Subject: License Amendment Request Regarding New Fuel Storage Vault and Spent Fuel Storage Pool Criticality Methodologies, with Proposed Changes to Technical Specifications Sections 4.3.1 and 5.6.5

1.0 SUMMARY DESCRIPTION

In accordance with 10 CFR 50.90, "Application for amendment of license, construction permit, or early site permit," Exelon Generation Company, LLC (EGC) requests an amendment to Renewed Facility Operating License Nos. NPF-11 and NPF-18 for LaSalle County Station (LSCS), Units 1 and 2, respectively. Specifically, EGC is utilizing a new criticality safety analysis (CSA) methodology (Reference 6.1) for performing the criticality safety evaluation for legacy fuel types in addition to the new GNF3 fuel design in the spent fuel pool (SFP). Use of the new SFP CSA methodology necessitates a change to the LSCS Technical Specifications (TS) 4.3.1, "Criticality." EGC is also proposing a change to the new fuel vault (NFV) CSA to utilize the GESTAR II methodology (Reference 6.4) for validating the NFV criticality safety for GNF3 fuel in the GE design NFV racks. Lastly, EGC requests the modification of TS 5.6.5 to remove the Framatome analytical method references that are no longer utilized for core operating limit determination. No Framatome fuel remains in either current operating core.

2.0 DETAILED DESCRIPTION

2.1 <u>Spent Fuel Pool Criticality Safety Analysis</u>

EGC transitioned from the GNF2 fuel design to GNF's new GNF3 fuel design at LSCS beginning in the spring of 2021. The previous SFP legacy fuel CSAs, in addition to the new fuel introduction GNF3 CSA, were prepared by Framatome Inc. (Framatome) and Holtec (see References 6.7 and 6.8). The CSA for the LSCS SFPs is now being rebaselined by GNF to:

- Simplify the validation of GNF3 fuel designs against the CSA criteria. The new analysis will move LSCS away from the need to validate the in-rack k_{inf} value for each new lattice design to now validating the in-core standard cold core geometry (SCCG) k_{inf} value against the defined limit. The SCCG k_{inf} value is generated for every lattice in each assembly design as part of the standard calculation set.

- Improve consistency among the Boiling Water Reactor (BWR) criticality safety analyses of record methods utilized across the fleet. This also includes the methods utilized to verify new GNF3 fuel designs against the criticality safety analysis of record (AOR) limitations as listed in the Technical Specifications.

The reason for this license amendment is the rebaselined SFP CSA's change from Framatome methodology to GNF methodology. This proposed methodology change requires NRC approval prior to using the CSA in support of storage of fuel in the LSCS Unit 1 and Unit 2 SFPs. The LSCS Unit 1 and Unit 2 SFP racks are designed to accommodate BWR fuel. The Unit 1 SFP racks credit BORAL for reactivity control and the Unit 2 SFP racks credit Curtiss-Wright's NETCO-SNAP-IN rack inserts made of Boralcan. The Unit 2 SFP analysis does not credit any residual Boraflex material that may remain in the rack walls in the same manner as the previous NRC approved CSA for the introduction of rack inserts to the LSCS Unit 2 SFP (Reference 6.7). The revised analysis shows that the effective neutron multiplication factor (k_{eff}) in the SFP racks fully loaded with fuel of the highest anticipated reactivity, at a temperature corresponding to the highest reactivity, does not exceed the regulatory limit of 0.95 at a 95 percent probability, 95 percent confidence level required by 10 CFR 50.68. Reactivity effects of abnormal and accident conditions are also evaluated to assure that under all credible abnormal and accident conditions, the reactivity will not exceed the regulatory limit.

The SFP analysis is performed consistent with 10 CFR 50.68 and industry guidance, including NEI 12-16, Revision 4, "Guidance for Performing Criticality Analyses of Fuel Storage at Light-Water Reactor Power Plants" (Reference 6.2). Guidance pertaining to soluble boron in the SFP is not applicable because LSCS is a BWR plant and has no soluble boron in the SFP. The calculations are performed using GNF's method of analyzing SCCG k_{inf} values and in-rack k_{inf} values and validating the linear correlation between these parameters across a wide range of k_{inf} values. This method then demonstrates that maintaining all fuel below the chosen SCCG k_{inf} upper limit results in an in-rack k_{eff} value no greater than 0.95 after accounting for biases and uncertainties (i.e., k_{max} (95/95) ≤ 0.95). A copy of the NEI 12-16 Criticality Analysis Checklist is included in Attachment 5 to identify the areas of the analysis that conform or do not conform to the guidance in NEI 12-16. Additional information is provided for any deviations or non-applicable checklist items from NEI 12-16 in Attachment 5.

