August 27, 2009

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10 CFR 50.90

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

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

Response to Request for Additional Information
License Amendment Request 247
Spent Fuel Pool Storage Criticality Control

References
(1) FPL Energy Point Beach Letter to NRC, License Amendment Request 247, Transmittal of Changes to Technical Specifications re: Spent Fuel Pool Storage Criticality Control, dated July 24, 2008 (ML082240685)
(2) FPL Energy Point Beach Letter to NRC, Supplement to License Amendment Request Number 247, Spent Fuel Pool Storage Criticality Control, dated September 19, 2008 (ML082630114)
(3) FPL Energy Point Beach Letter to NRC, Response to Request for Additional Information, License Amendment Request 247, Spent Fuel Pool Storage Criticality Control, dated April 14, 2009 (ML091050499)
(4) NRC letter to FPL Energy Point Beach, Point Beach Nuclear Plant, Units 1 and 2 - Request for Additional Information from Reactor Systems Branch Related to License Amendment Request No. 247 Spent Fuel Pool Storage Criticality Control, dated April 22, 2009 (ML090900617)
(5) NextEra Energy Point Beach Letter to NRC, Response to Request for Additional Information, License Amendment Request 247, Spent Fuel Pool Storage Criticality Control, dated May 22, 2009 (ML091420436)
(6) NRC letter to NextEra Energy Point Beach, Point Beach Nuclear Plant, Units 1 and 2 - Request for Additional Information from Reactor Systems Branch Related to License Amendment Request No. 247 Spent Fuel Pool Storage Criticality Control - Round 2, dated July 9, 2009 (ML091770550)
(7) NextEra Energy Point Beach Letter to NRC, Response to Request for Additional Information, License Amendment Request, 247, Spent Fuel Pool Storage Criticality Control, dated August 7, 2009 (ML092220273)

NextEra Energy Point Beach, LLC (NextEra), (formerly known as FPL Energy Point Beach, LLC) submitted a proposed license amendment request for Commission review and approval pursuant to 10 CFR 50.90 for Point Beach Nuclear Plant (PBNP), Units 1 and 2 (Reference 1). The proposed amendment revises the 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. NextEra provided a supplemental response (Reference 2) containing additional quantitative information to support the fidelity of key methodology aspects described in Reference (1).

NextEra committed to provide a response by August 28, 2009, to Question 4a) from Reference (2). The enclosure of this letter provides the NextEra response as committed in Reference (7).

This letter contains no new commitments and no revisions to existing commitments.

In accordance with 10 CFR 50.91, a copy of this letter is being provided to the designated Wisconsin Official.

I declare under penalty of perjury that the foregoing and enclosed information is true and correct. Executed on August 27, 2009.

Very truly yours,

NextEra Energy Point Beach, LLC

Larry Meyer
Site Vice President

Enclosures

cc: Administrator, Region III, USNRC
Project Manager, Point Beach Nuclear Plant, USNRC
Resident Inspector, Point Beach Nuclear Plant, USNRC
PSCW

ENCLOSURE

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

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
LICENSE AMENDMENT REQUEST 247
SPENT FUEL POOL STORAGE CRITICALITY CONTROL

The following information is provided by NextEra Energy Point Beach, LLC (NextEra) in response to the NRC staff's request for additional information (RAI) dated July 9, 2009, and as committed to in the NextEra response dated August 7, 2009 (Reference 7) to support continued review of Point Beach Nuclear Plant (PBNP) License Amendment Request 247.

Regarding licensee letter dated, September 19, 2008:

Regarding Question 4

a) *Please provide a quantitative justification to demonstrate that power suppression assemblies do not result in a more reactive assembly.*

NextEra Response

In response to Question 4 from the acceptance review of WCAP-16541-P, Revision 2, (Reference 1 of this enclosure) a qualitative justification for neglecting the presence of peripheral power suppression assemblies (PPSA) was provided. These assemblies are located in the 12 peripheral assembly locations face adjacent to the baffle. Each assembly contains 16 fingers; one inserted into each guide tube. The fingers are spider mounted. They insert from the top of the assembly, and suspend a four foot long hafnium rod at and below the core midplane. The rods are suspended by Zircaloy tubes which pass through the upper portion of the assembly. These assemblies are used to reduce fluence to the reactor pressure vessel in order to prevent embrittlement. The use of these assemblies has been discontinued in Unit 1 and is likely to be discontinued in the future in Unit 2.

