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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: License Amendment Regarding the Use of Neutron Absorbing Inserts in Unit 2 Spent Fuel Pool Storage Racks

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 Facility Operating License Nos. NPF-11 and NPF-18 for LaSalle County Station (LSCS), Units 1 and 2. The proposed change is necessary to allow full recovery of spent fuel storage rack cells that are unusable due to Boraflex neutron absorber degradation.

The proposed change is necessary to resolve a non-conservative Technical Specification (TS), in accordance with NRC Administrative Letter (AL) 98-10, "Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety." Specifically, as a result of Boraflex degradation in the LSCS Unit 2 spent fuel storage racks, EGC has determined that some of the spent fuel storage rack cells in the Unit 2 spent fuel pool (SFP) are unusable due to loss of neutron absorbing material, and additional spent fuel storage rack cells will become unusable in the future. Therefore, the existing limit on Unit 2 spent fuel storage pool capacity contained in TS Section 4.3.3, "Capacity," is not sufficient to ensure that K_{eff} is less than or equal to 0.95 if fully flooded with unborated water, as required by TS Section 4.3.1.1.a. Administrative controls are currently in place to prevent loading spent fuel in the spent fuel storage rack cells that are unusable.

In accordance with AL 98-10, EGC is requesting a license amendment to revise TS Section 4.3.1, "Criticality," to address the non-conservative TS. The proposed change addresses the Boraflex degradation issue in the Unit 2 spent fuel storage racks by revising TS Section 4.3.1 to allow the use of NETCO-SNAP-IN® rack inserts in Unit 2 spent fuel storage rack cells as a replacement for the neutron absorbing properties of the existing Boraflex panels.

The rack inserts will only be installed in the Unit 2 spent fuel storage racks; however, the proposed change is also applicable to Unit 1 since the Unit 1 and Unit 2 SFPs at LSCS are connected, with the ability to store fuel from either reactor in both SFPs. As a result, the

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proposed change adds a new requirement to TS Section 4.3.1 to specify the bounding reactivity fuel design allowed for storage in both the Unit 1 and Unit 2 SFPs.

On January 29, 2009, and March 18, 2009, pre-application meetings were held between the NRC and EGC. The purpose of the pre-application meetings was to provide an overview of the status of the Unit 2 SFP and Boraflex degradation, summarize the integrated approach to resolution, describe the NETCO-SNAP-IN® rack inserts, discuss the associated criticality analysis, and describe the scope of information to be included in the proposed license amendment request.

This request is subdivided as follows.

- Attachment 1 provides a description and evaluation of the proposed change.
- Attachment 2 provides a markup of the affected TS page.
- Attachment 3 provides an AREVA NP Inc. criticality analysis that supports the proposed change.
- Attachment 4 provides a figure of the NETCO-SNAP-IN® rack insert.
- Attachment 5 provides a report describing the material qualification of the Rio Tinto Alcan composite material, which is used in the NETCO-SNAP-IN® rack insert.
- Attachment 6 provides an affidavit that sets forth the basis for withholding information in Attachment 3 from public disclosure, and provides a non-proprietary version of the information contained in Attachment 3.
- Attachment 7 provides a listing of regulatory commitments made in this submittal.

Some of the information in Attachment 3 is proprietary to AREVA NP Inc., and is supported by an affidavit signed by AREVA NP Inc., the owner of the information. The affidavit, provided in Attachment 6, sets forth the basis on which the information may be withheld from public disclosure by the NRC and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.390, "Public inspections, exemptions, requests for withholding." Accordingly, it is respectfully requested that the information be withheld from public disclosure in accordance with 10 CFR 2.390. A non-proprietary version of the information contained in Attachment 3 is also provided in Attachment 6.

The proposed change has been reviewed by the LSCS Plant Operations Review Committee and approved by the Nuclear Safety Review Board in accordance with the requirements of the EGC Quality Assurance Program.

EGC requests approval of the proposed change by June 30, 2010. The expedited review time is based on the need for prompt action to restore full core discharge capability at LSCS and to restore margin with respect to the TS requirements. In the interim, EGC plans to continue maintaining the administrative controls that were previously put in place to prevent loading spent fuel in the spent fuel storage rack cells that are unusable. Once approved, the amendment will be implemented within 30 days. This implementation period will provide adequate time for the affected station documents to be revised using the appropriate change control mechanisms.

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," paragraph (b), EGC is notifying the State of Illinois of this application for license amendment by transmitting a copy of this letter and its attachments to the designated State Official.

Regulatory commitments are contained in Attachment 7. Should you have any questions concerning this letter, please contact Mr. Kenneth M. Nicely at (630) 657-2803.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 5th day of October 2009.

Respectfully,

Patrick R. Simpson
Manager – Licensing

Attachments:
1. Evaluation of Proposed Change
2. Markup of Proposed Technical Specifications Page
3. 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 (PROPRIETARY INFORMATION)
4. Figure of NETCO-SNAP-IN® Neutron Absorber Rack Insert
5. Northeast Technology Corp. Report No. NET-259-03, "Material Qualification of Alcan Composite for Spent Fuel Storage," Revision 5
6. AREVA NP Inc. Affidavit and Non-Proprietary Version of Attachment 3
7. Summary of Regulatory Commitments

cc: NRC Regional Administrator, Region III
NRC Senior Resident Inspector – LaSalle County Station
Illinois Emergency Management Agency – Division of Nuclear Safety

bcc:

NRC Project Manager, NRR - LaSalle
Director - Licensing (w/o attachments)
Manager - Licensing, LaSalle
Site Vice President – LaSalle
Regulatory Assurance Manager – LaSalle
Exelon Document Control Desk – Licensing
Commitment Coordinator – Cantera
Ken Nicely
Steve Shields
Pete Wicyk
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ATTACHMENT 1
Evaluation of Proposed Change

ATTACHMENT 1
Evaluation of Proposed Change

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 Facility Operating License Nos. NPF-11 and NPF-18 for LaSalle County Station (LSCS), Units 1 and 2. The proposed change allows the use of NETCO-SNAP-IN® neutron absorbing rack inserts in the Unit 2 spent fuel storage rack cells.

The proposed change is necessary to allow full recovery of spent fuel storage rack cells that are unusable due to Boraflex degradation. Specifically, as a result of Boraflex degradation in the LSCS Unit 2 spent fuel storage racks, EGC has determined that some of the spent fuel storage rack cells are unusable due to loss of neutron absorbing material, and additional spent fuel storage rack cells will become unusable in the future. Administrative controls are currently in place to prevent loading spent fuel in the Unit 2 spent fuel storage rack cells that are unusable.

The proposed change requests NRC approval of an alternate mechanism other than Boraflex for criticality control. This application requests approval to use a neutron absorbing rack insert which can be installed into a spent fuel storage rack cell and credited as a replacement for the neutron absorbing properties of the Boraflex panels. EGC is requesting this license amendment to use NETCO-SNAP-IN® rack inserts to provide an alternative method of ensuring neutron absorption in the Unit 2 spent fuel storage racks to meet the effective neutron multiplication factor, K_{eff}, criticality requirements without reliance on Boraflex. The installation of these rack inserts will allow spent fuel to be stored in the spent fuel storage rack cells declared unusable due to Boraflex degradation.

The Boraflex degradation issue is only applicable to the Unit 2 spent fuel storage racks. Unit 1 spent fuel storage racks are designed with BORAL® neutron poison material, and have not experienced the degradation seen with the Boraflex. The Unit 1 spent fuel storage racks remain capable of meeting the criticality requirements of Technical Specifications (TS) Section 4.3.1.

It is estimated that fabrication and installation of the NETCO-SNAP-IN® rack inserts in all accessible spent fuel storage rack cells (e.g., cells with no obstructions preventing a rack insert and/or a fuel assembly from being placed in the cell) in the Unit 2 spent fuel pool (SFP) will be complete in 2016. At that time, reliance on Boraflex as a neutron poison material will have been completely mitigated. EGC's plans are to deploy NETCO-SNAP-IN® rack inserts at a rate sufficient to recover spent fuel storage rack cells as they are declared unusable due to Boraflex degradation. This will be accomplished utilizing the design change process which will evaluate all design aspects to ensure the spent fuel racks will meet their intended design functions with the rack inserts installed. In accordance with the design change process, the installation and testing of NETCO-SNAP-IN® rack inserts will be evaluated under the provisions of 10 CFR 50.59.

The NETCO-SNAP-IN® rack insert design and supporting technical information and the Rio Tinto Alcan Composite Surveillance Program will be reflected in Section 9.1.2.2 of the LSCS Updated Final Safety Analysis Report (UFSAR).

2.0 DETAILED DESCRIPTION

The LSCS TS requirements related to spent fuel storage are contained in TS Section 4.3, "Fuel Storage." TS Section 4.3.1 currently identifies requirements related to the design of the spent fuel storage racks. Specifically, Section 4.3.1.1.a requires K_{eff} to be less than or equal to 0.95 if fully flooded with unborated water, and includes an allowance for uncertainties as described in Section 9.1.2 of the UFSAR. Section 4.3.1.1.b requires a nominal 6.26-inch center-to-center distance between fuel assemblies placed in the spent fuel storage racks.

The proposed change adds two new TS requirements, 4.3.1.1.c and 4.3.1.1.d, which state:

c. For Unit 2 only, a neutron absorbing rack insert shall be installed in spent fuel storage rack cells prior to loading fuel assemblies in cells that cannot otherwise maintain the requirements of 4.3.1.1.a.

d. Fuel assemblies shall 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.