The change of the SFP CSA AOR necessitates a change to Technical Specifications Section 4.3.1, "Criticality." The TS change is discussed further in Section 2.3.

2.2 New Fuel Vault Criticality Safety Analysis

The LSCS NFV racks are General Electric (GE) designed low density racks with an interrack spacing of 12.25 inches (see section 9.1.1.2 of LSCS UFSAR). The NFV rack CSA coverage for the new GNF3 fuel will be the GESTAR II (Reference 6.4) analysis for GE designed low density NFV racks upon approval of this proposed license amendment. The applicability of GESTAR II to the GNF3 fuel type is documented in the GNF3 GESTAR II validation report (Reference 6.6). The LSCS NFV interrack pitch is ≥ 10.5 inches (the criteria listed in GESTAR II) and thus the racks may be utilized to store new GNF fuel with in-rack SCCG k_{inf} ≤ 1.31 (Reference 6.4).

No TS change is needed for implementation of the GESTAR II NFV CSA methodology. The SCCG limit of k_{inf} ≤ 1.31 is the GESTAR II basis NFV CSA limit for LSCS storage of fresh GNF3 fuel.

2.3 Proposed Changes to Technical Specifications Section 4.3.1

The LSCS, Units 1 and 2 TS requirements related to spent fuel storage are contained in TS Section 4.3, "Fuel Storage." TS 4.3.1 identifies requirements pertaining to the design of the SFP storage racks. Specifically, TS 4.3.1.1.b requires a nominal 6.26-inch center-to-center distance between fuel assemblies placed in the SFP storage racks in both pools. TS 4.3.1.1.c requires that fuel stored in the Unit 2 SFP only be in cells that contain NETCO-SNAP-IN rack inserts and that all inserts maintain a minimum certified ^{10}B areal density ≥ 0.0086 $g\,^{10}B/cm^2$. Also, TS 4.3.1.1.e requires (for the Unit 2 SFP) at the interface between a non-insert rack module and an insert rack module of the spent fuel pool, that the placement of inserts will be expanded one row and one column into the non-insert rack module as necessary to completely surround all assemblies in the insert rack module with four wings of an insert. None of these sections require update as a result of the proposed change in CSA methodology.

The extraneous Framatome analysis reference in TS 4.3.1.1.a is removed, leaving a pointer only to Section 9.1.2 of the Updated Final Safety Analysis Report (UFSAR). Also, the governing k_{inf} limit structure for acceptable SFP fuel storage in TS 4.3.1.1.d is replaced with a new condition in accordance with the new CSA basis. The proposed changes are shown in the table below.

Current TS 4.3.1.1.a	**Proposed TS 4.3.1.1.a**
$k_{eff} \leq 0.95$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in either: (1) Section 9.1.2 of the UFSAR, or (2) AREVA NP Inc. Report No. ANP-2843(P), "LaSalle Unit 2 Nuclear Power Station Spent Fuel Storage Pool Criticality Safety Analysis with Neutron Absorbing Inserts and Without Boraflex," Revision 1, dated August 2009, for the Unit 2 spent fuel storage racks with rack inserts.	$k_{eff} \leq 0.95$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 9.1.2 of the UFSAR.
Current TS 4.3.1.1.d	**Proposed TS 4.3.1.1.d**
The combination of U-235 enrichment and gadolinia loading shall be limited to ensure fuel assemblies have a maximum k-infinity of 0.9185 for all lattices in the top of the assembly, a maximum k-infinity of 0.8869 for all lattices in the intermediate portion of the assembly, and a maximum k-infinity of 0.8843 for all lattices in the bottom of the assembly as determined at 4°C in the normal spent fuel pool in-rack configuration. The bottom, intermediate, and top zones are between 0"-96", 96"-126", and greater than 126" above the bottom of the active fuel.	Fuel assemblies having a maximum k_{inf} of 1.275 in the normal reactor core configuration at cold conditions.

