FPL Energy Point Beach, LLC, 6610 Nuclear Road, Two Rivers, WI 54241

FPL Energy.
Point Beach Nuclear Plant

July 24, 2008

NRC 2008-0044
10 CFR 50.90
10 CFR 50.68

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

Point Beach Nuclear Plant, Units 1 and 2
Dockets 50-266 and 50-301
Renewed License Nos. DPR-24 and DPR-27

<u>License Amendment Request Number 247:</u>
<u>Spent Fuel Pool Storage Criticality Control</u>

References:
(1) Nuclear Management Company, LLC Letter to NRC, Point Beach, Units 1 and 2, License Amendment Request Number 247, Spent Fuel Pool Storage Criticality Control, dated December 21, 2006 (ML070160461)
(2) LER 06-002-00 for Point Beach Unit 2, re Fuel Assemblies in Spent Fuel Pool Do Not Meet Technical Specification Requirements, dated August 22, 2006 (ML062420239)
(3) NMC Letter to NRC, Point Beach, Unit 1 and 2, Withdrawal of License Amendment Request 247 Spent Fuel Pool Storage Criticality Control, dated September 7, 2007 (ML072500403)
(4) NMC Letter to NRC, Point Beach, Units 1 and 2 - Response to Request for Additional Information Regarding the Plant License Renewal Application, dated April 1, 2005 (ML051020357)

Pursuant to 10 CFR 50.90, FPL Energy Point Beach, LLC, proposes to revise the Point Beach Nuclear Plant (PBNP) Units 1 and 2 licensing basis to reflect a revision to the spent fuel pool (SFP) criticality analysis methodology. The revised criticality analysis for the SFP storage racks credits burnup, integral fuel burnable absorber (IFBA), Plutonium-241 decay and soluble boron, where applicable. Associated changes are proposed to Technical Specifications (TS) 3.7.12, "Spent Fuel Pool Storage," and 4.3.1, "Criticality," to reflect the results of the new criticality analysis.

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Please replace this document with the one that was submitted on July 18, 2008.

This application had previously been submitted via Reference (1) to address a Technical Specification non-conformance reported to the Commission via Reference (2). The application was withdrawn by FPL Energy Point Beach.

Enclosure 1 provides a description and analysis of the proposed changes and includes the technical evaluation and associated no significant hazards determination and environmental evaluation. Enclosure 2 contains the proposed TS changes. Enclosure 3 contains the revised TS Bases. Enclosure 4 contains the boron dilution analysis performed in support of this amendment request. Enclosure 5 contains WCAP-16541-P Revision 2, "Point Beach Units 1 and 2 Spent Fuel Pool Criticality Safety Analysis," June 2008 (Proprietary). Enclosure 6 contains WCAP-16541-NP Revision 2, "Point Beach Units 1 and 2 Spent Fuel Pool Criticality Safety Analysis," June, 2008 (Non-proprietary). Enclosure 7 contains Westinghouse authorization letter, CAW-08-2447, accompanying affidavit, Proprietary Information Notice, and Copyright Notice. As WCAP-16541-P Revision 2 contains information proprietary to Westinghouse Electric Company LLC, it is supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the requested 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 which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to the copyright or proprietary aspects of the items listed above or the supporting Westinghouse Affidavit should reference CAW-08-2447 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

FPL Energy Point Beach currently holds an exemption for PBNP Units 1 and 2 from the requirements of 10 CFR 70.24. Upon approval of this license amendment request the criticality licensing basis for PBNP Units 1 and 2 will be 10 CFR 50.68.

These changes have been reviewed and approved by the PBNP Plant Operations Review Committee. The changes were determined to not involve a significant hazard as defined in 10 CFR 50.92.

FPL Energy Point Beach requests approval of the proposed license amendment by June 30, 2009. Once approved the license amendment will be implemented within 90 days.

Summary of Commitments

This submittal contains the following new regulatory commitment:

- FPL Energy Point Beach currently holds an exemption for 10 CFR 70.24. As required by 10 CFR 50.68(b)(8) FPL Energy Point Beach will revise the Final Safety Analysis Report for PBNP no later than the next periodic update required via 10 CFR 50.71(e) to reflect the adoption of 10 CFR 50.68(b).

The following commitments previously proposed in Reference (4) will no longer be effective with implementation of the proposed amendments:

a. Maintenance of a data base to track the position and movement of spent fuel assemblies in the spent fuel storage racks.

b. Implementation of an enhanced Boraflex monitoring program prior to the period of extended operation.

c. Accelerated Boraflex panels areal density and blackness testing.

d. The first Boraflex areal density testing of the Boraflex panels will be performed prior to the period of extended operation.

e. Creation of a new procedure to schedule and perform Boraflex areal density and blackness testing.

f. If silica sampling and trending indicates a boron areal density depletion trend to a value less than the acceptance criteria (i.e., maintaining the 5% subcriticality margin) prior to the next scheduled test, then an evaluation will be performed within the corrective action program and the frequency of blackness and areal density testing increased.

g. Corrective actions will be taken to ensure that the 5% subcriticality margin of the spent fuel racks in the SFP is maintained during the period of extended operation. Corrective actions will be initiated if the test results find that the 5% subcriticality margin cannot be maintained because of current or projected future degradation. Corrective actions may include, but are not necessarily limited to, the following:

   * Reanalysis
   * Repair and/or Replacement

In accordance with 10 CFR 50.91, a copy of this amendment application, with the non-proprietary enclosures, is being provided to the designated State of Wisconsin Official.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on July 24, 2008.

Very truly yours,

FPL Energy Point Beach, LLC

Larry Meyer
Site Vice President

Enclosures:

1) - Description and Analysis of Change
2) - Proposed Technical Specification Changes
3) - Revised Technical Specification Bases
4) - Boron Dilution Analysis
5) - Proprietary version of the Westinghouse PBNP criticality analysis
6) - Non-Proprietary version of the Westinghouse PBNP criticality analysis
7) - Westinghouse authorization letter, CAW-08-2447, accompanying affidavit, Proprietary Information Notice, and Copyright Notice.

cc: Regional Administrator, USNRC, Region III (w/o Enclosure 5)
Resident Inspector, USNRC, Point Beach Nuclear Plant
Project Manager, USNRC, Point Beach Nuclear Plant
Public Service Commission of Wisconsin (w/o Enclosure 5)

ENCLOSURE 1

FPL ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

LICENSE AMENDMENT REQUEST 247
SPENT FUEL POOL STORAGE CRITICALITY CONTROL

1.0 SUMMARY DESCRIPTION

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1.0 SUMMARY DESCRIPTION

This application requests amendments to Operating Licenses DPR-24 and DPR-27, Point Beach Nuclear Plant (PBNP) Units 1 and 2. The proposed changes to the PBNP Operating Licenses will revise the Technical Specifications (TS) to incorporate the results of a new spent fuel pool criticality analysis. The new criticality analysis for the spent fuel pool (SFP) storage racks credits burnup, integral fuel burnable absorber (IFBA) , Plutonium-241 decay and soluble boron, where applicable. The results provide the basis for the necessary changes to the TS for each unit. Changes to the following TS are proposed to conform to the results of the new criticality analysis.

- TS 3.7.12 - Spent Fuel Pool Storage
- TS 4.3.1 - Criticality
- B 3.7.11 - Fuel Storage Pool Boron Concentration (Bases)
- B 3.7.12 - Spent Fuel Pool Storage (Bases)

The Technical Evaluation portion of this enclosure (Section 3.0) describes the SFP rack criticality analysis methodology and boron dilution evaluation and provides the basis for the acceptability of the proposed TS changes.

2.0 DETAILED DESCRIPTION

Approval of this license amendment request will resolve potential future issues with Boraflex degradation since Boraflex is not credited in the analysis, a current non-compliance with the PBNP TS concerning storage of 12 spent fuel assemblies in the SFP and a nonconformance identified with spent fuel rods that are stored in fuel assembly guide tubes for five fuel assemblies. This analysis was also performed using extended power uprate conditions.

This application does not change or modify the fuel, fuel handling processes, spent fuel racks, the number of fuel assemblies that may be stored in the SFP, the decay heat generation rate or the spent fuel pool cooling and cleanup system.

<u>Resolution of Boraflex Degradation</u>

As discussed in NRC Generic Letter 96-04, Boraflex degrades in the SFP environment in light water reactors. Boraflex is presently credited in the PBNP Units 1 and 2 criticality analysis to ensure the sub-criticality of the SFP. The new criticality analysis does not credit Boraflex in any of the storage configurations.

<u>Resolution of LER 06-002-00</u>

On June 26, 2006, PBNP discovered that 12 spent fuel assemblies stored in the SFP did not meet the requirements of TS 3.7.12. (Reference 1) The current criticality analysis was approved on September 4, 1997 and requires fuel assemblies with an initial U-235 enrichment greater than 4.60 w/o to have an acceptable number of IFBA rods based on TS Figure 3.7.12-1. The 12 assemblies had a nominal initial enrichment of 4.70 w/o and no IFBA rods, which meets the prior TS requirement of 4.75 w/o initial enrichment, and IFBA rods were not required. The current criticality analysis, and the TS, formerly included an alternate analysis methodology to accommodate these 12 assemblies. The alternate criticality analysis methodology allowed assemblies with an initial enrichment greater than 4.60 w/o to be stored if they had a k-inf less than a specified value. On February 26, 1999, Westinghouse issued Nuclear Safety Advisory Letter (NSAL) 99-003 (Reference 2) which stated they were abandoning the k-inf methodology because it could lead to IFBA requirements lower than those required by the IFBA enrichment curve. PBNP Operating License Amendments 194 and 199 issued by NRC on March 20, 2000, removed the k_{inf} methodology from the TS without recognizing the effect on the criticality provisions for storage of the 12 assemblies. With NRC approval of this LAR the revised criticality analysis and proposed TS changes will restore compliance with the criticality analysis licensing basis and remedy this condition.

Resolution of Fuel Rods Stored in the Guide Tubes

On August 12, 2005, it was discovered that five fuel assemblies with fuel rods stored in the guide tubes are not addressed by the current criticality analysis. This non-conforming condition was the result of past plant practices to store damaged fuel rods in spent fuel assembly guide tubes. This condition is analyzed in the revised criticality analysis to demonstrate that storage of these fuel rods in guide thimbles is acceptable.

Power Uprate

The licensed power limit is 1540 MWt for Units 1 and 2. The proposed power uprate for Units 1 and 2 will, if approved, increase the reactor power to 1800 MWt (1806 MWt NSSS power). The new criticality analysis considers the uprated power conditions for absolute power level and moderator temperature that are specific to the PBNP cores. The use of uprated conditions in the new criticality analysis leads to conservative results relative to the pre-uprate conditions.

Technical Specification Changes

A brief description of the associated proposed TS and TS Bases changes is provided below along with a discussion of the justification for each change.

TS 3.7.11 – Fuel Storage Pool Boron Concentration: To maintain SFP k_{eff} <0.95 for postulated accidents, boron is dissolved in the SFP water. The SFP boron concentration is required to be greater than or equal to 2100 ppm. This concentration is the minimum required concentration for fuel assembly storage and movement within the SFP. The specified concentration provides significant margin to the concentration of 664 ppm determined in the new criticality analysis.

TS Surveillance Requirement (SR) 3.7.11.1 requires verification of the boron concentration every 7 days, consistent with SR 3.7.16.1, in NUREG-1431, "Standard Technical Specifications, Westinghouse Plants" (Reference 3). No changes are proposed to Specification 3.7.11 or the dissolved boron concentration specified therein. However, FPL Energy Point Beach is proposing to revise the Bases for Specification 3.7.11 to reflect the results of the new criticality analysis.

TS 3.7.12 – Spent Fuel Pool Storage: The present TS 3.7.12 defines acceptable conditions for fuel storage in the SFP based on fuel assembly initial enrichments of ≤4.6 w/o U-235 without IFBA or for the combinations of initial enrichment and number of IFBA rods specified in current TS Figure 3.7.12-1.

Based on the results of the new criticality analysis, FPL Energy Point Beach proposes to revise Limiting Condition of Operation (LCO) 3.7.12 to re-define the conditions for fuel storage as a function of initial fuel assembly enrichment, burnup, and decay time. This will allow any fuel assembly meeting the required conditions to be stored at any storage location (cell) within the SFP. This configuration is referred to as the All-Cell configuration and is the least restrictive storage configuration for PBNP SFP. The following changes are proposed:

- Revise LCO 3.7.12 to remove LCO 3.7.12.a, which specifies a maximum fuel assembly initial enrichment of ≤4.6 w/o U-235 for fuel without IFBA.
- Revise LCO 3.7.12 to remove LCO 3.7.12.b, which refers to Figure 3.7.12-1 to specify the acceptable number, and poison material loadings, of the IFBA pins as a function of fuel assembly enrichment.
- Revise the text of LCO 3.7.12 and replace existing Figure 3.7.12-1 with a new figure that defines the acceptable range for fuel storage in the All-Cell configuration as a function of initial fuel assembly enrichment, burnup and decay time.
- Revise the text of LCO 3.7.12 to indicate that fuel must meet the conditions specified in Figure 3.7.12-1 or meet the storage configurations specified in Specification 4.3.1.1 by adding a reference to Specification 4.3.1.1.

FPL Energy Point Beach is proposing to revise the Bases for Specification 3.7.12 to reflect the results of the new criticality analysis.

