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

August 23, 2011

Mr. Michael J. Pacilio
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 SPENT FUEL STORAGE RACKS (TAC. NOS. ME6834 AND ME6835)

Dear Mr. Pacilio:

By letter to the U.S. Nuclear Regulatory Commission (NRC) dated April 18, 2011, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML111090258) Exelon Generation Company, LLC provided additional information to the NRC staff regarding the spent fuel pool storage racks for LaSalle Count Station, Unit 2.

The NRC staff reviewed 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 response is requested 30 days from the date of this letter.

Pursuant to Section 2.390 of Title 10 of the *Code of Federal Regulations* (10 CFR), we have determined that the enclosed request for additional information does not contain proprietary information. Draft proprietary and non-proprietary versions of the enclosure were sent to your staff on August 4, 2011. Subsequently, on August 16, 2011, Mr. Ken Nicely notified the NRC staff that your staff did not have any comments on the non-proprietary version of the enclosure.

The NRC staff considers that timely responses to requests for additional information help ensure sufficient time is available for NRC 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) 415-3302.

Sincerely,

Araceli T. Billoch Colón

Araceli T. Billoch Colón, 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

cc w/encl: Distribution via ListServ

REQUEST FOR ADDITIONAL INFORMATION

LASALLE COUNTY STATION. UNITS 1 AND 2

DOCKET NO. 50-373 AND 50-374

In reviewing the Exelon Generation Company's (Exelon's) submittal dated April 18, 2011, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML111090258) related to spent fuel pool (SFP) storage racks, for the LaSalle County Station (LSCS), Units 1 and 2, the U.S. Nuclear Regulatory Commission (NRC) staff has determined that the following information is needed in order to complete its review:

1. The NRC staff has reviewed the reports for the three BADGER test campaign at the LSCS Unit 2 (U2) SFP: NETCO NET-14901 R1 April 14, 2011, which documents the LSCS U2 BADGER Campaign conducted August 18th through August 25th 1999, NETCO NET-269-01 R1 April 15, 2011, which documents the LSCS U2 BADGER Campaign conducted May 4, 2006, through May 10, 2006, and NETCO NET-331-01 R2 April 15, 2011, which documents the LSCS U2 BADGER Campaign conducted July 13, 2009, through July 15, 2009. With respect to these BADGER test campaign reports please provide the following information:

    a. The text in each report indicates the BADGER source head is filled with [ ], yet the figure depicting the BADGER source head indicates it is filled with [ ]. Which is correct? Verify the neutron transport model used the actual material.

    b. NET-149-01 states, "[ ]"

        i. [ ]

        ii. [ ]

        iii. [ ]

iv. [ ]

c. Neither NET-269-01 nor NET-331-01 indicates the need for a [ ] The LSCS U2 SFP geometry did not change. What changed such that a [was not required to calibrate BADGER for the LSCS U2 SFP geometry for NET-269-01 nor NET-331-01? How does this change affect the ability to compare one BADGER test campaign to another?

d. The BADGER calibration for NET-269-01 and NET-331-01 used the more common BADGER calibration which requires a [ ] Yet these reports indicate the actual ^{10}B areal density of individual panels is unknown at the LSCS U2. How was the ^{10}B areal density of the [ ] determined for NET-269-01 and NET-331-01? What is the uncertainty of the ^{10}B areal density of the [ ] determined for NET-269-01 and NET-331-01? How does the uncertainty of the ^{10}B areal density of the [ ] determined for NET-269-01 and NET-331-01 affect the results?

e. NET-149-01 lists the number of neutrons per detector per panel. Is this the number of neutrons that reach the detector or the number of neutrons emitted by the source? Provide the justification that this provides a sufficient number of neutrons reaching the detectors at each elevation measured on the panel. Neither NET-269-01 nor NET-331-01 includes a similar discussion. Has this aspect of the BADGER tool changed from NET-149-01 R1? If so, how so and what is the impact.

