NEXTera ENERGY SEABROOK

January 30, 2012

10 CFR 50.90

SBK-L-11245
Docket No. 50-443

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

Seabrook Station

License Amendment Request 11-04

Changes to the Technical Specifications for New and Spent Fuel Storage

In accordance with the provisions of Section 50.90 of Title 10 of the Code of Federal Regulations (10 CFR), NextEra Energy Seabrook, LLC (NextEra) is submitting License Amendment Request (LAR) 11-04 for an amendment to the Technical Specifications (TS) for Seabrook Station. The proposed change revises the TS for new and spent fuel storage as the result of a new criticality analyses for the new fuel vault and the spent fuel pool. The new criticality analysis was developed using the guidance in DSS-ISG-2010-01, revision 0, "Staff Guidance Regarding the Nuclear Criticality Safety Analysis for Spent Fuel Pools."

The Enclosure to this letter provides NextEra's evaluation of the proposed change. The Enclosure contains five attachments. Attachment 1 contains mark-ups of the TS showing the requested changes. Enclosed in attachments 2 and 4 are copies of Licensing Report for Seabrook Spent Fuel Pool and New Fuel Vault Analyses (Holtec International document HI-2114996, Revision 2, Proprietary) and Licensing Report for Seabrook Spent Fuel Pool and New Fuel Vault Analyses (Holtec International document HI-2114996, Revision 2, Non-Proprietary), respectively. Enclosed in attachment 3 is Holtec International affidavit pursuant to 10 CFR 2.390. Attachment 5, which contains proposed TS bases changes, is provided for information only. The TS bases will be revised in accordance with TS 6.7.6.j, Technical Specification (TS) Bases Control Program, upon implementation of the license amendment.

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NRR

NextEra Energy Seabrook, LLC, P.O. Box 300, Lafayette Road, Seabrook, NH 03874

Attachment 2 of the Enclosure contains information proprietary to Holtec International and is supported by an affidavit in attachment 3 signed by Holtec International, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b) (4) of Section 2.390 of the Commission's regulations. Accordingly, it is respectfully requested that the information that is proprietary to Holtec International be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

As discussed in the Enclosure, the proposed change does not involve a significant hazards consideration pursuant to 10 CFR 50.92, and there are no significant environmental impacts associated with the change.

No new commitments are made as a result of this change.

The Station Operation Review Committee has reviewed this LAR. A copy of this LAR has been forwarded to the New Hampshire State Liaison Officer pursuant to 10 CFR 50.91(b).

NextEra requests NRC review and approval of LAR 11-04 with issuance of a license amendment by January 30, 2013 and implementation of the amendment within 60 days.

Should you have any questions regarding this letter, please contact Mr. Michael O'Keefe, Licensing Manager, at (603) 773-7745.

Sincerely,

NextEra Energy Seabrook, LLC

Paul Freeman
Site Vice President

Enclosure

cc: NRC Region I Administrator
NRC Project Manager
W. J. Raymond, NRC Senior Resident Inspector

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NEXTera ENERGY SEABROOK

AFFIDAVIT

SEABROOK STATION UNIT 1

Facility Operating License NPF-86
Docket No. 50-443

License Amendment Request 11-04

Changes to the Technical Specifications for New and Spent Fuel Storage

The following information is enclosed in support of this License Amendment Request:

- Enclosure - NextEra Energy Seabrook's Evaluation of the Proposed Change
- Attachments to Enclosure:

1. Marked-up Technical Specification Pages
2. Licensing Report for Seabrook Spent Fuel Pool and New Fuel Vault Analyses (Holtec International document HI-2114996, Revision 2, Proprietary)
3. Holtec International letter ID 2064-AFFI-01, Affidavit Pursuant to 10 CFR 2.390
4. Licensing Report for Seabrook Spent Fuel Pool and New Fuel Vault Analyses (Holtec International document HI-2114996, Revision 2, Non-Proprietary)
5. Marked-up Technical Specification Bases Pages

I, Paul Freeman, Site Vice President of NextEra Energy Seabrook, LLC hereby affirm that the information and statements contained within this license amendment request are based on facts and circumstances which are true and accurate to the best of my knowledge and belief.

Sworn and Subscribed before me this 30th day of January, 2012

Victoria S. Brown
Notary Public

VICTORIA S. BROWN MY COMMISSION EXPIRES DEC. 11, 2012 NOTARY PUBLIC NEW HAMPSHIRE

Paul Freeman
Site Vice President

Enclosure

NextEra Energy Seabrook's Evaluation of the Proposed Change

Subject: Changes to the Technical Specifications for New and Spent Fuel Storage

Section

Attachments

1. Marked-up Technical Specification Pages
2. Licensing Report for Seabrook Spent Fuel Pool and New Fuel Vault Analyses (Holtec International document HI-2114996, Revision 2, Proprietary)
3. Holtec International letter ID 2064-AFFI-01, Affidavit Pursuant to 10 CFR 2.390
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1. Summary Description

This proposed license amendment to the Seabrook Unit 1 Technical Specifications (TS) is being submitted for NRC approval to: (1) reflect elimination of the need to credit Boraflex neutron absorbing material for reactivity control in the spent fuel pool (SFP), (2) credit soluble boron, burnup, cooling time, peripheral leakage, and rod cluster control assemblies (RCCAs) within the storage racks to maintain SFP reactivity within the effective neutron multiplication factor (k_{eff}) limits of 10 CFR 50.68(b)(4), and (3) revise the requirements for fuel storage within the new fuel vault (NFV).

This license amendment request (LAR) proposes to revise the design basis criticality safety analysis to permit partial credit for the presence of soluble boron and to implement a distinct two-zone configuration in the SFP consisting of:

- Region 1 fuel assembly storage racks, manufactured using Boral™ as its fixed neutron absorbing material, designed for placement of fresh fuel assemblies checkerboarded with burned assemblies, and
- Region 2 fuel assembly storage racks, manufactured using Boraflex but with the reliance on Boraflex as its fixed neutron absorbing material eliminated, designed for placement of burned fuel assemblies.

The LAR also modifies the requirements for the NFV by justifying full capacity loading of the NFV for fuel enriched up to 5.0 w/o U-235.

The SFP at Seabrook Station was designed and licensed as a single region storage rack with a total storage capacity of 1236 fuel assemblies. The SFP currently allows for the storage of three distinct fuel assembly configurations (types) according to initial enrichment/burnup limits for each fuel assembly configuration (type). When Seabrook Station began commercial operation, the storage racks that were installed in the pool provided a storage capacity for 660 fuel assemblies and used Boraflex as the fixed neutron absorber.

In the mid-1990s, the former licensee, North Atlantic Energy Service Corporation (North Atlantic) investigated options for adding an additional 576 storage cells to achieve the full capacity of 1236 fuel assemblies. Because of concerns relative to Boraflex degradation, North Atlantic completed the SFP rack installation with storage racks containing Boral™ neutron absorber material.

In 2003, an examination of the Boral™ surveillance coupons in the SFP identified blisters on the coupons. This abnormality was reported to the NRC pursuant to 10 CFR 21.21 on September 15, 2003 (Event #40159). The major concern relative to blisters is the potential to create a void in the Boral™ that will reduce the effect of the water gap flux trap, resulting in a potential increase in the reactivity in the racks. NextEra Energy Seabrook, LLC (NextEra), the current licensee, notified the NRC on October 6, 2003 that this abnormality did not involve a significant safety hazard and committed to: (a) implementation of a Boral™ monitoring program, and (b) the addition of a blistering allowance in the SFP criticality curves [Reference 6.1]. Although it is expected that the Boral™ blisters will refill with water, resulting in no change to the results of the criticality analysis, a blister penalty was determined using the following very conservative assumptions:

- The blisters will not refill with water but will create a void. This approach essentially reduces the amount of water in the flux trap.
- The thickness of the blisters was assumed to be 45 mils for each Boral™ panel, much higher than observed in the coupons.
- The blisters are over the entire length and width of the Boral™.

The Seabrook SFP TS currently uses two rack designs as previously described with fuel storage locations assigned according to fuel type regardless of the rack design. Fuel types currently are comprised of enrichment and burnup combinations delineated according to the upper and lower enrichment-burnup limit lines in Figure 3.9-1 of TS 3/4.9.13.

- A Type 1 fuel assembly is irradiated fuel having a burnup above the upper limit line for a given enrichment and may be stored anywhere.
- A Type 2 fuel assembly is irradiated fuel having a burnup bounded by the above upper and lower limit lines. These fuel assemblies may not be stored next to Type 3 fuel.
- A Type 3 fuel assembly is comprised of fresh fuel or irradiated fuel that has a burnup below the lower limit line for a given enrichment. Type 3 fuel may be checkerboard loaded with empty storage locations or fuel having burnups above the upper limit line (i.e., Type 1 fuel).

This LAR proposes to revise the TS to reflect no credit for Boraflex, incorporate a conservative estimate for Boral™ blistering and to take partial credit for soluble boron as allowed under NRC regulations. In addition, a conservative minimum Boral™ ^{10}B loading of 0.015 g/cm^2 is assumed. Section (b)(4) of 10 CFR 50.68 allows credit for soluble boron to maintain the effective neutron multiplication factor (k_{eff}) of the SFP at 0.95 or less. This LAR proposes changes to the TS and Design Features related to spent fuel storage requirements and SFP boron concentration. This submittal will correct a current Administrative Letter 98-10 condition by removing credit for Boraflex and documenting the impact of Boral™ blistering in the TS.

A boron dilution analysis of the SFP has been performed to support the minimum boron concentration requirement of the new criticality analysis. The plant systems, environmental factors, and operational scenarios that have been evaluated as potential contributors to an inadvertent dilution event are described in the dilution analysis in this amendment request.

The current accident analyses assumes credit for boron in the SFP only for abnormal configurations, and this is allowed based on plant procedures that require a weekly verification of SFP boron concentration. The proposed safety analysis has determined that a minimum SFP boron concentration of 500 ppm is required to maintain a k_{eff} of less than or equal to 0.95. The proposed change adds a new requirement on the SFP boron concentration which specifies a required minimum boron concentration of 2000 ppm. The dilution analysis has demonstrated that there is no credible event which could reduce the boron from the required minimum value of 2000 ppm to a value below 500 ppm.

