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

Peach Bottom Atomic Power Station, Units 2 and 3
Renewed Facility Operating License Nos. DPR-44 and DPR-56
NRC Docket Nos. 50-277 and 50-278

Subject: Spent Fuel Pool Criticality Documents

Reference: 1) Letter from D. P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "Spent Fuel Pool Criticality Documents," dated February 9, 2011

In the Reference 1 letter, as requested by the U.S. Nuclear Regulatory Commission Senior Resident Inspector at Peach Bottom Atomic Power Station, Exelon Generation Company, LLC (Exelon) submitted several documents for NRC review. We note that there is no outstanding license amendment request associated with this issue.

In a telephone discussion between Tom Loomis (Exelon) and John Hughey (U.S. Nuclear Regulatory Commission) on February 18, 2011, Mr. Hughey also requested a copy of Operability Evaluation 10-007. Attached is that evaluation.

If any additional information is needed, please contact Tom Loomis at (610) 765-5510.

Respectfully,

D. P. Helker

David P. Helker
Manager, Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Attachment: Operability Evaluation 10-007

cc: USNRC Region I, Regional Administrator
USNRC Senior Resident Inspector, PBAPS
USNRC Project Manager, PBAPS
R. R. Janati, Bureau of Radiation Protection (w/o Attachment)
S. T. Gray, State of Maryland (w/o Attachment)

Attachment

Operability Evaluation 10-007

1.0 ISSUE IDENTIFICATION:

1.1 IR #: 1127773-03

1.2 OpEval #: 10-007 **Revision:** 1

1.3 EC Number: N/A **Revision:** N/A

HU-AA-1212 review:

An HU-AA-1212 review was performed and per OP-PB-108-115-1002, an ITPR and a QRT review is required for the Operability Evaluation.

Revision 1 summary: This revision corrects the value contained in section 2.3 for the rack with the minimum areal density to match the value contained in paragraph 1.8.1. Revision bars also reflect formatting changes. This is considered a minor revision per OP-AA-108-115, paragraph 4.3.2.2 and has no impact on the conclusion of this evaluation.

General Information:

1.4 Affected Station: Peach Bottom Atomic Power Station

1.5 Units: 2 and 3

1.6 Systems: N/A

1.7 Components Affected:
The affected components are the Boraflex panels utilized in the Unit 2 and Unit 3 Spent Fuel Pool (SFP) storage racks.

1.8 Detailed description of what SSC is degraded or the nonconforming condition, by what means and when first discovered, and extent of condition for all similarly affected SSCs:

1.8.1

Purpose:

This Op-eval addresses a non-conservative Technical Specification (4.3.1.1.a) resulting from degrading Boraflex due to some of the fuel rack panels having an average areal density less than the minimum certified 0.021 gm/cm^2 assumed in the spent fuel storage rack criticality analyses for Units 2 and 3. This Op Eval evaluates the acceptability of storing fuel bundles in the Unit 2 and 3 SFP storage racks with a minimum B-10 average areal density of 0.01155 gm/cm^2, which is 55% of 0.021g/cm^2 (45% degradation). This will show that the SFP will be maintained 5% subcritical ($K_{eff} \leq 0.95$). The basis for this approach is to reduce the design basis limiting fuel assembly reactivity to a maximum K_{inf} of 1.26, which is consistent with NF-AA-610, paragraph 4.6.4 (2). This Op Eval will demonstrate that the K_{eff} for each SFP rack cell is maintained subcritical as required by Tech Specs.

Nonconforming Condition:

The current Peach Bottom Units 2 and 3 high-density Spent Fuel Pool (SFP) storage racks were designed and manufactured by Westinghouse Electric Corporation and placed in-service in 1986 (Unit 2) and 1989 (Unit 3) under plant modification # 1140. The high density racks utilize Boraflex as a neutron absorber material for reactivity control. It is used to maintain a 5% subcriticality margin. A Safety Analysis Report (SAR) in support of the upgraded racks and associated Technical Specification changes (Reference 2.5.3.8) was submitted to NRC as part of a License Amendment Request (LAR) in June of 1985 and supplemented in August of 1985 and December of 1985. Section 3.1 of this Safety Analysis Report addressed the criticality control capability of the racks. The LAR was subsequently reviewed and approved by NRC, as documented in license amendments 116 and 120 for Peach Bottom Units 2 and 3, respectively.