A mark-up of the proposed TS change is provided in Attachment 2. The LSCS UFSAR will be updated in accordance with 10 CFR 50.71(e) as part of implementation of the approved amendment. A summary of the proposed changes is provided below.

- Section 9.1.1, “New Fuel Storage,” – Will be changed to reflect the acceptability of storing GNF3 fuel in the NFV once this license amendment is approved.
- Section 9.1.1.3, “Safety Evaluation,” – Will be updating some GNF2 statements to reflect having fresh GNF3 fuel.
- Section 9.1.2.1.3.2.3, “GNF3 Fuel,” – Will be updating to reflect new CSA using new methodology for Unit 1 SFP racks.
- Section 9.1.2.2.3.2.3, “GNF3 Fuel,” – Will be updating to reflect new CSA using new methodology for Unit 2 SFP racks.
- Section 9.1.5, “References,” – Will be updating references consistent with the changes made in Section 9.1.

2.4 Proposed Changes to Technical Specifications Section 5.6.5

TS 5.6.5 currently contains references to Framatome methodologies used to support the limits in the Core Operating Limits Report (COLR). Both LSCS Units were operating with full cores of GNF2 fuel on January 1, 2021 (no Framatome fuel is currently present in either LSCS operating core). Since then, Unit 2 has introduced its first full reload of GNF3 fuel. EGC is confident that the reinsertion of a Framatome bundle in a future reload will not be necessary. The proposed TS change to 5.6.5.b removes all Framatome methodology references because they are no longer utilized. The reference to the Boiling Water Reactor Owner's Group (BWROG) stability methodology was also removed because it is contained within the one remaining reference, GNF's GESTAR II methodology topical report. The proposed change to TS 5.6.5.b is shown below.

Current TS 5.6.5.b	Proposed TS 5.6.5.b
b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents: 1. ANF-524(P)(A), "ANF Critical Power Methodology for Boiling Water Reactors." 2. ANF-913(P)(A), "COTRANSA 2: A Computer Program for Boiling Water Reactor Transient Analysis." 3. ANF-CC-33(P)(A), "HUXY: A Generalized Multirod Heatup Code with 10 CFR 50, Appendix K Heatup Option." 4. XN-NF-80-19(P)(A), "Advanced Nuclear Fuel Methodology for Boiling Water Reactors." 5. XN-NF-85-67(P)(A), "Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel." 6. EMF–CC-074(P)(A), Volume 4 – "BWR Stability Analysis: Assessment of STAIF with input from MICROBURN-B2." 7. XN-NF-81-58(P)(A), "RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model." 8. XN-NF-84-105(P)(A), "XCOBRA-T: A Computer Code for BWR Transient Thermal-	b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents: 1. NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel." The COLR will contain the complete identification for each of the TS referenced topical reports used to prepare the COLR (i.e., report number, title, revision, date, and any supplements).

Current TS 5.6.5.b	Proposed TS 5.6.5.b
Hydraulic Core Analysis." 9. EMF-2209(P)(A), "SPCB Critical Power Correlation." 10. ANF-89-98(P)(A), "Generic Mechanical Design Criteria for BWR Fuel Designs." 11. NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel." 12. NFSR-0091, "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods." 13. EMF-85-74(P)(A), "RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model." 14. EMF-2158(P)(A), "Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2." 15. NEDC-33106P, "GEXL97 Correlation for Atrium-10 Fuel." 16. EMF-2245(P)(A), "Application of Siemens Power Corporation's Critical Power Correlations to Co-Resident Fuel." 17. EMF-2361(P)(A), "EXEM BWR-2000 ECCS Evaluation Model." 18. NEDO-32465-A, "BWR Owners' Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications," August 1996. 19. ANF-1358(P)(A), "The Loss of Feedwater Heating Transient in Boiling Water Reactors." The COLR will contain the complete identification for each of the TS referenced topical reports used to prepare the COLR (i.e., report number, title, revision, date, and any supplements).	

A mark-up of this proposed TS change is provided in Attachment 2. The LSCS UFSAR will be updated in accordance with 10 CFR 50.71(e) as part of implementation of the approved amendment.