g. During the 1999 BADGER test campaign Boraflex panel BBB32-West was measured to have a ^{10}B areal density significantly below that predicted. An explanation for BBB32-West greater degradation was never given. A hypothesis was disproven in the conclusion of the report. Explain why BBB32-West had degraded significantly greater than predicted. Identify all other Boraflex panels that are susceptible to the same degradation. Explain why this panel was not retested during subsequent BADGER test campaigns.

h. During the 2006 BADGER test campaign Boraflex panel AA74-North was measured to have approximately [ ]% degradation, areal density significantly below the BADGER reference panel. AA74-North was an unirradiated panel and should have had little or no degradation. AA74-North was measured in NETCO-149-01 where it was found to have an areal density significantly above the BADGER reference panel. No explanation for the significant AA74-North degradation was given. Explain why AA74-North had degraded significantly from the 1999 BADGER measurement campaign to the 2006 BADGER measurement campaign. Identify all other Boraflex panels that are susceptible

to the same degradation. Explain why this panel was not retested during the subsequent 2009 BADGER test campaign.

i. Each BADGER test campaign report has a table comparing the RACKLIFE predicted percentage degradation and a BADGER measured percentage degradation. However, it is not clear from the reports what the percentages are based on. Provide the ^{10}B areal density those percentages are based on. Provide the justification for using those ^{10}B areal densities as the bases for those percentages. Discuss the effects on the conclusions of using different areal densities as the bases for those percentages.

j. In the text and conclusion of all three reports when Boraflex panels are measured below the minimum certified B10 areal density for the LSCS U2 SFP Boraflex panels the BADGER measurement uncertainty is essentially credited to conclude those panels are actually above the minimum certified ^{10}B areal density. Explain why this non-conservative application of the BADGER measurement uncertainty is appropriate. Explain why the BADGER measurement uncertainty wasn't considered in a conservative manner to conclude that these and other panels were below the minimum certified areal density.

k. The NET-269-01 and NET-331-01 reports indicate the average ^{10}B areal density of LSCS U2 SFP Boraflex panels is 0.0238 g/cm^2 with a ± 20% manufacturing tolerance. However, a ± 20% manufacturing tolerance means that panels on the low end will have a ^{10}B areal density of 0.0190 g/cm^2. This is less than the minimum certified areal density of 0.0200 g/cm^2. Confirm the actual range of ^{10}B areal densities of the Boraflex panels installed in the LSCS U2 SFP. Confirm that no panels with an initial as-built ^{10}B areal density less than 0.0200 g/cm^2 were installed in the LSCS U2 SFP.

l. NET-269-01 Table 5-1 provides a comparison of the RACKLIFE predicted ^{10}B areal density to the BADGER measured ^{10}B areal density for twelve panels tested during both the 1999 and 2006 BADGER measurement campaigns. The comparison takes into account the densification of the Boraflex panels caused by the shrinkage associated with the gamma induced cross-linking of the polymer. The comparison is in the form of a [ ] where a negative indicates RACKLIFE has non-conservatively predicted a higher areal density than was measured with BADGER. Table 5-1 indicates that for the 1999 BADGER test campaign RACKLIFE non-conservatively over predicted the areal density by an average [ ]% with a standard deviation of [ ]%. Table 5-1 indicates that for the 2006 BADGER test campaign RACKLIFE non-conservatism increased to over predicting the areal density by an average [ ]% with a standard deviation of [ ]%. Explain why this analysis was not included in the conclusion but the percentages from Table 4-1 were included.

m. NET-331-01 Table 5-1 provides a comparison of the RACKLIFE predicted ^{10}B areal density to the BADGER measured B10 areal density for three panels tested during both the 2006 and 2009 BADGER measurement campaigns, one of those

was also tested during the 1999 BADGER measurement campaign. The comparison takes into account the densification of the Boraflex panels caused by the shrinkage associated with the gamma induced cross-linking of the polymer. The comparison is in the form of a [ ] where a negative indicates RACKLIFE has non-conservatively predicted a higher areal density than was measured with BADGER. Table 5-1 indicates that for the 2006 BADGER test campaign RACKLIFE non-conservatively over predicted the areal density for these three panels by an average [ ]% with a standard deviation of [ ]%. Table 5-1 indicates that for the 2009 BADGER test campaign RACKLIFE conservatively under predicted the areal density by an average [ ]% with a standard deviation of [ ]%.