The rack Boraflex design and Peach Bottom Licensing Basis ensure that the SFP will remain subcritical with the fuel pool fully loaded with fuel assemblies having a $K_{inf} \leq 1.362$. assuming a uniform Boron-10 (B-10) areal density of 0.021 g/ cm^2, the minimum certified manufactured B-10 density. A reduction in the amount of Boraflex in the spent fuel pool racks will reduce the criticality margin ($K_{eff} \leq 0.95$) such that actions are required to ensure that the Licensing Basis requirements continue to be met.

In June of 1996, the NRC issued Generic Letter 96-04 to address the issue of Boraflex degradation in spent fuel pool storage racks. As documented in NRC Generic letter 96-04, the Electric Power Research Institute (EPRI) identified two issues with respect to using Boraflex in SFP racks. The first issue related to gamma radiation-induced shrinkage of Boraflex and the potential to develop tears or gaps in the material. The second issue concerned long-term Boraflex performance throughout the intended service life of the racks as a result of gamma irradiation and exposure to the wet pool environment. All licensees operating racks containing the Boraflex material were requested to provide an assessment of the physical condition of the Boraflex material and the impact on margin to criticality, as well as proposed actions to monitor ongoing Boraflex degradation.

PECo Nuclear's response to the generic letter for Peach Bottom confirmed minimal Boraflex degradation at that time and substantial margin to the regulatory limit existed based on Peach Bottom 2 Boraflex "blackness testing" calculations performed using the EPRI-developed RACKLIFE computer program, and criticality analyses performed by AEA Technologies. PECo Nuclear also implemented an ongoing Boraflex monitoring program, to include RACKLIFE simulation of the racks and blackness testing using the BADGER B-10 areal density measurement system.

Since 1996 Peach Bottom has continued to monitor the condition of the Boraflex material in the Unit 2 and 3 racks by evaluating the B-10 areal density of each Boraflex panel using the RACKLIFE computer program at six-month intervals. This monitoring program is controlled by station procedure RT-R-004-990-2(3), "Boraflex surveillance using the RACKLIFE program". The RACKLIFE program has been calibrated using empirical B-10 density data derived from a sampling of Boraflex panels. This benchmarking of RACKLIFE is performed at approximately 4-year intervals using the EPRI-developed BADGER system. BADGER testing is controlled by station procedure RT-R-004-995-2(3), "Boraflex surveillance using the BADGER test device".

Peach Bottom UFSAR Section 10.3 4.1.1.2, "Neutron Absorbing Material" specifies that the Boraflex contains a minimum B-10 areal density of 0.021 gm/cm^2. Tech. Spec. 4.3.1.1.a limits fuel assemblies to a maximum K_{inf} (infinite lattice multiplication factor) of 1.362 in the normal reactor core configuration at cold conditions. This limit ensures that the fuel pool will remain 5% subcritical with the SFP fully loaded with fuel assemblies with $K_{inf} = 1.362$ assuming the minimum certified B-10 areal density of 0.021 g/ cm^2. Peach Bottom currently meets the K_{inf} criteria, however, the current design basis analysis for the fuel rack K_{inf} limit was derived using the B-10 'minimum certified' areal density of 0.021 gm/cm^2 or 11.9% less than the as-manufactured average areal density of 0.0235 g/ cm^2. Per industry standard RACKLIFE Boraflex surveillance testing on November 1, 2010, the average B-10 areal density for Unit 2 was 0.0203 g/cm2 and for

Unit 3 was 0.0209 g/cm2. Panels with the greatest degradation have areal densities of 0.0146 g/cm2 (Unit 2) and 0.0180 g/cm2 (Unit 3).

1.8.2

Fuel Racks:
The high density SFP storage racks provide storage at the bottom of the fuel pool for the spent fuel received from the reactor vessel and new fuel for loading to the reactor vessel. The fuel storage racks at the bottom of the pool are covered with water (normally about 23 ft above the stored fuel) for radiation shielding. Sufficient shielding is provided by maintaining a minimum depth of water at all times. The racks are freestanding, full length top entry and are designed to maintain the spent fuel in a space geometry which precludes the possibility of criticality under any conditions. The high density spent fuel storage racks are of the "poison" type, utilizing a neutron absorbing material.

Storage Rack:
The high density spent fuel racks are constructed of stainless steel materials and each rack module is composed of cell assemblies, base plate, and base support assembly.

Cell Assembly:
Each cell assembly is composed of (1) a full-length enclosure constructed of 0.075 inch thick stainless steel, (2) sections of Bisco Boraflex (neutron absorbing material) and (3) wrapper plates constructed of 0.020 inch thick stainless steel.