From a criticality safety perspective, the concern posed by PPSAs is the potential for increased reactivity at assembly discharge caused by water displacement or other spectral hardening mechanisms present during depletion. Hafnium is mostly a resonance absorber, so little direct spectral hardening is created by its presence; but the water displacement effect of PPSAs may be significant. PPSAs are only used in fuel assemblies that have experienced at least two prior cycles of operation and are located in peripheral locations. The relative power in these locations is very low. The presence of a neutron absorber in the lower portion of the assembly forces power into the upper portion of the assembly, thereby reducing reactivity through increased burnup at the top end of the assembly. Competing effects of spectral hardening and a flattened burnup profile occur during the last 5 – 15 GWd/MTU of assembly depletion. The overall impact of the PPSAs is small, and the discharged reactivity will still be below the design basis assumptions presented in WCAP-16541-P, Revision 2. This was confirmed in the quantitative analysis described below.

The first step in providing the quantitative justification is a review of burnup profiles for fuel assemblies containing PPSAs for the last several cycles of PBNP Unit 2 operation. The Unit 2 profiles are applicable and representative of both units because the PPSAs have been used with the same strategies in both units. Six unique burnup profiles from assemblies containing PPSAs in Unit 2 Cycles 27 – 29 are presented in Figure 1.

Examination of Unit 2 burnup shapes in the context of PPSAs yields two potentially limiting profiles; Cycle 27 Shape 2 (C27 S2) and Cycle 28 Shape 1 (C28 S1). The C27 S2 profile is selected because it has the lowest relative burnup at the top of the assembly and is expected to have the most limiting, or highest, end effect reactivity of these assemblies. The C28 S1 profile is selected because it exhibits the largest local relative burnup suppression from PPSA use. Both fuel assemblies were discharged after four cycles of operation. The C27 S2 assembly contained a PPSA for its final cycle of operation and was discharged with a burnup of 56,553 MWd/MTU. The C28 S1 assembly contained a PPSA for its last two cycles of operation and was discharged with a burnup of 48,632 MWd/MTU. The PPSA exposure for this assembly bounds others in the population.

For this study, the selected axial burnup profiles are collapsed into a 9-zone model suitable for depletion calculations. The top and bottom 18 inches are each represented with three 6-inch nodes to explicitly capture the blankets and burnup gradient near the fuel assembly ends. The middle section of the fuel is broken into three nodes to isolate the hafnium absorber portion of the PPSA. Axial burnup profiles are generated based on core simulator models for both of the selected assemblies. A profile is generated for each assembly, without the PPSA and with the PPSA inserted. For example, the C27 S2 shape is depleted without the PPSA through 50,972 MWd/MTU and with the PPSA present for the remaining 5,581 MWd/MTU to reach the discharge burnup of 56,553 MWd/MTU. These relative burnup profiles, along with the nodalization and axial moderator temperature profile, are presented in Table 1. The moderator temperatures used are node average temperatures for the same inlet and outlet temperatures used in WCAP-16541-P, Revision 2. The actual moderator temperatures used in this study are different from those reported in Table 3-2 of WCAP-16541-P, Revision 2, because of the change in nodalization. The depletion calculations are performed at an absolute power level of 1806 MWt, consistent with WCAP-16541-P, Revision 2. Using the higher temperature and power levels in this analysis bounds operation at current and previous power levels and temperature profiles, as discussed in Section 3.3 of WCAP-16541-P, Revision 2.

The modeling of the fuel assemblies containing PPSAs in this analysis differed in some ways from the generic assumptions made in WCAP-16541-P, Revision 2. These differences are outlined here and are discussed in more detail below.