i. The dramatic improvement is not really explained in the report, but may be attributable to the use of a new version of the Boraflex degradation predicting code RACKLIFE. RACKLIFE 2.1 has a new local panel temperature thermal model. This change in methodology has not been reviewed by the NRC. Therefore, the NRC staff requests that RACKLIFE 2.1 and all supporting benchmark data be submitted for review.

ii. The dramatic improvement may also be attributable to inadequately explained BADGER measurement results in Table 5-1. Panel FF34-South's gamma dose increased from 1.2E+10 to 1.5E+10, a substantial increase in dose, but its BADGER measured areal density only decreased from [ ] g/cm^2 to [ ] g/cm^2. A much smaller decrease than should be expected and since the BADGER measurement uncertainty (σ) for any given measurement is indicated to be approximately [ ]% the decrease is less than the measurement uncertainty. Panel EE37-East's gamma dose increased from 1.0E+10 to 1.1E+10, a much smaller increase but still indicating a cell in active use, but its BADGER measured areal density actually increased; from [ ] g/cm^2 to [ ] g/cm^2. Similarly panel FF36-South's gamma dose essentially remained unchanged at 1.6E+10, indicating a potentially inactive cell, however its BADGER measured areal density also increased; from [ ] g/cm^2 to [ ] g/cm^2. NET-331-01 R2 indicates these two increases are within the BADGER measurement uncertainty, yet they are not. The increase for FF36-South is more than 2σ and the increase for EE37-East is almost 4σ. Explain these anomalous measurements.

n. The NET-269-01 and NET-331-01 reports indicate the Boraflex panels where RACKLIFE has significantly under predicted degradation are reasonably correlated. In the 2006 BADGER measurement campaign the four panels on cell FF36 were among those BADGER measured areal density was significantly less than the RACKLIFE prediction. In the 2009 BADGER measurement campaign the four panels on cell DD35 were among those BADGER measured areal density was significantly less than the RACKLIFE prediction. In the 2009 BADGER measurement campaign other panels in close proximity to cell DD35 were also among those whose BADGER measured areal density was

significantly less than the RACKLIFE prediction. Explain why this collocation of enhanced degradation is not addressed in the reports.

o. The BADGER measurement campaign reports indicate that the presence of cracks/gaps at the cell wall raised surfaces and accompanying Borafllex cutouts cannot be readily detected. The report is otherwise silent on what may be happening to the Boraflex panel at these locations. As the raised surfaces will restrict movement of the Boraflex panels during shrinkage these are likely areas for cracks/gaps to form. Presumably a crack/gap of sufficient size would be detectable even in the presence of the cell wall raised surfaces and accompanying Borafllex cutouts. Since the BADGER measurement tool can't confirm those cracks/gaps are not present, and they are likely places for cracks/gaps to form, explain and justify why it is not assumed that cracks/gaps at those elevations are present.

p. The BADGER measurement campaign reports indicate that the smallest crack/gap BADGER can detect is [ ]. Yet of the maximum gaps listed in NET-331-01 Table 4-1 only one is larger than BADGER's minimum detectable gap. One is listed as only [ ] inches. How are gaps this small detected?

q. In the 2009 BADGER measurement campaign there was concurrent work being done on the overhead crane. According to the report, the power cables associated with that work caused problems for the BADGER campaign. Detector #4 was disabled due to its "[ ]" Considering the following explain how this interference affected all of the BADGER measurements during the 2009 campaign.

   i. The apparent anomalous measurements cited above for FF34-South, EE37-East, and FF36-South.

