evaluated.
    d. Many of the uncertainties presented will vary as some other parameters vary. A more complete parametric study is needed to provide bounding uncertainty estimates. For example, the Δk for the rod pitch uncertainty will vary with the number of Gd rods, Gd content of the Gd rods, fuel initial enrichment, fuel burnup, axial zone, fuel depletion conditions, etc.
    e. The second footnote under Table 6.3 states that the value is equally valid for a fuel density of 95.85 percent TD. Was this calculated, or is it just the author's opinion? What is the purpose of this statement? Is the 95.85 percent value the nominal density for the Gd rods? If so, the uncertainty for the Gd rod density also produces an additional uncertainty in the Gd content for the rod. Thus it is unlikely that the density uncertainty for non-Gd rods and Gd rods would be the same.
    f. Where KENO is used to calculate Δk values, the associated Monte Carlo uncertainty should be included in the Δk value.

Where appropriate, revise the uncertainty analysis to address these issues.

35. In Section 6 of ANP-2843(P) (proprietary), provide a table showing the details of how all biases and uncertainties are combined to demonstrate compliance with applicable k_{eff} limits.

36. ANP-2843(P) (proprietary), Section 7 provides the analysis conclusions. An explicit conclusion addressing compliance with GDC-5 and GDC-62, and with 10 CFR 50.68(b) should be stated.

37. ANP-2843(P) (proprietary), Section 7, first sentence:

    This analysis demonstrates that all fuel assemblies delivered to the LaSalle Station (both Units 1 and 2) as of July 2009 can be safely stored in the LaSalle Unit 2 spent fuel pool with NETCO-SNAP-IN inserts.

    Contrary to this conclusion, the analysis, including that provided in Appendix B, did not show that all fuel currently at LSCS is acceptable for storage in the modified fuel storage racks. Instead, the analysis provided guidelines that could be used to check the existing inventory.

    If the applicant does intend for the screening to be accomplished through this report, the logic supporting that the REBOL lattice calculations bound all existing inventory needs to be clarified and strengthened. This should include a more thorough discussion of variations in fuel assembly designs utilized at either unit and of how reactor operations have varied since initial startup. Comparisons between the REBOL lattices and peak k_∞ values for Gd assemblies must include consideration of the uncertainties associated with fuel burnup to the peak reactivity point. The existing spent fuel inventory should be screened to identify any assemblies that are atypical (i.e. damaged or modified fuel assemblies, assemblies that experienced unusual reactor conditions for an extended period of time, etc.). Such assemblies may still be acceptable for storage, but may require individual analysis.

    Revise the text in Section 7 to fully and clearly address screening of the fuel inventory at both LSCS Units 1 and 2. If the intent was to screen all current inventory using the analysis presented in this report, strengthen the analysis to better support this screening.

38. ANP-2843(P) (proprietary), Appendix A, page A-1, last paragraph – This paragraph provides guidance for using a different version of CASMO-4. The text states that changes no larger than 0.005 Δk are acceptable. There are two problems with this. First, use of an unvalidated computer code or nuclear data set for safety calculations is not acceptable. Second, if future 0.005 Δk differences were acceptable, the $k_{95/95}$ should be adjusted to include allowance for this rather large variation in CASMO-4 results.

    The guidance giving permission to use a different version of CASMO-4 for acceptance screening should be removed.

39. ANP-2843(P) (proprietary), Appendix C – The set of critical experiments used to validate the KENO calculations included 11 mixed uranium/plutonium-oxide (MOX) configurations. The average k_{eff} values for the non-MOX and MOX configurations are 0.9942 and 0.9998, respectively. Considering that all of the KENO calculations used in the criticality analysis were for fresh fuel that did not include plutonium, inclusion of the MOX critical experiment results is not appropriate. Even if they were retained, trending analysis as a function of plutonium (Pu) content would reveal a statistically significant trend would need to be factored into calculation of bias and bias uncertainty.

    For validation of fresh fuel calculations, remove the MOX experiments from the validation set and recalculate the bias and bias uncertainty.

    If the analysis is expanded such that validation of burned fuel calculations is needed, include the mixed-oxide critical experiments documented in NUREG/CR-6979, "Evaluation of the French Haut Taux de Combustion (HTC) Critical Experiment Data" (ADAMS Accession No. ML082880452), in the burned fuel validation set.

40. Describe the statistical method and acceptance/rejection criteria used for determining that there are no trends in the data in Table C.5 in ANP-2843(P) (proprietary). Provide a reference describing the statistical method. While the $|T|>t$ and the p-values are low for EALF and enrichment trends, it is not clear that no valid trends exist.

