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

December 5, 2014

Mr. George H. Gellrich
Vice President
Exelon Generation Company, LLC
1650 Calvert Cliffs Parkway
Lusby, MD 20657

SUBJECT: AMENDMENT REQUEST NO. 1 TO RENEWED MATERIALS LICENSE NO. SNM-2505 FOR THE CALVERT CLIFFS SPECIFIC INDEPENDENT SPENT FUEL STORAGE INSTALLATION – FIRST REQUEST FOR ADDITIONAL INFORMATION (TAC NO. L24912)

Dear Mr. Gellrich:

By letter dated March 26, 2014, as supplemented July 25, October 10, and December 3, 2014, Exelon Generation Company, LLC (Exelon Generation), submitted license amendment request (LAR) No. 1 to the U.S. Nuclear Regulatory Commission (NRC) for Renewed Materials License No. SNM-2505 (LAR 2505-1) for the Calvert Cliffs specific independent spent fuel storage installation (ISFSI). The amendment, if approved, would authorize the storage of Westinghouse and Areva Combustion Engineering 14X14 fuel in the NUHOMS® 32PHB Dry Shielded Canister system.

The NRC staff has reviewed your application and has determined that a request for additional information (RAI) is required to complete its detailed technical review. The RAIs are provided in the enclosure to this letter. We request that you provide the information by December 31, 2014. Please inform us in writing at your earliest convenience, but no later than December 24, 2014, if you are not able to provide the information by the requested date. You should also include a new proposed submittal date and the reasons for the delay to assist us in re-scheduling your review.

Please reference Docket No. 72-8 and TAC No. L24912 in future correspondence related to this licensing action.

If you have any questions, please contact me at (301) 287-9250.

Sincerely,

/RA/

John M. Goshen, P.E., Project Manager
Spent Fuel Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards
Washington, DC 20555

Docket No.: 72-8

TAC No.: L24912

Enclosure: As stated

cc: CCNPP Service List (w/o enclosure)

If you have any questions, please contact me at (301) 287-9250.

Sincerely,

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CALVERT CLIFFS INDEPENDENT SPENT FUEL STORAGE INSTALLATION

RENEWED MATERIALS LICENSE NO. SNM-2505

DOCKET NO. 72-8

LICENSE AMENDMENT REQUEST NO. 1

FIRST REQUEST FOR ADDITIONAL INFORMATION

By letter dated March 26, 2014, as July 25, October 10, and December 3, 2014, Exelon Generation Company, LLC (Exelon Generation), submitted license amendment request (LAR) No. 1 to the U.S. Nuclear Regulatory Commission (NRC) for Renewed Materials License No. SNM-2505 (LAR 2505-1) for the Calvert Cliffs specific independent spent fuel storage installation (ISFSI). The amendment, if approved, would authorize the storage of Westinghouse and Areva Combustion Engineering 14X14 fuel in the NUHOMS®-32PHB Dry Shielded Canister (DSC) system.

Chapter 5 Structural Evaluation

RAI- 5-1 Explain rationale behind the 0.5 multiplication factor for the calculations involving the HSM-HB overturning due to flood load and the Horizontal Storage Module (HSM) HB sliding due to flood load in reference 13.10 of the Updated Safety Analysis Report (USAR).

Reference 13.10 is Transnuclear Calculation No. NUH32PHB-0208, HSM-HB Structural Analysis for NUHOMS®-32PHB System Design Calculation. The staff notes that in these calculations, the drag force used for the overturning moment and the sliding force is multiplied by a factor of 0.5. The explanation for this factor is, “50% of the drag force is assumed to act on one face of one module and 50% on opposite face of the adjacent module.” Assumption number 6 states, “For stability analysis of the HSM-HB subjected to flood load a minimum of two modules adjacent to each other are required to prevent overturning and sliding.” It is not clear how the interaction of the two modules reduces the drag force by 50%.

This information is needed to demonstrate compliance with 10 CFR 72.122.

RAI- 5-2 Provide NUH32PHB-0203, Rev 1, “PWR Fuel Rod Accident Side Drop Loading Stress Analysis for NUHOMS®-32PHB System.”