   ii. On all traces in earlier BADGER measurement campaign reports there is a neutron transmission peak at each pair of cell wall raised surfaces and accompanying Borafllex cutouts that corresponds closely to the nominal elevation of each. For the 2009 campaign only the lower most raised surface/Borafllex cutout pair have a corresponding transmission peak. The peaks for the other seem to be shifted 5-10 inches higher. Explain why the peaks are not occurring at the raised surface/Borafllex cutout pair elevations.

   iii. The LSCS U2 SFP Boraflex panels are 139 inches tall. Yet the BADGER traces, for the 2009 campaign, indicate the presence of neutron absorbing material to an elevation of approximately 150 inches. The BADGER traces from the earlier campaigns did not exhibit this phenomenon. Explain why BADGER is indicating the presence of neutron absorbing material at elevations above the actual panel height.

iv. NET-331-01 R1 indicates that during the scan of "unirradiated" panel G74S peaks showed on Detector #3 in the center region of the panel that were attributed to the "spurious" noise from the crane work and were not included in the analysis. What other data was attributed to the "spurious" noise from the crane work and discounted? What basis was used for determining what to include and exclude?

r. For the NET-331-01 report the NRC staff used the method of comparison between RACKLIFE predicted ^{10}B areal density and the BADGER measured ^{10}B areal density demonstrated in Table 5-1 for the 28 panels listed in Table 4-1 with a listed dose. In this comparison RACKLIFE non-conservatively over predicted the areal density on average by 4.0% with a standard deviation of 20.7%. Explain how NET-331-01 R2 concluded that RACKLIFE conservatively over predicted B4C loss.

2. The raised surfaces on the cell walls that provide spacing between the storage cells for the Boraflex panels allow a nominal spacing of 0.074". The LSCS U2 SFP Boraflex panels have a nominal thickness of 0.075". This indicates there is likely some initial contact between the cell walls and likely and compressive force on the Boraflex panels. How would this affect the degradation potential of the Boraflex?

3. The raised surfaces on the cell walls that provide spacing between the storage cells for the Boraflex panels also limit the potential movement of the Boraflex panels. However it is not clear what holds the lower most portion of a Boraflex panel at the analyzed elevation should a crack/gap form at the lower most pair of raised surfaces. Describe what holds the lower most portion of a Boraflex panel in place at the analyzed elevation should a crack/gap form at the lower most pair of raised surfaces.

4. NET-269-01 R1 indicates that Boraflex panels on the periphery of LSCS U2 spent fuel pool storage rack modules are experiencing accelerated degradation relative to other panels.

   a. How is this factored into the LSCS U2 Boraflex monitoring program?

   b. How is this modeled in the ANP-2578(P) analyses?

   c. How is this modeled in the various criticality analyses that form the bases for EC0000383637, "Unit 2 Spent Fuel Pool Criticality Analyses Impact from Boraflex BADGER Testing?"

   d. Why wasn't this tested in the subsequent BADGER measurement campaign?

5. The LSCS license conditions 30 and 31 allow storage of the fuel assemblies that meet the reactivity requirements of TS 4.3.1.1.d. Table 6.1, Summary of Criticality Safety Analysis of ANP-2578(P) indicates the total biases and uncertainties associated with storing an ATRIUM-10™ fuel assembly into the degraded Boraflex racks is [ ] Δk. When this is added to the "maximum k-infinity of 0.9185 for all lattices in the top of the assembly," the requirement of TS 4.3.1.1.a for $k_{eff} \leq 0.95$ is not met. Therefore a k-infinity (k_{inf}) of 0.9185 is an inappropriate limit for storing ATRIUM-10™ fuel assembly into the degraded Boraflex

racks. Provide a revised a k_{inf} limit for storing ATRIUM-10™ fuel assemblies in the degraded Boraflex racks. Include the NCS analysis that supports the new limit.

