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10 CFR 54

RS-15-201

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

LaSalle County Station, Units 1 and 2
Facility Operating License Nos. NPF-11 and NPF-18
NRC Docket Nos. 50-373 and 50-374

Subject: Response to NRC Request for Additional Information, dated June 25, 2015, Regarding the LaSalle County Station, Units 1 and 2, License Renewal Application, Environmental Review

References:

1. Letter from Michael P. Gallagher, Exelon Generation Company, LLC (Exelon Generation), to U.S. Nuclear Regulatory Commission (NRC) Document Control Desk, "Application for Renewed Operating Licenses," dated December 9, 2014
2. Letter from David Drucker, NRC, to Michael P. Gallagher, Exelon Generation, "Requests for Additional Information for the Review of the LaSalle County Station, Units 1 and 2, License Renewal Application," dated June 25, 2015

In the Reference 1 letter, Exelon Generation Company, LLC (Exelon Generation) submitted the License Renewal Application (LRA) for the LaSalle County Station, Units 1 and 2. In the Reference 2 letter, the NRC requested additional information to support the Staff's review of Section 4.13 (Impacts Common to All Alternatives: Uranium Fuel Cycle) in the LaSalle County Station Applicant's Environmental Report (Appendix E to the LRA).

The enclosure to this letter contains response sheets that provide information requested by each of the Staff's questions and/or identify supporting documents and materials.

This letter and its enclosure contain no regulatory commitments.

If you have any questions, please contact Ms. Nancy Ranek, Environmental Lead, Exelon Generation License Renewal, at 610-765-5369.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 7-29-2015

Respectfully,

Michael P. Gallagher
Vice President - License Renewal Projects
Exelon Generation Company, LLC

Enclosure:
LaSalle County Station Units 1 & 2 Response Sheets for NRC License Renewal Environmental Review Requests for Additional Information – Spent Fuel Transportation

cc: Regional Administrator - NRC Region III
NRC Project Manager (Environmental Review), NRR-DLR
NRC Project Manager (Safety Review), NRR-DLR
NRC Project Manager, NRR-DORL LaSalle County Station
NRC Senior Resident Inspector, LaSalle County Station
Illinois Emergency Management Agency - Division of Nuclear Safety

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ENCLOSURE

LaSalle County Station, Units 1 & 2

Response Sheets for NRC License Renewal Environmental Review Requests for Additional Information – Spent Fuel Transportation

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LaSalle County Station, Units 1 & 2

Response to Request for Additional Information

RAI #: **TR-01** **Category:** Spent Fuel Transportation

Statement of Question:
Provide an evaluation of the heat load for an irradiated fuel shipment for comparison to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, Table S-4.

An analysis of the heat load is contained in 10 CFR 51, Table S-4, but is not contained in the LaSalle County Station (LSCS), Units 1 and 2, Environmental Report (ER) (Section 4.13), the Transportation Calculation Package, or CALC-194-4735-02.

Response:
Exelon Generation used the ORIGEN code to estimate the decay heat at 5 years after discharge from the reactor for spent fuel with burnup of 75,000 MWD/MTU. The estimated heat load for a cask containing 0.5 MTU of such higher burnup fuel is approximately 2,160 W or 7,370 BTU/hr. This amount of heat is small and released over the entire transportation route.

Under separate correspondence to the NRC, Exelon Generation is providing a revised version of all text and tables in Section 4.13 of the LSCS License Renewal ER. The heat load information provided above will be included therein along with Exelon Generation's evaluation of its significance. That submission is planned to occur during July 2015.

LaSalle County Station, Units 1 & 2

Response to Request for Additional Information

RAI #: **TR-02** **Category:** Spent Fuel Transportation

Statement of Question:
The data is not used consistently between CALC-194-4735-02 and the actual RADTRAN run. Clarify and provide a revised analysis of the incident-free dose at stops.

In CALC-194-4735-02, the incident-free dose at stops is 2.51E-1 person-rem/shipment (see Table 3 and the RADTRAN output). However, in the Transportation Calculation Package, 2.15E-1 person-rem/shipment is used for the incident-free dose at stops, which results in the dose to general public (onlookers) being underestimated.

Page 5 of CALC-194-4735-02 states that the population density used at stops was 23,933 people/km^2. However, in the RADTRAN runs contained in Appendix C of CALC-194-4735-02, a population density of 19,944 people/km^2 was used.