This reference is not included in Section 13.13 of the USAR, but is referenced in Reference 13.9, Transnuclear Calculation No. NUH32PHB-0207, “Fuel Rod End Drop Analysis for NUHOMS®-32PHB System Design Calculation.” This document contains the material properties of Zircaloy-4 and M-5 cladding at

750° F that establishes the scaling factor of 1.082 that was used to calculate the maximum principle strain in the M-5 cladding as a result of the end drop.

This information is needed to demonstrate compliance with 10 CFR 72.122.

RAI- 5-3 Provide ANSYS input and output files associated with the structural calculations of section 13.13 of the USAR.

The staff requested these calculations in the Request for Supplemental Information. Much of the structural analysis is completed through the use of finite element analysis with ANSYS and cannot be evaluated without the input and output files. The staff specifically prefers text based files (i.e. .inp) with an appropriate level of comments to allow for a timely technical review.

This information is needed to demonstrate compliance with 10 CFR 72.122.

RAI- 5-4 Provide a time-limited aging analysis (TLAA) or an aging management program (AMP) to address the aging effect of cracking due to thermal cycling fatigue in the HSM-HB concrete.

Fatigue is an age-related degradation mechanism caused by cyclic stressing of a component by either mechanical or thermal stresses, which becomes evident by cracking of the component. The license amendment request (LAR) does not address thermal cycling fatigue of the concrete of the HSM-HB. A fatigue analyses may be submitted as a TLAA if based on design thermal transients involving time-limited assumptions. Otherwise, the LAR should justify the adequacy of the AMP approved in the renewed license (ML14274A038) or include a revised AMP to address this aging mechanism.

This information is needed to demonstrate compliance with 10 CFR 72.24(c), 72.122(b)(1) and (f), 10 CFR 72.162 and 10 CFR 72.172.

Chapter 6 Thermal Evaluation

RAI- 6-1a Provide a technical basis for the revised maximum air temperature rise of 80° F for the HSM-HB currently provided in Technical Specification 3.4.1.1.

The applicant retains the current limit of 64° F for the maximum air temperature rise in a HSM containing a 24P or 32P DSC, but is requesting an increased limit of up to 80° F for the maximum air temperature rise in the HSM-HB storage module when loaded with a 32PHB DSC. The increase seems excessive in comparison to the magnitude of the changes in the limiting total decay heat loads for the 32 PHB in the HSM-HB.

It is expected that the HSM-HB storage modules would be somewhat more efficient than the older HSMs in the ISFSI. The 80° F temperature rise limit means that with high ambient temperatures (with peaks typically in the range of 90° F for sustained periods of time in the summer), the exit air temperature could approach 170° F or higher for the HSM-HB, if loaded with a 32PHB at design basis decay heat (29.6 kW). The applicant should provide the basis explaining why an increase of the maximum air temperature rise limit is needed for the inlet-to-exit of the storage module when loaded with 32PHB DSC.

RAI- 6-1b Explain the methodology that is used to determine the inlet-to-exit temperature rise in the storage module (HSM and HSM-HB.) How is the measured temperature data processed and evaluated to determine the overall temperature rise through the module?

The staff is seeking to understand how compliance is evaluated with respect to the limit defined in Technical Specification 3.4.1.1.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-2a Provide the technical basis for allowing up to 8 hours to initiate corrective action when these time limits are exceeded, and show that the peak temperatures within the DSC, including the peak cladding temperature, do not exceed the specified limits.

The proposed new Technical Specification (TS) 3.4.3.2 "Time Limit for Completion of NUHOMS®-32PHB DSC Transfer Operation", defines specific time limits for operations from initiation of draining water from the DSC/TC annulus to completion of insertion of the DSC into the HSM-HB (72 hours for decay heat loads up to 23.04 kW, 48 hours for decay heat loads up to 25.6 kW, or 20 hours for decay heat loads up to 29.6 kW). If the specified time limit is exceeded, the "required ACTION" section states that the operators have 8 hours to INITIATE the corrective action, one of which is "complete the transfer of the DSC to the HSM." This in effect adds 8 hours to the stated time limits defined in 3.3.2.1. Therefore the operators actually have up to 80 hours, 56 hours, or 28 hours, respectively, as the corresponding limiting decay heat loads for completion of transfer operations. The thermal analyses presented in the Calculation Packages provided in support of this review include analyses only to the specified limits of 72 hours, 48 hours and 20 hours.