A markup of the proposed TS changes is provided in Attachment 2. The UFSAR will also be revised, upon implementation of the proposed change, as part of EGC's configuration control process to:

a. allow the use of NETCO-SNAP-IN® rack inserts to replace the neutron control function originally provided by Boraflex in Unit 2 SFP rack cells,

b. add the specific information (i.e., from Attachment 3) that defines the SFP criticality compliance requirements for future reload ATRIUM 10 fuel assemblies, and

c. add a surveillance program to ensure that the performance requirements of the Rio Tinto Alcan composite in the NETCO-SNAP-IN® rack inserts are met over the lifetime of the spent fuel storage racks with the rack inserts installed.

3.0 TECHNICAL EVALUATION

3.1 Overview

3.1.1 Current SFP Design Basis

UFSAR Section 9.1.2.2.1.1 documents the LSCS 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% delta K.

b. The spent fuel storage racks, containing their full complement of fuel (i.e., 4078 fuel assemblies, including fuel in the five defective fuel storage locations), are designed to withstand the seismic loadings of the operating basis earthquake (OBE) and the safe shutdown earthquake (SSE) in order to minimize distortion of the fuel storage arrangement.

c. The flooded SFP provides a water barrier that 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.

LSCS has two SFPs, one for each unit, that 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 Unit 1 and Unit 2 reactor cores.

The 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 and 43 special storage cells. The 3986 spent fuel storage cells consist of 3982 normal spent fuel storage cells and four defective fuel storage cells. The 43 special storage cells consist of 39 control rod storage cells (i.e., one rack of 18 and one rack of 21), and four control rod guide tube storage cells. The Unit 1 high density spent fuel storage racks contain a 0.079-inch thick sheet of BORAL® neutron poison material with a B-10 loading of 0.022 grams per square centimeter physically captured between the side walls of each box and sheathing welded to the sides of the box.

The Unit 2 SFP contains high-density spent fuel storage racks consisting of 20 individual spent fuel storage racks (i.e., modules) that have capacity for 4078 fuel assemblies and 38 special storage cells. The 4078 spent fuel storage cells consist of 4073 normal spent fuel storage cells and five defective fuel storage cells. The 38 special storage cells consist of 35 control rod storage cells (i.e., one rack of 18 and one rack of 17), and three control rod guide tube storage cells. The Unit 2 high density spent fuel storage racks contain a nominal 0.075-inch thick sheet of Boraflex neutron poison material with a nominal B-10 loading of 0.0238 grams per square centimeter physically captured between the side walls of all adjacent boxes. To provide space for the poison sheet between boxes, 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 poison sheet. Each spent fuel storage rack consists of an array of individual spent fuel storage cells shown in UFSAR Figure 9.1-2c.

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 Boraflex Degradation Management

NRC Generic Letter 96-04 (i.e., Reference 1) discusses that, when Boraflex is subjected to gamma radiation in a SFP environment, the silicon polymer matrix becomes degraded and silica filler, boron carbide, and soluble silica are released. Due to Unit 2 spent fuel storage rack Boraflex degradation, a comprehensive Boraflex monitoring program has been implemented at LSCS. The Boraflex monitoring program includes the following elements:

- Periodic offsite testing of part-length Boraflex surveillance coupons,
- Periodic onsite inspection of full-length Boraflex surveillance coupons,
- Periodic BADGER testing (i.e., neutron attenuation testing) of a sampling of spent fuel storage rack cell walls, and
- Use of the Electric Power Research Institute (EPRI) RACKLIFE computer code to model Boraflex degradation.

The Boraflex monitoring program will continue to be maintained for as long as EGC continues to credit Boraflex for criticality control, regardless of the implementation of NETCO-SNAP-IN® rack inserts.

3.1.3 Impact of Boraflex Degradation Upon Spent Fuel Storage

Results from the Boraflex monitoring program indicate that some of the Unit 2 spent fuel storage rack cells are currently unusable, since the cells have degraded to less than an acceptable threshold for Boron areal density. Based on the reactivity of as-fabricated fuel, the acceptance criterion for Boron areal density degradation while still maintaining a K_{eff} of less than 0.95 is 57.5%. Applying this acceptance criterion to the Unit 2 SFP Boraflex panels has resulted in 840 cells (i.e., approximately 21% of the Unit 2 spent fuel storage rack cells) being declared unusable as of July 1, 2009. Currently, there are 752 unoccupied, usable spent fuel storage rack cells, between the Unit 1 and Unit 2 SFPs, which is less than the number necessary to fully discharge the entire core from either reactor. Approximately 400 additional spent fuel storage rack cells per year become unusable due to continued Boraflex degradation. EGC has implemented administrative controls at LSCS to remove fuel from unusable spent fuel storage rack cells and to prevent loading fuel into Unit 2 spent fuel storage rack cells determined to be unusable due to Boraflex degradation.

3.1.4 Proposed Method for Recovery of Unusable SFP Cells

In order to recover the spent fuel storage rack cells that are unusable, the proposed change requests approval to install NETCO-SNAP-IN® rack inserts into individual spent fuel storage rack cells to ensure that the requirement to maintain K_{eff} less than or equal to 0.95, if fully flooded with unborated water is met. Attachment 4 provides a figure of a NETCO-SNAP-IN® rack insert.

The rack insert has a vertical length equivalent to the length of the spent fuel storage rack cell and the lower end is tapered to facilitate insertion into the spent fuel storage rack cell. The rack insert material contains boron carbide particles homogeneously distributed in the metal.

The chevrons are formed with a greater than 90° bend angle and this causes compression of the rack insert as it is installed into the spent fuel storage rack cell and subsequently forms the 90° angle between adjacent spent fuel storage rack cell walls. The width of each wing of the chevron is slightly less than the minimum inside dimension of the spent fuel storage cell.

Near the top of the NETCO-SNAP-IN® rack insert is a hole in each wing that engages the installation tool. The rack insert is designed to become an integral part of the spent fuel storage rack once it has been installed. This is achieved through the elastic deformation of the rack insert bearing against the spent fuel storage rack cell wall and the associated friction force. The force exerted due to this deformation is determined by the effective spring constant of the rack insert. The force between the wings of the rack insert and the spent fuel storage rack cell walls in conjunction with the static friction between these surfaces serves to retain the NETCO-SNAP-IN® rack insert and make it an integral part of the spent fuel storage rack once it is installed.

A criticality analysis for the Unit 2 SFP crediting the NETCO-SNAP-IN® rack inserts has been performed to support this design change. Analyses have been performed using a bounding Reactivity Equivalent Beginning of Life (REBOL) assembly that is more reactive than any fuel stored in either the Unit 1 or Unit 2 SFP and operating in either the Unit 1 or Unit 2 reactor, to assure compliance with the K_{eff} requirement. The criticality analysis is provided in Attachment 3.

The analysis demonstrates that K_{eff} remains less than or equal to 0.95 for the normal and abnormal cases evaluated, with credit for the NETCO-SNAP-IN® rack inserts. It is important to note that the Boraflex panels will remain in place providing additional, albeit diminished, neutron absorption capability that is not credited in the rack insert criticality analysis.

It is also known that some specific spent fuel storage rack cells will not be able to accept the insertion of either the NETCO-SNAP-IN® rack insert or spent fuel. In those specific spent fuel storage rack cells, there is piping above the spent fuel storage rack cells that physically prevents the hoist(s) from being able to place fuel or rack inserts into the cell. The criticality analysis addresses the effect on the SFP storage array K_{eff} when both rack inserts and fuel assemblies cannot be inserted into a spent fuel storage rack cell.

3.1.5 Demonstration of Proposed Method for Cell Recovery

The mechanical feasibility of the use of rack inserts has been demonstrated by installation of three rack inserts into the LSCS Unit 2 SFP. No credit for the neutron absorption capabilities of these rack inserts has been taken. Testing of the rack inserts was performed to establish the expected drag forces and interferences, if any, that will be encountered during the storage of spent fuel. The testing was performed with an empty fuel channel. The rack inserts installation demonstration, and testing was performed under the provisions of 10 CFR 50.59.

3.1.6 Implementation of Proposed Method for Cell Recovery

When installed, the rack insert abuts two adjacent faces of the spent fuel storage rack cell wall. The rack insert neutron absorbing material extends beyond the full length of the active fuel, as the rack insert is made entirely of the Rio Tinto Alcan composite material.

The rack inserts will be installed in stages, with each stage of installation resulting in the use of a rack insert in all accessible spent fuel storage rack cells of a given individual spent fuel storage rack and all accessible spent fuel storage rack cells of the first row and first column of adjoining spent fuel storage racks, such that all sides of the fuel assemblies within the spent fuel storage rack are adjacent to a face of the rack insert's wing. With each rack insert installed in the same orientation, every face of all fuel assemblies will have neutron absorber material existing between it and one face of the adjacent fuel assemblies. Since the rack inserts are fabricated of a neutron absorbing material, replacement of the initial reactivity control method is effectively achieved.

EGC plans to install rack inserts in one spent fuel storage rack at a time such that each spent fuel storage rack will be either completely credited for rack inserts or completely non-credited for rack inserts.