<u>TS 4.3.1 – Criticality:</u> TS 4.3, "Fuel Storage," provides the criteria for PBNP fuel storage. Specification 4.3.1.1 specifies design features providing criticality control for the SFP fuel storage racks. Based on the new criticality analysis, FPL Energy Point Beach proposes to revise Specification 4.3.1.1 to credit soluble boron in the SFP for fuel storage in accordance with 10 CFR 50.68(b)(4). Specification 4.3.1.1 will now define more restrictive new and spent fuel storage configurations in the SFP allowing storage based upon a combination of burnup, initial enrichment, Plutonium-241 decay time and number of IFBA pins, in conjunction with specifying the fuel loading requirements at the interfaces between various storage configurations. This will allow any fuel assembly not meeting the required conditions for the All-Cell configuration to be stored in a 1-out-of-4 for 5.0 w/o U-235 fresh fuel with no IFBA configuration or 1-out-of-4 for 4.0 w/o U-235 fresh fuel with IFBA storage configuration. The following changes are proposed to Specification 4.3.1; the items are renumbered as indicated:

- Replace Specification 4.3.1.1.a with a statement that fuel assemblies may have a maximum U-235 enrichment of 5.0 weight-percent.
- Revise Specification 4.3.1.1.b to increase the maximum k_{eff} from ≤0.95 to < 1.0 when the SFP is fully flooded with unborated water in accordance with 10 CFR 50.68(b)(4).
- Add Specification 4.3.1.1.c to specify the allowable k_{eff} as ≤0.95 when the SFP is fully flooded with borated water to the required accident concentration in accordance with 10 CFR 50.68(b)(4).
- Renumber existing Specification 4.3.1.1.c as Specification 4.3.1.1.d.

- Add a new Specification 4.3.1.1.e stating that new or spent fuel assemblies with a combination of discharge burnup, initial enrichment and decay time that is within in the "Acceptable" range of new Figure 3.7.12-1 may be allowed unrestricted storage in the fuel storage racks.

- Add a new Specification 4.3.1.1.f stating that new or spent fuel assemblies with a combination of discharge burnup, initial enrichment and decay time that is in the "Unacceptable" range of new Figure 3.7.12-1 will be stored in compliance with the additional requirements specified in new Figures 4.3.1-1 through 4.3.1-8.

3.0 TECHNICAL EVALUATION

Spent Fuel Pool Description

PBNP has a single SFP divided into north and south halves connected through a divider wall. Each half has inside dimensions of approximately 220 inches by 408 inches. The SFP has locations for 699 fuel assemblies in the north half and 803 assemblies in the south half. The north portion of the pool contains an area reserved for the loading of the spent fuel shipping cask or dry storage cask. Specific details of the spent fuel storage system and the fuel that are relevant to the criticality analyses are provided in Enclosures 5 and 6, "Point Beach Units 1 & 2 Spent Fuel Pool Criticality Analysis," (Reference 4.) This license amendment request does not propose any physical changes to the spent fuel storage systems or other plant systems which may have an affect on storage of fuel in the SFP.

Licensing Basis

General Design Criterion (GDC) 66, "Prevention of fuel storage criticality," states:

> Criticality in the new and spent fuel storage pits shall be prevented by physical systems or processes. Such means as geometrically safe configurations shall be emphasized over procedural controls.

The spent fuel rack k_{eff} was calculated in accordance with 10 CFR 50.68(b)(4) to remain less than 1.0 (subcritical) when flooded with unborated water with a 95-percent probability at a 95-percent confidence level. Implementation of the proposed changes in the required fuel storage configurations and the associated fuel assembly reactivity requirements will continue to satisfy the requirements of GDC 66. Specifically, the revised design basis for preventing criticality in the PBNP Unit 1 and 2 SFP in accordance with 10 CFR 50.68(b)(4) will be:

1. the k_{eff} of the fuel rack array shall be < 1.0 in unborated water, with a 95 percent probability at a 95 percent confidence level, including uncertainties; and

2. the k_{eff} of the fuel rack array shall be $\leq$0.95 in the pool containing borated water, with a 95 percent probability at a 95 percent confidence level, including uncertainties.

The current NRC regulatory requirements for maintaining subcritical conditions in SFPs are provided in 10 CFR 50.68, "Criticality Accident Requirements." Each holder of an operating license is required to either comply with 10 CFR 70.24, "Criticality Accident Requirements," to maintain a monitoring system capable of detecting a criticality event or comply with the 10 CFR 50.68 requirements to prevent a criticality event (or obtain an exemption from the regulation). FPL Energy Point Beach currently holds an exemption for PBNP from the requirements of 10 CFR 70.24 (Reference 5). The exemption states in-part:

> Based upon the information provided, there is reasonable assurance that irradiated and unirradiated fuel will remain subcritical during fuel handling and storage; furthermore, you maintain radiation monitors in accordance with PBNP's General Design Criterion 18 which is analogous to 10 CFR Part 50, Appendix A, Criterion 63. The low probability of a criticality together with your adherence to PBNP's General Design Criterion 18 constitute good cause for granting an exemption from 10 CFR 70.24.

The spent fuel rack criticality analysis methodology applied to the criticality analyses discussed herein invokes the requirements of 10 CFR 50.68. Approval of this license amendment request will make unnecessary the existing 10 CFR 70.24 exemption as discussed in NRC Regulatory Issue Summary 2005-05 (Reference 6).

This amendment request does not propose any physical changes to the SFP fuel storage racks or other plant systems which may have an affect on storage of fuel in the SFP. The proposed changes to the TS in this LAR implement the results of the revised analysis.

<u>Current Method of Criticality Analysis</u>

The current PBNP criticality analysis is contained in Westinghouse Report CAA-96-146, "Criticality Analysis of the Point Beach Nuclear Plant Spent Fuel Storage Racks Considering Boraflex Gaps and Shrinkage with Credit for Integral Fuel Burnable Absorbers" (Reference 7.) This analysis does not credit burnup or decay time, but does credit IFBA for fuel greater than 4.60 weight percent. The analysis also credits soluble boron to offset the reactivity increase associated with postulated accidents. Credit is taken for Boraflex with assumptions for shrinkage and gap formation.

<u>Proposed Criticality Analysis</u>

FPL Energy Point Beach proposes to use the analysis provided in Enclosures 5 and 6, "Point Beach Units 1 & 2 Spent Fuel Pool Criticality Safety Analysis," (Reference 4) as the new SFP analysis.

The methodology presented in Enclosures 5 and 6 is employed to assure the criticality safety of the SFP and to define limits placed on fresh and depleted fuel assembly storage configurations. The analysis methodology employs SCALE-PC, a personal computer version of the SCALE-4.4a code system, and the two-dimensional multi-group transport theory lattice code, PHOENIX-P, with an ENDF/B-VI neutron cross section library. The SCALE system was developed for the NRC to satisfy the need for a standardized method of analysis for evaluation of nuclear fuel facilities and shipping package designs. SCALE-PC is a version of the SCALE code system that runs on personal computers. SCALE-PC includes the control module CSAS25 and the following functional modules: BONAMI, NITAWL-II, and KENO V.a. Benchmarking of SCALE-PC for use in spent fuel rack criticality analyses is described in Enclosures 5 and 6 Section 1.4.2. The PHOENIX-P code performs a two-dimension 70-group nodal flux calculation which couples the individual sub-cell regions (pellet, cladding, and moderator) as well as surrounding rods via a collision probability technique.

SCALE-PC was used in benchmarking and evaluating the fuel assembly storage configurations. The PHOENIX-P code is used for simulation of in-reactor fuel assembly depletion.

Boron Dilution Analysis

A boron dilution analysis was performed to demonstrate that sufficient time is available to detect and mitigate the worst dilution event that can occur from the minimum technical specification boron concentration to the boron concentration required to maintain $k_{eff} \leq 0.95$.

The results of this analysis demonstrate that administrative controls are in place to prevent an unintended dilution event. Even if a dilution event were to occur, plant operators would have sufficient time to detect and mitigate the accident before the minimum boron concentration. The operators would have 12 hours to terminate the event after initiation. The boron dilution analysis report is included in Enclosure 4.

Fuel Assembly Burnup Determination

Fuel assembly burnup is a key input for determining how and where a fuel assembly may be stored in the SFP. Fuel assembly burnup values are determined using software approved under the software quality assurance (SQA) program. The software uses fuel vendor generated isotopic data, data from incore detector readings, and reactor operating history data. Qualified personnel use the software and perform independent reviews of input and output data.

The ShuffleWorks fuel movement planning software is approved under the SQA program. Burnup data input into software for planning fuel movements is performed and independently reviewed by qualified Reactor Engineers. Updates to the software data files are controlled by procedure and require independent review. Fuel movement sequences are planned and independently reviewed by qualified Reactor Engineers. Reactor Engineers use a procedure to verify by administrative means that fuel assemblies meet the requirements of TS 3.7.12 prior to storing fuel assemblies in the SFP.

Effect on Fuel Handling Operations

Point Beach performs pre-outage fuel moves to optimize space in the spent fuel pool. The number of additional fuel moves will vary depending on how many open spaces are available in the SFP, where the open spaces are located, scattering requirements for discharge fuel and the number of new fuel assemblies required for the operating cycle. Because the new criticality analysis will impose additional restrictions, some additional fuel moves to prepare for a refueling outage may be required.

All fuel movements are performed by qualified operators under the supervision of a Senior Reactor Operator (SRO.) Detailed instructions are available for use by refueling personnel. These instructions, the minimum operating conditions, and the design of the fuel handling equipment incorporating built-in interlocks and safety features, provide assurance that no incident could occur during refueling operations.

Barriers are put in place to prevent a mis-loaded fuel assembly. During movement of assemblies in the SFP a SRO and Reactor Engineer sign off for each move after it has been completed. All fuel handling operations in the SFP use a SRO and two fuel handling qualified operators. The two fuel handling qualified operators provide peer checking for each other during fuel movement, in addition to the SRO. Reactor Engineering is responsible for creating, reviewing and approving fuel movement authorization paperwork to ensure that physical control of Special Nuclear Material is maintained.

Decay Time Credit

To ensure necessary conservatism is maintained, burnup requirements for intermediate decay times are determined using the smaller decay time curve (e.g. for a decay time of 7 years, the 5 year decay curve is used.) Decay time is maintained in a data file. The data file is an input to the ShuffleWorks software. Changes to the data file are made by plant procedure and are independently reviewed.

Fuel Rods in Guide Tubes

There are five fuel assemblies stored in the SFP that contain fuel rods in the guide tubes. This results in a net increase in fissile material in these particular assemblies. This condition was specifically analyzed in Enclosures 5 and 6. This condition applies to the existing assemblies, and future storage of fuel rods in guide tubes (incremental to the existing five fuel assemblies in question) will not be allowed.

10 CFR 50.68 Compliance

The following summary is provided of how the PBNP intends to comply with 10 CFR 50.68, "Criticality Accident Requirements."

10 CFR 50.68(b)(1) - Plant procedures shall prohibit the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water.

FPL Energy Point Beach Compliance - Plant procedures require and document that the surveillance requirement 3.7.12.1 is completed prior to storing fuel assemblies in the spent fuel storage pool. The plant procedure verifies by administrative means that each fuel assembly meets the fuel storage limits. Performance of this surveillance ensures that at any one time, the fuel assemblies will meet the requirements of TS 3.7.12 and will remain subcritical, even under the most adverse moderation conditions feasible by unborated water.

10 CFR 50.68(b)(2) - The estimated ratio of neutron production to neutron absorption and leakage (k-effective) of the fresh fuel in the fresh fuel storage racks shall be calculated assuming the racks are loaded with fuel of the maximum fuel assembly reactivity and flooded with unborated water and must not exceed 0.95, at a 95 percent probability, 95 percent confidence level. This evaluation need not be performed if administrative controls and/or design features prevent such flooding or if fresh fuel storage racks are not used.

FPL Energy Point Beach Compliance - Criticality analyses previously performed for the fresh fuel storage racks have demonstrated that the k_{eff} does not exceed 0.95 at a 95 percent probability, 95 percent confidence level. The fresh fuel storage racks are used at the PBNP when required for unloading new fuel assemblies or control rods. The fresh fuel storage racks are designed to hold new fuel assemblies and are used primarily for the storage of the replacement fuel assemblies. The requirement of 10 CFR 50.68(b)(2) is already included in the plant TS under Specification 4.3.1.2(b).

10 CFR 50.68(b)(3) - If optimum moderation of fresh fuel in the fresh fuel storage racks occurs when the racks are assumed to be loaded with fuel of the maximum fuel assembly reactivity and filled with low-density hydrogenous fluid, the k-effective corresponding to this optimum moderation must not exceed 0.98, at a 95 percent probability, 95 percent confidence level. This evaluation need not be performed if administrative controls and/or design features prevent such moderation or if fresh fuel storage racks are not used.

FPL Energy Point Beach Compliance - Criticality analyses previously performed for the fresh fuel storage racks have demonstrated that k_{eff} will not exceed 0.98 at a 95 percent probability, 95 percent confidence level under optimum moderation. The requirement of 10 CFR 50.68(b)(3) is already included in the plant TS under Specification 4.3.1.2(c).

10 CFR 50.68(b)(4) - If no credit for soluble boron is taken, the k-effective 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. If credit is taken for soluble boron, the k-effective 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 borated water, and the k-effective must remain below 1.0 (subcritical), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water.

FPL Energy Point Beach Compliance - This new criticality analysis demonstrates that the SFP k_{eff} will not exceed 0.95, at a 95 percent probability, 95 percent confidence level when flooded with water borated to 402 ppm; and will remain below 1.0 at a 95 percent probability, 95 percent confidence level if flooded with unborated water.

10 CFR 50.68(b)(5) - The quantity of SNM, other than nuclear fuel stored onsite, is less than the quantity necessary for a critical mass.

FPL Energy Point Beach Compliance - PBNP has the approximate following quantities of non-fuel SNM: (1) 8 grams total of Pu-238 contained in two Pu-Be neutron sources; (2) 0.04 grams total of U-235 contained in 10 miniature incore movable detectors; (3) 35 grams total of U-235 contained in 5 excore detectors; and (4) 80 grams total of Pu-239 in sealed sources. The sum of the ratios for U-235 and Plutonium is less than unity as described in Regulatory Guide 10.3 for a quantity less than a critical mass. Plant procedures for tracking non-fuel SNM will be revised to ensure the quantity limits described in Regulatory Guide 10.3 are met prior to bringing new sources on-site and to indicate that this regulation is the plant licensing basis.

10 CFR 50.68(b)(6) - Radiation monitors are provided in storage and associated handling areas when fuel is present to detect excessive radiation levels and to initiate appropriate safety actions.