WCAP-16541-P, Revision 2 Modeling Assumptions	Modeling Assumptions Used in this Analysis
Blankets not explicitly modeled (solid, uniformly enriched fuel modeled)	Blankets (annular pellets and reduced enrichment) explicitly modeled
Bounding theoretical density modeled	Conservatively large, but not bounding theoretical density modeled. (Additional uncertainty calculated and included in biases and uncertainties)
Bounding Standard fuel pellet outer diameter modeled	Nominal Standard fuel pellet outer diameter modeled. (Additional uncertainty calculated and included in biases and uncertainties)
Constant bounding soluble boron concentration modeled during depletion	Variable bounding soluble boron concentration modeled during depletion
8-zone axial nodalization	9-zone axial nodalization
Bounding enrichment uncertainties	Some enrichment specific uncertainties

Both assemblies selected for this analysis (C27 S2 and C28 S1) contain six inch 2.6 w/o ^{235}U annular blankets at both ends. These blankets are explicitly modeled in the depleted fuel for this analysis. Explicit blanket modeling was not used in WCAP-16541-P, Revision 2. The fresh fuel used for determining additional uncertainties maintains the conservatism of neglecting the presence of reduced enrichment blankets.

The theoretical density is assumed to be 96.5%. Conservatively small volume reductions for pellet dishing and chamfering are also considered. The 96.5% theoretical density is the manufacturing process maximum. Pellet density at PBNP is less than this value. An additional uncertainty is applied for the impact of an assumed 1.0% combined dishing and chamfering effect. Nominally, the as-built dishing and chamfering volume reduction is 1.2%. Additional margin remains because only 1.0% is credited in this analysis. The non-blanketed central region of the fuel is assumed to have an enrichment of 5.0 w/o ^{235}U.

The pellet diameter for standard fuel is modeled in this analysis at the manufacturing drawing value. The tolerance effects are considered as discussed below rather than using the bounding pellet diameter used in WCAP-16541-P, Revision 2. The final modeling continues to be a conservative representation of the as-built assemblies used at PBNP.

For this study, the boron concentration assumed during depletion was also modified from the depletion calculations performed for WCAP-16541-P, Revision 2. A variable boron concentration was utilized as opposed to the constant cycle average value of 800 ppm assumed in WCAP-16541-P, Revision 2. Based on a review of previous cycles of PBNP Unit 2 operation, a conservative model (one with a higher average boron concentration) was generated with a constant boron concentration of 1275 ppm for the first 4000 MWd/MTU of cycle depletion, followed by a linear decrease to 10 ppm at end of cycle. The actual boron concentrations used in the depletion calculations vary slightly for each axial zone based on the exact burnup steps used. The average boron concentration in each zone is more than 770 ppm. The maximum cycle average boron concentration from recent cycles is approximately 768 ppm. A plot showing an example of the boron concentration assumed for one zone of the PPSA analysis is provided in Figure 2.

The PARAGON lattice code (Reference 2 of this enclosure) is used to perform the depletion calculations for this response. A base case depletion using the same conditions and the 8-zone axial burnup profile from WCAP-16541-P, Revision 2, is performed to allow reactivity comparisons on an equal basis for these PPSA calculations. The reactivity determinations for depleted fuel conditions are made using Version 5.1 of the SCALE code for both base and PPSA cases. Justification for the use of PARAGON and SCALE Version 5.1 was provided in the response to the question regarding code validation in Reference 3 of this enclosure.

The additional uncertainty calculations necessary to accommodate PPSA modeling, as discussed in this study, were performed using SCALE-PC Version 4.4a. This code version is used to ensure consistency with the other uncertainty calculations documented in WCAP-16541-P, Revision 2. To avoid the mixing of different code versions, SCALE Version 5.1 is not used to determine these additional uncertainties.

The first of the additional tolerance and uncertainty effects considered for this study involves variations in the percentage of theoretical density introduced by crediting 1.0% dishing and chamfering of the pellet. The second effect is the uncertainty in pellet diameter caused by modeling the nominal value instead of the bounding diameter as was used in WCAP-16541-P, Revision 2. The pellet diameter tolerance is provided in Section 3.4 of WCAP-16541-P, Revision 2. The uncertainty calculations are performed using SCALE-PC Version 4.4a. This version is used to be consistent with the other uncertainty calculations performed in WCAP-16541-P, Revision 2. SCALE Version 5.1 is not used in the determination of these additional uncertainties to avoid mixing of different code versions. Quantification of the two uncertainties for the "1-out-of-4 5.0 w/o Fresh with no IFBA" storage configuration are presented in Table 2. The results of the calculations show that the pellet diameter uncertainty does not cause a statistically significant increase in reactivity and could be neglected, but it is retained for additional conservatism.