This LAR does not change or modify the fuel, fuel handling processes, the total storage capacity, the decay heat generation rate, the SFP cooling and cleanup system, or the physical racks. However, for the purposes of this evaluation, it is conservatively assumed that no Boraflex is available for reactivity control and that every Boral™ panel is affected by the blistering phenomena previously identified.

2. Description of Proposed Changes

2.1 TS Changes - To provide a high-level overview, the proposed TS changes are described below in broad terms:

- 3/4.9.13 Refueling Operations – Spent Fuel Assembly Storage. The Limiting Condition for Operation (LCO), Surveillance Requirements (SR) and Actions are being revised to accomplish the following:

  - Document that the fuel requirements for storage in the SFP are defined in the Design Features. Fuel assemblies are characterized by nominal initial central zone enrichment, burnup history; and for Region 2, decay time. Figure 3.9-1 is removed and replaced with the information in the Design Features.
  - SR 4.9.13.1 and 4.9.13.2 are replaced by a single SR that is consistent with NUREG-1431, Standard Technical Specifications Westinghouse Plants [Reference 6.2].

- 3/4.9.14 New Fuel Assembly Storage. This TS is removed since there are no limitations for fuel storage in the NFV except for the maximum fuel enrichment which is already presented in the Design Features section.

- 3/4.9.15 Fuel Pool Storage Boron Concentration. This TS is added to provide the requirements for maintaining soluble boron to meet the requirements of 10 CFR 50.68 (b)(4).
  - Add a requirement for the minimum boron concentration allowable in the SFP,
  - Add a SR for the boron concentration required in the SFP.

- 5.6 Fuel Storage - Criticality. The Design Features are being revised to accomplish the following:
  - Establish fuel loading requirements for both the SFP and NFV.
  - Establish the use of full-length and full-strength RCCAs, and cooling time in the rack loading patterns of the SFP to meet subcriticality requirements.
  - Establish credit for peripheral leakage in one selected area of Region 2.
  - Establish the fuel loading requirements for the interface between Region 1 and Region 2.
  - Allow full capacity storage in the NFV for fuel enriched up to 5.0 w/o U-235.

To provide more specific description of the proposed amendments, the TS mark-ups are provided in Attachment 1. An item-by-item description of the technical changes is provided below for all non-administrative changes (changes to the Index) along with a brief justification for each change:

LCO 3.9.13

LCO 3.9.13 is revised to remove reference to Figure 3.9-1 and relocates the fuel storage requirements for the SFP to TS 5.6.1.3.

Justification: This change is editorial. Based on the volume of information necessary to describe the new loading patterns, the burnup and enrichment limits were relocated to the Design Features (TS Section 5.6). This location is consistent with NRC-approved LARs for Florida Power and Light Corporation (St. Lucie Unit 1 amendment 193 [Reference 6.3] and Turkey Point amendments 234 and 229 [Reference 6.4]).

<u>Action 3.9.13.a</u>

Remove reference to Figure 3.9-1 and replace with reference to TS 5.6.1.3 since that information has been moved to the Design Features.

Justification: This change is editorial. The information previously documented in Figure 3.9-1 has been relocated to the Design Features.

<u>SR 4.9.13.1</u>

This SR is revised to clarify this requirement and verify by administrative means that the fuel assembly meets the requirements of TS 5.6.1.3.

Justification: This change replaces the current wording with the requirements used in NUREG-1431, SR 3.7.17.1, to verify by administrative means that the fuel assembly placement is in accordance with Specification 5.6.1.3 prior to storing the fuel assembly.

<u>SR 4.9.13.2</u>

Remove this SR.

Justification: This SR is removed since the new SR 4.9.13.1 requires verification prior to fuel movement and replaces this requirement to verify after fuel movement.

<u>Figure 3.9-1</u>

Figure 3.9-1 is deleted and replaced as follows; (1) the burnup and enrichment requirements are moved to Section 5.6.1 and (2) the burnup and enrichment requirements are converted to tabular form (Table 5.6-1).

Justification: This change is editorial. All fuel storage requirement data is being relocated to the Design Features (TS 5.6)

<u>LCO 3.9.14 & SR 4.9.14.1</u>

This LCO and SR are removed since there are no actionable requirements for storage of fuel in the New Fuel Assembly Storage Area.

Justification: The new criticality analysis for the New Fuel Assembly Storage Area justifies full capacity storage of fuel up to 5.0 w/o U-235, the maximum allowable enrichment. Therefore, there are no actionable conditions for operation for the New Fuel Assembly Storage Area. All required information for the New Fuel Assembly Storage Area remains in TS 5.6.1.2.

New LCO 3.9.15

New LCO 3.9.15 is added to provide a requirement for the minimum boron concentration in the SFP.

Justification: This change is consistent with the safety analysis in Attachment 2 supporting the use of a two region rack which partially credits the presence of soluble boron in accordance with 10 CFR 50.68(b)(4). As required by 10 CFR 50.36, a new TS is necessary to document the limiting condition for operation for the SFP boron dilution analysis.

Action 3.9.15.a

New Action 3.9.15.a is added to suspend movement of fuel in the SFP and initiate action to restore boron concentration to the required value.

Justification: This change is consistent with the safety analysis in Attachment 2 justifying the methodology used to partially credit the presence of soluble boron in accordance with 10 CFR 50.68(b)(4).

Action 3.9.15.b

New Action 3.9.15.b is added to document that the provisions of Specification 3.0.3 are not applicable.

Justification: This LCO action is related strictly to the SFP and has no effect on reactor operation.

SR 4.9.15.1

New SR 4.9.15.1 adds a surveillance requirement that verifies the SFP boron concentration every 7 days.

Justification: The implementation of a SFP boron concentration surveillance every 7 days is similar to the NUREG-1431 requirements. The 7-day frequency is appropriate because no major replenishment of SFP water is expected in such a short period of time.

Design Feature 5.6.1.1.a

New 5.6.1.1.a reflects the sub-criticality requirements in 10 CFR 50.68(b)(4) to partially credit the presence of soluble boron in the SFP. The text also adds a discussion of biases and uncertainties in UFSAR Chapter 9.

Justification: This change in the limits reflects the sub-criticality requirements consistent with those used in the critically safety analysis in Attachment 2. Reference to the UFSAR for the biases and uncertainties is done to conform to NUREG-1431.

Design Feature 5.6.1.1.b

Previous Design Feature 5.6.1.1.a is re-numbered to 5.6.1.1.b and changed to reflect the new analysis basis. The text is modified for clarity and to add a discussion of biases and uncertainties in UFSAR Chapter 9.

Justification: This change is consistent with the sub-criticality requirements in 10 CFR 50.68(b)(4) to partially credit the presence of soluble boron in the SFP. Reference to the UFSAR for the bias and uncertainties is done to conform to NUREG-1431.

Design Feature 5.6.1.1.c

Previous Design Feature 5.5.1.1.b is re-numbered to 5.6.1.1.c.

Justification: This is editorial to allow the k_{eff} limits to be presented together.

Design Feature 5.6.1.2.a

The wording for 5.6.1.2.a is changed to be consistent with NUREG-1431by adding the word *fully* prior to flooded and to document that the biases and uncertainties are located in UFSAR Chapter 9.

Justification: This change is done to conform to NUREG-1431.

Design Feature 5.6.1.2.b

Previous Design Feature 5.6.1.2.a is re-numbered to 5.6.1.2.b. The text is revised to document that the biases and uncertainties are located in UFSAR Chapter 9.

Justification: This change is done to reword this Design Feature to conform to NUREG-1431.

Design Feature 5.6.1.2.c

The wording for 5.6.1.2.c is revised to clarify the center-to-center spacing for the NFV to document that the center column has a larger center-to-center spacing to adjacent columns.

Justification: This change adds detail relative to the actual NFV physical configuration.

Design Feature 5.6.1.3

5.6.1.3 is added to provide the storage patterns, enrichment, burnup and cooling time requirements that the criticality analyses have determined meet the requirements of 5.6.1.1.a and 5.6.1.1.b.

Justification: The revised spent fuel storage information aligns with the criticality analyses described in this evaluation and in Attachment 2.

Design Feature 5.6.1.3.a

5.6.1.3.a is added to limit Region 1 storage patterns to those that have been analyzed.

Justification: The revised spent fuel storage pattern for Region 1 aligns with the criticality analyses described in this evaluation and in Attachment 2.

Design Feature 5.6.1.3.b

5.6.1.3.b is added to limit Region 2 storage patterns to those that have been analyzed, including the allowable exception on the periphery of the SFP

Justification: The revised spent fuel storage patterns for Region 2 align with the criticality analyses described in this evaluation and in Attachment 2.

Design Feature 5.6.1.3.c

5.6.1.3.c is added to document how the allowable exception on the west wall of the SFP is to be implemented.

Justification: The implementation of the allowable exception documented here aligns with the criticality analyses described in this evaluation and in Attachment 2.

Design Feature 5.6.1.3.d

5.6.1.3 d is added to describe specific allowable storage patterns for the interface between Region 1 and Region 2.

Justification: The revised spent fuel storage patterns align with the criticality analyses described in this evaluation and in Attachment 2.

Design Feature 5.6.1.3.e

5.6.1.3.e is added to allow replacement of any assembly (with or without an RCCA) by an empty water cell, non-fuel hardware or a fuel rod storage basket.

Justification: The replacement of fuel has been shown to be acceptable in Attachment 2.

Table 5.6-1

Table 5.6-1 is added to replace Figure 3.9-1.

Justification: The Table documents the burnup requirements for each reactivity class of fuel and aligns with the criticality analyses described in this evaluation and in Attachment 2.

Table 5.6-2

Table 5.6-2 is added to document the evaluated fuel assemblies in Region 2 that credit peripheral leakage.

Justification: This list of assemblies documents the current inventory that was used to develop the bounding assembly that was specifically evaluated to credit peripheral leakage.

Figure 5.6-1

Figure 5.6-1 is added to provide the Region 1 storage array allowable for placement of fuel.

