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October 6, 2016

10 CFR 50.90

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- References:
1. Arizona Public Service Company (APS) letter number 102-07149, *License Amendment Request to Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis*, dated November 25, 2015, [Agencywide Documents Access and Management System (ADAMS) Accession Number ML15336A251]
 2. NRC document *Palo Verde 1, 2, and 3 – Official RAIs from SNPB for LAR that Requested Revision of TSs to Incorporate Updated Criticality Safety Analysis*, dated July 14, 2016 (ADAMS Accession Number ML16197A006)

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528, 50-529, and 50-530
Response to Request for Additional Information Regarding License
Amendment Request to Revise Technical Specifications to
Incorporate Updated Criticality Safety Analysis**

In Reference 1, Arizona Public Service Company (APS) submitted a license amendment request (LAR) to revise the PVNGS Technical Specifications (TS) for Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3. The proposed amendment would modify TS requirements to incorporate the results of an updated criticality safety analysis for both new and spent fuel storage. In Reference 2, the NRC staff requested additional information to support the review of the LAR.

The enclosure to this letter provides the APS response to the NRC staff request for additional information. A number of the RAIs involve information from Westinghouse Electric Company LLC. Attachment 2 of the enclosure is the non-proprietary version of the Westinghouse responses to specific NRC RAIs. Attachment 3 of the enclosure is the proprietary version of the Westinghouse responses to specific NRC RAIs.

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Attachment 1 of the enclosure is the Westinghouse affidavit signed by Westinghouse Electric Company LLC that sets forth the basis on which the proprietary information in Attachment 3 of the enclosure may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in 10 CFR 2.390(b)(4).

Correspondence with respect to the proprietary aspects of Attachment 3 of the enclosure or the supporting Westinghouse affidavit should reference Westinghouse letter number CAW-16-4474 and be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 3 Suite 310, Cranberry Township, Pennsylvania 16066.

In addition, APS has identified a new topic area that is addressed in the enclosure regarding spent fuel pool criticality. Due to recent operating experience at PVNGS, cell blocking devices that extend into the active fuel region are proposed. These in-cell blocking devices remove the potential for interferences with fuel assembly movement in adjacent cells. This topic area is described in greater detail as RAI-12 of the enclosure.

The APS responses do not affect the conclusion of the no significant hazards consideration determination [10 CFR 50.91(a)] provided in the original LAR.

This submittal does contain new regulatory commitments as defined by NEI 99-04, *Guidelines for Managing NRC Commitment Changes*, Revision 0. The new commitments are identified in the relevant RAI responses, RAI-1 and RAI-4. Specifically, the APS response to RAI-1, subpart g, states:

APS commits to incorporate fuel reconstitution limitations described in the APS response to the NRC staff Nuclear Performance and Code Review Branch (SNPB) RAI-1, into PVNGS procedures prior to reconstituting fuel, following implementation of the criticality license amendment.

The APS response to RAI-4 states, in part:

APS commits to ensure future cycles, starting after implementation of the criticality license amendment, are bounded by the operating parameters assumed in the WCAP-18030-P criticality analyses and to incorporate the limitations into PVNGS procedures. Specifically, to provide confidence that future cycles are bounded by the fuel design parameters assumed in WCAP-18030-P, APS procedures will include verifications against the criteria described in Section 4.4, *Final Depletion Analysis*, of WCAP-18030-P, which includes Table 4-7.

The original target date for this response was extended to October 7, 2016, based upon communications with the PVNGS NRC Project Manager, Mr. Siva Lingam, on September 7, 2016. The need to extend the date for the response was due to an emergent Westinghouse issue that impacted available resources.

By copy of this letter, this response is being forwarded to the Arizona Radiation Regulatory Agency in accordance with 10 CFR 50.91(b)(1).

102-07342-MLL/TNW

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Response to Request for Additional Information Regarding License Amendment Request to

Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis

Page 3

Should you have any questions concerning the content of this letter, please contact Michael D. Dilorenzo, Licensing Section Leader, at (623) 393-3495.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: October 6, 2016
(Date)

Sincerely,



MLL/TNW/CJS/af

Enclosure: Response to Request for Additional Information Regarding License
Amendment Request to Revise Technical Specifications to Incorporate
Updated Criticality Safety Analysis – Nuclear Performance and Code Review
Branch (SNPB)

cc:	K. M. Kennedy	NRC Region IV Regional Administrator
	S. P. Lingam	NRC NRR Project Manager for PVNGS
	M. M. Watford	NRC NRR Project Manager
	C. A. Peabody	NRC Senior Resident Inspector for PVNGS
	T. Morales	Arizona Radiation Regulatory Agency (ARRA)