3.0 TECHNICAL EVALUATION

3.1 Spent Fuel Pool Criticality Safety Analysis

3.1.1 Overview of System Design and Operation

The LSCS UFSAR Section 9.1.2, "Spent Fuel Storage," documents the Unit 1 and Unit 2 SFP safety design bases as follows:

A. The fuel array in the fully loaded spent fuel racks is subcritical, by at least 5% Δk.

B. The spent fuel storage racks, containing their full complement of fuel assemblies (i.e., 3986 for Unit 1, including the 4 defective fuel storage locations and 4078 for Unit 2, including the 5 defective fuel storage locations) are designed to withstand the seismic loadings of the operating basis earthquake (OBE) and the safe shutdown earthquake (SSE) to minimize distortion of the fuel storage arrangement.

C. The flooded spent fuel pools provide a water barrier which ensures sufficient shielding to protect plant personnel from exposure to radiation in excess of 10 CFR 20, “Standard for Protection Against Radiation,” guidelines.

D. The spent fuel storage facility is designed to prevent missiles generated by high winds from damaging the fuel.

To achieve the safety design bases LSCS has two joined SFPs, which provide for storage of new unirradiated and irradiated fuel in a safe manner. A double-gated transfer canal connects the two SFPs. The SFP facilities are designed to accept new unirradiated and irradiated fuel from both the LSCS Unit 1 and Unit 2 reactor cores (i.e., one unit’s fuel may reside in either or both SFPs).

The LSCS Unit 1 SFP contains high-density spent fuel storage racks consisting of 21 individual spent fuel storage racks that have capacity for 3986 fuel assemblies. The 3986 spent fuel storage cells consist of 3982 normal spent fuel storage cells and four defective fuel storage cells (larger cells). The Unit 1 high density spent fuel storage racks contain a sheet of BORAL neutron absorber material (see Attachment 3 for details) physically captured between the side walls of each box and sheathing welded to the sides of the box. The neutron absorber is positioned to ensure full coverage of the fuel’s axial active fuel region. The BORAL sheets are not seal welded into their captured locations and allow for the exchange of water and gasses between the sheet local environment and the bulk pool. No neutron absorber material is present on the periphery of the SFP rack array (the pool’s outermost rack’s out-facing side walls).

The LSCS Unit 2 SFP contains high-density spent fuel storage racks consisting of 20 individual spent fuel storage racks that have capacity for 4078 fuel assemblies. The

4078 spent fuel storage cells consist of 4073 normal spent fuel storage cells and five defective fuel storage cells (larger cells). The Unit 2 high density spent fuel storage racks originally contained a sheet of Boraflex neutron poison material physically captured between the side walls of all adjacent boxes (cells). To provide space for the original neutron absorber sheet between each box wall, a double row of matching flat round raised areas are coined in the side walls of all boxes. The raised dimension of these locally formed areas on each box wall is half the thickness of the original poison sheet. Each spent fuel storage rack consists of an array of individual spent fuel storage cells.

The organic PDMS (polydimethylsiloxane) based Boraflex sheet material experienced premature degradation at LSCS and across the industry. This was driven by high temperatures, high gamma radiation flux, and convection driven water flow that was able to enter and leave the areas between cells where the Boraflex resided. In response to the Boraflex degradation at LSCS, all possible fuel storage cells in the Unit 2 SFP racks had NETCO-SNAP-IN rack inserts installed. Any rack cell where an insert was not able to be installed cannot be utilized for the storage of fuel. The rack insert installation at LSCS was completed just before the end of December 2011.

The rack inserts are made of a thin sheet of Rio Tinto Alcan's Boralcan metal matrix composite material (formed from molten aluminum with a very fine particle B_4C added) formed into a chevron shape that fully covers two of the interior sides of each rack cell in the axial range of the active fuel. All rack inserts were installed in the rack cells with the chevron corner in each cell’s south-west corner. In this way all fuel in the rack cells will have one Boralcan neutron absorber insert wing between them. The one exception is in the fuel rack cells along the SFP’s north and east most rack’s edges. For these cells the higher neutron radial leakage into the bulk pool water and surrounding structural materials helps offset the impact of having less neutron absorber. With the addition of the rack inserts, no credit is taken for residual Boraflex in the racks. The entire area that was originally occupied by Boraflex is now assumed to contain water.

The specific NETCO-SNAP-IN rack inserts used at LSCS have a minimum ^{10}B areal density of 0.0086 g/cm^2.