Cell Enclosure:
The primary functions of the enclosure are to house fuel assemblies, to maintain the necessary separation between assemblies for subcriticality and to provide structural stiffness for the rack module. The inside square dimension of the cell enclosure is 6.070 inches nominal which accommodates either channeled or unchanneled fuel or consolidated fuel assemblies.

Neutron Absorbing Material:
The Bisco Boraflex manufactured by Brand Industrial Services provided the additional neutron absorbing media required above that inherent in the rack structure material. The Boraflex is fabricated to safety-related nuclear criteria of 10CFR50, Appendix B, and it consists of boron carbide particles as neutron absorbers held in place by a nonmetallic binder. Boraflex was manufactured with a minimum specified B10 areal density of 0.021 gm/cm^2. It is a continuous sheet centered on the length of the active fuel. Depending on the location of the cells in a rack module, some cells have the Boraflex on all four sides, some of three sides and some on two sides. Cells with four wrappers are located in the interior of the rack, cells with three wrappers are located on the periphery of the rack, and cells with two (adjacent) wrappers are located at the corners of the rack.

Wrapper Plate:
The wrapper plates are attached to the outside of the cell enclosure by intermediate spot welding along the entire length of the wrapper, forming the encapsulation of the Boraflex. A water tight seal is not provided between the wrappers and enclosures since the Boraflex is compatible with the pool environment.

2.0 <u>EVALUATION</u>:

2.1 Describe the safety function(s) or safety support function(s) of the SSC. As a minimum the following should be addressed, as applicable, in describing the SSC safety or safety support function(s):

The components associated with this evaluation (Fuel Assemblies and Spent Fuel Racks) are classified Safety Related. The SFP Racks house the spent fuel assemblies and prevent unwanted and uncontrolled criticality. The Boraflex panel areal density does not affect the structural integrity of the SFP racks as the integrity of the inner cell walls and wrapper plates are not dependent upon the Boraflex assemblies for support.

-Does the SSC receive/initiate an RPS or ESF actuation signal?

No. The degraded condition does not affect any electrical or control and instrumentation devices. The Boraflex panels are physically captured between the side walls of adjacent cells of the spent fuel pool storage racks in Units 2 and 3. The SFP storage racks, including the Boraflex panels receive no actuation signals.

- **Is the SSC in the main flow path of an ECCS or support system?**

No. The Boraflex panels are not part of or in the main flow path of an ECCS system or ECCS support system.

- **Is the SSC used to:**

- Maintain reactor coolant pressure boundary integrity?

No. The subject Boraflex panels are part of the SFP storage racks. The SFP is not part of the reactor coolant pressure boundary (RCPB), and as such do not maintain the RCPB.

- Shutdown the reactor?

No. The subject Boraflex panels are part of the SFP storage racks. Their purpose is to ensure the spent fuel remains subcritical. Boraflex is not associated with the Control Rods or the Standby Liquid Control System and hence is not used to shutdown the reactor

- Maintain the reactor in a safe shutdown condition?

No. The subject Boraflex panels are part of the SFP storage racks. Their purpose is to ensure the spent fuel remains subcritical. The condition of the SFP storage racks has no impact on maintaining the reactor in a safe shutdown condition.

-Prevent or mitigate the consequences of an accident that could result in offsite exposures comparable to 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11 guidelines, as applicable.

Yes. The SFP racks are designed to maintain $K_{eff} \leq 0.95$ (5% subcriticality) for all normal, off-normal and accident conditions. Additionally, under accident conditions, the spent fuel rack design needs to be of sufficient robustness as to prevent offsite exposures which exceed the 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2) and 10 CFR 100.11 guidelines and regulatory limits.

The following accident scenarios involving criticality were considered in the development of the fuel racks:

- drop of a fuel assembly on top of storage racks
- drop of a fuel assembly between the rack periphery and pool wall

- drop of a fuel assembly through the bottom of the storage racks
- Loss of cooling system (lower moderator density reduces K_{eff})

The existing station procedures and mitigating actions for SFP accident analyses and offsite exposures are unaffected by the degraded Boraflex condition.

- **Does the SSC provide required support (i.e., cooling, lubrication, etc.) to a TS required SSC?**

Yes. Even though the Boraflex panels do not perform a support function like cooling or lubricating, their purpose is to ensure the spent fuel remains subcritical, which can be considered to be a support function.

- **Is the SSC used to provide isolation between safety trains, or between safety and non-safety ties?**

No. The Boraflex panels are not used to provide any isolation between safety trains or between safety and non-safety ties. They exist to maintain the spent fuel pool at subcriticality.