Enclosure

**Response to Request for Additional Information Regarding License
Amendment Request to Revise Technical Specifications to
Incorporate Updated Criticality Safety Analysis– Nuclear Performance
and Code Review Branch (SNPB)**

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis– Nuclear
Performance and Code Review Branch (SNPB)

Table of Contents

Enclosure – Response to Request for Additional Information Regarding License Amendment
Request to Revise Technical Specifications to Incorporate Updated Criticality
Safety Analysis– Nuclear Performance and Code Review Branch (SNPB)

Attachment 1 – Westinghouse *Application for Withholding Proprietary Information
from Public Disclosure*, CAW-16-4474, September 22, 2016

Attachment 2 – Westinghouse Electric Company Responses to RAIs Non-Proprietary
Version

Attachment 3 – Westinghouse Electric Company Responses to RAIs Proprietary
Version

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis– Nuclear
Performance and Code Review Branch (SNPB)

Introduction

By letter dated November 25, 2015 [Agencywide Documents Access and Management System (ADAMS) Accession No. ML15336A087] (Reference 1), as supplemented by letters dated January 29 (Reference 2) and June 30, 2016 (Reference 3) (ADAMS Accession Nos. ML16043A361 and ML16182A519, respectively), Arizona Public Service Company (APS) submitted a license amendment request (LAR) to amend Facility Operating License Nos. NPF-41, NPF-51, and NPF-74, and revise the Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3, Technical Specifications (TSs). The LAR proposes to install NETCO-SNAP-IN[®] neutron absorbing rack inserts into some spent fuel pool (SFP) storage rack cells coupled with six classifications of fuel (i.e., regions) by initial enrichment, burnup, and decay time in six storage configurations (i.e., arrays) for criticality control. Approval of the license amendment will establish the new licensing basis for how APS meets the effective neutron multiplication factor ($k_{\text{effective}}$ or k_{eff}) criticality control requirements.

The U.S. Nuclear Regulatory Commission (NRC) Nuclear Performance and Code Review Branch (SNPB) provided official requests for additional information (RAIs) by Reference 4. Each of the NRC staff information requests of Reference 4 are provided first, followed by the APS response to each request. A number of the RAIs involve information from Westinghouse Electric Company LLC. The Westinghouse response elements for the RAIs are provided in Attachments 2 and 3 of this enclosure, and are referenced, as appropriate, in the relevant APS RAI responses.

In addition, APS has identified a new topic area that is addressed in this enclosure regarding spent fuel pool criticality. Due to recent operating experience at PVNGS, cell blocking devices that extend into the active fuel region are proposed. These in-cell blocking devices remove the potential for interferences with fuel assembly movement in adjacent cells. This topic area is described in greater detail as new RAI-12 of this enclosure.

Attachment 1 of this enclosure is the Westinghouse affidavit signed by Westinghouse Electric Company LLC that sets forth the basis on which the proprietary information in Attachment 3 of this enclosure may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in 10 CFR 2.390(b)(4). Attachment 2 of this enclosure is the non-proprietary version of the Westinghouse responses to specific NRC RAIs. Attachment 3 of this enclosure is the proprietary version of the Westinghouse responses to specific NRC RAIs.

APS plans to submit the revised Westinghouse report WCAP-18030-P/NP, *Criticality Safety Analysis for Palo Verde Nuclear Generating Station Units 1, 2, and 3*, including the affidavit, along with TS and TS Bases revisions, by the current target date of November 11, 2016, as discussed with the PVNGS NRC Project Manager, Mr. Siva Lingam, on September 7, 2016.