FPL Energy Point Beach Compliance - Two area radiation monitors are installed in the SFP area. These radiation monitors are connected to the plant radiation monitoring system and will alarm locally and in the control room. In addition, an area monitor is required to be operating on the SFP bridge crane during movement of fuel assemblies in the SFP.

10 CFR 50.68(b)(7) - The maximum nominal U-235 enrichment of the fresh fuel assemblies is limited to five (5.0) percent by weight.

FPL Energy Point Beach Compliance - Specification 4.3.1.2(a) limits the enrichment of the fuel assemblies stored in the fresh fuel storage racks to 5.0 percent by weight. The new criticality analysis analyzes fuel for storage in the SFP up to 5.0 w/o. Revised Specification TS 4.3.1.1 (a) will limit the maximum enrichment of fuel stored in the SFP to be 5.0 w/o.

10 CFR 50.68(b)(8) - The FSAR is amended no later than the next update which 50.71(e) of this part requires, indicating that the licensee has chosen to comply with 50.68(b).

FPL Energy Point Beach Compliance - PBNP will update the FSAR in accordance with this requirement.

4.0 REGULATORY ANALYSIS

4.1 Applicable Regulatory Requirements / Criteria

The Atomic Energy Commission (AEC) published proposed GDCs for public comment in 1967. The Atomic Industrial Forum (AIF) reviewed these proposed criteria and recommended changes. The PBNP GDCs are similar in content to the AIF version of the proposed 1967 GDCs. Appendix A of 10 CFR Part 50 contains a different set of GDCs that were published in 1971 (after PBNP construction permits were issued.) Note that the GDCs found in 10 CFR 50 Appendix A differ both in numbering and content from the GDCs adopted for PBNP.

The PBNP GDC addressing the prevention of criticality is GDC 66, "Prevention of Fuel Storage Criticality," which states:

> "Criticality in the new and spent fuel storage pits shall be prevented by physical systems or processes. Such means as geometrically safe configurations shall be emphasized over procedural controls."
>
> This is analogous to 10 CFR 50, Appendix A, GDC 62, which states:
>
> "Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations."

The revised design basis for preventing criticality in the SFP is consistent with the requirements of 10 CFR 50.68(b) satisfying the requirements of GDC 66. Implementation of the proposed TS changes in the required fuel storage configurations and the associated assembly reactivity requirements as determined by the PBNP plant-specific criticality analysis will continue to satisfy the requirements of GDC 66.

FPL Energy Point Beach concludes that the proposed changes are in accordance with 10 CFR 50.36(c)(3) with regard to maintaining the necessary quality of systems and components, sustaining facility operation within safety limits, and meeting the limiting conditions for operation. These changes also continue to meet the requirements stated in the PBNP FSAR. The proposed changes thus continue to be compliant with the above regulatory requirements and guidance.

4.2 Precedents

The soluble boron credit methodology applied in the new PBNP plant-specific criticality analysis is analogous to the NRC Safety Evaluation for Beaver Valley Power Station, Unit 2, dated March 27, 2008. (Reference 8)

4.3 No Significant Hazards Determination

Pursuant to 10 CFR 50.90, FPL Energy Point Beach is proposing to revise the PBNP Units 1 and 2 TS to reflect the application of the Westinghouse spent fuel pool (SFP) criticality analysis methodology. The Westinghouse criticality analysis determined acceptable storage conditions for fuel in the SFP fuel storage racks with credit for burnup, IFBA pins, Plutonium-241 decay and soluble boron, where applicable. Associated changes are proposed to the TS for storage of fuel in the SFP and design features for criticality control to reflect the results of the criticality analysis.

FPL Energy Point Beach has evaluated the proposed amendments in accordance with 10 CFR 50.91 against the standards in 10 CFR 50.92, "Issuance of Amendment," and has determined that the operation of PBNP in accordance with the proposed amendments presents no significant hazards.

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

Response: No

Operation of the facility in accordance with the proposed amendment request does not involve a significant increase in the probability or consequences of an accident previously evaluated. The presence of soluble boron in the SFP water being used for criticality control does not increase the probability of a dropped fuel assembly accident. The handling of the fuel assemblies in the SFP has always been performed and will continue to be performed in borated water.

There is no increase in the probability of the accidental misloading of fuel assemblies into the SFP fuel storage racks when considering the presence of soluble boron for criticality control. Fuel assembly placement will continue to be controlled pursuant to approved fuel handling procedures and in accordance with the spent fuel storage rack limitations specified in the TS. There is no increase in the consequences for an accidental misloading of fuel assemblies in the SFP fuel storage racks because the criticality analyses demonstrate that the pool will remain subcritical following an accidental misloading.

Soluble boron credit is used to provide margin to offset uncertainties, tolerances, and off-normal / accident conditions, and to provide subcritical margin such that the SFP k_{eff} is maintained less than or equal to 0.95. The plant-specific criticality analysis results demonstrate that the spent fuel rack k_{eff} will remain < 1.0 (at a 95/95 percent probability and confidence level) even with the SFP flooded with unborated water.

There is no increase in the probability of the loss of normal cooling to the SFP when considering the presence of soluble boron criticality control since a high concentration of soluble boron has always been maintained in the SFP water. A loss of normal cooling to the SFP will result in a reactivity increase for fuel assemblies stored in the All-Cell storage configuration. Maintaining 664 ppm boron in the SFP ensures that k_{eff} remains less than or equal to 0.95 for this accident scenario. Because adequate soluble boron will be maintained in the SFP water the consequences of a loss of normal cooling to the SFP will not be increased.

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

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

Response: No

Under the proposed amendment, no changes are being made to the fuel storage racks themselves, to any other systems, or to the physical structures of the primary auxiliary building. Therefore, there are no changes proposed to the plant configuration, equipment design, or installed equipment.

Criticality accidents in the SFP are not new or different types of accidents. They have been analyzed in the FSAR and in fuel storage criticality analysis reports associated with specific license amendments. The proposed new SFP storage limitations are those made in the new criticality analysis. They will not have a significant effect on normal SFP operations and maintenance. The most limiting accident scenario changes from a mis-loaded fresh fuel assembly adjacent to the storage racks, to a mis-loaded fuel assembly in a 1 out of 4 storage pattern. Established administrative controls will prevent a mis-loading event in the SFP. Administrative controls include use of independently prepared and reviewed fuel movement authorization paperwork, use of qualified fuel handling operators and oversight of fuel handling operations by an SRO.

The current TS include a SFP boron concentration limit that conservatively bounds the required boron concentration of the new criticality analysis. Since soluble boron has always been maintained in the SFP water, implementation of this requirement for SFP criticality control purposes has no effect on normal pool operations and maintenance. Since soluble boron has always been present in the SFP, a dilution event has always been a possibility. The loss of substantial amounts of soluble boron from the SFP that could lead to k_{eff} exceeding 0.95 was evaluated as part of the analyses in support of this license amendment request. The evaluation demonstrates that if a dilution event were to occur, plant operators would have sufficient time to detect and mitigate the accident before the minimum boron concentration is reached.

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

3) Does the proposed amendment result in a significant reduction in a margin of safety?

Response: No

The proposed amendment uses a different methodology to ensure the SFP will remain subcritical. The current licensing basis requires the SFP k_{eff} be less than or equal to 0.95 when flooded with unborated water. Approval of this license amendment request will change licensing basis to 10 CFR 50.68, which allows credit for soluble boron. The new methodology calculates the minimum boron concentration to ensure the SFP k_{eff} will be less than or equal to 0.95 when flooded with borated water.

The current TS SFP boron requirement significantly exceeds the required boron concentration determined in the new criticality analysis. Supporting analysis determined there is sufficient time for plant operators to detect and mitigate a boron dilution event in the SFP. Should an undetected dilution event occur, the new methodology also demonstrates the SFP k_{eff} will be less than 1.0 when flooded with unborated water. Therefore, the proposed changes do not involve a significant reduction in a margin of safety.

4.4 Conclusion

Operation of PBNP, Units 1 and 2 in accordance with the proposed license amendment will not result in a significant increase in the probability or consequences of any accident previously analyzed; will not result in a new or different kind of accident from any accident previously analyzed; and, does not result in a significant reduction in any margin of safety. Therefore, operation of PBNP in accordance with the proposed amendment does not result in a significant hazards determination.

5.0 ENVIRONMENTAL EVALUATION

FPL Energy Point Beach has evaluated the proposed changes and determined that (i) the proposed amendment involves no significant hazards considerations, (ii) there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite, and (iii) there is no significant increase in the individual or cumulative occupational exposure. Accordingly, the proposed changes meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9), and an environmental assessment of the proposed changes is not required.

6.0 REFERENCES

1. LER 06-002-00, "Fuel Assemblies in Spent Fuel Pool Do Not Meet Technical Specification Requirements," dated 6/26/2006.

2. Westinghouse NSAL-99-003, "Credit for Integral Fuel Burnable Absorbers in Spent Fuel Pool Criticality Analysis," dated February 26, 1999.

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

4. WCAP-16541-P Revision 2, "Point Beach Units 1 and 2 Spent Fuel Pool Criticality Safety Analysis," Revision 2, June 2008.

5. PB041146-04, "PBNP, Unit Nos. 1 and 2 - Issuance of Exemption from the Requirements of 10 CFR 70.24 (TAC NOS. M98973 AND M98974)," dated 10/6/1997.

6. NRC Regulatory Issue Summary 2005-05: "Regulatory Issues Regarding Criticality Analyses for Spent Fuel Pools and Independent Spent Fuel Storage Installations," dated March 23, 2005.

7. CAA-96-146, "Criticality Analysis of the Point Beach Nuclear Plant Spent Fuel Storage Racks Considering Boraflex Gaps and Shrinkage with Credit for Integral Fuel Burnable Absorbers," dated May 14, 1996.

8. Letter from N. S. Morgan (NRC) to P. P. Sena III (BVPS) "Beaver Valley Power Station, Unit No. 2 - Issuance of Amendment Re: Incorporation of the Results of a New Spent Fuel Pool Criticality Analysis (TAC No. MD2378)," dated 3/27/2008. (ML080920524).

ENCLOSURE 2

FPL ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

LICENSE AMENDMENT REQUEST 247
SPENT FUEL POOL STORAGE CRITICALITY CONTROL

PROPOSED TECHNICAL SPECIFICATION CHANGES

(14 pages follow)

3.7 PLANT SYSTEMS

3.7.12 Spent Fuel Pool Storage

LCO 3.7.12

~~Fuel assembly storage in the spent fuel pool shall be as follows:~~

~~a. Fuel assembly initial enrichment ≤4.6 % w/o U-235; or~~

~~b. Fuel assembly contains Integral Fuel Burnable Absorber (IFBA) rods within the "acceptable" range of Figure 3.7.12-1.~~

<u>The combination of initial enrichment, burnup and decay time of each fuel assembly stored in the spent fuel pool shall be within the Acceptable range of Figure 3.7.12-1 or in accordance with Specification 4.3.1.1.</u>

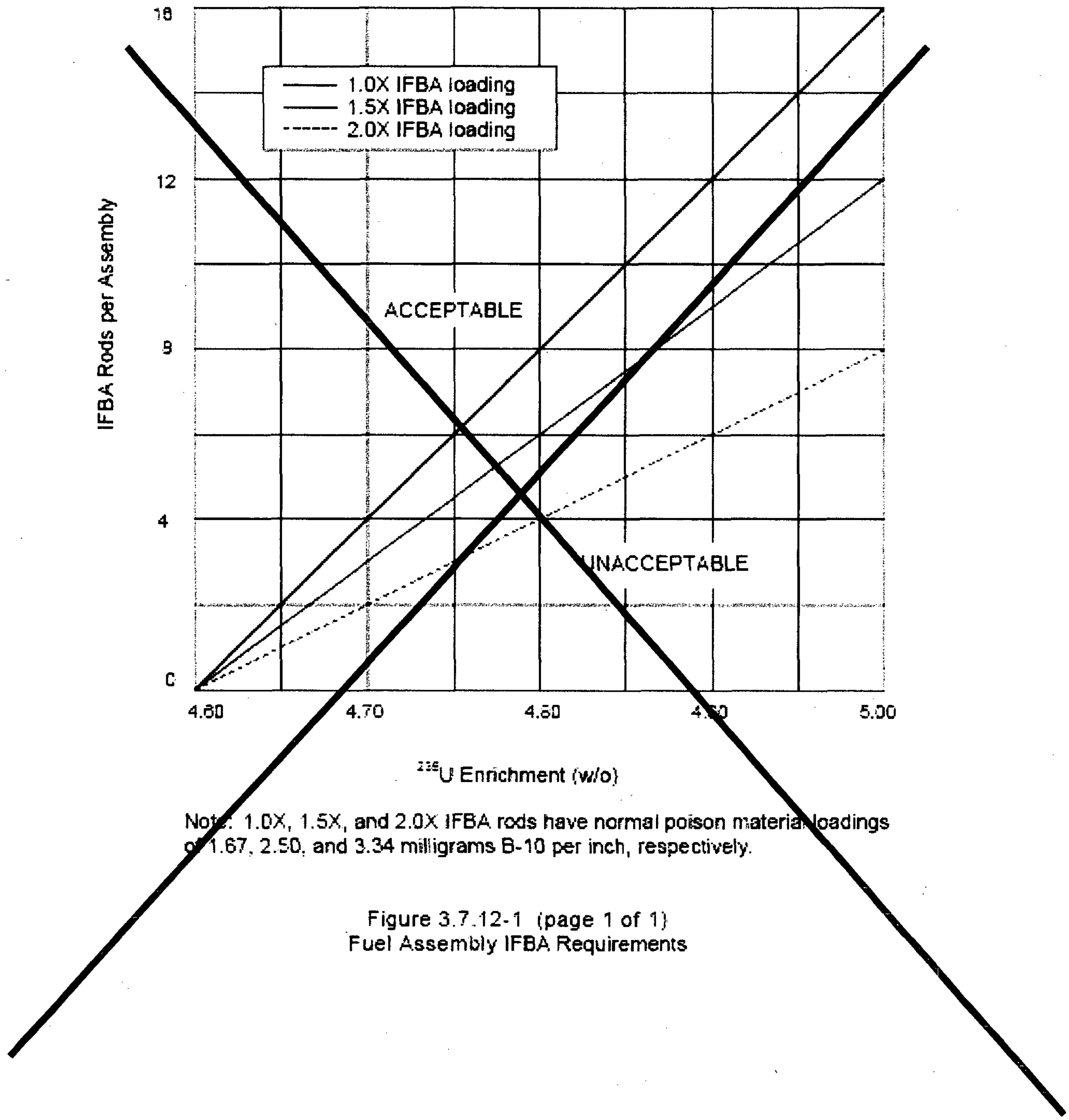
APPLICABILITY: Whenever any fuel assembly is stored in the spent fuel storage pool.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Requirements of the LCO not met.	-------------------NOTE------------------- LCO 3.0.3 is not applicable. -- A.1 Restore the spent fuel pool within fuel storage limits.	 Immediately