Justification: The revised spent fuel storage pattern aligns with the criticality analyses described in this evaluation and in Attachment 2.

Figure 5.6-2

Figure 5.6-2 is added to provide the Region 2 storage arrays allowable for placement of fuel.

Justification: The revised spent fuel storage patterns align with the criticality analyses described in this evaluation and in Attachment 2.

Design Feature 5.6.2

Section 5.6.2 will be relocated to follow the new table and figures inserted in Section 5.6.1. This relocation is purely editorial.

3. TECHNICAL EVALUATION

The bases and justifications for the proposed changes are provided herein. A description for each change along with justification for the administrative changes was provided in Section 2. A more detailed discussion is provided below for the more complex changes. The analyses/evaluations discussed below are provided to justify the proposed changes and address the collateral effects of implementing the proposed changes. Key topics include:

- Principal Design Criteria
- Criticality Evaluation
- Thermal-Hydraulic Evaluation
- Fuel Handling Accident
- Boron Dilution Analysis

This evaluation relies primarily on Holtec Report HI-2114996, "Licensing Report for Seabrook Spent Fuel Pool and New Fuel Vault Analyses", which is provided as Attachment 2. The following text will provide a guide to the requisite evaluations with reference to Attachment 2, providing supplementary information that may not be discussed in the Holtec Report.

3.1 Principal Design Criteria

The principal design criteria for SFP analysis are defined by the Seabrook UFSAR, section 9.1. Attachment 2, sections 3.3 and 4.3, provide additional codes, standards and regulations used in the development of the criticality analysis.

The proposed fuel patterns within the SFP were designed to accommodate the existing inventory of stored irradiated fuel, future fuel discharges, as well as the routine pre-staging of fresh fuel prior to refueling outages. The current fuel inventory in the SFP includes three Westinghouse 17x17 fuel assembly designs: Standard, Vantage 5, and Robust Fuel Assembly (RFA). The design specifications of each are provided in Table 4.5.1 of Attachment 2. The Westinghouse

17x17 Vantage 5 fuel assembly design was used as the reference design for all reactivity calculations. This design was determined to be most reactive fuel assembly design in Regions 1 and 2 for the range of applicable conditions.

3.2 Criticality Evaluation

The proposed amendment creates new loading patterns in the SFP storage racks, defines two distinct regions in the SFP, partially credits the presence of soluble boron, allows credit for RCCAs, allows credit for peripheral leakage in one area of Region 2, and also credits cooling time for Region 2. The criticality analyses that demonstrate that the new fuel patterns will meet the subcriticality criteria required for the presence of soluble boron in the SFP are described in Attachment 2. The assumptions regarding the absence of Boraflex and the blistering of the Boral™ panels, discussed above, have been incorporated into the criticality analysis.

The NFV has been reanalyzed to allow full capacity storage for fuel assemblies with enrichments up to 5.0 w/o U-235. The NFV analysis is provided in section 3 of Attachment 2.

The following subsections are provided to supplement the information in Attachment 2.

3.2.1 Loading Patterns / Storage Arrays

The proposed fuel storage patterns for Regions 1 and 2 are shown in proposed TS Figures 5.6-1 and 5.6-2 respectively. The burnup requirements for these patterns are defined in Table 5.6-1 as a function of nominal initial central zone enrichment and cooling time (for Region 2). The new analyses define the burnup credit restrictions in the following terms:

(a) 2x2 storage arrays,
(b) fuel categories (based on nominal initial central zone enrichment, burnup, and for Region 2 post-irradiation cooling time), and
(c) rules for combining the 2x2 arrays and fuel categories to create acceptable fuel storage in each Region of the SFP and along the interface between Region 1 and 2.

Each 2x2 array is defined for the fuel category that has the maximum allowable reactivity for that array. For example, a fuel assembly of Reactivity Class 3 in Region 2 would define each 2x2 array the fuel assembly resides within to be configured as Pattern B.

The 2x2 arrays for Region 2 require a range of the number of RCCAs: none, one or two.

It is important to note that each 2x2 array was analyzed with fuel of the maximum allowable reactivity such that a fuel assembly of lower reactivity may replace a fuel assembly of higher reactivity without penalty. It is not necessary to use all defined arrays, and replacement of fuel with an empty water channel is acceptable, including fuel assemblies in Patterns B and C, which should include an RCCA.

The failed fuel rod basket has been evaluated assuming each storage location is filled with fresh fuel with an initial enrichment of 5.0 w/o U-235. Attachment 2 demonstrates that the failed fuel rod basket may replace a fuel assembly in any 2x2 array. Trash baskets and other non-fuel hardware which have no fissile material may also replace fuel in any 2x2 array. Based on the calculation in Attachment 2, the most reactive conditions are the allowable fuel patterns fully loaded with fuel of the highest allowable reactivity. Any condition that eliminates fuel assemblies, that is, replacement by empty water channels, non-fuel hardware, or a fuel rod storage basket will reduce the reactivity of the 2x2 array and is acceptable.

Because the storage patterns are defined in terms of 2 x 2 arrays, each fuel assembly can anchor up to four 2 x 2 arrays. That is, each assembly belongs to the 2 x 2 array that includes it as the lower right hand corner, lower left hand corner, upper right hand corner and upper left hand corner. TS require that each fuel assembly be acceptable for storage in each and every one of the 2 x 2 arrays to which it belongs. A specific exception for the periphery of Region 2 which credits peripheral leakage has been analyzed and demonstrated to meet the criticality limits. The assemblies defined in Table 5.6-2 are acceptable when placed in the 2x2 locations defined by 5.6.1.3.c without any RCCAs. It should be noted that the 2x2 array defined by the second and third row away from the West Wall of the SFP are required to follow all Region 2 placement requirements. When an assembly listed in Table 5.6-2 is removed, replacement fuel assemblies are required to meet the requirements of Figure 5.6-2 and Table 5.6-1 for all 2x2 arrays in which they reside.

The Fuel Categories are shown, in order of decreasing reactivity, in TS Table 5.6-1. Each individual fuel assembly is placed in a fuel category based on enrichment, burnup and cooling time (Region 2 only). Seabrook will administratively control the placement of fuel assemblies and classification of fuel assemblies (based on the TS). Prior to repositioning an assembly, the planned destination location will be verified to be an acceptable placement location. The entire process for placement and classification will be independently verified by a qualified individual prior to fuel movement.

The defined 2 x 2 arrays and rules are explicitly described in the proposed TS. This includes the restriction for fuel placement on the interface between Region 1 and Region 2 that requires the fuel within Region 1 adjacent to Region 2 to meet the Region 2 requirements. The maximum calculated values of the neutron multiplication factor include appropriate bias effects, a margin for uncertainty in reactivity calculations, the effect of manufacturing tolerances on reactivity, and are calculated with a 95% probability at a 95% confidence level.

In addition to the cases analyzed above, reactivity effects of interfaces between racks within a Region is addressed by requiring each 2x2 to meet the requirements of an allowable pattern, conservatively ignoring the gaps between racks.

3.2.2 Criticality Design Criteria – The current licensing basis for the SFP is 10 CFR 50.68(b) without credit for soluble boron. This design criterion is being updated in this submittal to include partial credit for soluble boron in accordance with 10 CFR 50.68(b).

3.2.3 Quality Controls that Ensure Accurate Representation of Fuel and Rack Tolerances – The criticality analyses are based on worst-case tolerance limits for the physical parameters of the fuel, storage racks, and RCCAs. Quality control measures ensure that the worst-case tolerance limits used in the criticality analyses will not be exceeded. These quality control measures are an integral part of the Appendix B Quality Assurance programs for the storage rack and nuclear fuel vendors.

Storage rack tolerance parameters used in the Seabrook criticality analyses were extracted from the approved design drawings developed for the NFV and the SFP Region 1 and Region 2 storage racks. These racks were designed and fabricated under the requirements of an Appendix B Quality Assurance program.

Prior to initiating work on this criticality analysis, NextEra reviewed the nominal values as well as maximum and minimum values of a variety of fuel parameters, relevant to analyses, for each reload batch where fuel was supplied. Parameter values that bounded all these reload batches (for example depleted boron concentration) were subsequently used as verified input to the SFP criticality analysis. For the SFP, the maximum tolerances for the Vantage-5 fuel (the most reactive Westinghouse fuel assembly design) were utilized in the analysis. The NFV analysis considers the tolerances of only the RFA fuel, the fuel currently being utilized for core reloads.

Fuel assemblies used at Seabrook have been, and continue to be, fabricated under the requirements of an Appendix B Quality Assurance program. This assures that fuel assemblies fabricated in the future will conform with or be bounded by the design characteristics assumed in criticality analyses. A certification is provided for each fuel reload batch that the fuel assemblies comprising that reload batch have been fabricated in accordance with specifications. Nonconformance with product specifications is brought to the attention of the purchaser (normally NextEra Energy Seabrook); these items must be satisfactorily dispositioned prior to fuel receipt.

3.2.4 New Fuel Types – Changes in the characteristics of fuel assemblies used at Seabrook will be evaluated as part of NextEra's core reload design process. Procedurally, all core reloads are treated as design modifications and are subject to appropriate engineering reviews and 10 CFR 50.59 evaluations. If the 10 CFR 50.59 evaluation concludes that the new fuel type can be implemented without prior NRC approval, the change will be implemented and the UFSAR will be revised pursuant to 10 CFR 50.71(e). Otherwise, the introduction of a new fuel type will be submitted under 10 CFR 50.90 for NRC approval.

3.2.5 Integrity of Control Rod (RCCA) Neutron-Absorbing Capability – Full -Length RCCAs, with a neutron poison material composed of a silver-indium-cadmium (AgInCd) alloy, have been analyzed for use in certain storage arrays to meet subcriticality criteria. Details of the RCCA analysis are described in Attachment 2 Section 4.6.2. Worst case tolerances were determined and evaluated in the SFP criticality analysis. It is acceptable for the criticality analyses to use the nominal value for the RCCA's poison density in the Reference analysis because RCCAs are discharged from the reactor so as not to exceed mechanical integrity criteria rather than for reasons related to its poison depletion. The RCCA poison is a strong neutron absorber and its depletion is inconsequential over its operating life due to the increasing weight percent of cadmium, a strong thermal neutron absorber. The inconsequential depletion of the RCCA is a result of epithermal neutron absorption of silver and its subsequent transmutation into stable cadmium isotopes [Reference 6.5]. Long term depletion of the RCCA in the SFP is insignificant since the thermal neutron flux is orders of magnitude lower than that experienced in the reactor.