- **Is the SSC required to be operated manually to mitigate a design basis event?**

No. The Boraflex panels cannot be utilized to mitigate a design basis event. They are passive devices that maintain the spent fuel pool at subcriticality.

- **Have all specified safety functions described in TS been included?**

Yes. TS 4.3.1 "Criticality" specifies that the spent fuel pool storage racks are designed for and shall be maintained with:

> Fuel assemblies having a maximum K_{inf} of 1.362 in the normal reactor core configuration at cold conditions; (Using the more realistic limit of K_{in} =1.26 is within this value, and therefore acceptable)
>
> $K_{eff} \leq 0.95$ (5% subcritical) if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 10.3 of the UFSAR;
>
> and a nominal 6.280 inch center to center distance between fuel assemblies placed in the storage racks.

- **Have all safety functions of the SSC required during normal operation and potential accident conditions been included?**

Yes. The subject Boraflex panels have one safety function, to ensure the spent fuel remains 5% subcritical.

- **Is the SSC used to assess conditions for Emergency Action Levels (EALs)?**

No. The subject Boraflex panels are not used to assess the EALs. However, severe degradation could result in abnormal radiation levels necessitating entry into an EAL.

2.2 Describe the following, as applicable:

(a) the effect of the degraded or nonconforming condition on the SSC safety function(s)

The subject Boraflex panels are utilized in the spent fuel pool storage racks to ensure the spent fuel remains 5% subcritical. The original Westinghouse design analysis for the racks (and subsequent derived maximum K_{inf} of 1.362) was based on an assumed nominal areal density of 0.021 grams of B-10 per square centimeter of Boraflex material. Reduction of the areal density of the Boraflex material results in a reduction of SFP shutdown margin. However, since none of the fuel stored in either fuel pool has a K_{inf} of greater than 1.26, the SFP subcritical multiplication factor remains less than the 0.95 specified by Tech spec 4.3.1.1 (b) for each cell and the overall entire fuel pool. Each SFP storage rack cell currently provides margin to $K_{eff} < 0.95$ as required by 10 CFR 50.68(b)(4) assuming that all stored fuel assemblies have a K_{inf} of less than1.26.

(b) any requirements or commitments established for the SSC and any challenges to these

The Peach Bottom rack criticality analysis is based on the 'minimum certified' Boraflex B-10 areal density (0.021 gm/cm^2). The actual average, as fabricated B-10 areal density of all panels manufactured for the PB2 and 3 racks was 0.0235 gm/cm^2, 11.9% higher than the density assumed in the original analysis.

The existing Peach Bottom licensing basis rack criticality analysis is based on a bundle with an in-core K_{inf} of 1.362. The aforementioned technical evaluation identifies the margin associated with the actual, as-loaded peak bundle reactivity (in-core K_{inf} of 1.2344). A large majority of assemblies in the Peach Bottom pools have been depleted well beyond peak reactivity conditions, with in-core, cold, uncontrolled K_{inf} values less than 1.0, providing additional currently unaccounted for margin.

Boraflex is used as a neutron absorber material for reactivity control in SFP storage racks. It is used to maintain a 5% subcriticality margin. As defined in Technical Specification 4.3.1 and UFSAR 10.3.3 all arrangements of fuel in the spent fuel storage racks must be maintained in a subcritical configuration having a $K_{eff} \leq 0.95$ for all conditions. UFSAR Section 10.3 4.1.1.2, "Neutron Absorbing Material" specifies that the Boraflex contains a minimum B-10 areal density of 0.021 gm/cm^2. Per Commitment #T04330 for Boraflex Management Activities per UFSAR appendix Q, the Boraflex management activities provide for aging management of the spent fuel rack neutron poison material. These activities involve monitoring the condition of Boraflex by routinely sampling fuel pool silica levels and periodically performing in-situ measurement of B-10 areal density. The existing Boraflex management activities (ref UFSAR, Appendix Q, paragraph 2.2) are not impacted by this condition.

(c) the circumstances of the degraded/nonconforming condition, including the possible failure mechanism(s)

Use of Boraflex neutron absorber in SFP storage racks exposes the Boraflex to an aqueous environment as well as high intensity gamma radiation. The synergistic effects of gamma radiation and water cause the chemical composition of the polymer matrix of Boraflex to change from polydimethyl siloxane (PDMS) to amorphous silica, which is somewhat soluble in water. As the transferred matrix dissolves, it releases boron carbide and crystalline silica filler materials to the interior of the fuel racks and eventually to the SFP. The released boron carbide particles are larger than the silica particles and tend to settle on the floor of the pool and remain there. The smaller crystalline silica particles settle on the horizontal surfaces of the pool, fuel and other equipment in the pool under stagnant conditions. However, when fuel assemblies are moved and/or when natural circulation flow increases, such as during refueling operations, the crystalline silica can become re-suspended in the pool water causing pool turbidity due to its high reflectance.