The spent fuel storage racks are designed to maintain the stored spent fuel in a spatial geometry that precludes the possibility of criticality. The spent fuel storage racks maintain this subcritical geometry when subjected to maximum earthquake conditions, dropped fuel assembly accident conditions, and any uplift forces generated by the fuel handling equipment.

3.1.2 Criticality Evaluation

In accordance with 10 CFR 50.68, a CSA for the LSCS Units 1 and 2 SFPs has been performed to support the purposes discussed in Section 2.1. The analysis provided as Attachment 3 demonstrates that the maximum k_{eff} (i.e., k_{max} (95/95)) is less than the 10 CFR 50.68 limit of 0.95 for normal and credible abnormal operation with tolerances and computational uncertainties taken into account. All necessary requirements as outlined in NUREG-0800, Section 9.1.1 Revision 3 dated March 2007, have been met. NEI 12-16, Revision 4, "Guidance for Performing Criticality Analyses of Fuel Storage at Light-Water Reactor Power Plants," (Reference 6.2) was used as guidance for this analysis.

The revised CSA covers all legacy fuel in storage in either the LSCS Unit 1 or Unit 2 SFP and the new GNF3 product line. The description of the GNF3 product line is provided in Section 4.1 of Attachment 3, while the description of legacy fuel is provided in Appendix B of Attachment 3.

The peak in-core k_{inf} criterion method relies on a well-characterized relationship between the infinite lattice k_{inf} (in-core) for a given fuel design and a specific fuel storage rack k_{inf} (in-rack) containing that fuel. This methodology was shown to be appropriate for use at LSCS by validating that there exists a well-characterized, linear relationship between the infinite lattice k_{inf} (in-core) and fuel storage rack k_{inf} (in-rack). Appropriate application was also ensured by using a design basis lattice with conservative values of rack efficiency and in-core k_{inf} for all criticality analyses.

Appendix B of Attachment 3 shows this method produces an in-core k_{inf} which correlates to an in-rack k_{inf} for GNF3 fuel that bounds the legacy fuel. The CSA uses the minimum certified areal density for each neutron absorbing material. This is consistent with the requirements in 10 CFR 50.68(b).

In the CSA, the term "peak reactivity" is determined by depleting each fuel assembly lattice to find the exposure at which its reactivity is maximized in the in-core TGBLA06 lattice physics code. The lattice case is then restarted at that same exposure to produce the peak reactivity SCCG (cold, in-core, uncontrolled, no voids) reactivity. The isotopics of the lattice are determined using the TGBLA06 SCCG case and used as input to the three-dimensional Monte Carlo computer code MCNP-05P to produce a system k value. This peak reactivity considers nominal fuel assembly and storage rack dimensions and bounding core operating parameters.

The reactivity of the LSCS Units 1 and 2 SFP storage racks was calculated using the computer codes TGBLA06 and MCNP-05P. In this evaluation, in-core k_{inf} values and exposure dependent, pin-by-pin isotopic specifications were generated using TGBLA06, the NRC-approved GE-Hitachi Nuclear Energy Americas LLC (GEH)/GNF BWR lattice physics code. The fuel storage criticality calculations were then performed using MCNP-05P, the GEH/GNF proprietary version of the Los Alamos National Laboratory Monte Carlo neutron transport code MCNP5. TGBLA06 uses ENDF/B-V cross-section data to perform coarse-mesh, broad-group, diffusion theory calculations. MCNP-05P uses ENDF/B-VII.0 pointwise (i.e., continuous) cross-section data, and all reactions in the cross-section evaluation are considered. MCNP-05P has been validated and verified for spent fuel pool storage rack evaluations in accordance with the NUREG/CR-6698 guidance (included as part of Attachment 3). The method of analysis is discussed in greater detail in Section 3.0 of Attachment 3. Validation of the codes and libraries is described in Section 3.4 and Appendix A of Attachment 3.

The use of TGBLA06 for BWR core depletion calculations has been reviewed and accepted by the NRC as part of the approval of Reference 6.4. The NRC has also approved the MCNP-05P/TGBLA06 code package for use in similar fuel pool criticality analyses. Reference 6.5 documents an example of one NRC approved use of this code package.

3.1.3 Accident Conditions

The spent fuel rack configuration was analyzed for credible accident scenarios. The scenarios considered are presented in the bulleted list that follows and are discussed in Section 5.5.3 of Attachment 3.