Additionally, RCCAs are typically withdrawn from the active fuel region during full power operation of the core. Plant TS encourage operation with RCCAs withdrawn; limiting the depth of RCCA insertion for power shaping purposes and the cumulative RCCA insertion time during power operation. Procedural controls establish the fully withdrawn condition, as defined by the Core Operating Limits Report, to be the preferred operating position for RCCAs. These controls ensure conformance with the insertion requirements of TS 3.1.3.5 and 3.1.3.6 and provide a rationale for the RCCA nominal poison density assumption.

Comparisons of predicted and measured control rod reactivity worth, performed during low power physics testing, further support an assumption that RCCA depletion is not experienced at Seabrook. In-core residence time of full-strength RCCAs is constrained by calculations of cladding strain. NextEra has an active program to track the operational parameters related to strain and to procure replacement RCCAs, when necessary. As a result, existing procedures and administrative controls ensure that the poison density levels in RCCAs will not be significantly depleted and remain consistent with that assumed in the SFP criticality analysis.

3.2.6 Assurance of Control Rod (RCCA) Placement – Full-length RCCAs have been analyzed for use in certain storage arrays to meet subcriticality criteria. The RCCA is not an integral (nonremovable) part of a fuel assembly or storage rack; however, NextEra will use strict engineering controls, administrative controls, and independent verification to ensure that the RCCAs are installed as required.

3.3 Thermal-Hydraulic Evaluation

With respect to thermal-hydraulic performance of the SFP cooling function, the net effects of the proposed changes are:

1) A very small decrease in the bulk SFP water inventory due to the combined displacement of pool water by the blistering of all Boral™ panels.

2) A small increase in local hydraulic resistance will occur in Boral™ rack cells having blistered Boral™ panels as a result of a decrease in the hydraulic diameter of the flow area.

The proposed changes do not increase the number of fuel assemblies that may be stored in the pool, do not increase the decay heat load imposed on the pool, make no changes to the SFP cooling system, and do not impact the environment. In addition, the Boral™ panels are mounted on the outsides of the boxes that form the rack storage cells, meaning the panels are in the inter-cell water gaps. As the panels are outside of the storage cells, blistering and spalling of the Boral™ surface could not reduce the flow area through the storage cells and the equivalent hydraulic diameter used in the Thermal-Hydraulic evaluation is not affected. Therefore, the licensing-basis SFP local temperature analyses are not affected by Boral™ degradation as demonstrated in Section 2 of Attachment 2.

The impact of the Boral™ blistering was evaluated for the licensing-basis SFP bulk temperature evaluation and it was concluded in Section 2 of Attachment 2 that there is no effect on the current results. In addition, the time-to-boil evaluation showed (after a loss of forced cooling) only a negligible impact (0.09%) due to the maximum worst-case Boral™ degradation.

3.4 Fuel Handling Accidents

The Fuel Handling Accident (FHA) has been fully evaluated in Attachment 2. Fuel mis-loading events were also evaluated. All normal conditions were evaluated to determine if a potential event could occur to increase the reactivity of the SFP. All cases demonstrated acceptable results.

3.5 Boron Dilution Analysis

A boron dilution analysis has been performed to demonstrate that soluble boron can be credited for the Seabrook SFP criticality analysis. The criticality analysis assumes partial credit of 500 ppm of soluble boron to meet the $k_{eff} \leq 0.95$ limit of 10 CFR 50.68 (b)(4). A new TS is added to require a minimum of 2000 ppm for the SFP. The dilution analysis shows that sufficient time is available to detect and mitigate all credible dilution events from the 2000 ppm initial condition before the SFP criticality analysis design basis value of $k_{eff} \leq 0.95$ (500 ppm) is violated.

The boron dilution analysis evaluated:

- Boration Sources
- Dilution Sources
- Piping near SFP
- SFP Instrumentation and Administrative Controls
- Boron Dilution Initiating Events/Results
- Loss of Offsite Power Impact

The SFP volume has been calculated to be 264,895 gallons. This conservatively assumes all fuel storage locations are occupied by fuel and the pool level is at the low level setpoint. This volume only includes the area within the fuel storage area of the SFP. The maximum surface area of the SFP (including the cask and fuel transfer areas) was utilized in determining the water volume necessary to reach the high level alarm setpoint.

The required volume to dilute from an initial concentration to a final concentration can be described as:

Required Volume = [LN(initial concentration / final concentration)] * SFP Volume.

DI volume = LN(2000/525)*SFP volume = 354,298 gallons

The above calculation assumes 525 ppm instead of the required 500 ppm to minimize the dilution volume.

Spent Fuel Cooling/Purification

The SFP cooling system contains three SFP cooling pumps and two heat exchangers cooled by the primary component cooling water (PCCW) system. SFP water is provided to the suction of the SFP pumps through a strainer approximately two feet below the surface of the SFP. Cooled water returns to the SFP via a common discharge header approximately 10 feet above the top of the fuel. Draining of the pool due to failure of a penetration is limited by the 15' and 14' 6" elevation of the penetrations. Anti-siphon holes prevent draining below 13 feet above the fuel in the event of a piping failure external to the SFP at lower elevations.

The SFP water quality is maintained by the pool skimmer loop, which filters and demineralizes the cooling water. Five skimmers located at the surface of the pool maintain the pool surface free of floating particles and other materials. The 120 gpm flow from the skimmers passes through a series of filters and demineralizers and ultimately returns to the SFP through a four-inch return penetration at the 15' 6" elevation.

Boration Sources

The normal source of borated water to the SFP is the refueling water storage tank (RWST). The RWST volume (486,000 gallons) can be gravity fed to the SFP by opening two normally closed manual valves. The RWST boron concentration is greater than 2000 ppm; the cycle 15 COLR requirement, for example, is greater than 2400 ppm.

Another source of borated water is the Boric Acid Tanks (BAT). The BAT contains 44,000 gallons of water borated to greater than 7000 ppm, which can be pumped to the SFP via three normally closed manual valves.

Dilution Sources

There are several possible sources of unborated water that can be aligned to the SFP. Each possible source will be reviewed.

Reactor make-up water (RMW) can be pumped to the SFP by opening one normally closed manual valve. The design flow of a RMW pump is 280 gpm at 200 psi. The flow path through the available three inch and two inch lines would restrict flow to a much lower value; however, a flow rate of 280 gpm will be assumed. The RMW tank volume is 112,000 gallons.

The demineralized water tank can be pumped to the top of the SFP via a normally closed manual valve. This 200,000 gallon tank can be manually refilled from another demineralized water tank with a volume of 500,000 gallons.

The condensate storage tank (CST) can be gravity fed to the SFP by means of a fire hose and operation of a normally closed manual valve. This is a possible pathway in situations where pool level must be maintained and borated sources are unavailable. The CST tank volume is 400,000 gallons.

The fire protection (FP) water tank can be pumped to the SFP via fire hose and operation of a normally closed manual valve. This is a possible pathway in situations where pool level must be maintained and borated sources are unavailable. The FP tank volume is >1,000,000 gallons.

The removal of boron from the SFP by SFP purification or reverse osmosis skid was reviewed. There is insufficient resin volume compared to the volume and concentration of the SFP to significantly alter the SFP boron concentration. The reverse osmosis skid has been specifically analyzed and it is concluded that the maximum boron removal is limited to a 10 ppm change in boron concentration of the SFP. Therefore, these two potential dilution events are eliminated since they have just a small impact on the SFP.

There is no possible flooding from the natural environment due to the elevation of the SFP. Flood protection for the fuel storage building (FSB) is provided by a curb at 21.5 feet Mean Sea Level (MSL), which is above the maximum water level of 20.6 feet MSL for the worst case event. Protection against flooding in the SFP is assured since the pool operating floor level elevation is at 25' 0". The FSB is designed to withstand the effects of extreme natural phenomena, such as the safe shutdown earthquake, tornadoes, hurricanes, missiles, and floods.

Piping near the SFP

The possibility exists for pipe breaks to add water to dilute the SFP. The first possibility is for a failure of a small demineralized water line. These lines run from a common header and are less than two inches in diameter. A failure would result in a flow rate less than 250 gpm. Larger pipelines for FP and SFP cooling are adjacent to the SFP. A pipe break for one of these larger lines could result in a flow greater than 400 gpm. Mitigation of this type of event is discussed below.

SFP Instrumentation and Administrative Controls to mitigate a dilution event

Available Instrumentation in the SFP is designed to provide indication of any potential significant dilution event to the control room. The instrumentation includes:

a. SFP level indications will alarm at minimum and maximum levels. The small span from low to high level alarms (4.5 inches) allows for only a 4,500 gallon change to the SFP prior to a level alarm sounding in the control room.
b. SFP leak sump has a high level alarm that directs local response.
c. Sumps A and B in the FSB have high level alarms that direct local response.
d. Sumps A and B pump to 10,000 gallon floor tanks. These tanks each have high level alarms.

Additional alarms that would assist in determining an event in progress include:

a. RMW tank low level alarm will alert operation to a reduction in the RMW water level and auto-stop any running RMW pump.
b. Demineralized water tank low level alarms will annunciate at 50% and 6% respectively.
c. A loss of pressure in the FP header will result in a pump start and corresponding alarm. Response to this alarm when no fire is identified includes system leak checks, review of building sump levels, and isolation of leak.

Administrative controls for the SFP include normal walk downs of the area. The operators record SFP level as part of control board walk downs and primary rounds each shift. Additionally, security and radiation protection personnel patrol the FSB on a regular basis. A change in SFP level, the presence of water, or changing radiological conditions would be readily apparent and result in quick corrective action. Given the frequency of operator rounds and routine security and radiation protection patrols, it is expected that changing conditions in the FSB would be identified by patrol within 8 to 12 hours even if all the other indications described above were not promptly responded to or failed. It will be demonstrated that no credible dilution event could occur without sufficient indications to ensure that actions would be initiated well before the minimum boron requirement could be approached. Based on the SFP volume, a dilution flow rate greater than 450 gpm for 12 hours would be required to dilute the SFP to unacceptable concentrations.