SNPB RAI-1

WCAP-18030-P, Revision 0, "Criticality Safety Analysis for Palo Verde Nuclear Generating Station Units 1, 2, and 3 (Proprietary)," dated September 2015, fuel assembly reconstitution as normal condition is described as follows, "Fuel assembly reconstitution is defined as either pulling damaged fuel rods [pins] out of an assembly and reinserting intact rods with less reactivity than the damaged rod, or as removing undamaged rods from a damaged assembly for insertion in a new assembly. In most cases damaged rods will be

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis– Nuclear
Performance and Code Review Branch (SNPB)

replaced with stainless steel rods. Natural uranium rods may also be used. Additional information is provided in Section 5.4.2 of WCAP-18030-P." Please provide a full description of the fuel assembly reconstitution process, which includes at least the following:

- a. The description initially seems to be saying that damaged fuel pins could be replaced with fuel pins from another assembly, but then states that damaged fuel pins would only be replaced with either stainless steel or natural uranium pins. Provide clarification.
- b. If the intention is to allow damaged fuel pins to be replaced with intact fuel pins with less reactivity from another assembly, provide the methodology that will be used to identify the replacement fuel pins. Please clarify what will replace the intact fuel pins being moved.
- c. Please clarify where in the SFP does the fuel assembly reconstitution activity take place.
- d. What is the maximum number of fuel pins that can be missing for a given reconstituted assembly at one time? Please justify any limitation or lack thereof.
- e. Please clarify whether or not there is any limitation on the number of pins in any fuel assembly that are not part of its initial construction. Please justify any limitation or lack thereof.
- f. In WCAP-18030 Section 5.4.2 it states, "If a fuel assembly has a rod removed and the lattice location is left empty, that fuel assembly shall be treated as fresh fuel until the location is filled or analysis is performed demonstrating that the fuel assembly is bounded by the design basis assembly at the same burnup and initial enrichment levels." Please provide the methodology that will be used to perform the analysis. Please provide the analysis that demonstrates it is acceptable to store fuel with missing fuel pins as fresh. Please justify any limitations or lack thereof.
- g. Please provide a licensing commitment to incorporate requirements, resulting from reconstitution limitations, into the licensee's procedures.

APS Response:

SNPB RAI-1, Subpart a:

The NRC has approved the use of inert stainless steel rods (pins) as replacements for the failed fuel pins with the restrictions identified in Reference 5. The currently NRC approved methodology (Reference 5) for replacement of failed fuel pins by inert stainless steel rods prohibits stainless steel replacement rods from being inserted in specific locations within the fuel assembly (i.e., next to guide tubes, on the assembly periphery, adjacent to other inert stainless steel rods). If a failed fuel pin is located in a position which has not been approved for replacement with an inert stainless steel rod, the failed fuel pin can be replaced or 'swapped' with an intact fuel pin based on specific limitations associated with the initial uranium enrichment, depletion, and burnable absorber loading from the same or a different fuel assembly. An inert stainless steel rod can then be placed in the original location of the 'swapped' intact fuel pin so that the replacement restrictions established in Reference 5 are satisfied. Natural uranium pin may be used for fuel storage.

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis– Nuclear
Performance and Code Review Branch (SNPB)

SNPB RAI-1, Subpart b:

The PVNGS currently approved methodology for replacing damaged fuel pins does not allow stainless steel rods in all locations. When a fuel pin is damaged in a location where stainless steel rods are disallowed, a fuel pin 'swap' must be performed. For example, in order to avoid placing an inert stainless steel replacement rod in a prohibited location, for example, on the assembly periphery, a failed fuel pin located there would be replaced with an intact fuel pin of identical mechanical design, with specific limitations for initial enrichment, burnup, and initial burnable absorber loading from the interior. The inert stainless steel rod would be placed in the vacant interior location. Such fuel pin 'swap' guidelines have been used in fuel assembly reconstitutions as a means of complying with the NRC approved inert placement guidelines. These guidelines do not specifically require that the replacement intact fuel pins from another assembly be less reactive. The resulting reconstituted assembly will be stored consistent with the methodology described in the response to SNPB RAI-1, Subpart e, or Subpart f.

Additionally, fuel pin 'swaps' have been performed in the past as part of fuel cladding demonstrations, where individual fuel pins were burned in multiple cycles in different assemblies to achieve a high burnup.

In cases where the reconstituted fuel assembly was returned to the core, stainless steel rods were inserted such that the fuel assembly would contain 236 pins. In some cases, such as the cladding demonstrations where it was known the fuel assembly would not be returned to the core, those pin positions were left vacant. Fuel assemblies with less than 236 pins will be stored in Region 1, consistent with the methodology described in SNPB RAI-1, Subpart f. Fuel assemblies that have non-original pins, but contain 236 pins will be stored consistent with the methodology described in SNPB RAI-1, Subpart e.

SNPB RAI-1, Subpart c:

Fuel reconstitution activities are restricted to Region 1. Region 1 is defined as any combination of Array A and Array B from Figure 5-1 of WCAP-18030. The response to SNPB RAI-1, Subpart f, provides more specific information with regard to fuel reconstitution activities and analyses.