The installation of the rack inserts will be controlled as a design change. As such, a spent fuel storage rack which has inserts installed will have the rack inserts credited as the neutron control mechanism when all the design control process verifications and testing requirements have been completed and documented. This will occur prior to installation of any fuel assemblies into that spent fuel storage rack, and will ensure that all the rack inserts required to be installed are installed and correctly oriented prior to the use of spent fuel storage rack cells within that spent fuel storage rack. Additionally, if a rack insert cannot be installed in a spent fuel storage rack cell for any reason (e.g., SFP interferences which prevent the hoist(s) from allowing installation tool operation on a cell), no fuel will be stored in that cell. The configuration of spent fuel storage rack(s) credited with rack inserts will be included in the plant's design documents and reflected in plant procedures.

Site reactor engineers are responsible for identifying the correct spent fuel storage rack cell for all fuel assemblies, and qualified fuel handlers are responsible for moving fuel, under the supervision of a qualified fuel handling supervisor. All fuel moves are planned, and planned moves are documented on move sheets before the fuel is moved. The move sheets are prepared by qualified reactor engineers and independently reviewed by qualified reactor engineers. The approved move sheets are then provided to the fuel handling crew. The crew moves the fuel in accordance with the move sheets. Each move is signed off by the crew prior to the next move. In addition, each move is verified by the fuel handler, a second fuel handler, and the fuel handling supervisor.

Since the absorber rack inserts will be installed in stages, there will be periods when some individual spent fuel storage racks will have reactivity control via the installed rack inserts and adjacent individual spent fuel storage racks will have interim reactivity control via the current cell monitoring program for degraded Boraflex. Since each of these configurations have individually been shown to meet the 0.95 K_{eff} criterion, any combination of these configurations in the SFP will also meet the 0.95 K_{eff} criterion. After all the cells in an individual spent fuel storage rack have rack inserts installed, BADGER testing and RACKLIFE analyses on that spent fuel storage rack are no longer necessary.

3.2 Criticality

Attachment 3 provides a criticality analysis that was performed to support the storage of spent fuel in the LSCS Unit 2 SFP in various configurations with the NETCO-SNAP-IN® rack inserts installed with no credit for Boraflex in the spent fuel storage racks. The analysis demonstrates that the effective neutron multiplication factor, K_{eff}, is less than or equal to 0.95 with:

a. the spent fuel storage racks fully loaded with an ATRIUM 10 fuel design that has higher reactivity than any as-fabricated fuel in the LSCS Unit 1 or Unit 2 SFPs,

b. no negative reactivity credit for the Boraflex installed between spent fuel storage rack cells,

c. NETCO-SNAP-IN® rack inserts installed in all accessible spent fuel storage rack cells,

d. the SFP flooded with unborated water at a temperature corresponding to the highest reactivity (i.e., 4°C).

The reactivity of the LSCS Unit 2 spent fuel storage racks fitted with NETCO-SNAP-IN® rack inserts have been analyzed using KENO V.a from the SCALE package and CASMO-4. The KENO V.a method has been validated and verified for spent fuel storage rack evaluations by benchmarking calculations of light water reactor (LWR) critical experiments. CASMO-4, as used in the Attachment 3 analysis, has been benchmarked against KENO V.a. The NRC guidance in Reference 2 specifically identifies the CASMO and KENO codes as being acceptable for use in SFP criticality analyses.

KENO V.a is used herein to determine absolute reactivity in the LSCS Unit 2 SFP and to evaluate accident conditions, alternate loading conditions, and the reactivity associated with manufacturing tolerances. CASMO-4 is used when fuel and gadolinia depletion are required to determine maximum in-rack k-infinity for assemblies on site, to define reference bounding lattices, to define REBOL lattices, and to evaluate gadolinia content manufacturing reactivity uncertainty.

Section 5 and Appendices C and D of Attachment 3 provide additional information supporting the use of these computer methods in determining the reactivity associated with various LSCS Unit 2 SFP configurations.

The reference bounding ATRIUM-10 fuel assembly with the enrichment and gadolinia loading shown below at the burnup of peak reactivity is more reactive than any ATRIUM-10 or previous fuel product line (i.e., ATRIUM 9B, GE8x8, and GE14 fuel) in either of the LSCS SFPs and reactors. This fuel design bounds the peak reactivity of every fuel assembly at LSCS as shown in Appendix B of Attachment 3.

Reference Bounding Reactivity Limiting ATRIUM-10 Fuel Assembly

	Top Zone	Intermediate Zone	Bottom Zone
Enrichment, w/o U-235	4.47	4.57	4.57
Number of Gd Bearing Rods	10	10	10
w/o Gd_2O_3 in each Gd Rod	3.5	6.0	6.0

Although the reference design identified above has higher in-rack reactivity than all fuel designs in the LSCS Units 1 and 2 SFPs and reactors, the criticality analysis in Attachment 3 was conservatively performed using an ATRIUM-10 REBOL design that is approximately 1.0% ΔK more reactive than the reference reactivity limiting design shown above. The ATRIUM-10 REBOL design used in the KENO V.a SFP model is shown below.

REBOL ATRIUM-10 Fuel Assembly

	Top Zone	Intermediate Zone	Bottom Zone
Enrichment, w/o U-235	3.05	2.72	2.66
Number of Gd Bearing Rods	0	0	0
w/o Gd_2O_3 in each Gd Rod	0.0	0.0	0.0

Attachment 3 outlines the methodology and key assumptions used in assessing the reactivity of the LSCS Unit 2 SFP without Boraflex, but with NETCO-SNAP-IN® rack inserts. The analysis was performed using the ATRIUM-10 REBOL fuel assembly as the principal design basis for the spent fuel storage racks.

The maximum calculated reactivity for the spent fuel storage racks contains a margin for calculational uncertainty, including the reactivity uncertainty due to manufacturing tolerances, and is calculated with a 95% probability at a 95% confidence level. In addition, the reactivity effects of abnormal and accident conditions have also been evaluated and included to assure that, under all credible abnormal and accident conditions, K_{eff} will not exceed 0.95.

KENO V.a calculations were performed to evaluate the reactivity effects for all fuel and spent fuel storage rack manufacturing tolerances listed below, except gadolinia concentration. This tolerance was evaluated using CASMO-4. The reactivity associated with the uncertainty in the following parameters is included in the maximum LSCS Unit 2 spent fuel storage pool array K_{eff}:

- Fuel rod pitch,
- U-235 fuel enrichment,
- UO_2 fuel pellet density,
- Channel bulge,
- Pellet diameter,
- Clad diameter,
- Pellet volume,
- Gadolinia concentration,
- Areal B-10 density,
- NETCO-SNAP-IN® rack insert thickness,
- Stainless steel wall thickness,
- Spent fuel storage rack cell pitch, and
- Spent fuel storage rack cell inside dimension.

The impact of boron particle self-shielding on the in-rack reactivity was evaluated. For the small particle size distribution of the Rio Tinto Alcan composite material, the particle self-shielding impact on in-rack reactivity is insignificant.

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

Based on the information in Attachment 3, the KENO V.a computed K_{eff} (i.e., without uncertainties) is 0.916. When adjusted for model bias, calculational uncertainty, the reactivity effect of manufacturing tolerances, and abnormal/accident conditions, the K_{eff} at a 95% probability with a 95% confidence level is 0.940. This includes the reactivity effect of 0.003 ΔK from the scenario where a single neutron absorbing rack insert is missing from an interior spent fuel storage rack cell and the cell contains a fuel assembly. It should be noted that these results, as documented in Attachment 3, are based upon the use of a minimum certified B-10 areal density of 0.0086 gm/cm^2 which is slightly less than the Insert Quality Assurance testing minimum B-10 areal density of 0.0087 gm/cm^2 specified in Table 3-1 of Attachment 5.

The value of 0.940 was determined by formulating ATRIUM-10 REBOL lattices that are very high in reactivity compared to as-manufactured previously loaded fuel, yet low enough in reactivity to comply with the 0.95 K_{eff} design criteria when placed in the LSCS Unit 2 spent fuel storage racks with NETCO-SNAP-IN® rack inserts.

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

The ATRIUM-10 fuel assembly design limitations that ensure criticality compliance will be incorporated in reload design documents and SFP criticality compliance procedures.

Additionally, the design limitations will be reflected in Sections 9.1.2.1 and 9.1.2.2 of the LSCS UFSAR.

3.3 Materials

The rack insert material must insure that the neutron absorber remains in place over the lifetime of the spent fuel storage racks during normal operations and abnormal anticipated events.

Attachment 5 provides an evaluation of the Rio Tinto Alcan composite material for use in the LSCS SFP environment, and demonstrates that the material meets the requirements as a neutron absorber to maintain the SFP within design and regulatory limits over the life of the SFP. Testing has been performed to confirm its acceptability and a surveillance program described below in Section 3.9 will be established to confirm its continued acceptability to perform its required design functions.

The production process for manufacturing the rack inserts is described in detail in Attachment 5. The rack insert is made from one sheet of composite material. Rio Tinto Alcan has found that by adding small amounts of titanium (i.e., <2.5%) to the molten aluminum, the B_4C particles become stable in the molten aluminum, eliminating particle clusters, and a uniform blend is achieved.

Coupons will be cut from each rolled rack insert blank, which is of sufficient size to manufacture two rack inserts. Samples from the coupons are subjected to neutron attenuation testing to verify as-manufactured B-10 areal density and mechanical testing to assure sufficient ductility to permit forming.

The Rio Tinto Alcan composite is made from materials (i.e., boron carbide and aluminum) that are similar to another neutron absorber material (i.e., BORAL®) that has been used extensively for more than 40 years for both wet and dry storage applications. BORAL® has shown no in-service degradation of neutron attenuation capabilities. The composition, physical properties, and mechanical properties of both materials are compared below. BORAL® is used in the LSCS Unit 1 spent fuel storage racks.