Boron Dilution Potential Events

Dilution from the RMW tank

An addition to the SFP from the RMW tank via the chemical and volume control system (CVCS) blender is controlled by procedure and requires the manual start of a RMW pump and manual valve manipulation to align to the SFP. This procedure is normally used to supply borated water to the SFP; however, a misalignment of the boric acid line, a makeup controller failure, or deliberate operator action could deliver unborated water to the SFP via this pathway.

Indication of an event would be the SFP high level alarm sounding in the control room after only 4500 gallons had been added to the SFP followed by the low level alarm from the RMW tank. The RMW tank low level alarm will sound in the control room and send a shutdown signal to the RMW pumps. Procedural directions also provide guidance to shutdown the pumps with a low level alarm.

Since the RMW tank has insufficient volume to dilute the SFP to 500 ppm, additions to the RMW tank would require operator action. There are sufficient controls and alarms to recognize an inadvertent dilution was in progress to stop this event. In addition, there is insufficient available volume to challenge the SFP boron requirements without additional operator action. Therefore, the addition of water from the RMW tank via the CVCS blender is not a dilution path that represents a credible event.

An addition of unborated water to the SFP from the RMW tank which bypasses the CVCS blender is another potential pathway. However, the limitations of valve alignment, the need for manual start of a RMW pump, available high SFP level alarm, low RMW tank level alarm, and automatic pump stop exist. Ultimately, there are sufficient controls and alarms to prevent or mitigate an inadvertent dilution and insufficient available volume in the RMW tank to challenge the SFP boron concentration requirements.

Dilution from normal demineralized water fill of the SFP

A procedure requires the control room operators to monitor level trend during filling of the SFP and contains steps to ensure water addition will not dilute the pool. Manual valve manipulation is required in the FSB to end the water addition. If the valve is not closed properly at the end of the evolution, the SFP high level alarm will eventually be reached and alert the operators to changing SFP level. The fill line consists of one inch or smaller pipelines. The maximum flow of 100 gpm during the fill is insufficient to dilute the SFP.

Dilution from piping failure near the SFP

The failure of two inch or smaller lines over the cask area or around the SFP would result in a flow rate less than 250 gpm, much less than the 450 gpm value necessary to dilute the SFP in a 12 hour time frame. This flow, if directly into the SFP, would first be identified by a SFP high level alarm. A continued leak in the building would be identified by local patrol of the FSB or by floor drain tank and sump level alarms. Sufficient controls and alarms are present to identify and mitigate an inadvertent dilution. There is also insufficient flow rate and volume in the demineralized water tank to challenge the SFP boron concentration requirements within the 12 hours.

The failure of FP piping in the FSB has the potential to dilute the SFP within the required time frame. It should be noted that the location of this piping would result in the majority of the flow being released directly to the 21.5' elevation. The water would flow into sump A at greater than the capacity of the sump pumps and rapidly result in a high level alarm. Due to the elevation of the piping there is the potential for a portion of these flows to enter the SFP; however, the high level alarm in the SFP would provide additional indication of an event in progress.

Additional protection for a failure of a PCCW line is provided by the level instrumentation and alarm features for the PCCW head tank. In the event of a failure of a FP line, a procedure directs investigation and isolation of a faulted fire protection line. It is concluded that failure of a larger diameter piping near the SFP will be rapidly identified and mitigated prior to diluting the SFP to unacceptable levels.

Dilution from PCCW heat exchanger tube failure

A failure of the SFP heat exchanger may also result in a dilution event. A failure on the tubeside of the heat exchanger has the potential to mix SFP water with PCCW and dilute the SFP. Flow into or out of the heat exchanger tubes will be evident as a change in the PCCW head tank level, and a level change of less than 1,000 gallons will result in annunciation in the control room. The volume available from this potential event is not sufficient to dilute the SFP to unacceptable levels.

Dilution event with failure of the SFP high level alarm

An assessment of the other available indications of a dilution event that would be available if the SFP high level alarm failed was performed. With the high level alarm operational, a maximum of 4500 gallons unborated water could be added to the SFP prior to the level alarm. Without the high level alarm, it is possible that a larger dilution could occur. This evaluation is independent of the source of the unborated water; it is designed to look at the controls in place in addition to the high level alarm. This evaluation covers the potential for water addition from the CST and the FP system, each of which has sufficient volume to potentially dilute the SFP to below 500 ppm.

With an ongoing dilution, approximately 17,500 gallons would be required to raise the SFP level from the low level alarm to the 25′ operating level. At this point, water would begin to flood outside the SFP. Once the 25′ operating level begins to flood, the curbing around the SFP has three low points that will allow flow to areas around the SFP. Overfill from the east side of the operating level will flow down to the 10′ elevation and to sump B. Overfill from the south side of the pool will travel down the stairs near the middle of the pool and directly to the area around sump A, or down the stairs in the southwest corner of the pool and onto the 21.5′ elevation of the FSB.

Along the north and east walls of the 21.5′ elevation are multiple through-floor conduit penetrations to the 7′ elevation, which drain to sump A via floor drains. The 21.5′ elevation also has two floor drains to sump A. The two remaining flow paths from the 21.5′ elevation are two walkways near the northeast corner. The first is along the east wall leading to the 7′ elevation near sump A, and the second is along the south side of the 21.5′ elevation, which leads to the truck bay on the 20.5′ elevation. Flow to the 20.5′ elevation does not drain to the FSB sumps; however, the curbing around this walkway would direct flow from the 21.5′ elevation to travel over the conduit penetrations or floor drains. The walkway that leads to the 7′ elevation is in close proximity to the walkway that leads to the 20.5′ elevation; it is reasonable that a large portion of overfill to the 21.5′ elevation will flow to sump A via floor drains and spillage to the 7′ elevation.

It is assumed that 20,000 gallons of water could be distributed around the FSB prior to entry into the sumps. Based on dimensions from FSB plan drawings, this assumption is equivalent to five inches of standing water in the FSB 7′, 10′, 20.5′, and 21.5′ elevations. Assuming both floor drain tanks are empty at the beginning of the event, 20,000 gallons are required to fill both tanks. Finally, it is assumed that both sump A and sump B, which are four feet deep, each have a capacity of 5,000 gallons at the high level setpoint. The 5,000 gallons per sump is based on the known depth of four feet and an estimated surface area of 150 ft^2.

In the unlikely event that the SFP high level alarm was unavailable, approximately 67,500 gallons could be added to the SFP prior to the high level alarms from the FSB sumps. This could occur only if the floor drain tanks high level alarms along with the flooding were ignored. This volume is significantly less than the 354,298 gallons necessary to dilute the SFP to the criticality boron value.

Loss of Pool Level – Beyond design basis

The preferred source of water in response to a loss of SFP level is the borated RWST. In the event the borated makeup source is unavailable, an abnormal procedure directs using unborated water from the CST or FP tanks to maintain level in the SFP. The procedure also directs monitoring of pool temperature and investigation for leakage. The volume of these unborated sources is essentially unlimited; however, the ultimate focus of the abnormal procedure is to ensure sufficient water is available to offset boiling losses and to identify/repair the leak to allow a return to normal pool level and cooling. In these extreme conditions, it may be possible to intentionally dilute the SFP below 500 ppm. Even if borated water supplies cannot be utilized, the requirements of keff <1.00 with 0 ppm will be met at all times.

Loss of Station Power

A loss of station power would reduce the number of methods to detect and mitigate a dilution event in the SFP; however, there is no recognized potential for a loss of station power to initiate a boron dilution. All dilution pathways require component manipulation, electrical power to pumps, a pipe break, or a combination of these factors. In the unlikely event of an ongoing dilution with a subsequent loss of station power, it is noted that operator rounds would continue to be available to identify and respond to changing conditions.

<u>Boron Dilution Conclusion</u>

It is concluded that sufficient programmatic controls and process alarms are in place to prevent, identify, or mitigate an inadvertent dilution event prior to challenging the minimum boron concentration of the SFP.

The method of normal makeup to offset evaporative losses uses a demineralized water lineup that is restricted to less than 100 gpm. Procedural controls require constant monitoring during fill from this lineup. Pool high level alarms and other building alarms are available in the unlikely event of a prolonged unmonitored fill.

Procedural requirements ensure that all other additions to the SFP be of adequate boron concentration to prevent dilution of the pool below administrative limits.

The preferred source of water in the event of a loss of pool level is the borated RWST. Borated water is available from this source by gravity feed should offsite power be lost.

For an event that results in overfill of the SFP and/or flooding of the FSB, additional alarms are available from the level instrumentation on the two local sumps and the tanks that these sumps pump to. Alarm response to the actuation of a pool high level, low pool level, or high sump alarm includes local response to the FSB to visually assess pool level.

In order to dilute the SFP to the design keff of 0.95, more than 350,000 gallons of water are required. This volume exceeds the capacity of any normally connected tanks without manual action to refill. The addition of less than 100,000 gallons would result in pool high level alarms, FSB sump level alarms, drain tank high level alarms, and general flooding of the FSB. A SFP dilution event would be readily detected by plant personnel via alarms, flooding, or normal operations or security rounds through the FSB and would result in quick corrective action. There are no credible dilution events that could maintain a sufficient flow rate for the 12 hours necessary to dilute the SFP to unacceptable concentrations without multiple indications being ignored.

This evaluation therefore concludes that an inadvertent dilution of the SFP to 500 ppm boron, or keff of 0.95, is not credible.

4. REGULATORY EVALUATION

4.1 Precedent

This LAR has been prepared with deference to licensing precedent and has incorporated to the extent practical, information that should address RAIs (Requests for Additional Information) that were issued for preceding licensing actions. The following precedents were most influential in preparation of this LAR:

Administratively Controlled Fuel Loading Patterns - Licensing precedent has already been established for eliminating reliance on Boraflex and taking credit for administratively controlled fuel loading patterns and credit for RCCAs. Turkey Point Units 3 and 4, license amendments 234 and 229 (ML071800198) are recent examples.