For this study, enrichment-specific effects on reactivity of tolerance or uncertainties in fuel enrichment are also determined for the "1-out-of-4 5.0 w/o configuration using SCALE-PC Version 4.4a." This is a more realistic calculation than the bounding uncertainties presented in WCAP-16541-P, Revision 2. The enrichment uncertainty in Table 3-5 of WCAP-16541-P, Revision 2, is calculated by increasing the enrichment of the three low reactivity assemblies from 1.33 w/o to 1.38 w/o. Considering the maximum allowable fresh enrichment of the low reactivity assemblies, in addition to the 5.0 w/o fresh assembly in the 1-out-of-4 5.0 w/o configuration, bounds the effect of the enrichment uncertainty and is a conservative calculation for the WCAP-16541-P, Revision 2 analysis. However, fuel having an initial enrichment this low would not be capable of producing the level of burnup, or the corresponding axial shapes considered, and would not accommodate PPSAs during a third or fourth operating cycle. When considering PPSAs, the maximum fresh enrichment is modeled, consistent with the levels of initial enrichment required to achieve these burnups (i.e., the 48,632 MWd/MTU of shape C28 S1 or the 56,553 MWd/MTU of shape C27 S2).

The PPSA assemblies used in this study are modeled as having an initial enrichment of 5.0 w/o, for the "1-out-of-4 5.0 w/o Fresh with no IFBA" storage configuration. A new enrichment uncertainty calculated for this case showing the impact of an initial enrichment increase in all four assemblies from 5.0 w/o to 5.05 w/o. The enrichment uncertainty was also recalculated with the three low reactivity assemblies having an initial enrichment of 4.0 w/o, and therefore being increased to 4.05 w/o for the tolerance case. The fresh assembly in this case increased from 5.0 to 5.05 w/o. The results of the enrichment specific uncertainties at both 4.0 and 5.0 w/o ^{235}U for the 1-out-of-4 5.0 w/o configuration are presented in Table 3.

The cumulative reactivity tolerance effects applicable to PPSAs for the 1-out-of-4 5.0 w/o configuration, and a comparison with results from WCAP-16541-P, Revision 2, Table 3-5 is at the bottom of Table 4. The margin identified is lower for the case of the low reactivity assemblies having an initial enrichment of 5.0 w/o, this margin will be carried forward below. If an enrichment specific uncertainty is not determined, the impact of the pellet diameter and theoretical density uncertainties on the overall sum of biases and uncertainties is modest.

Reactivity effects related to uncertainties in the pellet stack density and pellet diameter are also calculated for the "1-out-of-4 4.0 w/o Fresh with IFBA" configuration. Enrichment specific uncertainties are not calculated for this configuration. These reactivity effects have also been calculated in SCALE-PC Version 4.4a to maintain consistency with the results from WCAP-16541-P, Revision 2. The results of these uncertainty calculations are in Table 5, and a new uncertainties rack-up is provided in Table 6. Variations in the fuel pellet diameter have been evaluated considering both positive and negative dimensional changes, with no statistically significant reactivity increase observed. This effect is entered as zero in Table 6. The small reactivity penalty associated with these additional uncertainty effects is shown at the bottom of Table 6, and is incorporated in the results of the depletion calculations discussed below.

The depletion calculations are performed using the input parameters discussed above. Each assembly is depleted from fresh conditions to the end of the last cycle before PPSA insertion with the burnup profile from the end of that cycle. The node-average temperatures present during depletion are presented in Table 1. The fuel assemblies are then depleted for one or two cycles, as appropriate, using the profile appropriate for the inserted PPSA. These profiles, as discussed above, are presented in Table 1. The assembly average burnup range over which each profile is used is also presented in Table 1. The discharged assembly isotopic number densities are then used in SCALE Version 5.1 calculations for both the "1-out-of-4 5.0 w/o Fresh with no IFBA" and "1-out-of-4 4.0 w/o Fresh with IFBA" storage configurations. The latter configuration uses a 4.0 w/o fresh assembly with no IFBA for these calculations.