RAI- 6-2b Provide additional analysis, justifying that the 8-hour time limit is conservative for this bounding configuration, as well as for the more benign failure from steady-state with forced cooling (FC).

The thermal analysis in the calculation package NUH32PHB-0401 is presented to show that an 8-hour time limit for initiating corrective action in response to loss of the forced air in the DSC/TC annulus during transfer operations is sufficient to assure that temperature limits, including peak cladding temperature, are not exceeded. This analysis assumes that loss of FC occurs from a steady-state condition with FC, which has no time limit for completion of transfer operations. (The calculation package reports a steady-state PCT of 689° F for the maximum permitted decay heat load case of 29.6 kW.)

The staff has noted that the failure of FC from a steady-state condition is not bounding and may not be conservative. The bounding case for failure of FC would be at the point where the time limit applicable to the DSC (depending on its decay heat load), as defined in TS 3.3.3.1, has been exceeded, and FC has just been initiated as a corrective action. The PCT at this point in the transient would be expected to be much higher than the steady-state PCT with FC active.

The staff has noted that the failure of FC from a steady-state condition with FC is not bounding and may not be conservative. The applicant should provide additional analysis for determining the time period to complete the transfer operation without exceeding peak temperature limits, as a function of the period of time that FC was in operation before failure.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-3 Explain why a temperature of 280° F is considered in the thermal evaluation for the NS-3 neutron shield.

The applicant stated in calculation package NUH32PHB-0101 that a maximum bulk temperature of 280° F is considered in the thermal evaluation for the NS-3 neutron shield to limit the off-gas pressure and to limit the hydrogen loss to less than 10% within the NS-3 neutron shield.

The applicant should provide more information to explain why a maximum temperature of 280° F is considered for the NS-3 neutron shield and how this temperature considered in the thermal analysis will limit the off-gas pressure and the hydrogen loss (to less than 10%) in the NS-3 neutron shield.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-4 Provide more information to support the bounding correlation of the DSC shell temperatures, comparing the HSM-H model with 61BTH DSC and HSM-HB model with 32PHB DSC.

The applicant provided the summary of boundary conditions in Section 5.1.2 of calculation package NUH32PHB-0403 as (a) the 32PHB DSC length of 176.5 inches is shorter than the 61BTH DSC length of 195.8 inches, (b) the 32PHB DSC heat load of 29.6 kW is less than the 61BTH DSC heat load of 31.2 kW, and (c) the shorter 32PHB DSC in HSM-HB has a lower hydraulic resistance than the 61BTH DSC in HSM-H. Therefore based on these assumptions the applicant assumed the DSC shell temperatures from the HSM-H model with 61BTH DSC are bounding for the 32PHB, and can be used as the DSC shell temperatures for the thermal analysis of HSM-HB model with 32PHB DSC.

There are significant configuration differences between the HSM-H (containing the 61BTH DSC) and the HSM-HB (containing the 32PHB DSC). Therefore, the DSC shell temperatures of 61BTH DSC in HSM-H may not bound the DSC shell temperatures of 32PHB DSC in HSM-HB. The applicant should provide more information to support the bounding correlation for the DSC shell temperatures between HSM-H model with 61BTH DSC and HSM-HB model with 32PHB DSC.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-5 Justify why an ambient temperature of 0° F is selected as the design basis DSC shell temperatures under normal storage for 32PHB DSC storage conditions.

The applicant stated in Section 5.1.2 of calculation package NUH32PHB-0403 that the DSC shell temperatures for the 31.2 kW heat load in the HSM-H model are used to map the surface temperatures for 32PHB DSC shell surface temperatures. The DSC shell temperatures based on normal ambient 0° F, off-normal ambient 117° F and accident 40-hour blocked vent from the HSM-H model are the design basis DSC shell temperatures for 32PHB DSC storage conditions.