41. ANP-2843(P) (proprietary), Appendix D, Section D.3.3 – This section provides a 0.0030 Δk depletion uncertainty and cites reference D.3 [EMF-2158(P)(A)]. The uncertainties presented in reference D.3 are for the combination of CASMO-4 and MICROBURN-B2. It is not clear that the CASMO-4+MICROBURN-B2 uncertainty applies to the in-rack storage calculations. In reactor geometry, offsetting errors associated with variation from fresh to high burnup fuel may mask a burnup-dependent trend. The reactor simulation uses many CASMO calculations, while the spent fuel storage racks peak reactivity calculation uses three, none of which are fresh fuel. The differences between the reactor simulation and the in-rack k_∞ calculations are so significant that little confidence can be placed in the CASMO-4 depletion uncertainty value adopted in Section D.3.3.

    Provide better justification for the CASMO-4 depletion uncertainty used in the analysis.

42. ANP-2843(P) (proprietary), Appendix D, Section D.5.1, "Area of Applicability" – The AOA should be more fully described. The CASMO-to-KENO comparisons were performed with only fresh Atrium 9 and 10 fuel having enrichments ranging from 2.2 to 3.1 wt percent ^{235}U, in assemblies that had no Gd rods, and at temperatures of 4, 20, and 100 degrees Celcius.

    Revise the AOA to more accurately describe the range of the code-to-code comparisons that are made. Justify the extension of the AOA beyond the parameters evaluated.

43. ANP-2843(P) (proprietary), Appendix D, Section D.5.2 - Note that variations in initial enrichment were studied and for only Atrium 9 and 10 assembly designs. Code-to-code variations in Δk due to variations in densities, wall thicknesses, pin pitches, Gd concentrations, areal ^{10}B densities, etc. were not studied.

Expand the analysis presented in D.5.2 to provide bias and bias uncertainty estimates for using CASMO-4 to calculate the uncertainty quantities used in Section 6.

Revise the AOA to more accurately describe the range of the code-to-code comparisons for calculation of Δk values. Justify the extension of the AOA beyond the parameters and fuel assembly designs evaluated.

44. ANP-2843(P) (proprietary), Appendix D, Section D.6, footnote at the bottom of page D-17 – From the discussion provided in the footnote, there appears to be some confusion concerning the "5% of the reactivity decrement" uncertainty suggested by Kopp in Reference D.1. This uncertainty was intended to cover uncertainty in the calculation of burned fuel compositions and in calculating k_{eff} for systems with burned fuel. The reactivity decrement uncertainty was not meant to cover modeling simplifications and approximations.

    The peak reactivity for a BWR Gd assembly includes credit for both fuel burnup and for residual Gd. As applied to BWR fuel assemblies with Gd rods, the uncertainties due to changes in actinide and fission product compositions should be calculated separately from the uncertainty due to modeling of Gd depletion.

    The suggested 5 percent of the reactivity decrement applies only to the reactivity decrement associated with changes in actinides and fission products. It is necessary to also adopt some additional uncertainty associated with calculation of the amount of gadolinium still present at peak reactivity.

    While it is not clear, the analysis presented in the footnote appears to be taking 5 percent of the reactivity increase from zero burnup to the peak burnup point. This is not consistent with the uncertainty suggested by Kopp in Reference D.1.

    Revise or remove the discussion provided in the footnote.

45. ANP-2843(P) (proprietary), Appendix D, Section D.7, First paragraph – The conclusion stated in the 1st paragraph is overly broad. The AOA for the analysis reported in Appendix D was much narrower than is suggested by the conclusion.

    It is not clear exactly what the 3rd paragraph is trying to accomplish. However, there does not appear to be any analysis provided in Appendix D that evaluated lattice-specific bias dependence relative to use of CASMO-4 for the various lattices. Provide the logic supporting this assertion or remove this text.

    Fourth paragraph – It is not clear that the 0.01 Δk adder is adequate to cover uncertainties associated with calculation of peak rack k_∞ values.

    Revise the conclusions to more clearly and accurately state the conclusions that can be drawn from the work presented in Appendix D.

    Also, explain how the CASMO bias and bias uncertainty determined in Appendix D are incorporated into the maximum k_{eff} determination.

effective use of staff resources. If circumstances result in the need to revise the requested response date, please contact me at (301) 415-3719.

Sincerely,

/RA/

Cameron S. Goodwin, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-373 and 50-374

Enclosure:
Request for Additional Information

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