Response:
Exelon Generation has revised both CALC-194-4735-02 and the Transportation Calculation Package using an updated RADTRAN analysis for LSCS high-burnup spent fuel. In conjunction with these revisions, all dose-per-shipment values in the Transportation Calculation Package were verified to be consistent with the revised CALC-194-4735-02 (CALC-194-4735-02, Revision 1). Also, the updated RADTRAN analysis was performed using the correct population density at stops, which is 23,933 people/km^2.

Under separate correspondence to the NRC, Exelon Generation is providing a revised version of all text and tables in Section 4.13 of the LSCS License Renewal ER. The ER revisions describe all results from the updated RADTRAN analysis, CALC-194-4735-02, Revision 1 and the revised Transportation Calculation Package. That submission is planned to occur during July 2015.

LaSalle County Station, Units 1 & 2

Response to Request for Additional Information

RAI #: **TR-03** **Category:** Spent Fuel Transportation

Statement of Question:
Provide rationale and justification for the 5 normalized shipments of spent nuclear fuel (SNF) per year used in the impact calculation. The NRC staff considers that the number of shipments are to be of irradiated fuel normalized to the 1100 MW(e) reference reactor with a capacity factor of 0.8. When normalizing the shipments, consider for the following and revise the calculations as appropriate:

a. Provide the number of irradiated fuel shipments using a shipping container capacity of 0.5 MTU/container. For the purposes of comparison to Table S-4, a cask capacity of 0.5 MTU/cask, based on WASH-1238, should be used.

b. In the Transportation Calculation Package, incident-free impacts were calculated based on 5 normalized shipments of SNF per year. The 5 normalized shipments appear to have been calculated based on 5.65 shipments/year (unnormalized), which appears to be based on 28.27 MTU/year annual reload/5 fuel assemblies/cask= 5.65. Instead, the calculation should have started with 28.27 MTU/year annual reload/(5 fuel assemblies/shipment x 0.1767 MTU/fuel assembly)= 32 shipments/year (unnormalized).

c. The spent fuel cask capacity used in the analysis was 9 assemblies, derated to 5 assemblies, or 0.884 MTU/cask (5 fuel assemblies/cask x 0.1767 MTU/fuel assembly= 0.884 MTU/shipment). Again, for the purposes of comparison to Table S-4, a cask capacity of 0.5 MTU/cask, based on WASH-1238, should be used.

d. Using a cask capacity of 0.5 MTU/shipment would result in 46.5 normalized shipments per year. {28.27 MTU/year annual reload/0.5 MTU/shipment x (1100 MWe x 0.8) [reference reactor]/(1163.5 MWe x 0.92)= 46.5 shipments}.

Response:
Exelon Generation has revised both CALC-194-4735-02 and the Transportation Calculation Package using an updated RADTRAN analysis for LSCS high-burnup spent fuel. The following items indicate how each of the corresponding items listed in the RAI above is addressed by the revisions.

a. CALC-194-4735-02 and the Transportation Calculation Package were revised to use a cask capacity of 0.5 MTU per cask.

b. Based on updated information concerning the amount of fuel replaced during a typical refueling outage (i.e., 36% of the 764 fuel assembly core inventory in each unit on staggered 24-month refueling cycles), the number of spent fuel shipments annually per reactor was calculated as follows:
   (0.36 x 764 fuel assemblies/refueling) x (0.1767 MTU/fuel assembly)
   x (1 refueling/2 yrs) ÷ 0.5 MTU/shipment = 48.60 shipments/yr (unnormalized).

c. CALC-194-4735-02 and the Transportation Calculation Package were revised to use a cask capacity of 0.5 MTU per cask.

d. The normalized number of shipments per year was calculated as follows:
(24.30 MTU/yr [annual reload]) ÷ (0.5 MTU/shipment)
x (1100 MWe x 0.8 [reference reactor]) ÷ (1163.5 MWe x 0.92 [LSCS per unit])
= 39.95 shipments/yr.(normalized)

Incident-free Transportation

The revised normalized population dose estimates for 39.95 incident-free LSCS spent fuel shipments per year at the peak rod burnup are summarized below.