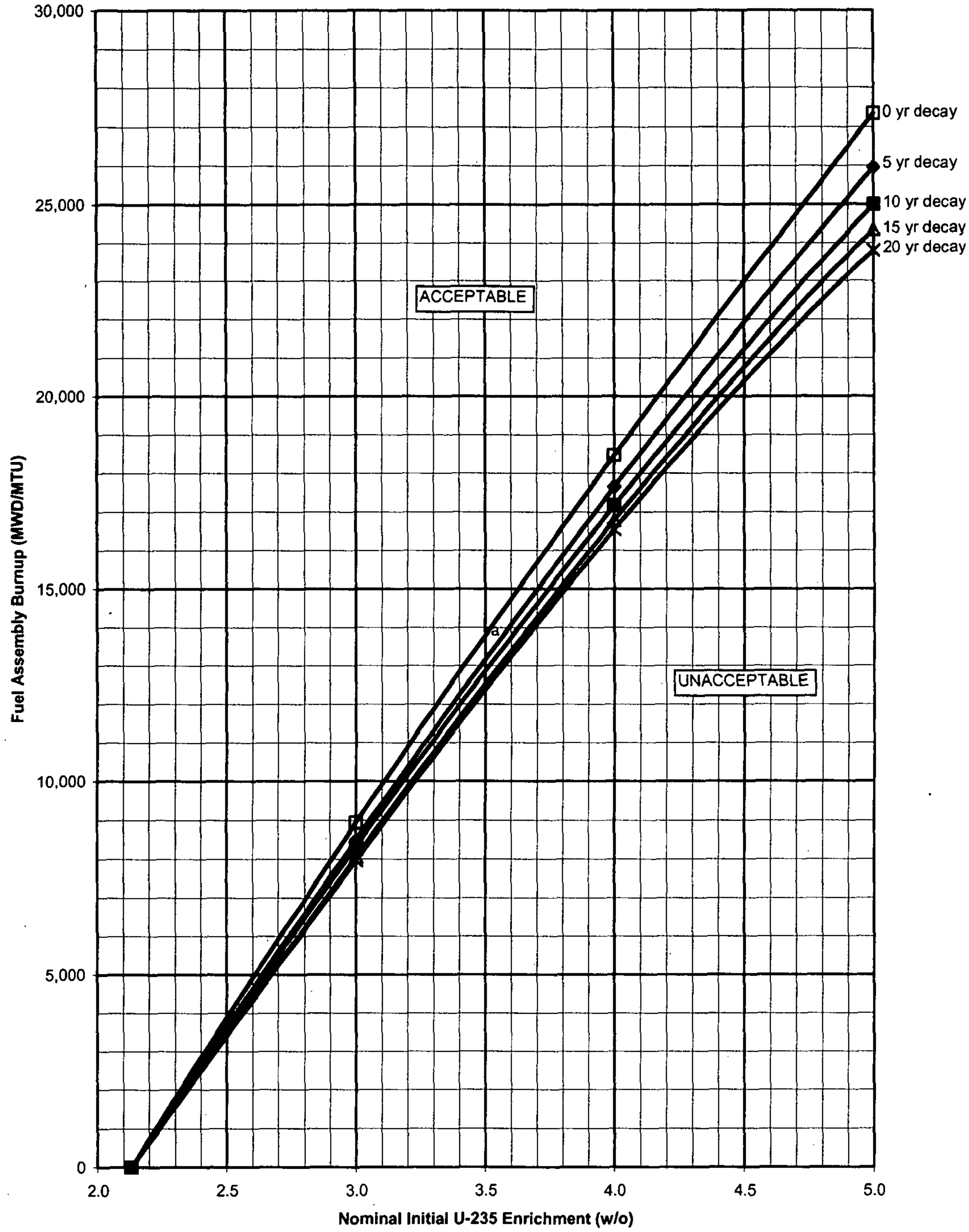
SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.12.1	Verify by administrative means each fuel assembly meets fuel storage limits.	Prior to storing the fuel assemblies in the spent fuel storage pool



Note: 1.0X, 1.5X, and 2.0X IFBA rods have normal poison material loadings of 1.67, 2.50, and 3.34 milligrams B-10 per inch, respectively.

Figure 3.7.12-1 (page 1 of 1)
Fuel Assembly IFBA Requirements



0 yr decay =	$20e^3 - 573e^2 + 12811e - 24881$
5 yr decay =	$-34e^3 - 13e^2 + 10506e - 21990$
10 yr decay=	$-39e^3 - 36e^2 + 10537e - 21904$
15 yr decay=	$-108e^3 + 710e^2 + 7764e - 18715$
20 yr decay=	$-128e^3 + 865e^2 + 7269e - 18170$

Figure 3.7.12-1
Fuel Assembly Burnup Requirement of "All-Cell" Storage Configuration

4.0 DESIGN FEATURES

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. Fuel assemblies meeting at least one of the following storage limits may be stored in the spent fuel storage racks:

1. Fuel assemblies with an enrichment ≤4.6% weight percent U-235; or

2. Fuel assemblies which contains Integral Fuel Burnable Absorber (IFBA) pins in the "acceptable range" of Figure 3.7.12-1.

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent;

b. keff ≤0.95 < 1.0 if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 9.4 of the FSAR Reference 1;

c. k_{eff} ≤0.95 if fully flooded with water borated to 402 ppm, which includes an allowance for uncertainties as described in Reference 1;

c. d. A nominal 9.825 inch center to center distance between fuel assemblies placed in the fuel storage racks;

e. New or spent fuel assemblies with a combination of discharge burnup, initial enrichment and decay time in the "Acceptable" range of Figure 3.7.12-1 may be allowed unrestricted storage in the fuel storage racks; and

f. New or spent fuel assemblies with a combination of discharge burnup, initial enrichment and decay time in the "Unacceptable" range of Figure 3.7.12-1 will be stored in compliance with Figures 4.3.1-1 through 4.3.1-8.

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

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent;

4.0 DESIGN FEATURES

b. k_{eff} ≤0.95 if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 9.4 of the FSAR;

c. k_{eff} ≤0.98 under optimum moderator density conditions, which includes an allowance for uncertainties as described in Section 9.4 of the FSAR; and

d. A nominal 20 inch center to center distance between fuel assemblies placed in the storage racks.

4.0 DESIGN FEATURES

4.3 Fuel Storage (continued)

4.3.2 Drainage

The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 40 ft 8 in.

4.3.3 Capacity

The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than 1502 fuel assemblies.

REFERENCES

1. "Point Beach Units 1 and 2 Spent Fuel Pool Criticality Safety Analysis," WCAP-16541-P, Revision 2 Westinghouse Electric Company, June 2008.

4.0 DESIGN FEATURES

L1	H1
L1	L1

H1: Fresh fuel assembly with maximum 5.0 w/o U-235.

No restriction on burnup.

L1: Spent fuel assemblies in the "Acceptable" range of Figure 4.3.1-6.

Figure 4.3.1-1
1-Out-of-4 for 5 w/o with no IFBA Storage Configuration

4.0 DESIGN FEATURES

L2	H2
L2	L2

H2: Fresh fuel assembly with maximum 4.0 w/o U-235 with no IFBA or maximum 5.0 w/o U-235 with IFBA in the "Acceptable" range of Figure 4.3.1-8.

No restriction on burnup.

L2: Spent fuel assemblies in the "Acceptable" range of Figure 4.3.1-7.

Figure 4.3.1-2
1-Out-of-4 for 4 w/o with IFBA Storage Configuration

4.0 DESIGN FEATURES

A	A	A	A	A	A	A
A	A	A	A	A	A	A
A	A	A	A	A	A	A
L1	L1	L1	L1	A	A	A
H1	L1	H1	L1	A	A	A
L1	L1	L1	L1	A	A	A
H1	L1	H1	L1	A	A	A

1-Out-of-4 for 5 w/o Fresh

All-Cell

A: Fuel assembly in "Acceptable" range of Figure 3.7.12-1.

H1: Fresh fuel assembly with maximum 5.0 w/o U-235.
No restriction on burnup.

L1: Spent fuel assemblies in the "Acceptable" range of Figure 4.3.1-6.

Figure 4.3.1-3
1-Out-of-4 for 5 w/o with no IFBA / "All Cell" Interface

1-Out-of-4 for 4 w/o Fresh with IFBA

A	A	A	A	A	A	A
A	A	A	A	A	A	A
A	A	A	A	A	A	A
L2	L2	L2	L2	A	A	A
H2	L2	H2	L2	A	A	A
L2	L2	L2	L2	A	A	A
H2	L2	H2	L2	A	A	A

All-Cell

A: Fuel assembly in “Acceptable” range of Figure 3.7.12-1.

H2: Fresh fuel assembly with maximum 4.0 w/o U-235 with no IFBA or maximum 5.0 w/o U-235 with IFBA in the “Acceptable” range of Figure 4.3.1-8.

No restriction on burnup.

L2: Spent fuel assemblies in the “Acceptable” range of Figure 4.3.1-7.

Figure 4.3.1-4
1-Out-of-4 for 4 w/o with IFBA / “All Cell” Interface

4.0 DESIGN FEATURES

1-Out-of-4 for 4 w/o Fresh with IFBA

L1	L1	L1	L1	L1	L1	L1
L1	H1	L1	H1	L1	H1	L1
L1	L1	L1	L1	L1	L1	L1
L2	L2	L2	L2	L1	H1	L1
H2	L2	H2	L2	L1	L1	L1
L2	L2	L2	L2	L1	H1	L1
H2	L2	H2	L2	L1	L1	L1

1-Out-of-4 for 5 w/o Fresh

H1: Fresh fuel assembly with maximum 5.0 w/o U-235.

No restriction on burnup.

L1: Spent fuel assemblies in the "Acceptable" range of Figure 4.3.1-6.

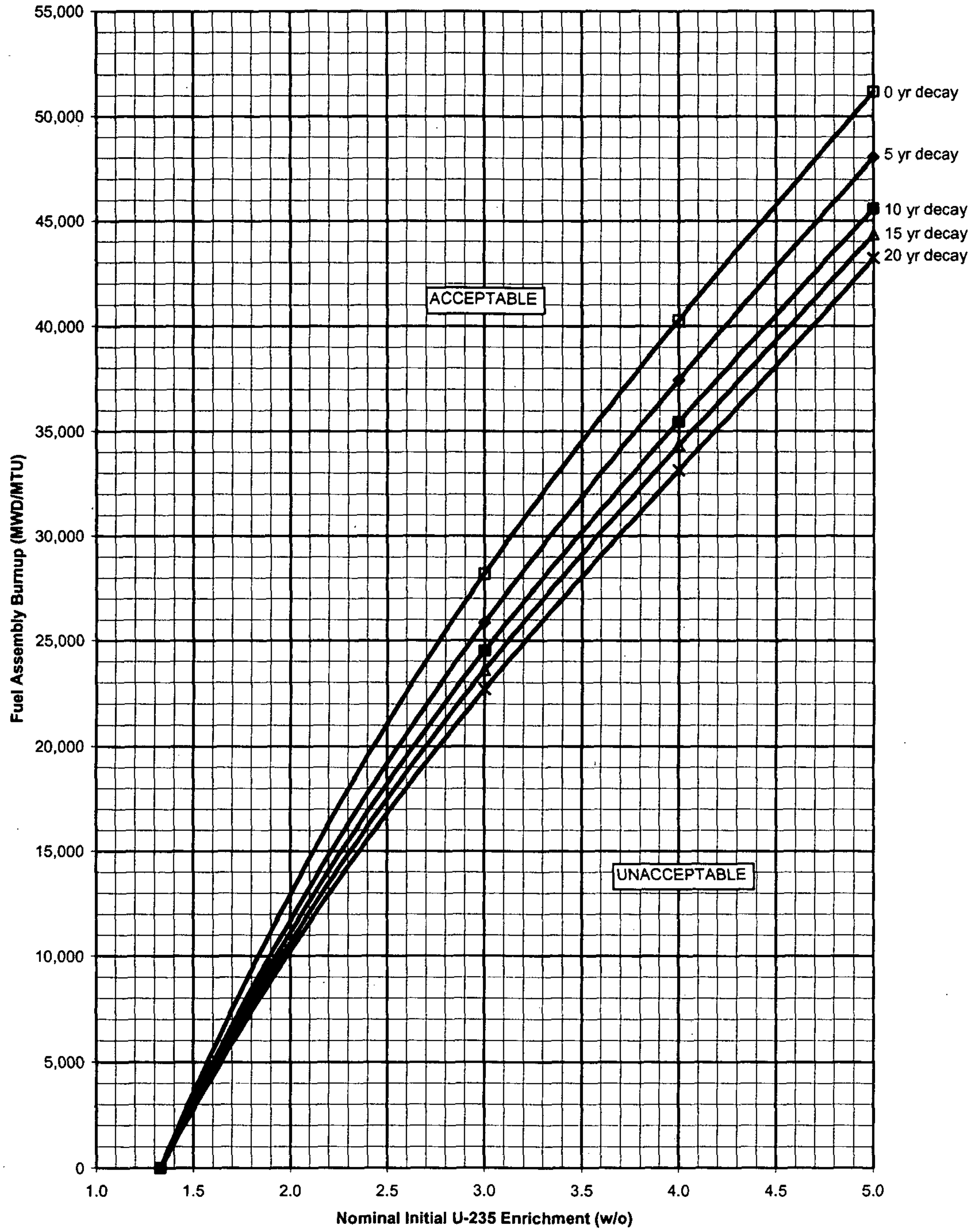
H2: Fresh fuel assembly with maximum 4.0 w/o U-235 with no IFBA or maximum 5.0 w/o U-235 with IFBA in the "Acceptable" range of Figure 4.3.1-8.