- SFP temperature exceeding the normal range (moderator temperature/density changes)
- Dropped and dropped + damaged fuel assemblies
- A missing BORAL panel
- Rack movement (seismic)
- Mislocated fuel assembly (an assembly in the wrong location outside a storage rack)

The criticality analysis for the storage of BWR assemblies in the LSCS Unit 1 SFP racks with BORAL has been performed. The results for the normal condition show that k_{eff} is ≤ 0.95 with the storage racks fully loaded with fuel of the highest anticipated reactivity, at a temperature corresponding to the highest reactivity. The results for the bounding accident condition, i.e., the “Misplaced Assembly Side of Pool” (Case T17.B8), also show that k_{eff} is ≤ 0.95 with the storage racks fully loaded with fuel of the highest anticipated reactivity, at a temperature corresponding to the highest reactivity.

The criticality analysis for the storage of BWR assemblies in the LSCS Unit 2 SFP racks with Boralcan rack inserts has been performed. The results for the normal condition show that k_{eff} is ≤ 0.95 with the storage racks fully loaded with fuel of the highest anticipated reactivity, at a temperature corresponding to the highest reactivity. The results for this bounding accident condition, i.e., the “Misplaced Assembly Side of Pool” (Case T18.B8), also show that k_{eff} is ≤ 0.95 with the storage racks fully loaded with fuel of the highest anticipated reactivity, at a temperature corresponding to the highest reactivity.

Reactivity effects of abnormal and accident conditions have been evaluated to assure that under all credible abnormal and accident conditions, the reactivity will not exceed the regulatory limit of 0.95 with a 95% probability at a 95% confidence level.

4.0 REGULATORY EVALUATION

4.1 <u>Applicable Regulatory Requirements/Criteria</u>

10 CFR 50.68, "Criticality accident requirements," paragraph (b)(4) states that the k_{eff} of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity and flooded with unborated water must not exceed 0.95, at a 95 percent probability, 95 percent confidence level. Further, paragraphs (b)(2) and (b)(3) state the equivalent neutron multiplication factor limit for the NFV, including the impact that “optimum moderation” scenario might have. The requirements stated include that the k_{eff} of the fresh fuel in the fresh fuel storage racks loaded with fuel of the maximum fuel assembly reactivity and flooded with unborated water must not exceed 0.95, at a 95 percent probability, 95 percent confidence level. The regulation also states that for the optimum moderation case the k_{eff} must not exceed 0.98 at a 95 percent probability, 95 percent confidence level. The optimum moderation case is not applicable to LaSalle’s NFV as it is a moderation controlled area (see Section 9.1.1.3 of the LSCS UFSAR). The LSCS SFP criticality analysis, provided as Attachment 3 to this submittal along with the GESTAR II NFV criticality analysis in Reference 6.4, demonstrate that these requirements are met.

Paragraph (b)(7) of 10 CFR 50.68 states that the maximum nominal U-235 enrichment of the fresh fuel assemblies is limited to 5.0 percent by weight. LSCS new fuel is below 5.0 percent by weight ^{235}U enrichment.

GDC 62, "Prevention of criticality in fuel storage and handling," states that criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations. The evaluation of LSCS's conformance with GDC 62 is discussed in both Section 9.1.1, “New Fuel Storage,” and Section 9.1.2, "Spent Fuel Storage," of the LSCS UFSAR. The racks in which new and spent fuel assemblies are placed, are designed and arranged to ensure subcriticality in the vault and storage pool. The LSCS criticality analysis has been performed to demonstrate that, given the current spent fuel storage system design, k_{eff} will remain less than or equal to 0.95 for legacy fuel types in addition to the reload GNF3 fuel design.

10 CFR 50.36 (c)(4), "Design Features," states that design features are those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered in categories described in paragraphs (c) (1), (2), and (3) of 10 CFR 50.36.

10 CFR 50.36 (c)(5), "Administrative Controls," states that administrative controls are the provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure operation of the facility in a safe manner. Each licensee shall submit any reports to the Commission pursuant to approved technical specifications as specified in § 50.4.