The "All-Cell" storage configuration is not considered in these calculations because the minimum discharge burnup for fuel assemblies that have experienced depletion with PPSAs is more than 35,000 MWd/MTU. The burnup requirements for storage in the "All-Cell" configuration range up to 27,349 MWd/MTU. The minimum burnup margin between the two conditions is therefore in excess of 7000 MWd/MTU, which is worth approximately 3.5% Δk_{eff}. This large margin offsets any potential reactivity effect caused by PPSA use. The results of these calculations, as well as the re-analyzed SCALE Version 5.1 reference case performed consistent with WCAP-16541-P, Revision 2, conditions and assumptions are presented in Table 7. Reactivity margin is identified in all configurations for both fuel assemblies. The reactivity margin determined above (i.e., the minimum value from Table 4) for the "1-out-of-4 5.0 w/o Fresh with no IFBA" storage configuration, considering updated uncertainty calculations, is shown in the table and is included in the final margin identified. The reactivity penalty for the "1-out-of-4 4.0 w/o Fresh with IFBA" storage configuration quantified for the PPSA application, based on additional uncertainty analyses documented here, is also included in the table and in the final results.

Based on these results the presence of peripheral power suppression assemblies (PPSAs) does not result in a more reactive assembly than the design basis assumptions of WCAP-16541-P, Revision 2. No modification of burnup, enrichment or post-irradiation cooling time criteria is required to accommodate PPSA exposure in any of the proposed PBNP spent fuel pool assembly storage arrays.

Table 1 - Axial Burnup and Moderator Temperature Profiles

Zone	Height (in)	Cycle 28 Shape 1		Cycle 27 Shape 2		Moderator Temp (°F)
		Relative BU, No PPSA	Relative BU, PPSA	Relative BU, No PPSA	Relative BU, PPSA	
9	6	0.460	0.549	0.423	0.540	613.8
8	6	0.742	0.844	0.760	0.917	610.8
7	6	0.907	1.019	0.924	1.085	607.8
6	42	1.069	1.215	1.082	1.210	595.7
5	48	1.089	0.875	1.087	0.850	573.1
4	18	1.121	1.204	1.117	1.197	556.5
3	6	1.006	1.052	1.001	1.109	550.4
2	6	0.833	0.868	0.831	0.942	547.4
1	6	0.494	0.552	0.444	0.543	544.4
Max. Assy. Avg. BU		39661	48632	50972	56553	

Table 2 - Additional Uncertainty Calculations for the "1-out-of-4 5.0 w/o Fresh with no IFBA" Storage Configuration, Calculated with SCALE-PC Version 4.4a

Case	k_{eff}	σ	Δk_{eff}
Fuel 96.5% Theoretical Density	0.97215	0.00020	
Fuel with 1% Dishing and Chamfering	0.97126	0.00022	0.00131
Nominal Fuel Pellet Diameter	0.97363	0.00022	
Increased Fuel Pellet Diameter	0.97364	0.00022	0.00045

Table 3 - Enrichment-Specific Enrichment Uncertainty Calculations for the "1-out-of-4 5.0 w/o Fresh with no IFBA" Storage Configuration, Calculated with SCALE-PC Version 4.4a

Case	k_{eff}	σ	Δk_{eff}
All Assemblies 5.0 w/o	1.16720	0.00017	
All Assemblies 5.05 w/o	1.16932	0.00019	0.00248
Low Reactivity Assemblies 4.0 w/o	1.15604	0.00019	
All Assemblies +0.05 w/o	1.15781	0.00018	0.00214

Table 4 - Uncertainty Rack-ups for the "1-out-of-4 5.0 w/o Fresh with no IFBA" Storage Configuration, Calculated with SCALE-PC Version 4.4a

Uncertainty	Δk_{eff}		
	WCAP Table 3-5	5 w/o	4 w/o
Fuel Enrichment	0.00434	0.00248	0.00214
Clad Diameter and Thickness	0.00197	0.00197	0.00197
Storage Cell Pitch	0.00103	0.00103	0.00103
Rack Thickness	0.00105	0.00105	0.00105
Off-Center Positioning	0.00174	0.00174	0.00174
Burnup	0.00527	0.00527	0.00527
Methodology	0.00642	0.00642	0.00642
Theoretical Density	0	0.00131	0.00131
Low Reactivity Assembly Fuel Pellet Diameter	0	0.00045	0.00045
Statistical Sum of Uncertainties	0.00984	0.00928	0.00920
Incremental Margin		0.00056	0.00065

Table 5 - Additional Uncertainty Calculations for the "1-out-of-4 4.0 w/o Fresh with IFBA" Storage Configuration, Calculated with SCALE-PC Version 4.4a