No restriction on burnup.

L2: Spent fuel assemblies in the "Acceptable" range of Figure 4.3.1-7.

Figure 4.3.1-5
1-Out-of-4 for 4 w/o with IFBA / 1-Out-of-4 for 5 w/o with no IFBA

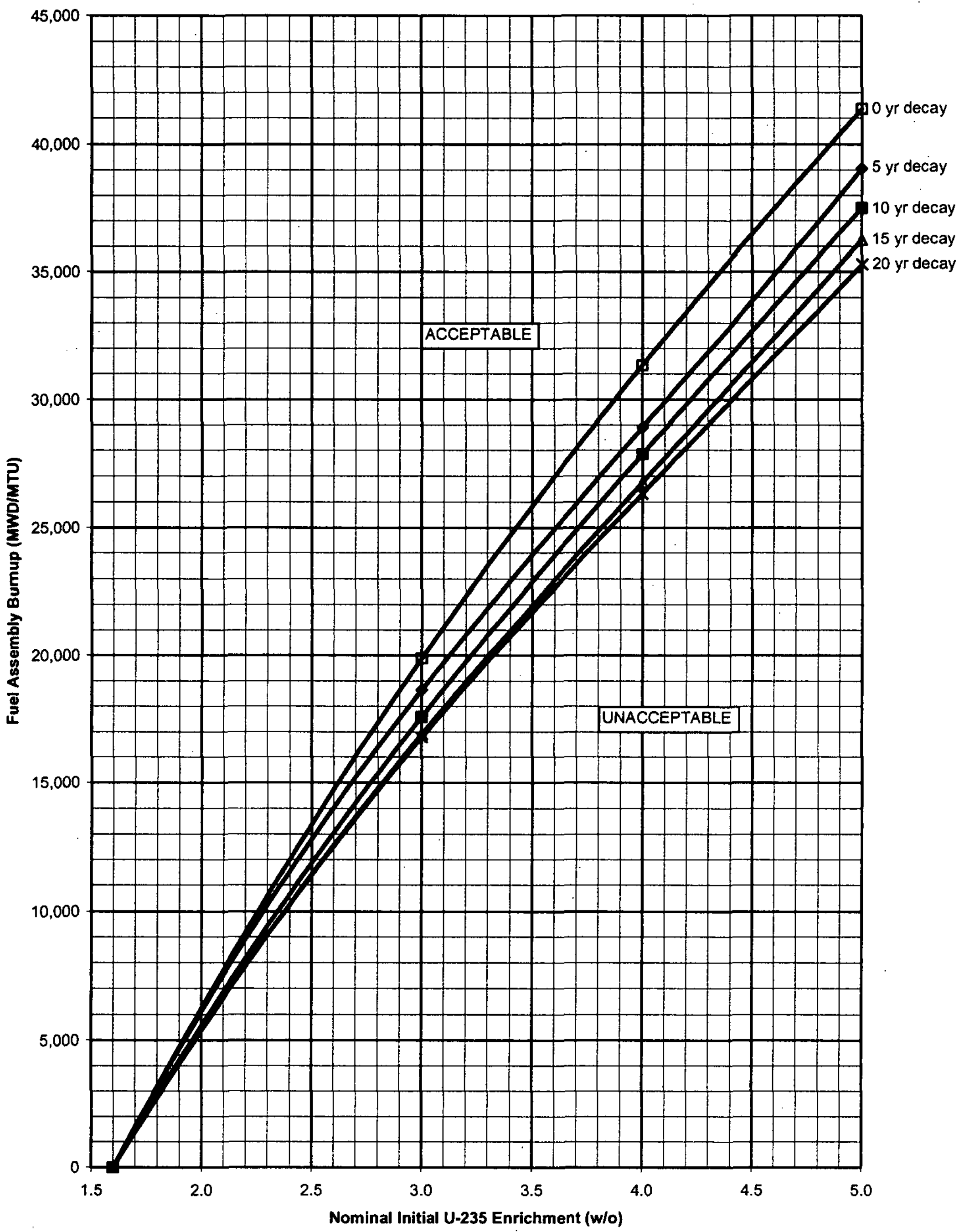
4.0 DESIGN FEATURES




```
0 yr decay = 322e³ - 4474e² + 31502e - 34741
5 yr decay = 260e³ - 3624e² + 27340e - 30563
10 yr decay= 269e³ - 3638e² + 26461e - 29391
15 yr decay= 250e³ - 3357e² + 24973e - 27864
20 yr decay= 265e³ - 3377e² + 24293e - 26960
```

Figure 4.3.1-6
Spent Fuel Assembly Burnup Requirements for 1-Out-of-4 for 5.0 w/o with no IFBA

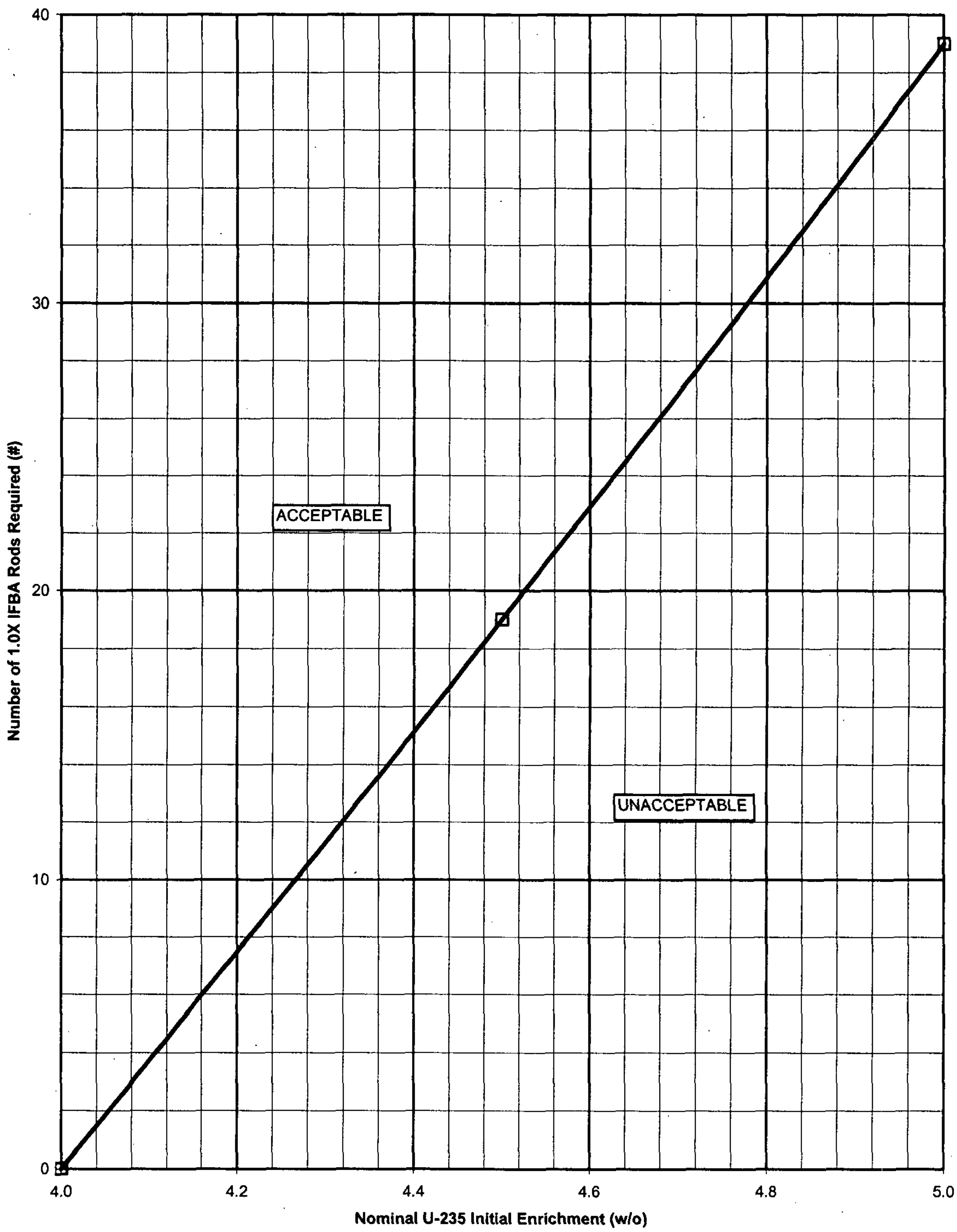
4.0 DESIGN FEATURES



$$0\ yr\ decay = 124e^3 - 2209e^2 + 22335e - 30589$$
$$5\ yr\ decay = 358e^3 - 4351e^2 + 27475e - 34288$$
$$10\ yr\ decay = 192e^3 - 2610e^2 + 21433e - 28398$$
$$15\ yr\ decay = 219e^3 - 2806e^2 + 21397e - 27949$$
$$20\ yr\ decay = 217e^3 - 2887e^2 + 21718e - 28247$$

Figure 4.3.1-7
Spent Fuel Assembly Burnup Requirements for 1-Out-of-4 for 4.0 w/o with IFBA

4.0 DESIGN FEATURES



Number of IFBA Pins = $2e^2 + 21e - 116$

Figure 4.3.1-8
Fresh Fuel IFBA Requirements

ENCLOSURE 3

FPL ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

LICENSE AMENDMENT REQUEST 247
SPENT FUEL POOL STORAGE CRITICALITY CONTROL

REVISED TECHNICAL SPECIFICATION BASES

(6 pages follow)

B 3.7 PLANT SYSTEMS

B 3.7.11 Fuel Storage Pool Boron Concentration

BASES

BACKGROUND

In the spent fuel storage rack design, the spent fuel pool is considered a single region. The spent fuel storage pool will accommodate 1502 fuel assemblies with a maximum enrichment of 5.0 wt% U-235. The racks may contain fresh or spent fuel within the acceptable domain according to Figure 3.7.12-1, in the accompanying LCO. Fuel assemblies not meeting the criteria of Figure 3.7.12-1 shall be stored in accordance with paragraph 4.3.1.1 in section 4.3, Fuel Storage.

The water in the spent fuel storage pool normally contains soluble boron, which results in large subcriticality margins under normal conditions. However, the NRC guidelines, based upon the accident condition in which all soluble poison is assumed to have been lost, specify that the limiting k_{eff} of less than 1.0 be evaluated in the absence of soluble boron. Hence, the design of the spent fuel storage racks is based on the use of unborated water, which maintains the spent fuel pool in a subcritical condition during normal operation with the pool fully loaded. The double contingency principle discussed in ANSI N-16.1-1975 and the April 1978 NRC letter (Ref. 3) allows credit for soluble boron under abnormal or accident conditions, since only a single accident need be considered at one time. For example, the most severe accident scenario is associated with the accidental mis-loading of a fresh 5.0 wt% U-235 fuel assembly in a spent fuel assembly location for the "1-out-of-4 5.0 w/o with no IFBA" configuration. To mitigate these postulated criticality related accidents, boron is dissolved in the pool water. Safe operation of the spent fuel rack with no movement of assemblies may therefore be achieved by controlling the location of each assembly in accordance with LCO 3.7.12, "Spent Fuel Assembly Storage." Prior to movement of an assembly, it is necessary to perform SR 3.7.12.1.

APPLICABLE SAFETY ANALYSES

Most accident conditions do not result in an reactivity increase for the fuel stored in the spent fuel pool. An example accident condition is dropping of a fuel assembly on the top of the racks. However, accidents can be postulated that could increase the reactivity. This increase in reactivity is unacceptable with unborated water in the storage pool. Thus, for these accident occurrences, the presence of soluble boron in the storage pool prevents criticality. For these events, the spent fuel pool k_{eff} storage limit of 0.95 is maintained by maintaining a minimum boron concentration of 664 ppm (Ref. 2). Simultaneous occurrence of these events is not postulated. The double

BASES

APPLICABLE SAFETY ANALYSES (continued)	contingency principle discussed in ANSI N-16.1-1975 and the April 1978 NRC letter (Ref. 3) allows credit for soluble boron under abnormal or accident conditions, since only a single accident need be considered at one time. The accident analyses are provided in the FSAR, Section 14.2.1 (Ref. 4). The concentration of dissolved boron in the fuel storage pool satisfies Criterion 2 of 10CFR 50.36(c)(2)(ii).
LCO	The fuel storage pool boron concentration is required to be ≥2100 ppm. The specified concentration of dissolved boron provides significant margin to the boron concentration used in the analyses of the potential critical accident scenarios as described in Reference 4. This concentration is the minimum required concentration for fuel assembly storage and movement within the fuel storage pool.
APPLICABILITY	This LCO applies whenever fuel assemblies are stored in the spent fuel storage pool and encompasses movement of fuel assemblies in the spent fuel storage pool. This LCO provides assurance that k_{eff} of the spent fuel storage pool will remain less than or equal to 0.95, even under postulated accident conditions.
ACTIONS	The Required Actions are modified by a Note indicating that LCO 3.0.3 does not apply. If the LCO is not met while moving irradiated fuel assemblies in MODE 5 or 6, LCO 3.0.3 would not be applicable. If moving irradiated fuel assemblies while in MODE 1, 2, 3, or 4, the fuel movement is independent of reactor operation. Therefore, inability to suspend movement of fuel assemblies or restoration of boron concentration is not sufficient reason to require a reactor shutdown. <u>A.1</u> When the concentration of boron in the fuel storage pool is less than required, immediate action must be taken to suspend the movement of fuel assemblies. This does not preclude movement of a fuel assembly to a safe position. By suspending movement of fuel, inadvertent placement of a fuel assembly in an incorrect storage location is precluded.