4.2 Precedent

1. Final Safety Evaluation for River Bend Station, “River Bend Station, Unit 1 - Issuance of Amendment No. 201 RE: Change to the Neutron Absorbing Material Credited in Spent Fuel Pool for Criticality Control (EPID L-2018-LLA-0298), December 31, 2019 (ADAMS Accession Number ML19357A009)

4.3 No Significant Hazards Consideration

In accordance with 10 CFR 50.90, "Application for amendment of license, construction permit, or early site permit," Exelon Generation Company, LLC (EGC) requests an amendment to Renewed Facility Operating License Nos. NPF-11 and NPF-18 for LaSalle County Station (LSCS), Units 1 and 2, respectively. Specifically, EGC is utilizing a new Criticality Safety Analysis (CSA) methodology for performing the criticality safety evaluation for legacy fuel types in addition to the new GNF3 fuel design in the spent fuel pool (SFP). EGC is also going to utilize the GESTAR II CSA (new for LAS use) and apply this to storage of the GNF3 fuel in the new fuel vault (NFV). EGC is proposing a change to the LSCS Technical Specifications (TS) 4.3.1, "Criticality," in support of the new SFP CSA. EGC is also making an editorial modification to the TS 5.6.5, “Core Operating Limits Report (COLR),” to remove the Framatome COLR related methodologies that are no longer utilized.

According to 10 CFR 50.92, "Issuance of amendment," paragraph (c), a proposed amendment to an operating license involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not:

(1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or

(2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or

(3) Involve a significant reduction in a margin of safety.

EGC has evaluated the proposed change for LSCS using the criteria in 10 CFR 50.92, and has determined that the proposed change does not involve a significant hazards consideration. The following information is provided to support a finding of no significant hazards consideration.

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No

The proposed amendment involves a revised NFV CSA and a revised SFP CSA for the LSCS Units 1 and 2 SFPs using new methodologies. The proposed amendment does not change or modify the fuel, fuel handling processes, spent fuel storage racks, number of fuel assemblies that may be stored in the SFP, decay heat generation rate, or the SFP cooling and cleanup system.

The proposed amendment was evaluated for impact on the following previously evaluated events and accidents:

- A fuel handling accident (FHA),
- A fuel mispositioning event,
- A seismic event, and
- A loss of SFP cooling event

The probability of an FHA is not increased because implementation of the proposed amendment will employ the same equipment and processes to handle fuel assemblies that are currently used. The FHA radiological consequences are not increased because the methodology used in support of the CSA does not impact the radiological source term of a single fuel assembly. Therefore, the proposed amendment does not significantly increase the probability or consequences of an FHA.

Operation in accordance with the proposed amendment will not significantly increase the probability of a fuel mispositioning event because fuel movement will continue to be controlled by approved fuel handling procedures. These procedures continue to require identification of the initial and target locations for each fuel assembly that is moved. The consequences of a fuel mispositioning event are not changed because the reactivity analysis demonstrates that the requirements will be met for the worst-case fuel mispositioning event.

Operation in accordance with the proposed amendment will not change the probability of a seismic event. The consequences of a seismic event are not increased because the forcing functions for seismic excitation are not increased and because the mass of storage racks has not changed.

Operation in accordance with the proposed amendment will not change the probability of a loss of SFP cooling event because the systems and events that could affect SFP cooling are unchanged. The consequences are not significantly increased because there are no changes in the SFP heat load or SFP cooling systems, structures or components due to the proposed change in CSA methodology. Furthermore, conservative analyses indicate that the current design requirements and criteria continue to be met with the presence of Boral blisters.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No

Onsite storage of fresh and spent fuel assemblies in the LSCS, Units 1 and 2 shared NFV and SFPs is a normal activity for which LSCS has been designed and licensed. As part of assuring that this normal activity can be performed without endangering the public health and safety, the ability to safely accommodate different possible accidents in the new fuel vault and spent fuel pools have been previously analyzed. These analyses address accidents such as radiological releases due to dropping a fuel assembly; and potential inadvertent criticality due to misloading a fuel assembly. The proposed amendment does not change the method of fuel movement or spent fuel storage and does not create the potential for a new accident.

The proposed use of new methodologies for performing the LSCS NFV and SFP CSAs does not change or modify the fuel, fuel handling processes, spent fuel racks, number of fuel assemblies that may be stored in the pool, decay heat generation rate, or the SFP cooling and cleanup system. The potential for blistering on the Boral has been evaluated and the neutron absorber will continue to fulfill its function.