Case	k_{eff}	σ	Δk_{eff}
Fuel 96.5% Theoretical Density	0.97120	0.00019	
Fuel with 1% Dishing and Chamfering	0.96943	0.00020	0.00216
Nominal Fuel Pellet Diameter	0.97234	0.00019	
Increased Fuel Pellet Diameter	0.97223	0.00019	negative
Decreased Fuel Pellet Diameter	0.97206	0.00020	negative

Table 6 - Uncertainty Rack-up for the "1-out-of-4 4.0 w/o Fresh with IFBA" Storage Configuration, Calculated with SCALE-PC Version 4.4a

Case	Δk_{eff}
Fuel Enrichment	0.00549
High Reactivity Assembly (OFA) Fuel Pellet Diameter	0.00125
Clad Diameter and Thickness	0.00198
Storage Cell Pitch	0.00146
Rack Thickness	0.00201
Off-Center Positioning	0.00420
Burnup	0.00589
Methodology	0.00644
Theoretical Density	0.00216
Low Reactivity Assembly (STD) Fuel Pellet Diameter	0
Statistical Sum of Uncertainties	0.01184
WCAP-16541-P, Rev. 2 Table 3-6	0.01165
Margin Lost	0.00019

Table 7 - Depletion Calculation Results

Burnup (MWd/MTU)	Base Case		Cycle 28 Shape 1		Cycle 27 Shape 2	
	k_{eff}	σ	k_{eff}	σ	k_{eff}	σ
1-out-of-4 5 w/o Fresh with No IFBA						
48632	0.98243	0.00042	0.98208	0.00022		
56553	0.96539	0.00042			0.96480	0.00022
Delta (Base Case – PPSA Shape)			0.00035		0.00059	
Uncertainty Margin from Table 4			0.00056		0.00056	
Final Margin Demonstrated			0.00091		0.00115	
1-out-of-4 4 w/o Fresh with IFBA						
48632	0.95821	0.00036	0.95660	0.00020		
56553	0.94138	0.00042			0.93725	0.00020
Delta (Base Case – PPSA Shape)			0.00161		0.00413	
Uncertainty Penalty from Table 6			0.00019		0.00019	
Final Margin Demonstrated			0.00142		0.00394	