3.3.1 Comparison of the Rio Tinto Alcan Composite with BORAL®

<u>Composition</u>

Both the Rio Tinto Alcan composite and BORAL® neutron absorber materials utilize AA1100 alloy as the metal matrix that retains the boron carbide. The compositions of the AA1100 alloy matrices are compared below. With the exception of the addition of titanium to the Rio Tinto Alcan composite, as noted previously, the compositions are almost identical. In fact, the Rio Tinto Alcan aluminum alloy matrix requirements for other elements are somewhat more stringent than the BORAL® requirement.

Comparison of Aluminum Alloy Matrices

Element	BORAL®	Rio Tinto Alcan Composite
Aluminum	99.00% min	97.25% typical
Silicon + Iron	1.00% max	0.45% max
Copper	0.05 - 0.20%	0.05 - 0.20%
Manganese	0.05% max	0.05% max
Zinc	0.10% max	0.10% max
Magnesium	-	0.05% max
Titanium	-	1.75% typical
Others	0.15% max each	0.15% total, 0.05% max each

The Rio Tinto Alcan boron carbide specification is more restrictive in terms of allowable impurities and requires a much smaller particle size. The smaller particle size results in a more homogeneous absorber, less potential for neutron streaming, and a more effective neutron absorber material.

Comparison of Boron Carbide

Constituent	BORAL®	Rio Tinto Alcan Composite
Total Boron	70.0 w/o min	76 w/o min
Boric Oxide	3.0 w/o max	0.03 w/o typical
Iron	2.0 w/o max	0.075 w/o typical
Total Boron & Carbon	94.0 w/o min	99.6 w/o typical
Particle Size	75 – 250 microns	17.5 ± 2 microns

Neutronic Properties

The average particle size of boron carbide in BORAL® is 85 microns and individual particles can range up to 250 microns. Particles of these dimensions introduce self-shielding effects that can diminish the neutron absorption effectiveness. Using a collimated thermal energy neutron beam, NETCO has measured the neutron attenuation characteristics of BORAL® and of the Rio Tinto Alcan composite, the latter material with average boron carbide particle size of 17.5 microns. For the same areal density, BORAL® absorbs fewer neutrons than the Rio Tinto Alcan absorber (see Figure 4-3 of Attachment 5).

Manufacturing Process

The manufacturing of BORAL® starts with the complete blending of atomized AA1100 powder and boron carbide. An AA1100 rectangular box approximately 12 to 15 inches on a side, and a few inches high (i.e., depending on the thickness of the finished product), is filled with the blended powder. The walls of the box are approximately one inch thick. After a top is welded on the box, the billet is ready for hot rolling to final gage. In its finished form, BORAL® consists of: (1) a core of uniformly mixed and distributed boron carbide and alloy AA1100 aluminum particles, and (2) an AA1100 surface cladding on both sides of the core serving as a solid barrier.

The production process for the Rio Tinto Alcan material differs from the BORAL® process in that the boron carbide powder is blended into molten aluminum and a rectangular billet formed by direct chill casting. Hot rolling is used to produce the final sheet. The Rio Tinto Alcan composite in its final form is a fully dense homogeneous mixture of fine boron carbide particles embedded in AA1100 series aluminum. As such, it contains no porosity that can allow water intrusion and potential problems associated with internal moisture.

Mechanical Properties

This comparison shows that the tensile properties of the two materials are similar but the Rio Tinto Alcan composite has improved ductility.

Room Temperature Mechanical Properties of BORAL® and Rio Tinto Alcan Composite

Property	BORAL®	Rio Tinto Alcan Composite
Tensile Strength (ksi)	10	10
Elongation (%)	0.1	7.0

3.3.2 Areal Density of Boron

If the areal density of boron is too low, the rack insert will not absorb sufficient neutrons, and thus will be less effective in performing its safety function. If the areal density of boron is too high, there are manufacturing problems such that the material will crack during the bending process. The manufacturing insert quality assurance testing lower limit for the areal density of boron in the Rio Tinto Alcan composite is given in terms of the isotope of B-10, and is 0.0087 gm/cm^2. Verification of the areal density of boron in the rack inserts is done prior to installation. Verification that bending of the rack inserts does not cause cracking of the bend is performed by pre-installation visual inspection. Verification of the areal density of boron over the lifetime of the racks will be performed through the Long-Term Surveillance Program described below in Section 3.9.2.

3.3.3 Corrosion

Resistance to material loss, pitting, cracking, and blistering is important to ensuring that the B-10 will not be lost, and that distortion of the rack insert will not interfere with future fuel movement. Corrosion rates have been taken into account in the design of the rack inserts.

An accelerated corrosion test program has been designed to determine the susceptibility of the Rio Tinto Alcan composite to general (i.e., uniform) and localized (i.e., pitting) corrosion in BWR SFPs. This program is described in detail in Attachment 5. Three types of coupons are being tested: (1) general coupons are rectangular, to determine the rate at which a uniform oxide film forms; (2) bend coupons have been formed to the same bend angle and bend radius used for the NETCO-SNAP-IN® rack insert to determine whether or not bend deformation and stress adversely affect the corrosion susceptibility of the Rio Tinto Alcan material; and (3) galvanic (i.e., bi-metallic) coupons have been prepared with the Rio Tinto Alcan composite and 304L stainless steel, Inconel 718, and Zircaloy materials to evaluate the potential for galvanic corrosion. Coupons have been tested at the NETCO laboratory in deionized water, simulating BWR pool conditions at 195°F (i.e., 90.5°C), to accelerate any corrosion effects for greater than 8000 hours (i.e., approximately one year). Coupons have been removed after approximately 2000, 4000, 6000, and 8000 hours and subjected to testing. This test program has been completed and the evaluation presented in Attachment 5.

Prior to testing, the coupons were pre-characterized with respect to thickness, weight, and B-10 areal density. After testing, the coupons were subjected to post-test characterization of these same attributes. The testing results are described in Attachment 5. Corrosion rates are very low (i.e., -0.04 mils/year for 16 vol% and 25 vol% B_4C). The reason for this extremely low corrosion rate is that once an oxide film forms on all surfaces, the film tends to be self-passivating (i.e., it tends to retard further corrosion). This property of the oxide film lends to the excellent corrosion resistance of AA1100 aluminum alloy. This excellent corrosion resistance has been observed in other aluminum boron carbide composites tested by NETCO. It is noted that the conversion of a thin, uniform layer to the oxide does not result in a loss of the boron carbide neutron absorber. This is confirmed by the neutron attenuation measurement results that show no change in B-10 areal density.

Optical microscopy was performed to verify that the oxide films were substantially removed prior to determining coupon weight loss and to inspecting for any anomalies along the outer bend radii of the bend coupons. Optical microscopy of the inside and outside radius of the bend coupons before and after acid cleaning revealed no cracks or other anomalistic corrosion behavior.

Initial corrosion rates in the Unit 2 SFP will be established using the Fast Start Coupon Surveillance Program described below in Section 3.9.1. Corrosion rates will be confirmed to be within acceptable limits via the Long-Term Surveillance Program described in Section 3.9.2.

Once installed, the rack inserts assume a constant strain condition within the spent fuel storage rack cell. This compression leads to internal stresses, especially at the bend, that might make the rack inserts susceptible to stress corrosion cracking. An examination of the literature on the subject (i.e., References 3 and 4) indicates that in general, high-purity aluminum and low-strength aluminum alloys are not susceptible to stress corrosion cracking. However, surveillance bend coupons to be placed in the SFP prior to the installation of the rack inserts will be maintained under the same strain conditions to provide indication of any unexpected crack phenomena.

3.4 Mechanical

3.4.1 Fuel Assembly Clearance

Placement of the rack inserts in a spent fuel storage rack cell slightly reduces the cell inside dimensions available for fuel assembly insertion. Noting that bowed fuel channels continue to be an issue at LSCS, EGC plans to implement a qualification program to establish the suitability of a given fuel assembly to be stored in a spent fuel storage rack cell where there is a NETCO-SNAP-IN® rack insert installed. This program will involve the use of "go/no-go" gauges that will provide limiting dimensional measurements for both the fuel assemblies and the spent fuel storage rack cells. The gauges will be designed such that a assembly with the maximum acceptable bow will fit, with no interference, in a spent fuel storage rack cell with the minimum acceptable storage area.

If there is unexpected warping or bowing of the rack insert after installation which reduces the fuel assembly to spent fuel storage rack insert clearance, then the fuel handler would notice increased force on the bridge when attempting to raise (i.e., remove) an assembly. If the rack insert did inadvertently come out of a spent fuel storage rack cell with an assembly, then this condition would be bounded by the missing rack insert evaluation of the criticality analysis (i.e., Section 6.5 of Attachment 3). If a spent fuel assembly cannot fit into the Unit 2 spent fuel storage rack cells containing rack inserts due to mechanical clearances, it will be moved over to the Unit 1 spent fuel storage racks.

3.4.2 Mechanical Wear

Material loss may occur due to the friction of fuel/channel sliding into and out of spent fuel storage rack cells during placement and removal of assemblies. Some spent fuel storage rack cells and associated rack inserts might only experience the removal/insertion of a fuel assembly once. Other spent fuel storage rack cells and associated rack inserts might experience multiple removals/insertions of fuel assemblies every refueling outage. Minimal material loss is expected because the insertion and removal forces (i.e., friction) for a fuel assembly are very low as determined by on-site drag testing performed using a fuel channel. The use of go/no-go gauge ensures that this low drag will be maintained for future spent fuel moves using spent fuel storage rack cells with rack inserts installed.