Crediting Soluble Boron To Provide Criticality Control – Many nuclear units have modified the criticality analysis to partially credit soluble boron in the SFP. An example is St. Lucie Unit 1, license amendment 193, issued September 23, 2004 (ML042670562).

4.2 Significant Hazards Consideration

Description of amendment request:

> The proposed license amendment to Facility Operating License NPF-86 for Seabrook Nuclear Station will revise TS to eliminate the current SFP storage configurations which rely on Boraflex absorbing material in the SFP. The new patterns use a combination of partial credit for soluble boron, Boral™ for Region 1, burnup, RCCAs, peripheral leakage in one area of Region 2, and cooling time to maintain k_{eff} below regulatory limits with a 95% probability at 95% confidence level. The storage racks in Region 1 will account for the potential for blistering of Boral™ and the storage racks in Region 2 will no longer credit the presence of any Boraflex as a neutron absorbing material.
>
> The proposed license amendment will also revise TS to allow full capacity fuel storage in the NFV at the maximum allowable enrichment.

Pursuant to 10 CFR 50.92, a determination may be made that a proposed license amendment 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; (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. Each of these considerations is discussed below:

Would operation of the facility in accordance with the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

No. Operation in accordance with proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated. 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 spent fuel pool (SFP) or the new fuel vault (NFV, decay heat generation rate, or the SFP cooling and cleanup system. There are also no changes to the NFV storage racks or the new fuel handling processes.

Operation of the SFP utilizes soluble boron; crediting this boron for criticality control does not change the probability of any accident. The proposed amendment was evaluated for impact on the following previously evaluated events and accidents:

a. A fuel handling accident (FHA),
b. A fuel mis-positioning event,
c. A seismic event, and
d. A loss of SFP cooling event

The probability of a 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 radiological source term of a single fuel assembly will remain unchanged. Therefore, the proposed amendment does not significantly increase the probability or consequences of a FHA.

Operation in accordance with the proposed amendment will not significantly increase the probability of a fuel mis-positioning 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 mis-positioning event are not changed because the reactivity analysis demonstrates that the new subcriticality criteria and requirements will be met for the worst-case fuel mis-positioning 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. Furthermore, conservative analyses indicate that the current design requirements and criteria continue to be met with the presence of Boral™ blisters.

The proposed amendment also does not increase the probability of any event in the NFV since there are no changes to the handling of fuel within the NFV or to the fuel storage racks. The proposed amendment was evaluated for impact for the previously evaluated full flooded and optimum moderated accidents. Operation in accordance with the proposed amendment will not change the probability of the NFV being flooded with full density or optimum density water. The consequences of the fully flooded event have been demonstrated to meet applicable criteria. Therefore, the proposed amendments do not significantly increase the probability or consequences of an event within the NFV.

Based on the above, it is concluded that the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

Would operation of the facility in accordance with the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

No. Operation in accordance with the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated. The proposed amendment does not change or modify the fuel, fuel handling processes, spent fuel racks or new fuel vault rack, number of fuel assemblies that may be stored in the pool or the new fuel vault, decay heat generation rate, or the SFP cooling and cleanup system.

Seabrook procedures require soluble boron to be present in the SFP, as such; the possibility of an inadvertent fuel pool dilution event has always existed. However, the SFP dilution analysis that accompanies this submittal demonstrates that no credible dilution event could increase fuel pool reactivity such that the effective neutron multiplication (k_{eff}) exceeds 0.95. Therefore, implementation of credit for soluble boron to control reactivity in the SFP will not create the possibility of a new or different type of criticality accident.

The limiting fuel assembly mispositioning event does not represent a new or different type of accident. The mispositioning of a fuel assembly within the fuel storage racks has always been possible. The locations of SFP rack modules and the specific modules assigned to each storage region remain unchanged; analysis results show that the storage racks remain sub-critical, with substantial margin, following a worst-case fuel misloading event. Therefore, a fuel assembly misload event that involves new fuel storage arrangements required by the criticality analysis does not result in a new or different type of criticality accident.

The potential for blistering on the Boral™ has been evaluated and the neutron poison will continue to fulfill its function. Therefore, there is no possibility of a new or different type of accident associated with this change.

The change in the storage requirements for the NFV does not introduce the probability of a new or different accident since procedures used for fuel movement will remain unchanged.

Based on the above, it is concluded that operation with the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

Would operation of the facility in accordance with the proposed amendment involve a significant reduction in a margin of safety?

No. Operation of the facility in accordance with the proposed amendment does not significantly reduce the margin of safety. The proposed change was evaluated for its effect on margins of safety related to criticality and spent fuel heat removal capability.

The changes proposed by this license amendment ensure that the fuel in the SFP will remain sub-critical under normal and accident conditions. The controlled placement of fuel assemblies within the SFP will maintain k_{eff} less than or equal to 0.95 as required by TS 5.6.1.1 for spent fuel storage and less than 1.0 if flooded with unborated water. The proposed amendment maintains the 0.95 limit on k_{eff} by restricting the placement of fuel and by partially crediting soluble boron in the fuel pool water.

The proposed change does not affect spent fuel heat generation or the spent fuel cooling systems. A conservative analysis indicates that the design basis requirements and criteria for spent fuel cooling continue to be met with Boral™ blistering considered.

The changes for the NFV proposed by this license amendment ensure that the fuel remains sub-critical under normal and accident conditions. The NFV will continue to meet the keff limits as defined by TS 5.6.1.2.a and TS 5.6.1.2.b.

Based on these evaluations, operating the facility with the proposed amendment does not involve a significant reduction in any margin of safety.

4.3 Conclusions

The evaluation concludes that the proposed technical specification changes do not involve a significant safety hazard and are acceptable for submittal to the NRC. Therefore, the elimination of reactivity credit for Boraflex, the restriction of fuel storage to a distinct two region rack based on allowable 2x2 arrays, and requiring the presence of a minimum soluble boron concentration of 2000 ppm in LCO 3.9.15 are acceptable changes. Storage of fuel at full capacity within the NFV has been evaluated and it has been demonstrated that this change does not involve a significant safety hazard.

5. ENVIRONMENTAL CONSIDERATION

NextEra has reviewed the proposed license amendment for environmental considerations. The review 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, and would change an inspection or surveillance requirement. However, the proposed changes do not involve a significant hazards consideration, nor increase the types and amounts of effluent that may be released offsite, nor significantly increase individual or cumulative occupational radiation exposures. Based on the foregoing, NextEra concludes that the proposed changes meet the criteria delineated in 10 CFR 51.22 (c)(9) for a categorical exclusion from the requirements for an Environmental Impact Statement. Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment needs to be prepared in connection with the proposed amendment.

6 REFERENCES

6.1 NextEra Energy Seabrook Letter NYN-03082, "Seabrook Station Boral™ Spent Fuel Pool Test Coupons Report Pursuant to 10 CFR Part 21.21," October 6, 2003.

6.2 NUREG-1431, Standard Technical Specifications Westinghouse Plants, Revision 3, June 2004.

6.3 NRC letter "St. Lucie Plant, Unit -1, Issuance of Amendment Regarding Spent Fuel Pool Soluble Boron Credit (TAC NO. MB6864)," September 23, 2004 (ML042670562).

6.4 NRC letter "Turkey Point Plant, Units 3 and 4 – Issuance of Amendments Regarding Spent Fuel Pool Boraflex Remedy (TAC NO. MC9740 and MC9741)," July 17, 2007 (ML071800198).

6.5 Control Rod Materials and Burnable Poisons, EPRI NP-1974, November 1981.

Attachment 1

Marked-up Technical Specification Pages

Mark-up of the Technical Specifications (TS)

The attached markups reflect the currently issued version of the TS and Facility Operating License. At the time of submittal, the Facility Operating License was revised through Amendment No. 127.

Listed below are the license amendment requests that are awaiting NRC approval and may impact the currently issued version of the Facility Operating License affected by this LAR.

LAR	Title	NextEra Energy Seabrook Letter	Date Submitted
LAR 10-02	Application for Change to the Technical Specifications for the Containment Enclosure Emergency Air Cleanup System	SBK-L-10074	05/14/2010
LAR 11-01	Application to Revise the Technical Specifications for Reactor Coolant Leakage Detection Instrumentation	SBK-L-11066	04/21/2011
LAR 11-03	License Amendment Request Regarding Containment Spray Nozzle Surveillance Requirement	SBK-L-11130	07/14/2011
LAR 11-09	Removal of Locations Specified in Technical Specification 3.3.3.5, Remote Shutdown System, Table 3.3-9	SBK-L-11194	11/17/2011

The following TS pages are included in the attached markup:

Technical Specification	Title	Page
---	TS Index	ix x xi
3.9.13	Spent Fuel Assembly Storage	3/4 9-16 3/4 9-17
3.9.14	New Fuel Assembly Storage	3/4 9-18
3.9.15 (new)	Spent Fuel Pool Boron Concentration (new)	3/4 9-17
5.6	Design Features	5-10 5-11 5-12 (new) 5-13 (new) 5-14 (new) 5-15 (new) 5-17 (new)

INDEX

LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

DELETE (3/4.9.13 and FIGURE 3.9-1)

REPLACE WITH (THIS SPECIFICATION NUMBER IS NOT USED) (3/4.9.14)

DELETE ① (3/4 10-1)

INSERT: 3/4.9.15 SPENT FUEL POOL BORON CONCENTRATION 3/4 9-18

LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

INDEX

5.0 DESIGN FEATURES

6.0 ADMINISTRATIVE CONTROLS

DELETE → 1

3/4.9.13 SPENT FUEL ASSEMBLY STORAGE

LIMITING CONDITION FOR OPERATION

3.9.13 Fuel assemblies stored in the Spent Fuel Pool shall be placed in the spent fuel storage racks according to the criteria shown in Figure 3.9-1. ← Specification 5.6.1.3

APPLICABILITY: Whenever fuel is in the Spent Fuel Pool.