The staff questions the description of an ambient temperature of 0° F as "normal". This temperature is in some cases used as "cold, normal", but a more appropriate mapping of the DSC shell temperatures would be at "hot, normal" ambient, which is more typically 100° F, and is usually selected as the design basis ambient temperature for normal storage conditions. A lower ambient temperature of 0°F would be less conservative in thermal calculations under normal storage. The applicant is required to clarify use of 0° F ambient to define normal storage conditions in the evaluations in calculation package NUH32PHB-0403.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-6 Justify the application of the solar heat load to only the top half of the horizontal package during outdoor transfer operations. Perform sensitivity studies of the effect of this assumption by applying the solar heat load to the full circumference of the cask when in the horizontal orientation.

The applicant assumes that only the 'top half' of the cask sees the solar heat load when in the horizontal orientation. However, the heat load values specified in 10 CFR 71.71 are based on a circumferential average, calculated from detailed studies of specular solar radiation on exposed surfaces of various shapes, taking into account the fact that the lower half of a horizontal cylinder still sees some solar radiation, due to reflection from the ground, and the changing angle of the sun throughout the day. The averaged values specified in 10 CFR 71.71 should therefore be applied to the full circumference of the cask. The applicant should explain in detail (including analyses of specular radiation on horizontal cylinders, if appropriate) why it might be appropriate to apply the 10 CFR 71.71 solar heat load value to only the top half of the cask when in the horizontal orientation.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-7 Analyze meshing sensitivity and spatial discretization error with the GCI method and provide the calculations for review.

The applicant performed the thermal calculations of 32PHB DSC using 3-D ANSYS finite element model. The sensitivity of meshing on temperature distribution was investigated for 32P DSC (not 32PHB DSC) and the results show the maximum fuel cladding temperature change is within 1°F for 14x14 meshing when compared to the coarse meshing. The applicant stated in calculation package NUH32PHB-0403 that the results from the model meshing sensitivity analysis of 32P DSC can be applied to 32PHB DSC model with a meshing of 14x14.

Given that the application is aimed for 32PHB DSC and the 32PHB DSC model is available, the applicant should analyze the spatial discretization error directly using the 32PHB DSC model with the grid convergence index (GCI) method which is described in NUREG-2152 "Computational Fluid Dynamics Best Practice Guidelines for Dry Cask Applications".

When using the GCI method to estimate the discretization error, the following criteria should be met:

- The solution from the different grids used display monotonic convergence.
- The solution from the different grids used should be in the asymptotic range

The applicant should provide the calculations for review.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-8 Explain how the 1.3% increase of the loss coefficient due to the dose reduction inserts is determined when calculating the maximum air temperature rise limit in the cask annulus.

The applicant stated in Section M of Calvert Cliffs ISFSI USAR that the dose reduction inserts for inlet vents of HSM-HB are included in the models developed for the thermal analysis to determine the maximum air temperature rise limit in the storage module. The dose reduction inserts introduce a flow resistance to the air flow through the HSM-HB and will have an effect on the air temperature used for evaluating the NUHOMSO-32PHB DSC in HSM-HB. The increase of the loss coefficient due to the dose reduction inserts constitutes approximately 1.3% of the overall loss coefficient in the HSM-H-B.

The applicant should explain how the loss coefficient increase of 1.3% due to the dose reduction inserts was determined. The applicant should provide the estimate or calculations for staff's review and evaluation.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-9 Evaluate the impact to thermal performance of the poison plate when adding the required minimum areal densities for basket types A and B of 32PHB DSC.

The applicant stated in Calvert Cliffs ISFSI USAR that the proposed amendment will add the required minimum areal density for 32PHB DSC poison plates. The 32PHB DSC poison plate shall have a minimum B^{10} areal density of 0.019 g/cm^2 for basket type A and 0.027 g/cm^2 for basket type B. Given that the change in the properties of the poison plate may affect the heat removal capability, the applicant should evaluate the impact to the thermal performance of the poison plate when adding the required minimum areal densities for basket types A and B of the 32PH DSC.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-10 Justify the removal of the additional conservatism included in 32P thermal analysis.

The applicant noted in calculation package NUH32PHB-0407 that the radial effective thermal conductivity for the 32PHB DSC are provided up to 1100° F (Figure 8-3) by removing additional conservatism included in the 32P DSC thermal analysis, due to limiting of the temperature scale to 614° F.

The staff needs to understand what additional conservatism is removed from 32P DSC thermal analysis and assure the removal of conservatism from 32P DSC is reasonable and will not affect the thermal evaluation of 32PHB DSC.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-11 Check the equations of air and helium thermal properties and assure that correct values are used in the actual model calculations.