Any effect of wear due to repeated insertion and removal of assemblies from the spent fuel storage racks is accommodated due to the presence of boron carbide particles homogeneously distributed in the metal rack insert composite.

Subsequent to the installation of three demonstration rack inserts placed in the Unit 2 SFP, drag testing was performed on each of the spent fuel storage rack cells using a new fuel channel as a drag gauge. All testing using the fuel channel showed that, over a minimum of two trials, there was no drag or interference resulting from use of the rack inserts. Additionally, drag testing using an irradiated, bowed channel is planned. The use of these bowed channels for drag testing will bound the insertion and removal of unchanneled assemblies. Due to the fuel assembly clearance, established by the go/no-go gauges, there will be no significant drag. Therefore, mechanical wear is expected to be minimal.

3.4.3 Retention Forces

The rack inserts are intended to be a permanent addition to the spent fuel storage racks. It is important to ensure that the installed rack inserts remain in place under loads experienced during insertion and removal of fuel assemblies from the spent fuel storage rack cells. The retention forces have been measured in clean pool testing. These forces are sufficient to ensure the rack insert remains in place during all normal (i.e., fuel handling) conditions as shown by fuel assembly drag forces being much less than retention forces and abnormal (i.e., seismic) conditions as shown by the analysis described in Section 3.6.

3.4.4 Insertion Forces

In competition with the need to provide sufficient retention force for the rack inserts is the need to minimize the amount of force required to install the rack inserts.

UFSAR Section 9.1.4.2.1.2 requires loads over the spent fuel storage racks be limited to less than or equal to 1290 pounds. The design weight of the installation tool with the rack insert is limited to 1290 pounds. The rack inserts each weigh approximately 12 pounds, and the installation tool weighs less than 1000 pounds. This limits the force available to be applied to the rack insert during installation since the gravitational weight of the installation tool is the only force applied to install the rack insert. This insertion force will not damage the existing spent fuel storage racks structural integrity or the rack insert itself.

Testing of the rack inserts has been performed in a clean pool environment and in the LSCS Unit 2 SFP for the following phenomena: insertion forces, drag forces, and withdrawal forces. Lessons learned from this testing was incorporated into an improved rack insert design and insertion tool design.

3.4.5 Stress Relaxation in the Absorber Rack Inserts

During installation, the absorber rack inserts are compressed from an initial bend angle greater than 90° to the square dimensions of the spent fuel storage rack cell interior.

Once installed, the rack inserts maintain a fixed strain within the spent fuel storage rack cell that may be susceptible to relaxation over time. This relaxation would result in less force against the spent fuel storage rack cell wall and lower retention force. If the relaxation is severe enough, the rack insert could be removed from a spent fuel storage rack cell along with a fuel assembly. An analysis of stress relaxation in aluminum alloys has been performed to establish the expected performance of the rack inserts in this regard.

During initial prototype testing, it was demonstrated that the Rio Tinto Alcan W1100N.16 B alloy had similar mechanical characteristics to 6061 aluminum alloys. Reference 5 details stress relaxation performance of 6061-T6 alloy after 1000 hours at various temperatures. The data show approximately 15% stress relaxation after 1000 hours at 100°C.

Average bulk pool temperatures within the LSCS SFP are approximately 85°F. Stress relaxation at this temperature is expected to be significantly lower than 15% over 1000 hours. As an upper limit, however, data for AA1100-H112 series aluminum was analyzed (i.e., Reference 6) to estimate total stress relaxation after 20 years of service. The results of that analysis showed that the AA1100 series aluminum was, based upon extrapolated data, expected to have experienced an approximate stress reduction of 50% over 20 years.

Typical breakaway withdrawal forces were measured and can range between 300 psi and 600 psi. At the 15% relaxation predicted for the 6061-T6 alloy, a reduction in retention force between 45 and 90 pounds-force after 1000 hours at 100°C would be expected. At the limiting case of a 50% reduction in retention force over 20 years, the rack inserts could be reduced to between 150 and 300 lbf of retention within the spent fuel storage rack cell. These values are adequate to maintain the rack inserts in their configuration during fuel movement operations provided the fuel assemblies are qualified for use in those spent fuel storage rack cells (see Section 3.4.1). However, a reduction in retention force of less than 50% is anticipated due to the following factors that tend to mitigate the stress relaxation effects:

1. Stress relaxation in boron carbide reinforced aluminum would be less than for the pure alloy, and

2. The formation of an oxide film on the surface of the rack inserts would increase the stress, by increasing the spacing between the spent fuel storage rack cell wall and the rack insert, as well as the coefficient of friction between the rack insert and the spent fuel storage rack cell wall.

3.5 Structural

A structural analysis has been performed to show that the in-service loads on the rack insert during normal and seismic conditions are insufficient to cause an operational failure of the rack insert. An operational failure in this context is the inability of the rack insert to perform its intended function as a neutron absorber or to maintain the critical characteristics to which it was manufactured.

3.5.1 Stress On Rack Structure During Normal Conditions

The rack insert has a pre-installed angle of greater than 90°. The force on the spent fuel storage rack cell wall was conservatively assumed to be 1600 pounds in the evaluation. The rack inserts exert a force against the spent fuel storage rack cell wall less than or equal to the force required to install them. As the weight of the tool is the only force available for installation and the maximum allowed combined weight of the insertion tool and rack insert, as described in Section 3.10, is limited to 1290 pounds, the resultant wall force must be less than 1600 pounds. The stress on the structure of the existing spent fuel storage racks due to the force exerted from the effective spring constant of the rack insert has been evaluated. The maximum local stress is two orders of magnitude less than the yield stress of the spent fuel storage rack cell wall material (i.e., 304 stainless steel) and therefore acceptable.

3.6 Seismic

The spent fuel storage racks are designed to comply with Seismic Category I requirements in accordance with NRC Regulatory Guide 1.29, Revision 2. Loads and load combinations are in accordance with the Standard Review Plan (SRP) Section 3.8.4 for steel structures. Therefore, the rack inserts are classified as Seismic Category I. Two load effects associated with the use of the rack inserts have been evaluated.

First, the impact loads of fuel assemblies on the rack inserts during the safe shutdown earthquake (SSE) design basis event were evaluated. During the SSE design basis event, fuel assemblies will impact on the spent fuel storage rack cell walls and installed rack inserts due to horizontal acceleration of the individual fuel racks. With the NETCO-SNAP-IN® rack inserts installed the impact forces will be reduced as the horizontal distance for acceleration will be reduced by the thickness of the rack insert. Review of the seismic analysis of record indicates that even without a rack insert installed and conservatively assuming the total impact force is concentrated within one square inch of material, the horizontal impact stress on the spent fuel storage rack cell walls is an order of magnitude less than the yield stress of the Rio Tinto Alcan composite material.

Second, the weight added to the individual spent fuel storage racks due to the weight of the rack inserts was reviewed. The rack inserts each weigh approximately 12 pounds so that use of the rack inserts in all spent fuel storage rack cells of a 15x16 individual spent fuel storage rack (i.e., the largest in the LSCS Unit 2 SFP) would add approximately 2880 pounds to the overall rack and fuel weight. This compares with a dry weight of 192,000 pounds for the 15x16 individual spent fuel storage rack completely loaded with spent fuel assemblies. A review of the seismic analysis of record has shown that the impact loads of the largest loaded individual spent fuel storage rack with the pool walls and floors were calculated using the dry weight of the racks and fuel. The submerged weight of one NETCO-SNAP-IN® rack insert (i.e., 7.54 pounds) is less than the difference between the dry and submerged weight of stainless steel in one spent fuel storage rack cell (i.e., 13.25 pounds). Therefore, the difference between the dry and wet rack weights is significantly greater than the weight of 240 rack inserts in the largest individual spent fuel storage rack. The analysis of record indicates the loads on the pool walls/floor during the SSE to be larger than the actual loads, taking buoyancy effects into account, with rack inserts installed in every spent fuel storage rack cell.

3.7 Thermal-Hydraulic

The rack insert displaces water inventory in the SFP and may reduce natural circulation flow in the region within the spent fuel storage rack cell but outside of the fuel channel/assembly. This has an insignificant impact on the heat transferred to the SFP and the heat removal capability of the fuel pool cooling system. Fuel assembly heat removal via natural circulation through the fuel assembly itself is not affected.

Installation of the rack inserts does not alter the allowed maximum number of fuel assemblies, maximum heat loads, or methods of determining decay heat loads in the SFP.

The volume of water displaced by the rack inserts is <1% of the total SFP water volume. This has an insignificant impact on the time to boil and no impact on the boil off rate.

Therefore, there is minimal effect on the thermal-hydraulic design of the SFP by installation of the rack inserts.

3.8 Accidents

The following abnormal/accident conditions have been evaluated as part of the criticality analysis of Attachment 3:

- Missing NETCO-SNAP-IN® Rack Insert,
- Fuel Assembly Drop,
- Fuel Assembly Placed Alongside Spent Fuel Storage Rack,
- Eccentric Positioning, and
- Moderator Temperature Variations.

The most limiting reactivity condition for abnormal and accident conditions was determined to result from a missing NETCO-SNAP-IN® rack insert. The reactivity worth of this accident condition was determined to be 0.003 ΔK.

The impact of the use of the NETCO-SNAP-IN® rack inserts on the radiological consequences of the fuel handling accident in the SFP was evaluated. The radiological consequences are not changed when rack inserts are used.