Population dose (person-rem per shipment)		
Transportation workers	General public (onlookers)	General public (along route)
0.0357	0.439	0.0335
Population dose (person-rem per reactor year)		
Transportation workers	General public (onlookers)	General public (along route)
1.43	17.6	1.34

The population dose estimates shown above for transportation workers and the general public living along the transportation route are within the bounds of the 10 CFR 51.52, Table S-4 population dose levels, which are 4 person-rem per year and 3 person-rem per year respectively. However, the conservatively predicted population dose shown above for onlookers is higher than the corresponding Table S-4 value, which is 3 person-rem per year. Nevertheless, Exelon Generation concludes that impacts to human health or the environment from incident-free LSCS high-burnup spent fuel transport would be similar to the impacts envisioned in the 2013 GEIS, and would therefore be SMALL because the conservatively predicted population dose to onlookers would likely be below Table S-4 values if it were more realistically estimated.

Accidents during Transportation

Assuming shipments containing 0.5 MTU of spent fuel at the peak rod burnup, the normalized postulated accident risk associated with transportation of spent fuel is provided below.

Population dose-risk (person-rem per shipment)[1]	**Population dose-risk (person-rem per reference reactor year)**
5.64×10^{-7}	2.25×10^{-5}

The population dose shown above for accidents during transportation of LSCS high-burnup spent fuel to a repository is very small. However, no direct comparison can be made between 10 CFR 51.52, Table S-4 values and the values shown above because Table S-4 does not numerically quantify radiological effects stemming from transportation accidents. Rather, it characterizes such effects as “Small.” Even so, no detectable increase in environmental effects that otherwise occur from average

[1] The value presented is probability multiplied by collective dose.

background radiation exposure in the U.S. (i.e., 162,000 person-rem per year) is expected to result from adding the population dose values projected for accidents during transportation of LSCS high-burnup spent fuel. Therefore, Exelon Generation concludes that impacts to human health or the environment from accidents during LSCS high-burnup spent fuel transport would be similar to the impacts envisioned in the 2013 GEIS, and would therefore be SMALL.

Under separate correspondence to the NRC, Exelon Generation is providing a revised version of all text and tables in Section 4.13 of the LSCS License Renewal ER. The ER revisions describe all results from the updated RADTRAN analysis, CALC-194-4735-02, Revision 1 and the revised Transportation Calculation Package, as well as detailed discussions of the bases for Exelon Generation's conclusions regarding the impacts from incident-free transportation of high-burnup spent fuel and from accidents during transportation of such spent fuel. Submission of the ER revisions is planned to occur during July 2015.

LaSalle County Station Units 1 & 2

Response to Request for Additional Information

RAI #: **TR-04** **Category:** Spent Fuel Transportation

Statement of Question:
Explain the following inconsistencies and if appropriate, provide a revised analysis of transportation accident impacts.

Table 3 on page A7 of CALC-194-4735-02 contains a highway accident rate of 8.37E-6 accidents/km for Nevada. However, in the RADTRAN runs contained in Appendix C of CALC-194-4735-02, an accident rate of 8.37E-5 accidents/km was used for Nevada.

For high burnup, GNF2 fuel in Table 2 on page 6 of CALC-194-4735-02 lists the RADTRAN source term. Several values in this table do not match the values used in the RADTRAN analysis. For example, Ce-144 is 1.21E+4 Ci/cask in the table, but 2.44E+4 Ci/cask in the RADTRAN run; Cs-137 is 1.82E+5 Ci/cask in the table, but 3.55E+5 Ci/cask in the RADTRAN run; and Kr-85 is 1.20E+4 Ci/cask in the table, but 1.02E+4 Ci/cask in the RADTRAN run. The footnotes to Table 2 on page 6 of CALC-194-4735-02 indicate that Ba-137m is included as Cs-137, and that Pr-144 and Pr-144m are included as Ce-144, i.e., the Cs-137 and Ba-137m inventories are added and entered in the RADTRAN run for total Cs-137, and the Ce-144, Pr-144, and Pr-144m inventories are added and entered in the RADTRAN run as total Ce-144.

Determine if the dose conversion factors used in RADTRAN for Cs-137 and Ce-144 include the contributions from the short-lived progeny radionuclides Ba-137m, Pr-144, and Pr-144m, and provide the technical justification for adding these inventories as indicated in the footnote, and provide a revised analysis of transportation accident impacts.