BASES

ACTIONS (continued)

A.2

Immediate action must be taken to restore boron concentration in the fuel storage pool to ≥2100 ppm to assure protection from excessive fuel pool cooldown or heatup reactivity insertion events. Restoration of boron concentration could take several hours or days depending on the magnitude of change required, which may involve feed and bleed operations. Immediate initiation of action is warranted based on the importance of maintaining k_{eff} of the spent fuel pool ≤0.95. As stated in Reference 2, 664 ppm is adequate to prevent the spent fuel pool k_{eff} storage limit of 0.95 from being exceeded as a result of the most limiting accident. Accordingly, for minor deviations, significant margin exists to the analysis limit.

SURVEILLANCE REQUIREMENTS

SR 3.7.11.1

This SR verifies that the concentration of boron in the fuel storage pool is within the required limit. As long as this SR is met, the analyzed accidents are fully addressed. The 7 day Frequency is appropriate because no major replenishment of pool water is expected to take place over such a short period of time.

REFERENCES

1. FSAR. Section 9.4.

2. "Point Beach Units 1 and 2 Spent Fuel Pool Criticality Safety Analysis", WCAP-16541-P, Revision 2, Westinghouse Electric Company, June, 2008.

3. Double contingency principle of ANSI N16.1-1975, as specified in the April 14, 1978 NRC letter (Section 1.2) and implied in the proposed revision to Regulatory Guide 1.13 (Section 1.4, Appendix A).

4. FSAR. Section 14.2.1.

B 3.7 PLANT SYSTEMS

B 3.7.12 Spent Fuel Pool Storage

BASES

BACKGROUND

In the spent fuel storage rack design, the spent fuel pool is considered a single region. The spent fuel storage pool will accommodate 1502 fuel assemblies with a maximum enrichment of 5.0 wt% U-235. The racks may contain fresh or spent fuel within the acceptable domain according to Figure 3.7.12-1, in the accompanying LCO. Fuel assemblies not meeting the criteria of Figure 3.7.12-1 shall be stored in accordance with paragraph 4.3.1.1 in section 4.3, Fuel Storage.

The water in the spent fuel storage pool normally contains soluble boron, which results in large subcriticality margins under actual operating conditions. However, the NRC guidelines, based upon the accident condition in which all soluble poison is assumed to have been lost, specify that the limiting k_{eff} of <1.0 be evaluated in the absence of soluble boron. Hence, the design of the spent fuel storage racks is based on the use of unborated water, which maintains each region in a subcritical condition during normal operation with the regions fully loaded. The double contingency principle discussed in ANSI N16.1-1975 and the April 1978 NRC letter (Ref. 3) allows credit for soluble boron under other abnormal or accident conditions, since only a single accident need be considered at one time. For example, the most severe accident scenario is associated with the accidental mis-loading of a fresh 5.0 wt% U-235 fuel assembly in a spent fuel assembly location for the "1-out-of-4 5.0 w/o with no IFBA" configuration. To mitigate these postulated criticality related accidents, boron is dissolved in the pool water. Safe operation of the spent fuel storage racks with no movement of assemblies may therefore be achieved by controlling the location of each assembly in accordance with the accompanying LCO. Prior to movement of an assembly, it is necessary to perform SR 3.7.12.1.

APPLICABLE SAFETY ANALYSES

The hypothetical accidents can only take place during or as a result of the movement of an assembly (Ref. 4). For these accident occurrences, the presence of soluble boron in the spent fuel storage pool (controlled by LCO 3.7.11, "Fuel Storage Pool Boron Concentration") prevents criticality in the spent fuel pool. By closely controlling the movement of each assembly and by checking the location of each assembly after movement, the time period for potential accidents may be limited to a small fraction of the total operating time. During the remaining time period with no potential for accidents, the operation may be under the auspices of the accompanying LCO.

The configuration of fuel assemblies in the fuel storage pool satisfies Criterion 2 of 10CFR 50.36(c)(2)(ii).

BASES

LCO

The restrictions on the placement of fuel assemblies within the spent fuel pool, in accordance with Figure 3.7.12-1, in the accompanying LCO, ensures the k_{eff} of the spent fuel storage pool will always remain < 1.0, assuming the pool to be flooded with unborated water. Fuel assemblies not meeting the criteria of Figure 3.7.12-1 shall be stored in accordance with Specification 4.3.1.1 in Section 4.3.

APPLICABILITY

This LCO applies whenever any fuel assembly is stored in the fuel storage pool.

ACTIONS

A.1

Required Action A.1 is modified by a Note indicating that LCO 3.0.3 does not apply.

When the configuration of fuel assemblies stored in the spent fuel pool is not in accordance with Figure 3.7.12-1, or paragraph 4.3.1.1, the immediate action is to initiate action to make the necessary fuel assembly movement(s) to bring the configuration into compliance with Figure 3.7.12-1 or Specification 4.3.1.1.

If unable to move fuel assemblies while in MODE 5 or 6, LCO 3.0.3 would not be applicable. If unable to move irradiated fuel assemblies while in MODE 1, 2, 3, or 4, the action is independent of reactor operation. Therefore, inability to move fuel assemblies is not sufficient reason to require a reactor shutdown.

ENCLOSURE 4

FPL ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

LICENSE AMENDMENT REQUEST 247
SPENT FUEL POOL STORAGE CRITICALITY CONTROL

EC 12014

BORON DILUTION ANALYSIS TO SUPPORT LICENSE AMENDMENT REQUEST

(18 pages follow)

1.0 INTRODUCTION

CAA-96-146, "Criticality Analysis of the Point Beach Nuclear Plant Spent Fuel Storage Racks Considering Boraflex Gaps and Shrinkage with Credit for Integral Fuel Burnable Absorber" for the spent fuel pool demonstrates that k_{eff} will be less than 0.95 when filled with unborated water. This analysis also requires that all fuel is assumed to be fresh. The new Point Beach criticality analysis, WCAP-16541-P, "Point Beach Units 1 and 2 Spent Fuel Pool Criticality Safety Analysis" takes advantage of the soluble boron and burnup credits so that the Boraflex need no longer be credited. The NRC requires that licensees taking credit for soluble boron perform a boron dilution analysis to ensure the that sufficient time is available to detect and suppress the worst dilution event that can occur.

This boron dilution analysis has been completed to support the license amendment request based on WCAP-16541-P. This dilution analysis includes an evaluation of the following:

- Dilution Sources
- Boration Sources
- Instrumentation
- Administrative Procedures
- Piping
- Boron Dilution Initiating Events
- Boron Dilution Volumes and Times

The boron dilution analysis has been completed to ensure that sufficient time is available to detect and mitigate the dilution before the minimum boron concentration is reached.

2.0 SPENT FUEL POOL AND RELATED SYSTEM FEATURES

This section provides background information on the spent fuel pool and its related systems and features.

2.1 Spent Fuel Pool Structure

The design purpose of the spent fuel pool is to provide for the underwater storage of spent fuel assemblies, control rods and other inserts after their removal from the reactor. The applicable design criteria require that the spent fuel pool remain subcritical, provide for adequate decay heat removal, provide adequate radiation shielding and provide prevention against radioactive release. The water in the spent fuel pool is used to remove decay heat, provides shielding and reduces the amount of radioactive gasses released during a fuel handling accident. The fuel is maintained subcritical by fuel assembly storage cell spacing and a solid neutron absorber, Boraflex. The spent fuel pool is filled with borated water that is not credited for maintaining sub-criticality during normal operation but is credited for postulated accidents. Since boron is credited for postulated accidents in the spent fuel pool a minimum boron concentration is required in the technical specifications. Evaporation of spent fuel pool water requires periodic makeup to ensure minimum levels are maintained. Since boric acid is not lost during evaporation, an unborated water source may be used to refill the spent fuel pool.

The spent fuel pool is a reinforced concrete structure that is lined with a 3/16 inch welded stainless steel liner. Collection trenches are formed into the concrete behind the welds to detect liner leakage. The leakage in the collection trenches is routed through a series of pipes to a central collection point. The pool structure is constructed of reinforced concrete and is a Class I seismic design.

The Point Beach spent fuel pool is divided in two parts that are connected through an internal divider wall. The single spent fuel pool is shared by the two units. The fuel transfer canal is set to the east of the spent fuel pool and is common to both units. Two gates maintain spent fuel pool inventory and allow the transfer canal to be drained for maintenance of fuel handling equipment. The elevation of the bottom of the gates is above the top of the spent fuel racks. The gates employ inflatable seals supplied by Instrument Air and a redundant static seal that is seated to the door jamb by hydrostatic force. Both gates must be closed to isolate the transfer canal from the spent fuel pool. Normally, one or both gates are left open and the transfer canal is normally flooded unless maintenance is going to be performed.

The north portion of the pool contains an area reserved for the loading of the spent fuel shipping cask or dry storage cask. There is also a new fuel elevator, located on the east side of the spent fuel pool on the Unit 2 side. The new fuel elevator is used to lower new fuel assemblies into the spent fuel pool and for maintenance on spent fuel assemblies. The pit for the new fuel elevator winch is located to the east of the transfer canal and the cable passes through an opening in the floor that is approximately 1 foot 4 inches below the 66 foot elevation. This opening also passes through the transfer canal into the spent fuel pool.

The spent fuel pool is approximately 42 feet deep with the top of the structure at the 66 foot elevation in the plant. The bottom of the structure is at the 24 foot - 8 inch elevation. The 26 foot elevation is considered to be ground level.

In the event of excessive makeup flow into the pool, the water would fill the pool to the level of the opening for the new fuel elevator winch. At this point water added to the spent fuel pool would spill into the transfer canal through the elevator opening. The water would fill the transfer canal until it equalizes with the spent fuel pool. The spent fuel pool and the transfer canal would continue to fill up to the 66 foot elevation, at which point water would begin to spill into the rail area where floor drains are located. The floor drains will route the water to the PAB sump and from there ultimately to the waste holdup tank. If water flow exceeds the capacity of the drains, it would overflow onto the 66 foot elevation operating deck. Some water would flow into the new fuel vault and some of it would flow off and onto the 46 foot elevation of the auxiliary building. The water would all be routed to floor drains and ultimately go to the waste holdup tank on the 8 foot elevation of the auxiliary building.

The volume of the spent fuel pool given in FSAR 9.9, Spent Fuel Cooling & Filtration (SF) is 48,283 ft^3. The low level alarm is set at elevation 62 foot - 8 inches. A substantial amount of the water volume is displaced by objects in the pool. The maximum number of assemblies that can be loaded in the spent fuel pool is 699 assemblies in the north pool and 803 assemblies in the south pool. Assuming the rack and fuel area is solid and contains no water and not accounting for the water volume in the cask laydown area, the borated water volume determined by this analysis at the low level alarm is 236,406 gallons.

2.2 Spent Fuel Storage Racks

The spent fuel storage racks for the Point Beach Nuclear Plant are designed in accordance with Regulatory Guide 1.29, Revision 2, as seismic Category I components. The structural analysis of the racks has considered all the loads and load combinations specified in the NRC Standard Review Plan. The steel structure of the rack not only provides a smooth, all welded stainless steel box structure to preclude damage during normal and abnormal load conditions, but also provides an additional margin of safety in the form of internal structural damping created by the large areas of bearing surface between boxes in the array.

2.3 Spent Fuel Pool Cooling System

The spent fuel pool cooling system, common to Units 1 and 2, is designed to remove decay heat from fuel assemblies stored in the spent fuel pool after removal from the reactor vessel. The spent fuel pool cooling system consists of two separate cooling trains, with a common suction and return header, each having an identical heat exchanger and pump. Water from the pool is pumped through one or both heat exchangers for cooling and returned to the pool. Normal operating procedures are used to cross-connect the pumps and heat exchangers as conditions require. In the unlikely event of the cooling loop of the spent fuel pool being drained, the spent fuel storage pool itself cannot be drained and no spent fuel is uncovered since the spent fuel pool cooling suction and return connections terminate or contain a siphon breaker that would limit water drawdown to a level approximately 21 feet 11 inches above the fuel.

The spent fuel pool cooling system piping and the service water system piping supplying the spent fuel pool heat exchangers are classified Safety-Related, Seismic Class 1.

The spent fuel pool cooling pumps take suction through branch lines off a common header from beneath the surface of the north half of the spent fuel pool, pump the water through the tube side of the spent fuel pool cooling heat exchangers, and return it via a common header to the south half of the spent fuel pool. The system piping is arranged so that either pump can supply either heat exchanger.

The spent fuel pool cooling heat exchangers are cooled by service water on the shell side. Because the heat exchangers are safety related and cooled with service water, they are part of the GL 89-13 program and receive regular inspection, performance testing and eddy-current testing of the tubes for degradation.

2.4 Spent Fuel Pool Cleanup System

The clarity and purity of the spent fuel pool water are maintained by passing up to the design flow of 60 gallons per minute through a filter and demineralizer.

The purification system inlet taps off the cross-connect line between the "A" and "B" cooling trains at the discharge of the fuel pool cooling pumps. The purification system return line connects with the cooling system return header. The purification system is not safety related.

The spent fuel filter removes particulate material from the spent fuel pool water. The filter cartridge is synthetic fiber and the vessel shell is stainless steel.

The demineralizer is sized to pass approximately 60 gallons per minute to provide adequate purification of the fuel pool water for unrestricted access to the working area, and to maintain optical clarity.