The limiting SFP accident, the fuel mispositioning (Units 1 and 2) event does not represent a new or different type of accident. This event has always been possible; however, it is not always the limiting event. The proposed amendment involves a revised CSA for the LSCS Units 1 and 2 NFV and SFPs using new methodologies. The associated analysis results show that the storage racks remain sub-critical, with margin, following a worst-case fuel mispositioning (Units 1 and 2) event. The use of GESTAR II for the NFV CSA basis places the analysis of the NFV under GNF methodology. The use of this new methodology does not change the physical system of handling fresh fuel as it enters and exits the NFV. Thus, the use of the GESTAR II methodology does not impact the spectrum of possible accidents from those already analyzed.

Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

Response: No

The proposed amendment involves revised CSA for both the LSCS Units 1 and 2 shared NFV and SFPs using new methodologies. This change was evaluated for its effect on margins of safety related to criticality.

LSCS TS 4.3, "Fuel Storage," Specifications 4.3.1.1.a requires the spent fuel storage racks to maintain the effective neutron multiplication factor, k_{eff}, less than or equal to 0.95 when fully flooded with unborated water, which includes an allowance for uncertainties. Therefore, for spent fuel pool criticality considerations, the required safety margin is 5 percent. The 10 CFR 50.68(b)(2) regulation also requires a k_{eff} of less than or equal to 0.95 in the NFV (the optimum moderation, 10 CFR 50.68(b)(3), case does not apply to LaSalle).

The proposed change ensures, as verified by the associated criticality analyses, that k_{eff} continues to be less than or equal to 0.95, thus preserving the required safety margin of 5 percent. In addition, using the in-rack k_{inf} limit ensures that the SFP criticality analysis remains bounding and provides adequate protection to ensure public health and safety in that it determines the reactivity limit for the fuel assemblies that are allowed to be stored in the NFV and SFP storage racks.

The proposed use of a new methodology for performing the LSCS NFV and SFP CSAs does not affect spent fuel heat generation or the spent fuel cooling systems.

In addition, the radiological consequences of a dropped fuel assembly remain unchanged as the anticipated fuel damage due to a fuel handling accident is unaffected by the use of new methodologies to perform the CSAs. The proposed change also does not increase the capacity of the Unit 1 and Unit 2 spent fuel pools beyond the current capacity of not more than 3982 and 4078 fuel assemblies, respectively. The NFV capacity is also unaffected.

Based on the above, EGC concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of no significant hazards consideration is justified.

4.4 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

The proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

6.1 NEDC-33931P, "LaSalle County Station Fuel Storage Criticality Safety Analysis," Revision 0, April 2021 (Attachments 3 and 4 to RS-21-064 for the proprietary and non-proprietary versions, respectively)

6.2 NEI 12-16, Revision 4, "Guidance for Performing Criticality Analyses of Fuel Storage at Light-Water Reactor Power Plants," September 2019 (ADAMS Accession Number ML19269E069)

6.3 Final Safety Evaluation for River Bend Station, “River Bend Station, Unit 1 - Issuance of Amendment No. 201 RE: Change to the Neutron Absorbing Material Credited in Spent Fuel Pool for Criticality Control (EPID L-2018-LLA-0298), December 31, 2019 (ML19357A009)

6.4 GE Licensing Topical Report NEDE-24011-P-A, "GESTAR II" -Implementing Improved GE Steady-State Methods, Revision 31 (TAC No. MA6481) (ML20330A197)

6.5 Final Safety Evaluation for GE Hitachi Nuclear Energy Licensing Topical Report NEDC-33374P, Revision 3, "Safety Analysis Report for Fuel Storage Racks Criticality Analysis for ESBWR Plants", September 21, 2010 (ML102430580)

6.6 NEDC-33879P, Revision 4, “GNF3 Generic Compliance with NEDE-24011-P-A (GESTAR II), August 2020 (ML20244A105)

6.7 LaSalle County Station, Units 1 and 2, Issuance of Amendments Concerning Spent Fuel Neutron Absorbers (TAC NOS. ME2376 and ME2377)(RS-09-133), January 28, 2011 (ML110250051)

6.8 NRC Transmittal for LaSalle Station Unit 1 SFP, Issuance of Amendment (TAC No. M83697), February 24, 1993 (ML021120427)