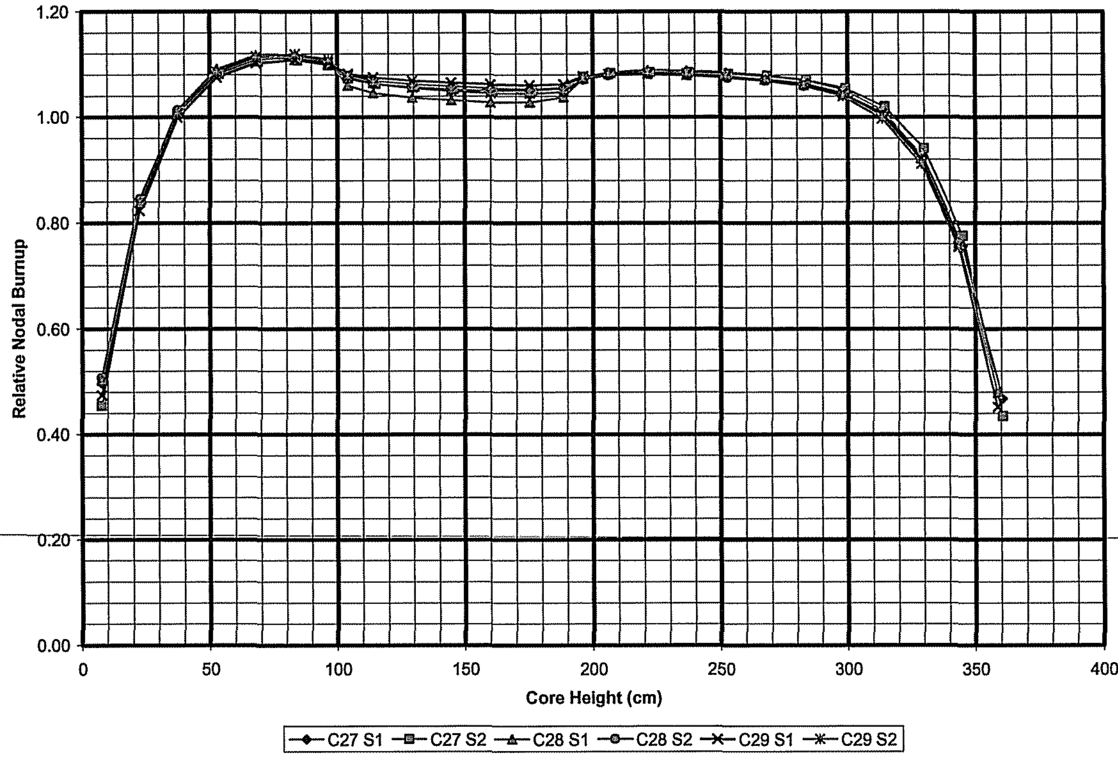

Figure 1 - Axial Burnup Profiles for Fuel Assemblies Containing PPSAs

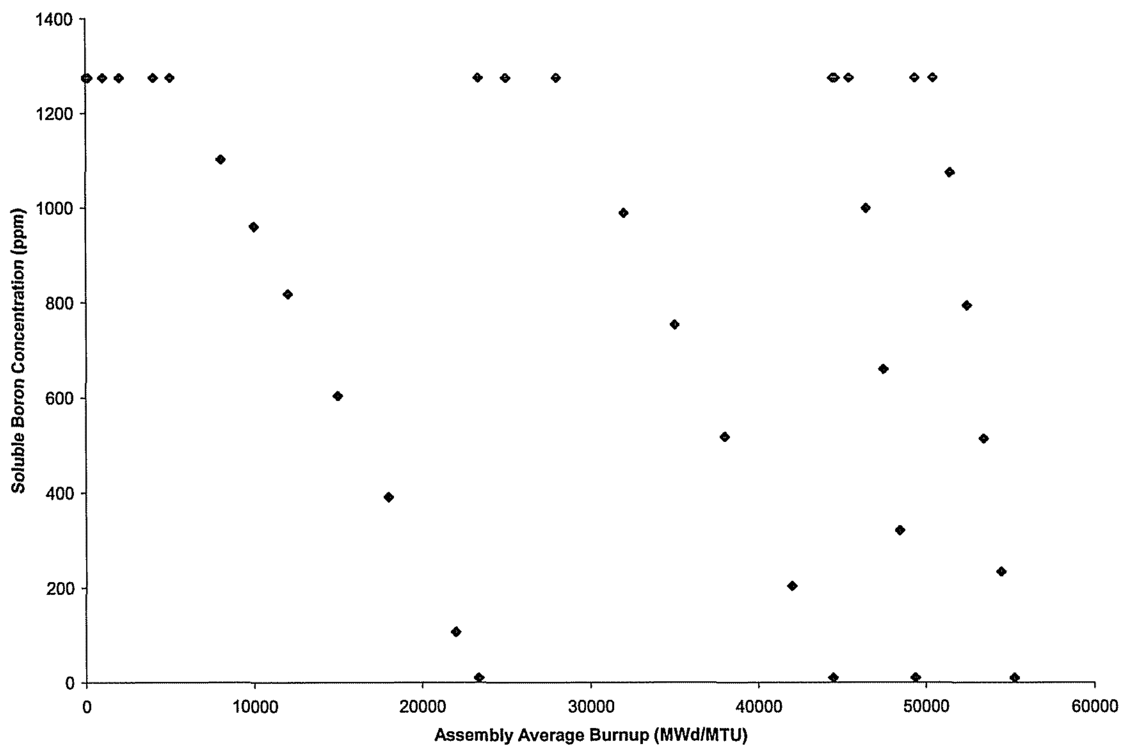

Figure 2 - Example Variable Boron Concentration for One Depletion Case

References

1. NextEra Letter to USNRC, Supplement to License Amendment Request Number 247, Spent Fuel Pool Storage Criticality Control, dated September 19, 2008 (ML082630114)
2. Letter from H. N. Berkow (NRC) to J.A. Gresham (Westinghouse), Final Safety Evaluation for the Westinghouse Topical Report WCAP-16045-P, Revision 0, Qualification of the Two-Dimensional Transport Code PARAGON, dated March 18, 2004 (ML040780402)
3. Next Era Letter to USNRC, Response to Request for Additional Information License Amendment Request 247, Spent Fuel Pool Storage Criticality Control, dated August 7, 2009 (ML092220273).