Response:
Exelon Generation has revised both CALC-194-4735-02 and the Transportation Calculation Package using an updated RADTRAN analysis for LSCS high-burnup spent fuel. In conjunction with these revisions, the error in the highway accident rate for Nevada has been corrected.

The RADTRAN library contains dose conversion factors and other radionuclide specific parameters for 149 radionuclides and allows for user-defined data to be defined in addition to utilizing the preset library values. Per the RADTRAN User Guide (Ref. 1, page 92), the dose conversion factor (DCF) for Cs-137 includes the weighted contributions from its short-lived daughter product, Ba-137m. Similarly, the Ce-144 DCFs in the RADTRAN library include the weighted contribution from short-lived daughter products Pr-144 and Pr-144m. Since the DCFs are already weighted for the dose increase due to the daughter products, there is no need to create user defined DCF inputs to separately account for the daughters. Simply adding the activities of the daughters to the activity of the parent isotope is conservative since the conversion factors were already weighted to account for the increase in dose due to the contributions of the daughter products.

References

1. Weiner, R.F.; Hinojosa, D.; Heames, T.J.; Ottinger Farnum, K.; Kalinina, E.A. RADTRAN 6/RADCAT 6 User Guide. Albuquerque, NM: Sandia National Laboratories; 2013 Sep; SAND2013-8095.

LaSalle County Station, Units 1 & 2

Response to Request for Additional Information

RAI #: **TR-05** **Category:** Spent Fuel Transportation

Statement of Question:
Clarify the source of the Am-242m listed in Table 2 of CALC-194-4735-02.

Am-242m is listed in Table 2 of CALC-194-4735-02. However, Am-242m is not listed in the ORIGEN output in of CALC-194-4735-02.

Response:
An Excel function was utilized to automate the reduction of the ORIGEN output into the RADTRAN source term presented in Table 2 of CALC-194-4735-02. However, one of the parameters for the function was left unspecified, which caused the function to default to looking for closest match instead of exact match. As a result, the Am-242 data were incorrectly specified as Am-242m. Exelon Generation has revised both CALC-194-4735-02 and the Transportation Calculation Package using an updated RADTRAN analysis for LSCS high-burnup spent fuel. In conjunction with these revisions, the erroneous RADTRAN source term for Am-242m in Table 2 of the revised CALC-194-4735-02 (CALC-194-4735-02, Revision 1) has been corrected to reflect 0 Ci of Am-242m. In addition, the remainder of the RADTRAN source term data in Table 2 of CALC-194-4735-02, Revision 1 has been line-by-line verified to assure its accuracy.

LaSalle County Station, Units 1 & 2

Response to Request for Additional Information

RAI #: **TR-06** **Category:** Spent Fuel Transportation

Statement of Question:
Clarify whether the light elements Co-58, Co-60, Fe-55, Fe-59, Mn-54, and Cr-51 listed in Table 2 on page 6 of CALC-194-4735-02 are from actual crud (i.e., exterior deposits on the fuel assembly) or if they are structural material. If they are structural material, the crud inventory for these radionuclides should also be provided.

The inventory for the light elements Co-58, Co-60, Fe-55, Fe-59, Mn-54, and Cr-51 is taken from CALC-194-4735-01 and appears to be from structural material, not crud deposits on the irradiated fuel.

Response:
The inventory for the light elements listed in Table 2 of CALC-194-4735-02 is assumed to be crud. As stated in the question, the inventory for the light elements is taken from CALC-194-4735-01 and is structural material. However, the structural material is all assumed to be turned into crud, which is conservative. This was done because no actual crud data were available.

LaSalle County Station, Units 1 & 2

Response to Request for Additional Information

RAI #: **TR-07** **Category:** Spent Fuel Transportation

Statement of Question:
Clarify the Sb-125 inventory in Table 2 of on page 6 of CALC-194-4735-02.

Table 2, page 6 of CALC-194-4735-02 lists a Sb-125 inventory of 7.19E+2 Ci/assembly. However, CALC-194-4735-01 lists two Sb-125 inventories, 7.19E+2 Ci/assembly from fission products (p. 15) and 1.69E+2 Ci/assembly from light elements (p. 14).

Response:
An Excel function was utilized to automate the reduction of the ORIGEN output into the RADTRAN source term presented in Table 2 of CALC-194-4735-02. The function originally utilized was not coded properly to look for duplicate inventory listings and stopped searching once a single row of data was found. As a result, the second Sb-125 inventory was inadvertently missed in the creation of the RADTRAN source term in Table 2 of CALC-194-4735-02.