SNPB RAI-1, Subpart d:

There is no limitation to the number of fuel pin locations that are permitted to be empty. The response to SNPB RAI-1, Subpart f, describes the methodology that will be used to demonstrate that it is acceptable to store fuel assemblies in Region 1. This methodology is applicable for any number of missing pins.

No storage restrictions will be applied to fuel assemblies with less than or equal to 10 pins as the small amount of fissile material in these assemblies provides adequate sub-criticality safety margin. There are currently six grid cages in the PVNGS spent fuel pools that contain less than or equal to four pins. Four of these are grid cages contain no special nuclear material (SNM), one grid cage has one-half of a pin and one grid cage has four pins. The fuel pins were transferred to new, empty assembly grid cages, so the pins could be reused or to the rod storage basket. In one case four pins could not be removed so they remain in their initial location. In another case a fuel pin broke while it was being removed.

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis- Nuclear
Performance and Code Review Branch (SNPB)

Approximately half of the fuel pin is in the fuel assembly; the balance of the fuel pin is stored in the fuel rod storage basket in the spent fuel pool.

SNPB RAI-1, Subpart e:

The design basis described in Section 4.3 of WCAP-18030 is representative of no specific fuel at PVNGS but, rather, bounds the actual and currently anticipated fuels. Because of the bounding nature of the proposed design basis, assembly pin 'swaps' can be performed without resulting in a new fuel design that is more reactive than the design basis assembly.

As described in Section 4.2.5 of WCAP-18030, a number of radial enrichment zoning patterns were analyzed as a function of burnup. The largest observed reactivity increase, due to radial enrichment zoning, was found to be 52 pcm. This was conservatively increased to a 100 pcm bias, and applied to all arrays as a bias. This conservative treatment provided confidence that other zoning patterns will be bounded by the 100 pcm bias.

To ensure that fuel assemblies with non-original fuel pins remain bounded by the design basis fuel assembly, they will be treated as described in Section 5.4.2 of WCAP-18030, which required the following two, parallel criteria:

1. The fuel assembly enrichment will be assumed to be the higher of the inserted fuel pin or reconstituted fuel assembly's initial enrichment; and
2. The fuel assembly burnup will be assumed to be the lower of the reconstituted fuel pin or reconstituted fuel assembly's burnup.

SNPB RAI-1, Subpart f:

Fuel reconstitution is an infrequently performed procedure. In this process the fuel assembly is placed on a spacer that is up to 22 inches tall, which elevates the fuel assembly. The fuel assembly is then partially disassembled to allow fuel pins to be removed and/or replaced. In a re-cage activity, all 236 pins are removed from one grid cage and placed in a different grid cage. During this re-cage process both assembly cages will be on a spacer.

Fuel reconstitution is not a storage configuration. Performance of this maintenance activity is restricted to Region 1 of the spent fuel pool. Assurance of conformance to the requirements of 10CFR 50.68 is provided by performing this activity in Region 1, elevating the fuel assembly on a spacer, and restrictions on any other activity in the pool. An analysis, therefore, will not be performed for the large number of permutation of pin arrangements that may exist during a reconstitution campaign. An assessment will be performed of the fuel assembly or fuel assemblies involved prior to placing the fuel in a storage condition to ensure that the resulting assemblies meet each of the assumptions of WCAP-18030-P, including, but not limited to, the fuel design assumption, the radial enrichment bias, and the treatment of fuel stored in Region 1 with less than 236 pins.

Some inspection activities are performed on individual fuel pins. These activities include movement of a single fuel pin from a fuel assembly or the rod storage basket to an inspection location and interfaces with inspection equipment. Movement and inspection of an individual fuel pin is a normal condition as described in WCAP-18030, Section 5.4.2, and does not result in a new or different storage configuration and does not require additional analysis. These inspection activities are limited to Region 1.

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis– Nuclear
Performance and Code Review Branch (SNPB)

The non-proprietary version of the response to SNPB RAI-1, Subpart f, is provided in Attachment 2 of this enclosure and the proprietary version is provided in Attachment 3 of this enclosure. Attachment 1 provides the basis for the elements of the response to be withheld from public disclosure pursuant to the criteria of 10 CFR 2.390.

SNPB RAI-1, Subpart g:

APS commits to incorporate fuel reconstitution limitations described in the APS response to the NRC staff Nuclear Performance and Code Review Branch (SNPB) RAI-1, into PVNGS procedures prior to reconstituting fuel, following implementation of the criticality license amendment.