ACTION:

INSERT immediately

a. With the requirements of the above specification not satisfied, suspend all other fuel movement within the Spent Fuel Pool and move the non-complying fuel assemblies to allowable locations in the Spent Fuel Pool in accordance with Figure 3.9-1. ← Specification 5.6.1.3.

b. The provisions of Specification 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS

REMOVE

4.9.13.1 The burnup of each fuel assembly to be stored in the Spent Fuel Pool shall be determined from it's measured burnup history prior to storage in the Spent Fuel Pool. A complete record of each assembly shall be maintained as long as that fuel assembly is retained on-site.

4.9.13.2 After fuel assembly(ies) movement into or within the Spent Fuel Pool, the position of the fuel assembly(ies) that was (were) moved shall be checked and independently verified to be in accordance with the criteria in Figure 3.9-1

Add

4.9.13.1 Prior to fuel assembly movement into or within the Spent Fuel Pool, verify by administrative means that the requirements of Specification 5.6.1.3 are satisfied.

DELETE

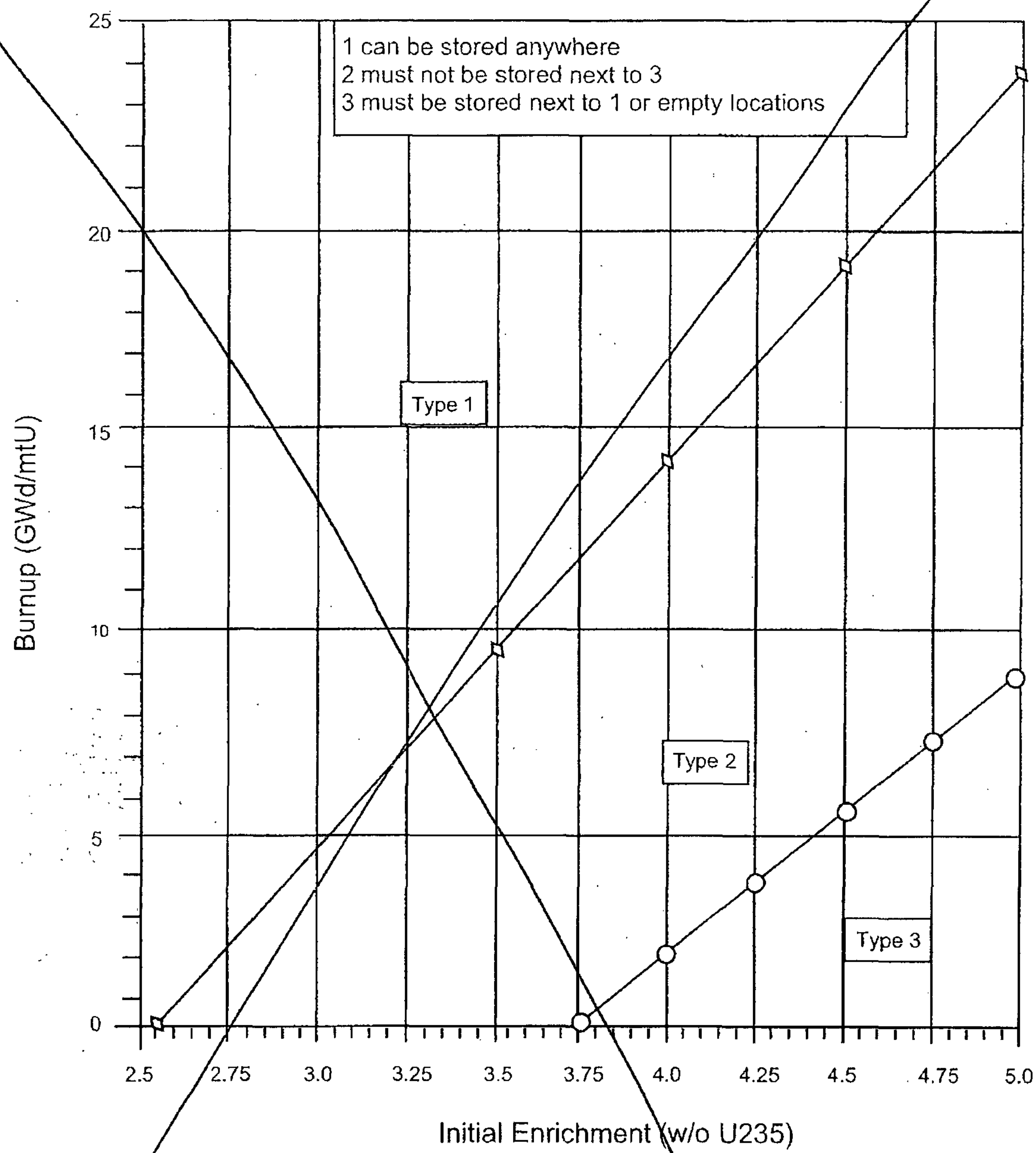


Figure 3.9-1
Fuel Assembly Burnup vs. Initial Enrichment
For Spent Fuel Assembly Storage

REPLACE
(THIS SPECIFICATION NUMBER IS NOT USED)

3/4.9.14 NEW FUEL ASSEMBLY STORAGE

LIMITING CONDITION FOR OPERATION

DELETE

DELETE

3.9.14 The New Fuel Storage Vault may be maintained with a full loading of 90 assemblies with fuel enrichment up to 3.675 w/o ^{235}U. The loading must be reduced to 81 assemblies for enrichments from 3.675 to 5.0 w/o ^{235}U by limiting the fuel assembly placement in the central column of the New Fuel Storage Vault to every other location.

APPLICABILITY: Whenever fuel is in the New Fuel Storage Vault.

ACTION:

a. With the requirements of the above specification not satisfied, suspend all other fuel movement within the New Fuel Storage Vault and move the non-complying fuel assemblies to allowable locations in the New Fuel Storage Vault in accordance with the requirements of the above specification.

b. The provisions of Specification 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS

4.9.14.1 After fuel assembly(ies) movement into or within the New Fuel Storage Vault, the position of the new fuel assembly(ies) that was (were) moved shall be checked and independently verified to be in accordance with the requirements of the above specification.

INSERT →

REFUELING OPERATIONS

3/4.9.15 SPENT FUEL POOL BORON CONCENTRATION

LIMITING CONDITION FOR OPERATION

3.9.15 The boron concentration in the Spent Fuel Pool shall be greater than or equal to 2000 ppm.

APPLICABILITY: Whenever fuel is in the Spent Fuel Pool

ACTION:

a. With boron concentration in the Spent Fuel Pool, less than 2000 ppm, immediately suspend movement of fuel in the Spent Fuel Pool and immediately initiate action to restore boron concentration to 2000 ppm or greater.

b. The provisions of Specification 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS

4.9.15.1 The boron concentration of the Spent Fuel Pool shall be verified to be 2000 ppm or greater at least once per 7 days.

5.6 FUEL STORAGE

REPLACE WITH INSERT 1

CRITICALITY

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

a. A k_{eff} equivalent to less than or equal to 0.95 when flooded with unborated water, which includes margin for uncertainty in calculation methods and mechanical tolerances with a 95% probability at a 95% confidence level.

b. A nominal 10.35 inch center-to-center distance between fuel assemblies placed in the storage racks.

5.6.1.2 The new fuel storage racks are designed and shall be maintained with:

a. A k_{eff} equivalent to less than or equal to 0.95 when flooded with unborated water, which includes margin for uncertainty in calculational methods and mechanical tolerances with a 95% probability at a 95% confidence level.

b. A k_{eff} equivalent to less than or equal to 0.98 when aqueous foam moderation is assumed, which includes margin for uncertainty in calculational methods and mechanical tolerances with a 95% probability at a 95% confidence level.

c. A nominal 21 inch center-to-center distance between fuel assemblies placed in the storage racks.

DRAINAGE

RELOCATE

5.6.2 The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 14 feet 6 inches.

CAPACITY

5.6.3 The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than 1236 fuel assemblies.

5.7 COMPONENT CYCLIC OR TRANSIENT LIMIT

5.7.1 The components identified in Table 5.7-1 are designed and shall be maintained within the cyclic or transient limits of Table 5.7-1.

INSERT ATTACHED
TABLE 5.6-1
TABLE 5.6-2

FIGURE 5.6-1
FIGURE 5.6-2

INSERT 1

5.6 FUEL STORAGE

CRITICALITY

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

a. A k_{eff} less than 1.0 when flooded with unborated water, which includes an allowance for biases and uncertainties as described in UFSAR Chapter 9.
b. A k_{eff} less than or equal to 0.95 when flooded with water borated to 500 ppm, which includes an allowance for biases and uncertainties as described in UFSAR Chapter 9.
c. A nominal 10.35 inch center-to-center distance between fuel assemblies placed in the storage racks.

5.6.1.2 The new fuel storage racks are designed and shall be maintained with:

a. A k_{eff} equivalent to less than or equal to 0.95 when fully flooded with unborated water, which includes an allowance for biases and uncertainties as described in UFSAR Chapter 9.
b. A k_{eff} equivalent to less than or equal to 0.98 if moderated by aqueous foam, which includes an allowance for biases and uncertainties as described in USFAR Chapter 9.
c. At least a nominal 21 inch center-to-center distance between fuel assemblies placed in the storage racks with a nominal 33 inches center-to-center distance (east to west) between fuel assemblies in the center column and adjacent columns.