3.8.1 Missing NETCO-SNAP-IN® Rack Insert

The condition whereby a single rack insert is missing from an interior spent fuel storage rack cell that contains a fuel assembly was evaluated. The reactivity worth of this accident condition was determined to be 0.003 ΔK.

3.8.2 Fuel Assembly Drop

The drop of a fuel assembly with the assembly coming to rest in an inclined or horizontal position on top of the fuel and spent fuel storage rack has been assessed. There will be no effect on the spent fuel storage array reactivity when the dropped assembly comes to rest in a horizontal or tilted position on top of the spent fuel storage rack because the dropped assembly will be neutronically isolated from the fuel in the spent fuel storage rack cells (i.e., with there being greater than 12 inches of water between the dropped assembly and the top of the active fuel zone of the fuel in the spent fuel storage rack).

The drop of a fuel assembly into an empty spent fuel storage rack cell could potentially deform the baseplate of the spent fuel storage rack cell. Consequently, the dropped assembly could be at a lower elevation than the other assemblies in the array. The reactivity of the array would be decreased due to increased neutron leakage. If the impact deformed the dropped assembly, a higher reactivity condition could be achieved. This situation is bounded by the other limiting accidents because it is limited to a localized area.

3.8.3 Fuel Assembly Placed Alongside Spent Fuel Storage Rack

The inadvertent positioning or drop of a fuel assembly along side of a spent fuel storage rack between the rack and the pool wall has been evaluated. The increase in SFP K_{eff} is less than 0.001 ΔK. This is well within the margin associated with the more limiting event scenario where a single neutron absorbing rack insert is missing from an interior cell of the LSCS Unit 2 spent fuel storage racks.

3.8.4 Eccentric Positioning

The positioning of fuel assemblies within the spent fuel storage rack cells with and without fuel channels was evaluated. Multiple configurations that pushed the assemblies towards each other were evaluated. The most reactive condition was found to be the nominal case with the assembly centered in the water region and a fuel channel installed.

3.8.5 Moderator Temperature Variations

The effect of variations in moderator density and temperature on the reactivity of the LSCS Unit 2 spent fuel storage racks has been analyzed. These analyses have demonstrated that the SFP with rack inserts is most reactive at 4°C (i.e., 39.2°F) water density conditions, which is assumed for the present evaluation, and that increases in water temperature result in a decrease in SFP reactivity.

3.8.6 Fuel Handling Accident

Use of the NETCO-SNAP-IN® rack insert does not affect the radiological consequences of the fuel handling accident in the SFP. For the analysis of record, the amount of fuel damage is not mechanistically demonstrated. A bounding value is assumed and is not affected by the use of these rack inserts. The fuel handling accident in the SFP involves dropped fuel assemblies, where one assembly falls onto another assembly or an assembly falls onto the top of the spent fuel storage racks. The dose consequences are limited by the number of rods that fail, and the number of rods that fail is limited by the energy of the collision between the dropped assembly and the other assembly or structure that is hit by the dropped assembly. The design of the rack insert installation tool and rack insert will ensure that the total number of fuel rods that fail would be less than the current design basis if either the installation tool or rack insert is dropped onto a fuel assembly, or if a fuel assembly is dropped onto an open cell with the rack insert installed. The design ensures this since the weight of the rack insert installation tool and rack insert is less than 1290 pounds. In addition, the use of the rack inserts does not affect the isotopic inventory of the affected fuel assemblies involved in the postulated fuel handling accident. Use of the rack insert after installation provides a passive method of controlling reactivity.

3.9 Rio Tinto Alcan Composite Surveillance Program

Rio Tinto Alcan is an aluminum boron carbide composite. Rio Tinto Alcan has not been previously used in SFP applications; however the NRC has approved it for use in dry storage casks. Initial corrosion testing in simulated SFP conditions has been described in Section 3.3. EGC plans to implement a Rio Tinto Alcan surveillance program that consists primarily of monitoring the physical properties of the absorber material and performing periodic neutron attenuation testing to confirm the physical properties. The long-term surveillance program will consist of a specially designed surveillance "tree" to which a series of surveillance coupons are attached. The long-term surveillance "tree" will be placed within the Unit 2 SFP as part of the first installation campaign of NETCO-SNAP-IN® rack inserts and will reside there as long as the spent fuel storage racks continue to be used. Periodically, coupons will be removed from the "tree" and sent to a qualified laboratory for testing. The coupon "tree" is described in Attachment 5.

During any surveillance, if an off-normal condition were confirmed, the condition would be entered into EGC's Corrective Action Program for disposition.

3.9.1 Fast Start Coupon Surveillance Program Description

The fast start coupon surveillance program consists of a series of 24 coupons cut from extra Rio Tinto Alcan composite produced for the LSCS demonstration program. This coupon string has been installed in the LSCS Unit 2 SFP. The coupons cut from the demonstration program Rio Tinto Alcan material are 2x4 inches in width and length and have two 0.25 inch diameter holes along the top and bottom edge. Each coupon contains a nominal 16 vol% boron carbide. The purpose of the fast start program is to provide early performance data on the Rio Tinto Alcan composite in the LSCS Unit 2 SFP environment.

Following each Unit 2 refueling outage, the fast start coupons will be placed in a spent fuel storage rack cell surrounded in all eight locations with freshly discharged fuel (i.e., located in the central spent fuel storage rack cell of a 3x3 array) and remain there until the next Unit 2 refueling outage. In this manner the gamma energy disposition and temperatures of the coupons will be maximized. Two coupons will be removed approximately every six months from the string and sent to a qualified laboratory for testing and inspection. The coupons have been subjected to pre-installation characterization and will be post-test characterized. Attachment 5 Table 6-1 lists the pre-installation and post-test inspections.

3.9.2 Long-Term Surveillance Program

The long-term surveillance program will consist of a specially designed surveillance "tree" to which a series of surveillance coupons are attached. The long-term surveillance "tree" will be placed within the Unit 2 SFP as part of the first installation campaign of NETCO-SNAP-IN® rack inserts and will reside there as long as the spent fuel storage racks continue to be used. Periodically as specified below, coupons will be removed and sent to a qualified laboratory for testing.

The surveillance "tree" will be a four-sided structure with 24 - 2"x4" coupons attached to each side (i.e., 96 total coupons). All coupons will be nominally 17 vol% boron carbide, and will reflect nominal characteristics of the rack insert. The long-term surveillance program coupons contain a slightly higher vol% boron carbide concentration than the fast start surveillance program coupons consistent with the expected as-fabricated design of the neutron absorbing rack inserts. The types and numbers of coupons included in the program are shown below.

Long-Term Surveillance Coupons

Coupon Type	Number	Objective
General	48	Quantify long-term corrosion
Bend	24	Track effects along bend radii
Galvanic (bi-metallic)	24	Trend galvanic corrosion with 304SS, Inconel 718 and Zircaloy coupons

Specific coupons will be removed from the "tree" on a frequency schedule as described below. The general coupons will be subject to pre- and post-examination according to the following table.

Long-Term Surveillance General Coupon Characterization

Test	Pre-Characterization	Post-Characterization	Acceptance Criteria
Visual (high resolution digital photo)	√	√	Evidence of visual indications
Dimension	√	√	Min thickness: 0.005 inch less than nominal thickness Length: Any change of +/- 0.02 inch Width: Any change of +/- 0.02 inch Thickness: Any change of +0.010 inch / - 0.004 inch
Dry Weight	√	√	Any change of +/- 5%
Density	√	√	Any change of +/- 5%
Areal Density	√ on select coupons	√	0.0087 B-10 gm/cm^2 minimum loading
Weight Loss		√	Any change of +/- 5%
Corrosion Rate		√	< 0.05 mil/yr
Microscopy		√ as required	At the discretion of the test engineer

The frequency for coupon inspection will depend on the coupon type and results of previous inspections. The frequency for inspection is shown in the following Table.

Frequency for Coupon Testing

Coupon Type	First Ten Years	After 10 Years with Acceptable Performance
General	2 coupons every 2 years	2 coupons every 4 years
Bend	1 coupon every 2 years	1 coupon every 4 years
Galvanic Couples 304 Stainless Zircaloy Inconel 718	 1 couple every 6 years 1 couple every 6 years 1 couple every 6 years	

3.9.3 Long-Term Rack Insert Characterization Surveillance

Camera aided visual examinations will be performed on two rack inserts at the frequency of the general coupon removal schedule described above to visually monitor for physical deformities such as bubbling, blistering, corrosion pitting, cracking, or flaking. Special attention will be paid to development of any edge or corner defects.

3.10 Installation of Rack Inserts

The installation tool with a NETCO-SNAP-IN® rack insert engaged is shown in Figure 2-3 of Attachment 5. At the top of the tool is a bail that replicates the bail on a BWR fuel assembly. As such the installation tool can be engaged with a fuel grapple or with the refueling mast. The bail is attached to an anvil assembly that provides a bearing surface on the top edge of the rack insert. Immediately below the anvil assembly is the head assembly. The head assembly contains two spring-loaded cylinders that engage the rack insert while it is being moved to the spent fuel storage rack cell into which it is destined for installation. When, during installation, the cylinders come into contact with the spent fuel storage rack cell wall they retract, thus allowing full insertion of the rack insert. The curvature of the upper edge of each cylinder is so configured that when the rack insert is fully installed, upward movement of the tool allows the cylinder to clear the engagement holes in the rack insert, leaving the rack insert fully seated in the spent fuel storage rack cell.