SNPB RAI-2

The burnup requirement coefficients given in WCAP-18030, Revision 0, Tables 6-2, 6-4, 6-6, and 6-8 are derived, by a curve fitting procedure, using the results from a series of depletion calculations that correspond to a specific average fuel assembly burnup and fuel enrichment. Please provide the burnup values used to define the burnup requirement coefficients given in WCAP-18030, Revision 0, Tables 6-2, 6-4, 6-6, and 6-8 so that the validity of the coefficients can be confirmed.

APS Response:

The non-proprietary version of the response to SNPB RAI-2 is provided in Attachment 2 of this enclosure and the proprietary version is provided in Attachment 3 of this enclosure. Attachment 1 provides the basis for the elements of the response to be withheld from public disclosure pursuant to the criteria of 10 CFR 2.390.

SNPB RAI-3

What isotopes were used in the nuclear criticality safety analysis? Please justify the use of any short lived or volatile isotopes.

APS Response:

The non-proprietary version of the response to SNPB RAI-3 is provided in Attachment 2 of this enclosure and the proprietary version is provided in Attachment 3 of this enclosure. Attachment 1 provides the basis for the elements of the response to be withheld from public disclosure pursuant to the criteria of 10 CFR 2.390.

SNPB RAI-4

Please describe how the licensee will ensure future cycles are bounded by the reactor operating parameters assumed in WCAP-18030-P. Please provide a commitment to incorporate that process into the licensee's procedures.

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis– Nuclear
Performance and Code Review Branch (SNPB)

APS Response:

PVNGS typically operates at hot full power, however, plant and market conditions may require operation at a lower power for limited periods. To ensure that future cycle fuel assemblies remain bounded by the reactor operating parameters in WCAP-18030-P, a cycle specific check of the 'as-burned' reactor operating parameters will be performed against the values in the *Depletion Analysis* column of Table 4-7, *Parameters Used in Depletion Analysis*, prior to core offload.

Rodded operation is another important assumption described in WCAP-18030-P, Section 5.7. To ensure that future cycle fuel assemblies remain bounded by this assumption, a check will be performed at the end of the operating cycle to ensure that less than 100 MWD/MTU of burnup was accrued with rods inserted deeper than 20 cm into the core at hot full power. In practice, rods cannot be inserted exactly 20 cm because each control rod step is 0.75 inches. So, rod insertion deeper than 7.5 inches (142.5 inches or 19.05 cm withdrawn) at hot full power will count toward the 100 MWD/MTU indicator.

If a fuel assembly experiences more than 100 MWD/MTU of operation with rods deeper than 142.5 inches withdrawn at hot full power, the burnup accumulated during rodded operation will not be credited when determining the fuel assembly burnup used in determining the fuel assembly storage requirements pursuant to the proposed TS 3.7.17.

This rodded operation check will not be performed for fuel assemblies currently in the spent fuel pool. Previous spent fuel pool criticality analyses did not have a requirement to monitor rodded operation, so this specific fuel assembly operational history information has not been retained in a quality record. The axial shape input used to determine the limiting axial shape includes 17 cycles of historical plant data and six hypothetical cycles, one of which was executed with all rods inserted 3 steps into the core (147.75 inches withdrawn). Additional bounding attributes of the design basis assembly include limiting flow, temperature, power, and physical design attributes provide confidence that the fuel assemblies currently resident in the spent fuel pool are less reactive than the design basis fuel assembly.

APS commits to ensure future cycles, starting after implementation of the criticality license amendment, are bounded by the operating parameters assumed in the WCAP-18030-P criticality analyses and to incorporate the limitations into PVNGS procedures. Specifically, to provide confidence that future cycles are bounded by the fuel design parameters assumed in WCAP-18030-P, APS procedures will include verifications against the criteria described in Section 4.4, *Final Depletion Analysis*, of WCAP-18030-P, which includes Table 4-7.