5.6.1.3 Fresh or irradiated fuel assemblies shall be stored in the spent fuel pool in compliance with the following:

a. Any 2x2 array of Region 1 storage cells containing fuel shall comply with the storage pattern in Figure 5.6-1 and the requirements of Table 5.6-1. The reactivity ranks of fuel assemblies in the 2x2 array (rank determined using Table 5.6-1) shall be equal or less that defined for the 2x2 array.
b. Any 2x2 array of Region 2 storage cells containing fuel shall comply with the storage requirements defined in Figure 5.6-2 and the requirements of Table 5.6-1 or with the allowable exception of evaluated assemblies stored on the periphery of Region 2 as defined in 5.6.1.3.c. The evaluated assemblies are listed in Table 5.6-2.
c. Fuel assemblies documented in Table 5.6-2 may be stored in any position in the two rows of storage cells closest to the West Wall. No RCCAs are required in the 2x2 arrays formed. There are no exceptions allowed to the requirements of Figure 5.6-2 and the requirements of Table 5.6-1 for fuel assemblies stored in the third row closest to the West Wall. Each 2x2 array formed by the fuel assemblies in the second and third row shall comply with the requirements of Figure 5.6-2 and the requirements of Table 5.6-1.
d. In addition to meeting the requirements defined in 5.6.1.3.a, fuel assemblies placed in Region 1 in the row adjacent to Region 2 shall continue the Region 2 patterns as defined in Figure 5.6-2 and shall meet the associated Region 2 reactivity class requirements.
e. Any fuel assembly (with or without an RCCA) may be replaced by an empty water cell, non-fuel hardware or a fuel rod storage basket.

Table 5.6-1

BURNUP REQUIREMENTS FOR EACH REACTIVITY CLASS

Bounding Polynomial Fits for Minimum Burnup Requirements

See Notes 1, 2 and 3 for use of Table 5.6-1

Reactivity Class (1)	Cooling Time	Coefficient A (2)		Coefficient B	Coefficient C		
RC 1 (3)	N/A	N/A		N/A	N/A		
RC 2	N/A	-24.1514		7.4643	0.0000		
		Enrichment <3.6 w/o Coefficients			Enrichment ≥ 3.6 w/o Coefficients		
		A	B	C	A	B	C
RC 3	0 years	-46.6454	23.4858	-1.4154	-45.1986	22.2592	-1.2715
	2.5 years	-45.0454	22.6125	-1.3487	-43.8453	21.4900	-1.2158
	5 years	-41.2633	20.4058	-1.0890	-41.1255	19.9583	-1.0482
	10 years	-38.5149	18.9692	-0.9504	-36.9034	17.6517	-0.7886
	15 years	-37.8530	18.7075	-0.9566	-37.7850	18.3083	-0.9167
	20 years	-37.3476	18.4617	-0.9412	-36.8808	17.8083	-0.8640
RC 4	0 years	-44.6593	26.7356	-1.7815	-41.8843	24.6516	-1.5317
	2.5 years	-45.2071	26.8990	-1.8595	-39.5300	23.4678	-1.4556
	5 years	-42.4764	25.2213	-1.6744	-38.4729	22.5981	-1.3619
	10 years	-41.0757	24.4119	-1.6310	-40.6071	23.5463	-1.5270
	15 years	-40.4829	23.9210	-1.5905	-28.5300	17.6078	-0.8556
	20 years	-39.4907	23.3811	-1.5518	-28.8514	17.6690	-0.8810
RC 5	0 years	-26.8286	20.9095	-0.9048	21.3500	-2.6889	1.7778
	2.5 years	-28.1650	21.2508	-1.0292	7.6614	3.7032	0.9365
	5 years	-29.2879	21.8885	-1.2030	-10.0714	12.2624	-0.1476
	10 years	-30.6536	22.5737	-1.4006	-24.0957	19.0173	-1.0460
	15 years	-31.8257	23.2386	-1.5643	-23.0257	18.2895	-0.9905
	20 years	-30.5557	22.3502	-1.4726	-26.5357	19.7184	-1.1683

Table 5.6-1 (continued)

BURNUP REQUIREMENTS FOR EACH REACTIVITY CLASS
Bounding Polynomial Fits for Minimum Burnup Requirements
See Notes 1, 2 and 3 for use of Table 5.6-1

<u>Notes</u>

1. Reactivity Classes are presented from High to Low, e.g., RC 1 is most reactive fuel, RC 5 is least reactive fuel.

2. The specific minimum burnup (Bu) required for each fuel assembly for Reactivity Classes 2-5 are calculated from the following equation:

$$Bu = A + B \times En + C \times En^2$$

where the coefficients A, B and C are defined above for each Reactivity Class and cooling time (if applicable) and En is defined as the nominal initial central zone enrichment. Actual cooling time is rounded down to the nearest value, e.g., an assembly with an actual cooling time of 12 years would utilize the10 year coefficients. No uncertainties should be applied when determining the minimum burnup requirement; all appropriate uncertainties have been included during the coefficient generation.

3. Fresh un-irradiated fuel with an enrichment of $\leq$ 5.0 w/o U-235.

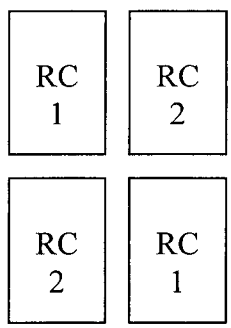
Table 5.6-2
EVALUATED ASSEMBLIES ON PERIPHERY OF REGION 2

C01	C17	C33	C49
C02	C18	C34	C50
C03	C19	C36	C51
C04	C20	C37	C52
C05	C21	C38	C53
C06	C22	C39	C55
C07	C23	C40	C56
C09	C24	C41	C57
C10	C26	C42	C58
C11	C27	C43	C59
C12	C28	C44	C60
C13	C29	C45	C61
C14	C30	C46	C62
C15	C31	C47	C63
C16	C32	C48	C64

Figure 5.6-1

ALLOWABLE STORAGE PATTERN REGION 1
(See Notes 1 and 2)

Pattern "A"
See Definition 1



DEFINITIONS:

1. Allowable pattern is Reactivity Class (RC) 1 or fuel of lower reactivity checkerboarded with RC 2 or fuel of lower reactivity. Minimum burnup for RC 1 and 2 is defined in Table 5.6-1 as a function of nominal initial central zone enrichment. Diagram is for illustration only.

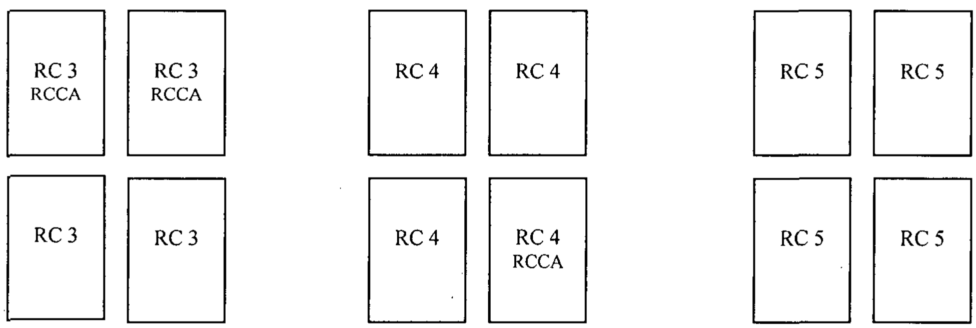
NOTES

1. There are no interface limitations within Region 1 between rack modules or within racks; however, each assembly must meet the burnup requirements of each 2x2 array that it resides within.
2. Replacement of any fuel assembly by an empty water hole, non-fuel hardware or fuel rod storage basket is acceptable.

Figure 5.6-2

ALLOWABLE STORAGE PATTERNS REGION 2 (See Note 1)

Pattern "B" | Pattern "C" | Pattern "D"



See Definition 1 | See Definition 2 | See Definition 3

DEFINITIONS

1. Allowable pattern is Reactivity Class (RC) 3 or fuel of lower reactivity in each of the 2x2 array locations combined with two RCCAs placed in any two locations within the 2x2 array. Minimum burnup for RC 3 is defined in Table 5.6-1 as a function of nominal initial central zone enrichment and cooling time. Replacement of any fuel assembly (with or without an RCCA) by an empty water hole, non-fuel hardware or fuel rod storage basket is acceptable. Diagram is for illustration only.

2. Allowable pattern is Reactivity Class (RC) 4 or fuel of lower reactivity in each of the 2x2 array locations with one RCCA placed anywhere in the 2x2 array. Minimum burnup for fuel RC 4 is defined in Table 5.6-1 as a function of nominal initial central zone enrichment and cooling time. Replacement of any fuel assembly (with or without an RCCA) by an empty water hole, non-fuel hardware or fuel rod storage basket is acceptable. Diagram is for illustration only.

3. Allowable pattern is Reactivity Class (RC) 5 in each of the 2x2 array locations. Minimum burnup for RC 5 is defined in Table 5.6-1 as a function of nominal initial central zone enrichment and cooling time. Replacement of any fuel assembly by an empty water hole, non-fuel hardware or fuel rod storage basket is acceptable. Diagram is for illustration only.

NOTES

1. The storage arrangements of fuel within a rack module may contain more than one pattern. There are no interface limitations within Region 2 between rack modules or within racks; however, each assembly must meet the burnup requirements of each 2x2 array that it resides within.

TABLE 5.7-1

COMPONENT CYCLIC OR TRANSIENT LIMITS

COMPONENT	CYCLIC OR TRANSIENT LIMIT	DESIGN CYCLE OR TRANSIENT
Reactor Coolant System	200 heatup cycles at ≤ 100°F/h and 200 cooldown cycles at ≤ 100°F/h	Heatup cycle - T_{avg} from ≤ 200°F to ≥ 550°F. Cooldown cycle - T_{avg} from ≥ 550°F to ≤ 200°F.
	200 pressurizer cooldown cycles at ≤ 200°F/h.	Pressurizer cooldown cycle temperatures from ≥ 650°F to ≤ 200°F.
	80 loss of load cycles, without immediate Reactor trip.	≥ 15% of RATED THERMAL POWER to 0% of RATED THERMAL POWER.
	40 cycles of loss-of-offsite A.C. electrical power.	Loss-of-offsite A.C. electrical ESF Electrical System.
	80 cycles of loss of flow in one reactor coolant loop.	Loss of only one reactor coolant pump.
	400 Reactor trip cycles.	100% to 0% of RATED THERMAL POWER.
	10 auxiliary spray actuation cycles.	Spray water temperature differential > 320°F.
	200 leak tests.	Pressurized to ≥ 2250 psig.
	10 hydrostatic pressure tests.	Pressurized to ≥ 3106 psig.
Secondary Coolant System	1 steam line break.	Break in a > 6-inch steam line.
	10 hydrostatic pressure tests.	Pressurized to ≥ 1481 psig.