2.5 Dilution Sources

2.5.1 Chemical and Volume Control System (CVCS) Holdup Tanks

There are three CVCS holdup tanks, each with an approximate volume of 61,000 gallons. The CVCS hold up tanks may be pumped to the spent fuel pool or the transfer canal via a

4 inch line. The holdup tanks are used to drain the transfer canal and store the canal water during maintenance operations and supply water back into the canal when maintenance is complete. This connection is normally isolated by a manually operated valve from the discharge of the holdup tank recirculation pump. The CVCS holdup tanks are an approved method of makeup to the spent fuel pool, though additional administrative requirements are put in place when using this source. The CVCS holdup tanks may also be used as a source during a loss of inventory event.

The holdup tanks cannot gravity-drain to the spent fuel pool because the maximum tank water level is below the minimum spent fuel pool level.

The holdup tank recirculation pump is shared between Units 1 and 2 and is used to mix the contents of a holdup tank or transfer the contents of one holdup tank to another or transfer the spent fuel pool transfer canal water to the hold up tanks or spent fuel pool. The wetted surface of this pump is constructed of austenitic stainless steel. By procedure, only one holdup tank is aligned to the transfer pump at a time. Manual valve manipulations are required to switch the pump suction to another tank. Each holdup tank has a total volume of approximately 61,000 gallons. The concentration of boric acid in the holdup tanks varies throughout core life from the refueling concentration to essentially zero at the end of the core cycle. Each holdup tank has a low level alarm at 13%. The design flow from this source is 500 gpm.

2.5.2 Reactor Makeup Water (RMUW) Tank.

One reactor makeup water tank is shared between the two units and is used to store makeup water, which is primarily supplied from the water treatment plant, but can also be supplied from the monitor tanks. The tank contains a diaphragm membrane and is constructed of coated carbon steel.

Two reactor makeup water pumps, shared between Unit 1 and Unit 2, take suction from the reactor makeup water tank. These pumps are used to feed dilution water to the boric acid blender and are also used to supply makeup water for intermittent flushing of equipment and piping. Each pump is sized to match the combined maximum letdown flow from each unit. One pump serves as a standby for the other.

The volume of the RMUW tank is approximately 96,150 gallons. The tank has a low level alarm at 4%. The tank administrative low level limit is 31%.

There is no direct flow path from the RMUW tank to the spent fuel pool. By plant procedure, reactor makeup water may be used for spent fuel pool makeup by sending it through either units' boric acid blender. From the boric acid blender the reactor makeup water is put into the spent fuel pool through the purification loop piping. During a loss of inventory accident, makeup is allowed by procedure through either units' boric acid blender. It could also possibly be routed to the spent fuel pool through the demineralizer flush line, though this is not a normal alignment and not allowed by procedure. The monitor tanks and pumps are used to flush the demineralizer line, which is isolated from the spent fuel pool during demineralizer flushing. The demineralizer flush valve is normally closed and locked shut.

The reactor makeup tank cannot gravity drain to the spent fuel pool because the top of the tank is lower than the top of the spent fuel pool low level alarm.

Makeup to the spent fuel pool using reactor makeup water through the boric acid blender is not preferred because of the number of manual valve manipulations involved. In addition the inlet valve to the spent fuel pool purification loop is a normally closed and locked shut valve. The design flow rate of a reactor makeup water pump is 270 gpm. The flow is limited by a flow control valve to 120 gpm.

2.5.3 Demineralized (DI) Water System

Demineralized water is supplied from the water treatment plant. DI water may be provided directly to the spent fuel pool cooling return line through a check valve and manually operated two inch diaphragm valve.

DI water is the typical means of makeup to the spent fuel pool. Additional administrative controls are put in place when using DI water to ensure that dilution below the technical specifications value does not occur. DI water may also be used during a loss of inventory event through the same flow path.

DI water is constantly supplied by the water treatment plant. The maximum flow rate from the water treatment plant is 400 gpm, though the actual amount that can be supplied to the spent fuel pool is approximately 200 gpm due to piping losses. 400 gpm is based on maximum values allowed in the plant operating procedure for the DI Water system.

2.5.4 Service Water

Each fuel pool cooling heat exchanger uses 3/4 inch U-tubes with service water on the shell side. There is no direct piping connection between the service water system and the spent fuel pool cooling system. The normal operating pressure of the service water system is higher than the normal operating pressure of the spent fuel pool cooling system. In the event of a heat exchanger tube break, differential pressure will normally result in leakage from the service water system to the spent fuel pool cooling system. Under certain conditions, for example during refueling when higher service water flow rates to the spent fuel pool heat exchangers are required, service water pressure may fall below spent fuel pool cooling system pressure. Under these conditions, a heat exchanger tube break will result in leakage from the spent fuel pool cooling system into the service water system. A spent fuel pool heat exchanger tube rupture is considered improbable based upon the low operating pressures, the seismic installation of the heat exchanger, and the heat exchanger design specifications.

Service water is operated between 50 psig and 90 psig. The discharge pressure of the spent fuel pool water at the heat exchanger outlet is low and typically less than 10 psig.

Conservatively assuming a 90 psi differential pressure between service water and the spent fuel pool, the expected flow through a 3/4 inch opening would be less than 200 gpm. If a leak were to develop given the size of the tubes, the flow rate would be bounded by the dilution from the DI water system.

It is expected that the flow rate of any leakage of service water would be very low due to the small difference in operating pressures between the two systems. Given that such an event is considered improbable, no further consideration will be given to service water as a dilution source.

In a loss of inventory event, service water may be used to add water to the spent fuel pool, though no direct connection exists and there is presently no detailed procedure guidance to perform this action. Also, the spent fuel pool as analyzed under the new criticality analysis will remain subcritical, even if filled with unborated water. The only time when service water would be used to add inventory to the spent fuel pool would be because some more limiting event had occurred.

2.5.5 Fire Protection System

In an emergency loss of spent fuel pool inventory, fire hose stations are available. There is one hose reel in each fan room and hose reels on the PAB 46 foot elevation, central area. The design flow rate of a hose station is 100 gpm of non-borated raw water. Although an available source, the fire hose is not specifically addressed by normal operating procedures for makeup and would only be required if some more limiting event were to occur where cooling and shielding of the spent fuel is the primary concern. Even if all four fire hoses were positioned into the spent fuel pool the flow rate would be 400 gpm and this is bounded by the DI water dilution event. In an event such as this, the criticality analysis still ensures that the spent fuel pool will remain subcritical, even in the presence of unborated water.

2.5.6 Monitor Tanks

Four monitor tanks can be shared by Unit 1 and Unit 2. Each tank has a capacity of approximately 10,000 gallons. Liquid effluent in the holdup tanks can be routed to the monitor tanks via the boric acid feed demineralizers for subsequent discharge. The tanks are located on the 26 foot elevation of primary auxiliary building. Two monitor tank pumps, shared by Units 1 and 2, discharge water from the monitor tanks. The pumps are constructed of austenitic stainless steel. The monitor tanks can also be filled with water from the water treatment plant. These tanks contain a diaphragm membrane and are constructed of stainless steel. The tanks have a low level alarm at 5% and a pump trip at 10%.

The monitor tanks and pumps are used during demineralizer resin replacement to flush the resin. During these operations, only one tank and one pump are aligned at a time to the spent fuel pool demineralizer. The purification loop for spent fuel cooling is isolated during resin replacement activities. The resin flush valve is normally closed and locked shut during purification loop operation.

The monitor tanks cannot gravity drain to the spent fuel pool because the top of the tanks is below the low level alarm in the spent fuel pool.

Because the monitor tanks take waste from the CVCS holdup tanks and can also be filled with water from the water treatment plant, their boron concentration can be variable. Normally, only one monitor tank is aligned to the pump during resin replacement activities. Manual valve manipulations and intentional disregard for operating procedures would be required to switch the pump to another tank. The design flow rate of one monitor tank pump is 60 gpm.

2.5.7 Dry Cask Storage Operations

During dry fuel storage evolutions, spent fuel pool water is added to the cask prior to placement in the spent fuel pool. After fuel loading the water is pumped back to the spent fuel pool. Additional sampling requirements are put in place as required by cask technical specifications. Since the water pumped from the cask was from the SFP, this is not considered a dilution source. DI water may used to rinse the cask down as it is removed from the spent fuel pool. Additional procedure controls are in place during these evolutions and require a flow totalizer be installed and limit the total rinse volume to 500 gallons. Rinse down work is conducted with a garden hose, further limiting the rate of flow. This is not considered a credible dilution source and will not be further evaluated.

2.5.8 Dilution Source and Flow Rate Summary

Based on the evaluation of potential spent fuel pool dilution sources summarized above, the following dilution sources were determined to be capable of providing a significant amount of non-borated water to the spent fuel pool. The potential for these sources to dilute the spent fuel pool boron concentration to the design basis boron concentration will be evaluated in Section 3.0.

Source	Design Flow Rate (GPM)
CVCS	
- Holdup tank to Spent Fuel Pool	500
RMUW	
- Unit 1 or 2 Boric Acid Blender	120
DI	
- Via SF-00812B valve	400
Monitor Tanks	
- Through demineralizer flush	60
Fire Protection	
- Fire hose station	100

2.6 Boration Sources

The normal source of borated water to the spent fuel pool is the boric acid blender. The other source is the CVCS hold up tanks, which are checked for acceptable boron concentration prior to use. Another possibility would be the addition of dry boric acid directly to the spent fuel pool water. The Refueling Water Storage Tanks (RWST) is also a possible borated water source.

2.6.1 Refueling Water Storage Tank

There is one Refueling Water Storage Tank (RWST) for each unit. Each RWST contains approximately 290,000 gallons of water borated to approximately 3,000 ppm (Technical Specifications require the RWST to be maintained greater than 275,000 gallons and greater than 2,700 ppm.)

The refueling water circulating pump is used primarily to circulate water in a loop between the RWST and the spent fuel pool demineralizer and filter. All wetted surfaces of the pump are austenitic stainless steel. The pump is operated manually from a local station.

RWST makeup to the spent fuel pool is only used in the case of a loss of inventory event. The RWST is not a source for normal makeup to the spent fuel pool . The refueling water circulation pump is powered from a non-vital bus power supply.

2.6.2 Boric Acid Storage Tanks (BAST)

The BASTs are an approved source of makeup to the spent fuel pool through either units' boric acid blender. This source is also approved for use during a loss of inventory accident. Because of the number of manual valve manipulations, this is not the preferred method to makeup to the spent fuel pool.

There are three boric acid storage tanks. Each of the three boric acid storage tanks has a capacity of 5000 gallons. The tanks are located on the 46 foot elevation of the primary auxiliary building.

2.6.3 Direct Addition of Boric Acid

If necessary, the boron concentration of the spent fuel pool could be increased by emptying bags of dry boric acid directly into the spent fuel pool. However, boric acid dissolves very slowly at room temperature and requires that the spent fuel pool cooling pumps be available for mixing the spent fuel pool water. Furthermore, there is no procedure currently in place to provide operator guidance for this method. Therefore, this method would be used only in an emergency and will not given additional consideration.

2.6.4 CVCS Holdup Tanks

The CVCS holdup tanks may be borated depending on which tank is selected and the time in core life. For the purposes of this analysis, the CVCS holdup tanks are assumed to be dilution sources.

2.7 Spent Fuel Pool Instrumentation

Instrumentation is available to monitor spent fuel pool water level and temperature. Additional instrumentation is provided to monitor the pressure and flow of the spent fuel pool cleanup system, and pressure, flow and temperature of the spent fuel pool cooling system.

The instrumentation to monitor spent fuel pool temperature and level alarm on a common annunciator in the control room. The alarm actuates on high spent fuel pool temperature and high or low spent fuel pool level. The temperature and level alarms are powered from the vital DC power supply.

Two area radiation monitors are available in the spent fuel pool area for low range and high range area monitoring.

The spent fuel pool low level alarm is set at 62 foot - 8 inches and the high level alarm is set at 64 foot - 10 inches. The temperature alarm is set for greater than 120 degF.

2.8 Administrative Controls

The following administrative controls are in place to control the spent fuel pool boron concentration and water inventory:

1. Procedures are available to aid in the identification and termination of dilution events.

2. Procedures for loss of inventory (other than normal makeup) are ordered such that borated water sources are used first.

3. Procedure for makeup allows use of DI water, RMUW, and CVCS hold up tank water provided it meets additional requirements for sampling and/or initial boron concentration.

4. In accordance with procedures, plant personnel perform rounds at the spent fuel pool at least once every 8 hours. The personnel making rounds to the spent fuel pool are trained to be aware of the change in the status of the spent fuel pool. They record temperature and level on data loggers during these rounds.

5. Administrative controls (locked closed valves on RMUW flow paths to the spent fuel pool cooling system; procedures requirements) are placed on the potential dilution paths.

6. When making up using DI water or RMUW, procedures require that the spent fuel pool initial boron concentration is greater than or equal to 2,500 ppm, the spent fuel cooling system is operating with a flow rate greater than or equal to 1,000 gpm and the makeup is limited to less than or equal to 12 inches of level. Prior to adding more water, the boron concentration must be re-verified greater than 2,500 ppm. CVCS holdup tanks must meet minimum chemistry requirements including boron concentration before being used as a makeup source.

7. The spent fuel pool boron concentration is administratively maintained at greater than 2,300 ppm and it is typically around 3,000 ppm. It is sampled every 7 days per technical specifications.

2.9 Piping

There is one dilution source system in the area of the spent fuel pool. A 2 inch DI water line runs on the floor on the west side of the spent fuel pool. The pipe lies to the west of the spent fuel pool and bridge rail and is separated by a cable trench and the rail. The pipe terminates at the middle of the SFP with one output that continues along the floor and a smaller 1 inch line flush connection available for decontamination services during spent fuel pool operations. Each outlet has an isolation valve and there is a second isolation valve for both of these valves. All three valves are normally closed. Because the pipe is not immediately adjacent to the spent fuel pool, a pipe break cannot directly flow into the spent fuel pool. Because the flow from this pipe will not all directly flow into the spent fuel pool, the outlets are behind double isolation and the source is the same as the bounding source evaluated in this analysis, failure of this pipe or valves is bounded and does not require further consideration.