SNPB RAI-5

WCAP-18030-P Section 5.4.1 states, "The SFP as a single system is over moderated. A single fuel assembly however, is significantly under-moderated, and reducing the interstitial [heatup] H/U ratio has a negative impact on the system k_{eff} ." With respect to these statements, please provide the following:

Response to Request for Additional Information Regarding License Amendment Request to Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis- Nuclear Performance and Code Review Branch (SNPB)

- a. The results of the SFP temperature bias sensitivity study mentioned in WCAP-18030-P Section 5.2.3.1.8 so that it can be confirmed that all proposed storage arrays for PVNGS are over moderated.
 - i. If one or more proposed storage arrays for PVNGS are not over moderated adjust the analysis accordingly or justify not making any adjustments.
- b. If the second sentence in the above quote is accurate, then several aspects of the analysis are potentially non-conservative.
 - i. Justify the assumptions and/or modeling simplifications that artificially reduce the interstitial H/U ratio.
 - ii. Justify bias and uncertainty determinations that only consider aspects that reduce the interstitial H/U ratio.

APS Response:

The non-proprietary version of the response to SNPB RAI-5 is provided in Attachment 2 of this enclosure and the proprietary version is provided in Attachment 3 of this enclosure. Attachment 1 provides the basis for the elements of the response to be withheld from public disclosure pursuant to the criteria of 10 CFR 2.390.

SNPB RAI-6

WCAP-18030-P Section 5.4.1 also states, "It has been shown in WCAP-16541-NP, "Point Beach Units 1 and 2 Spent Fuel Pool Criticality Safety Analysis" (Reference 13) that even storage of fuel pins in [guide tubes] GTs has a negative reactivity impact. Similar calculations have been performed for Palo Verde previously which resulted in the same conclusion as the Point Beach study. These studies demonstrate that individual fuel assembly lattices are significantly under moderated in the SFP environment and further reducing the H/U ratio will decrease reactivity." With respect to these statements:

- a. Please provide the calculations that were performed for PVNGS.
- b. Point Beach uses a [Westinghouse Electric Company LLC] WEC 14x14 fuel design whereas Palo Verde uses a [Combustion Engineering] CE 16x16 fuel design. Please provide justification as to why Point Beach a valid precedent for Palo Verde?
- c. Please clarify whether or not storage of fuel pins in instrument tubes is being requested as part of this LAR.
- d. The Point Beach WCAP-16541 was not a bounding analysis for all fuel pins stored in Point Beach's WEC 14x14 guide tubes. Please describe any limitations on storing fuel pins in PVNGS's CE 16x16 guide tubes and the justification for those limitations.

APS Response:

The non-proprietary version of the response to SNPB RAI-6 is provided in Attachment 2 of this enclosure and the proprietary version is provided in Attachment 3 of this enclosure. Attachment 1 provides the basis for the elements of the response to be withheld from public disclosure pursuant to the criteria of 10 CFR 2.390.

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis– Nuclear
Performance and Code Review Branch (SNPB)

SNPB RAI-7

In Section 5.5 of WCAP-18030-P, it is not clear how k-effective for the soluble boron cases was calculated. The limiting accident isn't necessarily the one with the largest reactivity increase, but rather the one which requires the most soluble boron to offset the reactivity increase. A storage array with a lower soluble boron worth could take more soluble boron to offset the reactivity increase, even with a smaller reactivity increase. Please demonstrate that the array configuration selected in determining the minimum soluble boron requirements corresponds to the limiting configuration.

- a. The values in Note 2 of Table 5-12 and Section 5.2.3.1.9 do not agree. Please provide clarification on this apparent discrepancy.

APS Response:

The non-proprietary version of the response to SNPB RAI-7 is provided in Attachment 2 of this enclosure and the proprietary version is provided in Attachment 3 of this enclosure. Attachment 1 provides the basis for the elements of the response to be withheld from public disclosure pursuant to the criteria of 10 CFR 2.390.

SNPB RAI-8

Section 5.2.3.2 of WCAP-18030-P makes reference to a study that Westinghouse performed to support its treatment of biases and uncertainties. Please provide the study or reference where the study has previously been submitted to the NRC.

APS Response:

The non-proprietary version of the response to SNPB RAI-8 is provided in Attachment 2 of this enclosure and the proprietary version is provided in Attachment 3 of this enclosure. Attachment 1 provides the basis for the elements of the response to be withheld from public disclosure pursuant to the criteria of 10 CFR 2.390.

SNPB RAI-9

The uncertainty in the SCALE 6.1.2 validation was performed on the uncertainty of the mean instead of the uncertainty of the population, which is inconsistent with NUREG/CR-6698, "Guide for Validation of Nuclear Criticality Safety Calculated Methodology," as referenced. Please revise the SCALE 6.1.2 validation to include the uncertainty of the population.