Exelon Generation has revised both CALC-194-4735-02 and the Transportation Calculation Package using an updated RADTRAN analysis for LSCS high-burnup spent fuel. In conjunction with these revisions, the RADTRAN source term in Table 2 of CALC-194-4735-02 has been revised (CALC-194-4735-02, Revision 1). In addition, the ORIGEN data files were re-examined, and three isotopes in Table 2 – Sb-125, Sr-89, and Y-90 – that were also affected by this issue were corrected.

LaSalle County Station, Units 1 & 2

Response to Request for Additional Information

RAI #: **TR-08** **Category:** Spent Fuel Transportation

Statement of Question:
Provide a reference for the gamma fraction of 0.91 and the neutron fraction of 0.09 used in CALC-194-4735-02.

No reference is listed for the gamma and neutron fractions.

Response:
NUREG-1437, Addendum 1 (pages 27-28) discusses the potential impacts of higher fuel burnup on gamma-ray and neutron emissions from a spent fuel transport cask. This document states that "[f]or nominal burnups, the dose rates at the surface and 2-m from the surface are approximately 90 percent gamma-rays and 10 percent neutrons." This is the justification for the gamma and neutron fractions used in CALC-194-4735-02. Since the high burnup shipments were derated to 0.5 MTU per shipment, but kept at the regulatory dose rate limits, the split between gamma and neutron fractions was not changed for the higher burnup case. This is further justified by the fact that neutron and gamma radiation are similarly attenuated in air up to about 700 m (2,296 feet). As a result, the transportation dose results are insensitive (less than a few percent) to the difference between 90% and 100% gamma fraction.

In addition to the attenuation of neutrons in air, transportation casks are designed to absorb neutrons and thus limit the neutron dose in the vicinity of the cask. As a result, several well know transportation analyses for spent fuel simply assume that the incident-free dose consists entirely of gamma radiation. A sensitivity study was performed using the high burnup case from CALC-194-4735-02. In this sensitivity study, the only parameter that was changed was the gamma/neutron fraction in the VEHICLE and the PACKAGE rows of the input file, which were changed from 0.91 and 0.09 to 1.0 and 0.0, respectively. The results of this sensitivity study are summarized below and show that the difference in the different components of the incident-free dose is less than 2%.

	Sensitivity Case 100% gamma	**CALC-194-4735-02 Case** 91% gamma / 9% neutron	**% Difference**
Incident-Free Doses			
CREW (person-rem)	3.54E-02	3.57E-02	-0.42%
OFF LINK (person-rem)	3.48E-02	3.35E-02	1.90%
ON LINK (person-rem)	6.23E-02	6.30E-02	-0.56%
STOPS (person-rem)	3.73E-01	3.76E-01	-0.40%
MAX IND (rem)	1.49E-06	1.49E-06	0.00%

LaSalle County Station, Units 1 & 2

Response to Request for Additional Information

RAI #: **TR-09** **Category:** Spent Fuel Transportation

Statement of Question:
Provide a revised analysis of incident-free and transportation accident impacts by applying the TRAGIS highway route controlled quantity (HRCQ) option and TRAGIS state-specific distances and population densities in urban, suburban, and rural areas.

The TRAGIS analysis for LSCS to Yucca Mountain was run using the assumption that a commercial route would be used with state-specific distances and generic population densities in urban, suburban, and rural areas. However, prior NRC sponsored or reviewed spent nuclear fuel shipment assessments (e.g., NRC's NUREG-2125 and the Department of Energy's Yucca Mountain EIS) analyzed the routing as a HRCQ shipment as well as applied state-specific distances and population densities in urban, suburban, and rural areas. Both features are available in current online version of TRAGIS.

Response:
Exelon Generation has revised both CALC-194-4735-02 and the Transportation Calculation Package using an updated RADTRAN analysis for LSCS high-burnup spent fuel. The revised RADTRAN analysis uses routing from WebTRAGIS that specifies HRCQ routes—an option not available at the time the original RADTRAN analysis for the LSCS License Renewal Environmental Report was done. The HRCQ routing and associated state-specific distances and population densities are presented in the revised CALC-194-4735-02 (CALC-194-4735-02, Revision 1).