In Figure 2-3 of Attachment 5, a counterweight is shown suspended from three rods below the head assembly. In addition to partially providing downward insertion force, the counterweight, which contributes to rack insert stability during installation, lowers the center of gravity of the tool. The insertion tool is constructed entirely of stainless steel. UFSAR Section 9.1.4.2.1.2 requires loads over the spent fuel storage racks be limited to less than or equal to 1290 pounds. The design weight of the installation tool with the rack insert is limited to no more than 1290 pounds.

The installation tool does not have the capability of removal of a rack insert. There is no plan to remove any rack inserts after installation in the SFP. Prior to removal of any rack insert, the installation tool will need to be modified. Any required removal of rack inserts will be treated as a maintenance/repair activity with the associated configuration controls and confirmation of restored configuration.

As previously indicated, the rack inserts will be installed in stages, with each stage of installation resulting in the use of a rack insert in all the spent fuel storage rack cells of a given individual spent fuel storage rack and all the cells of the first row and first column of the adjoining spent fuel storage racks, such that all sides of the fuel assemblies within the spent fuel storage rack are adjacent to a face of the rack insert's wing.

3.11 Summary and Conclusions

The proposed change is necessary to resolve a non-conservative Technical Specification (TS), in accordance with NRC Administrative Letter (AL) 98-10, "Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety." Specifically, as a result of Boraflex degradation in the LSCS Unit 2 spent fuel storage racks, EGC has determined that some of the spent fuel storage rack cells in the Unit 2 SFP are unusable due to loss of neutron absorbing material.

The proposed change adds two new TS requirements, 4.3.1.1.c and 4.3.1.1.d, which state:

c. For Unit 2 only, a neutron absorbing rack insert shall be installed in spent fuel storage rack cells prior to loading fuel assemblies in cells that cannot otherwise maintain the requirements of 4.3.1.1.a.

d. Fuel assemblies shall 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.

A markup of the proposed TS changes is provided in Attachment 2. The UFSAR will also be revised, upon implementation of the proposed change, as part of EGC's configuration control process to:

a. allow the use of NETCO-SNAP-IN® rack inserts to replace the neutron control function originally provided by Boraflex in Unit 2 spent fuel storage rack cells,

b. add the specific information (i.e., from Attachment 3) that defines the SFP criticality compliance requirements for future reload ATRIUM 10 fuel assemblies, and

c. add a surveillance program to ensure that the performance requirements of the Rio Tinto Alcan composite in the NETCO-SNAP-IN® rack inserts are met over the lifetime of the spent fuel storage racks with the rack inserts installed.

The proposed TS change does not adversely affect the plant's safety analyses.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

General Design Criterion (GDC) 61, "Fuel storage and handling and radioactivity control," specifies, in part, that fuel storage systems shall be designed with residual heat removal capability having reliability and testability that reflects the importance of safety of decay heat removal, and with the capability to prevent significant reduction in fuel storage coolant inventory under accident conditions. The evaluation of LSCS's conformance with GDC 61 is discussed in Section 3.1.2.6.2 of the LSCS UFSAR. The proposed change does not affect the conclusions of UFSAR Section 3.1.2.6.2 since no physical modifications to the fuel storage systems are proposed. The proposed change only affects the SFP criticality analysis.

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. In SRP Section 9.1.1, the NRC has established a 5% subcriticality margin (i.e., K_{eff} less than or equal to 0.95) for nuclear power plant operators to comply with GDC 62. The evaluation of LSCS's conformance with GDC 62 is discussed in Section 3.1.2.6.3 of the LSCS UFSAR. The NETCO-SNAP-IN® rack insert criticality analysis has been performed in accordance with SRP guidance, demonstrating that K_{eff} will remain less than or equal to 0.95 with no credit for the Boraflex neutron poison material present in the Unit 2 spent fuel storage racks.

10 CFR 50.68, "Criticality accident requirements," paragraph (b)(4) requires that, if no credit for soluble boron is taken, the K_{eff} of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with unborated water. The rack insert criticality analysis demonstrates that this requirement is met.

4.2 Precedent

Licensing precedent has been established for the use of rack inserts installed in spent fuel storage racks to provide an alternate method of criticality control, thus addressing Boraflex degradation. NRC approval for rack inserts was obtained for Turkey Point in Reference 7. The Turkey Point rack inserts were licensed to mitigate Boraflex degradation. The Turkey Point rack inserts were manufactured by Holtec using a Metamic material. The proposed LSCS rack inserts are manufactured by NETCO using Rio Tinto Alcan material. Both materials provide similar methods of neutron control. The Holtec design requires removal of the rack insert if the fuel assembly is inserted or removed. The NETCO design is a permanent installation in that rack inserts are not removable and remain in the spent fuel storage rack cell during fuel assembly insertion and removal.

The proposed amendment is the first use of NETCO-SNAP-IN® rack inserts in a SFP for neutron control. Other applications of the Rio Tinto Alcan composite include dry cask storage systems. The Rio Tinto Alcan material has been approved for use in dry cask storage systems at Limerick Generating Station and Oyster Creek Nuclear Generating Station.

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 Facility Operating License Nos. NPF-11 and NPF-18 for LaSalle County Station (LSCS), Units 1 and 2. The proposed change revises Technical Specifications (TS) Section 4.3.1, "Criticality," to allow the use of NETCO-SNAP-IN® rack inserts in Unit 2 spent fuel storage rack cells as an alternative replacement for the neutron absorbing properties of the existing Boraflex panels.

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 any 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, 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 change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No

   The proposed change adds an additional requirement to TS Section 4.3.1 to install a NETCO-SNAP-IN® rack insert in spent fuel storage rack cells that cannot otherwise maintain the requirements of TS Section 4.3.1.1.a to ensure that the effective neutron multiplication factor, K_{eff}, is less than or equal to 0.95, if the SFP is fully flooded with unborated water. The proposed change also includes a revision to TS Section 4.3.1 to specify the bounding reactivity fuel design allowed for storage in the Unit 1 and Unit 2 SFPs. Since the proposed change pertains only to the SFP, only those accidents that are related to movement and storage of fuel assemblies in the SFP could be potentially affected by the proposed change.

   The current licensing basis for the LSCS Unit 2 SFP credits the neutron absorbing properties of the Boraflex neutron poison material in the spent fuel storage racks. The current licensing basis demonstrates: (1) adequate margin to criticality for spent fuel storage rack cells that credit the neutron absorption capabilities of Boraflex, (2) adequate margin for fuel assemblies inadvertently placed into locations adjacent to the spent fuel storage racks, and (3) adequate margin for assemblies accidentally dropped onto the spent fuel storage racks. Therefore, the probability that a misplaced fuel assembly would result in an inadvertent criticality is unchanged since the process and procedural controls governing fuel movement in the SFP will not be changed. The dose consequences of the most limiting drop of a fuel assembly in the SFP is limited by the number of the fuel rods damaged and other engineered features unaffected by the proposed change, including the fuel design, fuel decay time, water level in the SFP, water temperature of the SFP, and the engineering features of the Reactor Building Ventilation System.

The installation of NETCO-SNAP-IN® rack inserts does not result in a significant increase in the probability of an accident previously analyzed. The revised criticality analysis takes no credit for the Boraflex material. The use of a rack insert provides an alternative neutron absorber to take the place of the degraded Boraflex material, without removal of the existing Boraflex. The probability that a fuel assembly would be dropped is unchanged by the installation of the NETCO-SNAP-IN® rack inserts. These events involve failures of administrative controls, human performance, and equipment failures that are unaffected by the presence or absence of Boraflex and the rack inserts.

The installation of NETCO-SNAP-IN® rack inserts does not result in a significant increase in the consequence of an accident previously analyzed. A criticality analysis has been prepared to demonstrate adequate margin to criticality for spent fuel storage rack cells with rack inserts in the LSCS Unit 2 SFP, and adequate criticality margin for assemblies accidentally dropped onto the spent fuel storage racks.

The installation of NETCO-SNAP-IN® rack inserts does not affect the consequences of a dropped fuel assembly. The consequences of dropping a fuel assembly onto any other fuel assembly or other structure, are unaffected by the change. The consequences of dropping a fuel assembly onto a spent fuel storage rack cell with a rack insert are bounded by the event of dropping an assembly onto another assembly, both for criticality and for radiological consequences. For criticality, the effects on K_{eff} of dropping a fuel assembly have been evaluated and are acceptable. For radiological consequences, the number of rods damaged when a fuel assembly is accidentally dropped onto a spent fuel storage rack cell with or without a rack insert is bounded by the number of rods damaged by an assembly dropped onto another assembly. The change does not affect the effectiveness of the other engineered design features to limit the offsite dose consequences of the limiting fuel assembly drop accident.

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

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

   Response: No

   Onsite storage of spent fuel assemblies in the SFP 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 public health and safety, the ability to safely accommodate different possible accidents in the SFP, such as dropping a fuel assembly or misloading a fuel assembly, have been analyzed. The proposed spent fuel storage configuration does not change the methods of fuel movement or spent fuel storage. The proposed change allows for continued use of spent fuel storage rack cells that have been determined unusable based on the degradation of Boraflex within those spent fuel storage rack cells. The rack inserts are passive devices. These devices, when inside a spent fuel storage rack cell, perform the same function as the Boraflex in that cell without the potential for degradation. These devices do not add any limiting structural loads or affect the removal of decay heat from the assemblies. No change in total heat load in the SFP is being made. The devices are resistant to corrosion and will maintain their structural integrity over the life of the SFP. An accidental fuel assembly drop does not challenge their structural integrity. The existing fuel handling accident, which assumes the drop of a fuel assembly, bounds the drop of a rack insert and/or rack insert installation tool. This change does not create the possibility of a misloaded assembly into a spent fuel storage rack cell.