- a. Please provide Tables A-3, A-4, A-5, A-6, and A-7 in spreadsheet format so that the NRC can perform confirmatory analysis.

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis- Nuclear
Performance and Code Review Branch (SNPB)

APS Response:

The non-proprietary version of the response to SNPB RAI-9 is provided in Attachment 2 of this enclosure and the proprietary version is provided in Attachment 3 of this enclosure. Attachment 1 provides the basis for the elements of the response to be withheld from public disclosure pursuant to the criteria of 10 CFR 2.390.

SNPB RAI-10

Do the fuel assembly grids expand over the course of their utilization in the reactor? If they do expand, how does this affect the nuclear criticality safety analysis for the SFP?

APS Response:

Grid growth is a phenomenon involving the grid material, the manufacturing technique used in the fabrication process, and core conditions, such as temperature and neutron flux. Attachments 2 and 3 of the enclosure provide a description of the reactivity impact of grid growth and the conservatism of the approach. Arrays crediting burnup have each been revised to include an explicit grid growth bias. Additional supporting information justifying the approach outlined in this RAI response will be provided in WCAP-18030-P, Revision 1.

The non-proprietary version of the response to SNPB RAI-10 is provided in Attachment 2 of this enclosure and the proprietary version is provided in Attachment 3 of this enclosure. Attachment 1 provides the basis for the elements of the response to be withheld from public disclosure pursuant to the criteria of 10 CFR 2.390.

SNPB RAI-11

Section 5.2.3.1.1 of WCAP-18030-P discusses the manufacturing tolerances. The information provided in Figures 5-2 and 5-3 appears to be too limited to support the conclusions drawn from them. With respect to Figures 5-2 and 5-3, please provide the following:

- a. What is the source of the information presented in Figures 5-2 and 5-3? Please justify its applicability for PVNGS.
- b. Please justify the use of the information under full and optimum moderation scenarios for new fuel storage.
- c. Please justify not applying an instrument tube uncertainty.

APS Response:

The non-proprietary version of the response to SNPB RAI-11 is provided in Attachment 2 of this enclosure and the proprietary version is provided in Attachment 3 of this enclosure. Attachment 1 provides the basis for the elements of the response to be withheld from public disclosure pursuant to the criteria of 10 CFR 2.390.

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis– Nuclear
Performance and Code Review Branch (SNPB)

RAI-12

In addition to the RAIs from Reference 4, APS identified a new topic that is addressed in this enclosure regarding spent fuel pool criticality. Due to recent operating experience at PVNGS, cell blocking devices that extend into the active fuel region are proposed. These in-cell blocking devices remove the potential for interferences with fuel assembly movement in adjacent cells. This topic area is described in greater detail in the following APS response.

APS Response:

During fuel movement in the Fall 2015 and Spring 2016 refueling outages fresh fuel assemblies came into contact with cell blocking devices from an adjacent cell, damaging grid straps. The causal investigation identified the blocking device design to be the cause of the events. The current spent fuel pool cell blocking device design is a metal "T" that rests diagonally across the top of the blocked cell. The blocking device spans the top of the rack and does not extend down into the active region of the fuel. Design tolerances allow the tab of blocking devices to extend more than an inch into adjacent cells.

In response to these events a new blocking device design, which was not included in WCAP-18030-P, Revision 0, will be included in WCAP-18030-P, Revision 1. This blocking device will consist of a pipe that is up to 3.55 inches in diameter with a maximum 0.4 inch wall thickness. This pipe will be attached to a support plate which rests on the bottom of the rack and will be capped with a device that is visibly conspicuous from fuel assemblies, will not allow a fuel assembly to be inserted, will permit natural circulation of water and meet the use of blocking device criteria described on page 16 of the Enclosure to Reference 1. The base plate and top plate will be below and above the active fuel region of adjacent fuel assemblies. This new blocking device design is intended to prevent recurrence of the fuel assembly grid strap damage events.

Westinghouse analyzed the proposed blocking device in Array A and Array C. To demonstrate compliance with the requirements of 10 CFR 50.68, the in-cell blocking device was modeled in the centerline of the empty cells of Array A and Array C at the enrichments described in WCAP-18030. Additional cases were run with the centerline of the pipe two inches off center from the centerline of the cells. Since the pipe inner and outer diameters are bounding values, no uncertainty in pipe size is considered. All cases showed a decrease in reactivity. It is acceptable to place a blocking device in Array B without further analysis because the trash can described in WCAP-18030 bounds the blocking device. Additional detail will be provided in WCAP-18030-P, Revision 1.