For air thermal properties (Table 4-8, page 16) and helium thermal properties (Table 4-9, page 17) shown in calculation package NUH32PHB-0402, the equations reported on these two pages for polynomial fits of thermal conductivity, specific heat, and viscosity for air and helium appear to be in error. The equations are given as (for example, with thermal conductivity):

$$k = \sum C_i T_i$$

To be actual polynomial fits, the formula should be

$$k = \sum C_i T_i^i$$

Using the formula as documented (without exponents) yields erroneous values for thermal conductivity, specific heat, and viscosity. (The staff verified this by checking reported gas thermal properties in standard heat transfer textbooks). Using the formula as corrected, with exponents, yields correct and consistent values for these properties over the range reported for Table 4-8.

The applicant should check whether this is documentation error. The applicant should verify that the incorrect values, generated from incorrect equations which are "directly" setup in the model, were not used in the actual calculations. The applicant should verify the modeling input, and provide revised documentation, if appropriate. If modeling input errors are found, the applicant should provide revised calculations, and provide revised results for the thermal analyses.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-12 Provide derivation of the effective thermal conductivity of nitrogen in the 0.02 Al/Poison contact gap and DSC-rail gap.

The applicant listed the effective thermal conductivity of nitrogen (N_2) for 0.02 Al/Poison contact gap in Table 5-3 and for DSC-rail gap in Table 5-8 of calculation package NUH32PHB-0403.

Explain how the "effective" thermal conductivity (both parallel and across effective thermal conductivities) was derived. The applicant should provide calculations (e.g., Excel spread sheets) to show how the effective thermal conductivity is derived for the 32PHB DSC which has different configuration from other DSCs.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-13 Provide derivation of the radial effective thermal conductivity of CE 14x14 fuel assembly for nitrogen backfill/blowdown during vacuum drying.

The applicant listed the "radial" effective thermal conductivity of CE 14x14 fuel assembly in 32PHB DSC for nitrogen backfill/blowdown during vacuum drying, in Table 8-2 of the calculation package NUH32PHB-0407.

Explain how the "radial effective" thermal conductivity is derived and provide the calculations (e.g., Excel spread sheets) to show how these radial effective thermal conductivity is derived for the 32PHB DSC which has different configuration from other DSCs.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-14 Provide derivation of the effective thermal properties of basket stainless steel plate and basket Al1100 plate used in the thermal evaluations of 32PHB DSC.

The applicant listed the "effective" thermal properties for basket stainless steel plate in Table 5-5 and for basket Al1100 plate in Table 5-7 for 32PHB DSC in the calculation package NUH32PHB-0403.

Explain how these "effective" thermal properties are derived and provide the calculations (e.g., Excel spread sheets) to show how these effective thermal properties are derived for the 32PHB DSC which has different configuration from other DSCs.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-15 Provide References 6 and 7 cited in the calculation package NUH32PHB-0406.

The applicant set the short-term temperature limit of 1300° F for accident conditions per Reference 6 (Engineering Report #NS3-020) in calculation package NUH32PHB-0406. The applicant is required to provide this report for review, so the staff can assure the limit of 1300° F is acceptable.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

RAI- 6-16 Clarify the Action 4 under TS 3.3.2.1 to assure the specification is applicable to 32PHB DSC.

The applicant added new TS 3.3.2.1 in this amendment application, and stated, under Action 4 of TS 3.3.2.1 (see Attachment 2 of Enclosure 5, Marked Up Technical Specification Pages), "*Return the transfer cask to the cask to the cask handling area and fill the transfer cask/DSC annulus with clean water, or initiate appropriate external cooling of the transfer cask outer surface by other means to limit the surface temperature increase*."

Clarify (a) whether the transfer cask is in vertical orientation or horizontal orientation under Action 4, and (b) what can be the "other means" for limiting the surface temperatures? The clarification of actual activities allowed in Action 4 will help assure that the 32PHB DSC within the TC is maintained within acceptable thermal limits when transfer time limits are exceeded and FC is not available.

This information is required by the staff to determine compliance with 10 CFR 72.128(a)(4).

Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2, ISFSI

cc:

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