6. In Section 6.3, Uncertainties, ANP-2578(P) indicates that rather than determine uncertainties for an ATRIUM-10™ fuel assembly uncertainties determined in a difference analysis for an ATRIUM-9B™ fuel assembly were used. The NRC staff considers it inappropriate to use the uncertainties for one fuel assembly design for another without explicit justification that the bounding uncertainties were used. For the NCS used to answer RAI # 5 either determine uncertainties for the ATRIUM-10™ fuel assembly or provide the analysis that demonstrates that the ATRIUM-9B™ uncertainties bound the ATRIUM-10™ uncertainties.

7. ANP-2578(P) does not consider Boraflex self-shielding. The B_4C in Boraflex is typically in relatively large particle sizes. The outer layer of these particles effectively shields the inner layers enough that representing them as homogenously distributed in the Boraflex is non-conservative. For the NCS used to answer RAI # 5 either determine the effect of Boraflex self-shielding or justify why the Boraflex in the LSCS U2 SFP is not subject to self-shielding.

   a. If self-shielding is a concern for the Boraflex in the LSCS U2 SFP, determine its effect on the conclusions regarding the other fuel assembly designs evaluated in the LSCS evaluation EC0000383637.

8. ANP-2578(P) does not consider an uncertainty on the Boraflex degradation. For the 2009 BADGER in situ measurement campaign the RACKLIFE computer over predicted the Boraflex ^{10}B areal density (AD) on average by 4% with a standard deviation of 20.7%. For the Boraflex panels with the most degradation RACKLIFE over predicted the areal density by as much as 37%. As four of the seven the panels with the worst measured degradation were all in the same cell, and the remaining three were close by, these both should be treated as a bias. For the NCS used to answer RAI # 5 include an appropriate bias and bias uncertainty on the predicted areal density to ensure that a single calculation of k_{eff} is $\leq$ 0.95 awith a 95 percent probability and a 95 percent confidence.

   a. Describe and justify the effect on the conclusions regarding the other fuel assembly designs evaluated in the LSCS evaluation EC0000383637.

9. There is no validation of the code used to determine k_{eff}. There is no methodology bias or bias uncertainty. Provide the validation of the code used to determine k_{eff}.

10. ANP-2578(P) discusses a KENO V.a to CASMO-4 adjustment. However, there are insufficient details to review to determine what this adjustment was used for, how it was determined, or whether or not it was appropriate to use such an adjustment. Provide a description of what KENO V.a to CASMO-4 adjustment was used for, how it was determined, and the justification for its use.

11. ANP-2578(P) models a single 1" gap in the Boraflex panels. There is no mention of where this gap is located. Due to the unique design of the LSCS Boraflex panels, each panel is actually likely to have four of these gaps and the gaps will all be at the same elevations for each panel. Justify the modeling of the gaps in the Boraflex panels.

a. Describe and justify the effect on the conclusions regarding the other fuel assembly designs evaluated in the LSCS evaluation EC0000383637.

12. ANP-2578(P) does not consider non-uniform degradation of the Boraflex panels. According to the BADGER measurement campaign reports for the LSCS U2 SFP, non-uniform degradation is localized thinning of the Boraflex panels beyond that represented in the panel average AD. Explain and justify why non-uniform degradation of the Boraflex panels was not considered in ANP-2578(P).

13. ANP-2578(P) does not consider a depletion uncertainty for the depletion analysis that depleted the fresh fuel assembly to its burnup of peak reactivity. Explain and justify why a depletion uncertainty was not considered in ANP-2578(P).

14. The evaluation of the other fuel assembly designs evaluated in the LSCS evaluation EC0000383637 does not appear to consider edge degradation while ANP-2578(P) does. Explain why EC0000383637 does not appear to consider edge degradation when the 2009 BADGER measurement campaign had a detector on the edge of the Boraflex panels inoperable.

If circumstances result in the need to revise the requested response date, please contact me at (301) 415-3302.

Sincerely,
/RA/

Araceli T. Billoch Colón, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-373 and 50-374

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