Response to Request for Additional Information Regarding License Amendment Request to Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis– Nuclear Performance and Code Review Branch (SNPB)

- References:**
1. APS letter number 102-07149, *License Amendment Request to Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis*, dated November 25, 2015, (ADAMS Accession Numbers ML15336A251 and ML15336A087)
 2. APS letter number 102-07181, *Supplemental Information Regarding License Amendment Request to Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis*, dated January 29, 2016 (ADAMS Accession Number ML16043A361)
 3. APS letter number 102-07275, *Response to Request for Additional Information Regarding License Amendment Request to Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis*, dated June 30, 2016 (ADAMS Accession Number ML16182A519)
 4. NRC document *Palo Verde 1, 2, and 3 – Official RAIs from SNPB for LAR that Requested Revision of TSs to Incorporate Updated Criticality Safety Analysis*, dated July 14, 2016 (ADAMS Accession Number ML16197A006)
 5. CE Topical Report CENPD-289-P-A, *Use of Inert Replacement Rods in ABB CENF Fuel Assemblies*, dated July 1999

Enclosure

Response to Request for Additional Information Regarding License Amendment Request to
Revise Technical Specifications to Incorporate Updated Criticality Safety Analysis– Nuclear
Performance and Code Review Branch (SNPB)

ATTACHMENT 1

Westinghouse Application for Withholding Proprietary Information from Public Disclosure

CAW-16-4474, September 22, 2016



Westinghouse Electric Company
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Cranberry Township, Pennsylvania 16066
USA

U.S. Nuclear Regulatory Commission
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Rockville, MD 20852

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CAW-16-4474

September 22, 2016

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: Suggested Responses to the Request for Additional Information on WCAP-18030-P Criticality Safety Analysis for Palo Verde Nuclear Generating Station Units 1, 2, and 3 (Proprietary)

The Application for Withholding Proprietary Information from Public Disclosure is submitted by Westinghouse Electric Company LLC (Westinghouse), pursuant to the provisions of paragraph (b)(1) of Section 2.390 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-16-4474 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The Affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying Affidavit by Arizona Public Service Company.

Correspondence with respect to the proprietary aspects of the Application for Withholding or the Westinghouse Affidavit should reference CAW-16-4474, and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 3 Suite 310, Cranberry Township, Pennsylvania 16066.

A handwritten signature in black ink, appearing to read 'J A Gresham'.

James A. Gresham, Manager
Regulatory Compliance

CAW-16-4474
September 22, 2016

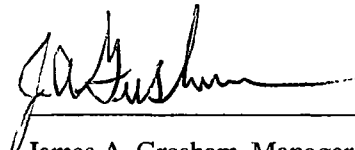
AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

SS

COUNTY OF BUTLER:

I, James A. Gresham, am authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief.


James A. Gresham, Manager
Regulatory Compliance

- (1) I am Manager, Regulatory Compliance, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.
- (2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.
- (3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.
- (4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.
 - (i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.
 - (ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitute Westinghouse policy and provide the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

 - (a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

- (b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.
 - (c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.
 - (d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.
 - (e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.
 - (f) It contains patentable ideas, for which patent protection may be desirable.
- (iii) There are sound policy reasons behind the Westinghouse system which include the following:
- (a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.
 - (b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.
 - (c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

- (d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.
 - (e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.
 - (f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.
- (iv) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, is to be received in confidence by the Commission.
 - (v) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.
 - (vi) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in NF-APS-16-39 P-Attachment, "Suggested Responses to the Request for Additional Information on WCAP-18030-P Criticality Safety Analysis for Palo Verde Nuclear Generating Station Units 1, 2, and 3" (Proprietary), for submittal to the Commission, being transmitted by Arizona Public Service Company letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with the request for approval of WCAP-18030-P, and may be used only for that purpose.
 - (a) This information is part of that which will enable Westinghouse to obtain NRC approval of WCAP-18030-P, "Criticality Safety Analysis for Palo Verde Nuclear Generating Station Units 1, 2, and 3."

- (b) Further, this information has substantial commercial value as follows:
- (i) Westinghouse plans to sell the use of similar information to its customers for the purpose of demonstrating the sub-criticality of the spent fuel pool.
 - (ii) Westinghouse can sell support and defense of industry guidelines and acceptance criteria for plant-specific applications.
 - (iii) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and non-proprietary versions of a document, furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the Affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

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