   The misloading of a more reactive assembly targeted for placement in the LSCS Unit 1 SFP or the LSCS Unit 2 SFP Boraflex region in a rack insert region of the LSCS Unit 2 SFP has been prevented since the most reactive fuel assembly at LSCS is bounded by the rack insert criticality analysis, and the most reactive fuel assembly allowed for future insertion in either the Unit 1 or Unit 2 SFP is being limited to the reference bounding ATRIUM-10 fuel assembly.

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

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

   Response: No

   LSCS TS 4.3.1.1 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 criticality, the required safety margin is 5% including a conservative margin to account for engineering and manufacturing uncertainties.

   The proposed change provides an alternative method to ensure that K_{eff} continues to be less than or equal to 0.95, thus preserving the required safety margin of 5%. The criticality analysis demonstrates the required margin to criticality of 5%, including a conservative margin to account for engineering and manufacturing uncertainties, is maintained assuming an infinite array of fuel with all fuel at the peak reactivity. In addition, the margin of safety for radiological consequences of a dropped fuel assembly are unchanged because the event involving a dropped fuel assembly onto a spent fuel storage rack cell containing a fuel assembly with a rack insert is bounded by the consequences of a dropped fuel assembly without a rack insert. The proposed change also maintains the capacity of the Unit 2 SFP to be no more than 4078 fuel assemblies.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above evaluation, EGC concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92, paragraph (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 the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

EGC has determined that 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, "Standards for Protection Against Radiation." 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 effluent 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, "Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review," paragraph (c)(9). Therefore, pursuant to 10 CFR 51.22, paragraph (b), no environmental impact statement or environmental assessment needs to be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. NRC Generic Letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks," dated June 26, 1996

2. Memorandum from L. Kopp (U.S. NRC) to T. Collins (U.S. NRC), "Guidance on the Regulatory Requirements for Criticality Analysis of Fuel Storage at Light-Water Reactor Power Plants," dated August 19, 1998

3. J. R. Davis, Corrosion of Aluminum and Aluminum Alloys, ASM International, dated November 2000

4. M. Bauccio, ASM Metals Reference Book, Third Edition, ASM International, dated April 2003

5. K. Farrell, "ORNL/TM-13049 Assessment of Aluminum Structural Materials for Service Within the ANS Reflector Vessel," Oak Ridge National Laboratory, dated August 1995

6. John Gilbert Kaufman, Properties of Aluminum Alloys, ASM International, dated 1999

7. Letter from B. L. Mozafari (U.S. NRC) to J. A. Stall (Florida Power and Light Company), "Turkey Point Plant, Units 3 and 4 – Issuance of Amendments Regarding Spent Fuel Pool Boraflex Remedy (TAC NO. MC9740 and MC9741)," dated July 17, 2007

ATTACHMENT 2
Markup of Proposed Technical Specifications Page

LaSalle County Station, Units 1 and 2

Facility Operating License Nos. NPF-11 and NPF-18

REVISED TECHNICAL SPECIFICATIONS PAGE

4.0-2

4.0 DESIGN FEATURES (continued)

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

a. $k_{eff} \leq 0.95$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 9.1.2 of the UFSAR; and

b. A nominal 6.26 inch center to center distance between fuel assemblies placed in the storage racks.

c. For Unit 2 only, a neutron absorbing rack insert shall be installed in spent fuel storage rack cells prior to loading fuel assemblies in cells that cannot otherwise maintain the requirements of 4.3.1.1.a.

d. Fuel assemblies shall 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.

4.3.2 Drainage

The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 819 ft.

4.3.3 Capacity

The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than 3986 fuel assemblies for Unit 1 and 4078 fuel assemblies for Unit 2.

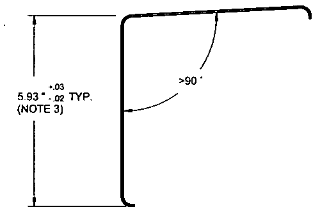
ATTACHMENT 4

Figure of NETCO-SNAP-IN® Neutron Absorber Rack Insert

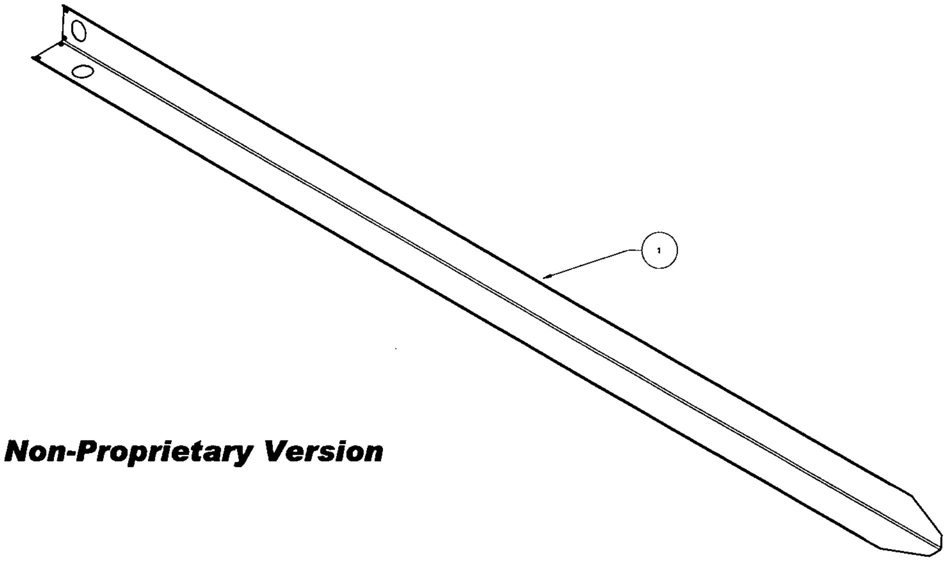
Item Number	Quantity	Part Number	Part Name	Revision	Comment
1	1	Alcan Sheet	17 volume % Alcan Sheet	1	

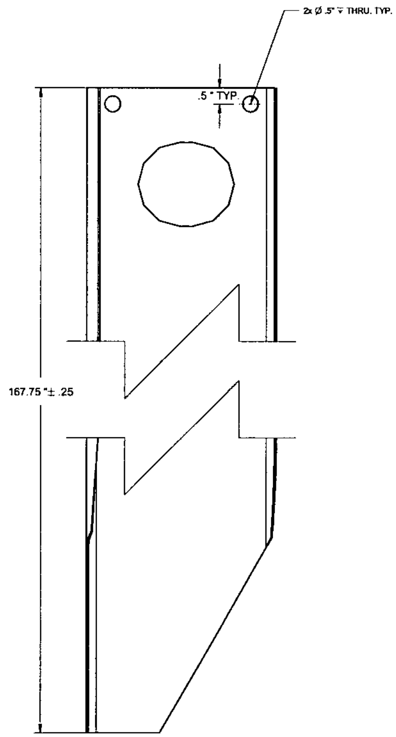
REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
D3	1	Changed Part Description	10/14/08	KOL
D2	1	Changed Material Specification to 17 volume %	10/14/08	KOL
D4	2	Added >90° Dimension for Bend Angle	01/08/09	KOL
D3	3	Removed References to Part Thickness	04/30/09	KOL

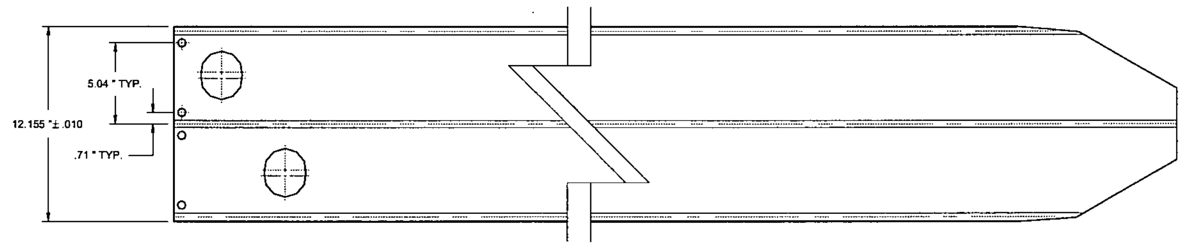


FORMED VIEW
1:3 SCALE





Non-Proprietary Version



FLAT VIEW
1:6 SCALE

NOTES:

1. WALL STRAIGHT TO WITHIN .06 IN/FT. ACCUMULATIVE LONGITUDINAL BOW NOT TO EXCEED .125"
2. HOLE DIMENSIONS REFERENCED FROM CENTER LINE
3. DIMENSION REFERENCED FROM OUTSIDE MOLD LINE TO OUTER EDGE OF BEND

NETCO	DRAWN KSL	DATE 4/30/09	NETCO-SNAP-IN Neutron Absorber Insert
	CHECKED KOL		Alcan BWR Insert (NSI-LS2-A-02)
	QA		
TOLERANCE: X.XX" ± 0.05" X.XXX" ± 0.005"	MFG		SIZE C · FSCM NO. · DWG NO. NET-259-NSI-LS2-A-02 · REV 3
UNLESS OTHERWISE NOTED	APPROVED KOL		SCALE See Dwg. · SHEET 1 of 1