3.0 SPENT FUEL POOL DILUTION EVALUATION

3.1 Calculation of Boron Dilution Times and Volumes

For the purposes of evaluation of spent fuel pool dilution times and volumes, the total pool volume available for dilution, as described in section 2.1, is conservatively assumed to be 236,406 gallons.

Based on the new criticality analysis, the soluble boron concentration required to maintain the spent fuel pool at $k_{eff} \leq 0.95$, including all biases and uncertainties and assuming the most limiting single accident is 664 ppm.

The spent fuel pool boron concentration is typically maintained above the administrative value of 2,300 ppm at around 3,000 ppm (technical specification value is 2,100 ppm.) If the concentration falls below 2,100 ppm, Point Beach enters a Technical Specification Action Condition to restore the concentration to within limits immediately. For the purposes this of evaluation, the initial spent fuel pool boron concentration is assumed to be at the technical specification limit of 2,100 ppm. The evaluations are based on the spent fuel pool boron concentration being diluted from 2,100 ppm to 664 ppm. To dilute the spent fuel pool volume of 236,406 gallons from 2,100 ppm to 664 ppm would conservatively require 303,725 gallons of non-borated water. This is based on initially filling the spent fuel pool to the elevation where water spills into the transfer canal, then filling the transfer canal, filling the spent fuel pool and the transfer canal to the top of the structure and then spilling over the structure onto the floor. This sequence of events maximizes the time until the high level alarm would be actuated.

This analysis assumes thorough mixing of all the non-borated water added to the spent fuel pool with the contents of the spent fuel pool. Based on the design flow of 1,250 gpm per spent fuel pool pump, the 236,406 gallon system volume is turned over approximately every 3 hours with one pump running, which is the normal alignment. It is unlikely with cooling flow and convection from the spent fuel decay heat, that thorough mixing would not occur. However, if mixing was not adequate, it would be conceivable that a localized pocket of non-borated water could form somewhere in the spent fuel pool. This possibility is addressed by the criticality analysis which shows that the spent fuel rack k_{eff} will be less than 1.0 with the spent fuel pool filled with non-borated water. Thus, even if a pocket of non-borated water formed in the spent fuel pool, k_{eff} would not exceed 1.0 anywhere in the pool.

3.2 Evaluation of Boron Dilution Events

The time to dilute the spent fuel pool depends on the initial volume of the pool and the postulated rate of dilution. The potential spent fuel pool dilution events that could occur are evaluated below.

3.2.1 Dilution from CVCS Holdup Tanks

Dilution water from a CVCS holdup tank can be transferred via the recirculation pump to the spent fuel pool directly. The flow path to the spent fuel pool is isolated through a normally closed valve. The tanks are also kept isolated as a source to the pump through normally closed valves until the water is needed to be moved. This connection is a designated source of makeup water in a loss of spent fuel pool inventory event. This is also a designated source of normal makeup to the spent fuel pool. Each of the three CVCS holdup tanks has a total volume of approximately 61,000 gallons. The water in the tanks has a variable boron concentration which could be as low as 0 ppm. Any amount of boron in the CVCS holdup tank water would increase the required dilution volume from transfer of CVCS holdup tank water to the spent fuel pool. To dilute the spent fuel pool volume from 2,100 ppm to 664 ppm requires 303,725 gallons of unborated water. The combined contents of three CVCS holdup tanks (approximately 183,000 gallons) is less than the total required dilution volume. The recirculation pump is rated to flow at 500 gpm. If transfer of the CVCS holdup tanks were initiated and left unattended, it would take approximately 199 minutes to increase the spent fuel pool level from the low to high alarm setpoint and 10 hours to provide the 303,725 gallons required to dilute the pool from 2,100 ppm to 664 ppm, assuming 0 ppm boron in the tanks and an unlimited supply in the tanks. Note that the low level alarm for the Primary Auxiliary Building operator is 13% level in the tanks. In addition, the B holdup tank is administratively maintained with sufficient boron at 3.5 weight percent to support a plant cooldown. The boron in the this tank would further reduce the total volume of dilution water that can be supplied to the spent fuel pool.

The CVCS recirculation pump can take suction from any of three CVCS holdup tanks. Administrative procedures specify that the pump is aligned to one holdup tank at a time. Manual valve manipulations are required to switch the pump suction to another tank. Thus, it is assumed for the purposes of this evaluation that only the contents of one CVCS holdup tank are available for a spent fuel pool dilution event. The 61,000 gallons of water contained in one CVCS holdup tank is less than the 303,725 gallons necessary to dilute the spent fuel pool from 2,100 ppm to 664 ppm. There is no automatic makeup to the CVCS holdup tanks.

3.2.2 Dilution From Reactor Makeup Water Storage Tank

The contents of the Reactor Makeup Water Storage (RMUW) tank cannot be transferred via the RMUW pumps directly to the spent fuel but it can be indirectly transferred via either units' boric acid blender. It could also be transferred to the spent fuel pool via the purification loop through the demineralizer flush line, though this is not in a plant approved procedure and would require the mis-positioning of manual valves.

The RMUW system consists of a single water storage tank and two pumps for both operating units. RMUW can be supplied to the spent fuel pool cooling system from the tank and pumps through either units' boric acid blender. This is an approved makeup method for both normal pool makeup and loss of inventory events. The RMUW tank contains approximately 96,150 gallons of de-ionized water. Because 303,725 gallons of water is required to dilute the spent fuel pool from 2,100 ppm to 664 ppm, the tank does not have sufficient inventory to dilute the spent fuel pool.

In addition, only one of the two RMUW pumps is kept available at any time. The other pump is maintained in a pullout condition. The RMUW pumps are not in constant operation, but start only on command from the control room.

The design flow rate of a reactor makeup water pump is 270 gpm. The flow is limited by a flow control valve to 120 gpm. If makeup to the spent fuel pool were started and then left unattended (and the tank had an unlimited supply), the pool would rise from the low level alarm to the high level alarm in 829 minutes. For the given flow rate it would take 42 hours to supply the required 303,725 gallons. There is no automatic makeup to the RMUW tank.

3.2.3 Dilution from the Demineralized (DI) Water System

DI water is supplied and administratively controlled from the water treatment plant in the turbine building of the plant. The DI system can makeup directly to the spent fuel pool through a 2 inch connection to the purification loop return line. The demineralized water system is rated to supply water at 400 gpm, though actual available supply rate is about 200 gpm. Use of DI water to makeup to the spent fuel pool is controlled by procedure. At the specified flow rate, it would take 249 minutes to increase the spent fuel pool to the high level alarm and 12 hours to add the required dilution volume of 303,725 gallons.

3.2.4 Dilution from Fire Protection System

The fire protection system draws raw water directly from the lake. In order to have firewater makeup to the spent fuel pool, a hose station would need to be unrolled and a nozzle positioned to the spent fuel pool and constantly attended. The nearest fire hoses are the Unit 1 and 2 fan rooms or from the 46 foot of the PAB. The fire protection system is estimated to be capable of supplying about 100 gpm at the nozzle. The only reason fire water would be used is in the case of an emergency. At the given flow rate it would take 994 minutes to raise the water level to the high alarm and 50 hours to provide the necessary 303,725 gallons of dilution.

3.2.5 Dilution from the Monitor Tanks

The monitor tanks consist of four tanks, each 10,000 gallons. The tanks may contain unborated water or borated water awaiting discharge. These tanks and their associated pumps are the source of water used during demineralizer flushing of the spent fuel pool. Demineralizer flushing and recharge are administratively controlled so that the demineralizer is isolated from the spent fuel pool during recharge. In addition, only one monitor tank is allowed to be used at a time. Even if the all four tanks were aligned, the dilution source is less than that required to dilute the spent fuel pool.

The rated flow of the monitor tank pump is 60 gpm. At this flowrate (assuming an unlimited supply) it would take 1,657 minutes to raise the level from the low level alarm to the high level alarm. It would take 84 hours to supply the total dilution volume.

3.2.6 Review of Operating Experience

1. LER 369-94005, McGuire, 7/10/1994, The spent fuel pool boron concentration was diluted below the technical specification limit. This when the transfer canal was being pumped to the spent fuel pool in preparation for maintenance. A DI misting system was placed in service during the draindown to limit airborne activity. The DI water mixing with the transfer canal water diluted the water as it was pumped to the spent fuel pool. The spent fuel pool was 50 ppm below technical specification limit. Boron was added to restore the spent fuel pool to above the technical specification limit.

Point Beach does not have a similar misting system installed. If decontamination of the transfer canal walls is necessary prior to maintenance, a flow totalizer is used to track how much water is added to the transfer canal. Prior to pumping water from the holdup tank back to the spent fuel pool, the hold up tank must be analyzed to ensure the boron concentration is not below the technical specification limit. When draining the canal water is first pumped to the spent fuel pool and then to the holdup tanks by procedure.

2. LER 289-980204, Three Mile Island, 2/4/1998, Operators failed to notify chemistry to sample the spent fuel pool after adding makeup water. This was a repeat occurrence. The spent fuel pool boron concentration was not diluted below the technical specification minimum.

By procedure the spent fuel pool boron concentration must be verified to be greater than 2,500 ppm prior to filling. The total fill volume is limited to 12 inches of level and must be re-verified prior to additional filling using DI water or RMUW.

3.3 Summary of Dilution Events

The five available water sources for spent fuel pool dilution are RMUW, DI water, CVCS holdup tanks, monitor tanks and fire protection. Fire protection is the least likely source since it would only be used as a measure of last resort in a loss of inventory accident and because the makeup hose is not located in the vicinity of the spent fuel pool. The monitor tanks are the next least likely source since they are only used for demineralizer flushing and not for normal or emergency makeup. The RMUW tank is the next least likely source since there is not a direct makeup path to the spent fuel pool. It may be used but is not the preferred source because of the required valve lineup. The CVCS holdup tank source is the second most likely, but they are normally borated to some degree. The volume of all three tanks is less than that required to dilute the spent fuel pool from 2,100 ppm to 664 ppm. The DI water source is the most likely source because it has a direct connection and an unlimited supply from the water treatment plant. It is also the preferred makeup source for the spent fuel pool.

Flow rates from the DI water system supply pump vary depending on plant mode and other plant demands. The maximum flow the DI water system can supply is 400 gpm with two pumps running. Typically only one pump and demineralizer are in service, limiting the maximum design output to 200 gpm. The actual flow rate would be less given the length of the piping run and pipe size. Even at the maximum flow rate, it takes 249 minutes to fill the spent fuel pool to the high level alarm assuming the pool level was initially at the low level alarm. If the transfer canal were full, as is the normal case, the high level alarm would alert the control room much sooner. Assuming that the high level alarm were to fail, the pool would overflow, spilling onto the refueling floor, resulting in water filling the PAB sump. If the flow exceeds the capacity of the drains, it would flow out over the refueling deck and into other parts of the building. All water would eventually end up in the waste holdup tank. The waste holdup tank volume is 23,960 gallons with a high alarm at 63% (variable) of tank level and a high-high alarm at 85% tank level. Thus, the waste holdup tank would act as a secondary backup to the spent fuel pool high level alarm. By procedure, the operator must inform the water treatment operator prior to filling the spent fuel pool. Continued makeup to the spent fuel pool should be noticed by the water treatment operator. In addition, it would take 12 hours to reach the required dilution volume and routine operator rounds of the area would identify the overflow of the spent fuel pool.

Failure of the DI pipe in the area would result in the same flow rate as that assumed for normal make-up. Although the initiation of the dilution would not be known, plant operators are still performing rounds of the area and the same instrumentation is available to alert the operators to a high level.

Furthermore, for any dilution scenario to successfully add 303,725 gallons of water to the spent fuel pool, plant operators would have to fail to question or investigate the continuous makeup of water to the spent fuel pool for the required time period, and fail to recognize that the need for extended water supply to the spent fuel pool was unusual.

4.0 CONCLUSIONS

A boron dilution analysis has been completed for the spent fuel pool. As a result of this spent fuel pool boron dilution analysis, it is concluded that there is sufficient time to detect and mitigate an unplanned or inadvertent event which would result in the dilution of the spent fuel pool boron concentration from 2,100 ppm to 664 ppm. This conclusion is based on the following:

The preferred method of normal makeup to the spent fuel pool is DI water from the water treatment plant. Use of this source requires verification of the spent fuel pool concentration prior to filling and limits the amount that may be filled. Additional filling requires re-verification of the spent fuel pool boron concentration.

If an inadvertent dilution were to be initiated, administrative procedures are in place to address a high level alarm in the spent fuel pool. Borated water from the RWST is available via the refueling water circulation pump. Borated water is also available from the BAST via the boric acid blender of either unit to the purification loop of the spent fuel cooling system.

In order to dilute the spent fuel pool to k_{eff} 0.95, a substantial amount of water (303,725 gallons) is needed. To provide this volume, an operator would have to initiate the dilution flow, then abandon monitoring of the pool level, and ignore administrative procedures, and a high level alarm for a period of at least 12 hours. The required dilution volume of 303,725 gallon exceeds the volume of all unborated water sources in the plant used for normal makeup with the exception of the DI water system.

The technical specification surveillance requirement interval for boron concentration is once every seven days. This frequency remains appropriate since normal makeup to the spent fuel pool is administratively controlled to ensure the spent fuel pool remains above its technical specification (and administrative) limit.

For the volume of water required, a spent fuel pool dilution event would be detected by plant personnel via alarms, flooding in the primary auxiliary building or by operator rounds through the spent fuel pool area.

It should be noted that this boron dilution evaluation was conducted by determining the time and water volumes required to dilute the spent fuel pool from 2,100 ppm to 664 ppm. The 664 ppm endpoint was used to ensure that k_{eff} for the spent fuel racks would remain less than or equal to 0.95. As part of the criticality analysis for the spent fuel racks, a calculation has been performed to show that the spent fuel rack k_{eff} remains less than 1.0 with non-borated water in the pool. Even if the spent fuel pool were diluted to zero ppm, which would take significantly more than the volume determined above, the spent fuel pool would remain subcritical and the health and safety of the public would be assured.