In June of 1996 NRC issued Generic Letter 96-04 to address the issue of Boraflex degradation in SFP storage racks. As documented in NRC Generic letter 96-04, the Energy Power Research Institute (EPRI) identified two issues with respect to using BORAFLEX in SFP racks. The first issue related to gamma radiation-induced shrinkage of BORAFLEX and the potential to develop tears or gaps in the material. The second issue concerned long-term BORAFLEX performance throughout the intended service life of the racks as a result of gamma irradiation and exposure to the wet pool environment. All licensees operating racks containing the Boraflex material were requested to provide an assessment of the physical condition of the Boraflex material and the impact on margin to criticality, as well as proposed actions to monitor ongoing Boraflex degradation.

PECo Nuclear's response to the generic letter for Peach Bottom confirmed minimal Boraflex degradation at that time and substantial margin to the regulatory limit of 5% subcritical based on Peach Bottom 2 Boraflex "blackness testing" calculations performed using the EPRI-developed RACKLIFE computer program, and criticality analyses performed by AEA Technologies. PECo Energy also proposed an ongoing Boraflex monitoring program, to include RACKLIFE simulation of the racks and blackness testing using the BADGER B-10 areal density measurement system.

Since 1996 Peach Bottom has continued to monitor the condition of the Boraflex material in the Unit 2 and 3 racks by evaluating the B-10 density of each Boraflex panel using the RACKLIFE computer program at six-month intervals. This monitoring program is controlled by station procedure RT-R-004-990-2(3), "Boraflex surveillance using the RACKLIFE program". The RACKLIFE program has been calibrated using empirical B-10 density data derived from a sampling of Boraflex panels. This benchmarking of RACKLIFE is performed at approximately 4-year intervals using the EPRI-developed BADGER system. BADGER testing is controlled by station procedure RT-R-004-995-2(3), "Boraflex surveillance using the BADGER test device".

A reduction in the amount of Boraflex in the SFP racks will reduce the criticality margin ($K_{eff} \leq 0.95$) such that compensatory and corrective actions are required to ensure that the Technical Specification and UFSAR requirements continue to be met. These mitigating actions are described in detail in Section 3.0 "Action Item List" of this Op-Eval.

d) whether the potential failure is time dependent and whether the condition will continue to degrade and/or will the potential consequences increase

Boraflex panel degradation is time dependent. Degradation increases with time as the panels are continually exposed to radiation fields and water flow.

The rate at which the Boraflex panels degrade is primarily dependent upon the activity of the spent fuel bundles stored adjacent to them. For any particular cell in the spent fuel storage racks the Boraflex degradation is not uniform. The reduction in margin is specific and unique to a rack cell resulting in local reductions in margin. By ensuring margin for each individual cell is maintained, subcriticality for the entire fuel pool is also maintained.

This is because:

- Different fuel types (e.g., GNF-2, GE-14, etc...) have different activity levels.
- For a given fuel type, activity decreases with time.

The potential consequence of the degrading Boraflex, i.e., reducing the criticality margin to a point of exceeding $K_{eff} \leq 0.95$, does not increase as degradation continues, however, the margin will be reduced.

(e) the aggregate effect of the degraded or nonconforming condition in light of other open Op Evals

A review of the current Peach Bottom open Op Evals and issues associated with the impacted SSCs has revealed no aggregate or latent failure affects.

	YES	NO
2.3 Is SSC operability supported? Explain basis (e.g., analysis, test, operating experience, engineering judgment, etc.):	[X]	[ ]

If 2.3 = NO, notify Operations Shift Management **immediately**.
If 2.3 = YES, clearly document the basis for the determination.

An assessment of margin to criticality limits has been performed for the Peach Bottom spent fuel pool storage racks via IR 864431-15, R3. The evaluation is premised on all fuel loaded in the racks having an in-reactor, cold, uncontrolled infinite lattice multiplication factor (K_{inf}) of less than 1.26 at peak reactivity conditions, as evaluated using GNF's NRC approved TGBLA06A lattice physics methodology. The evaluation accounts for actual fuel in storage as well as fuel projected to be stored in the future, and relies principally upon criticality analyses previously reviewed and approved by NRC. Historical analysis results have been validated using more current methods and applied in a conservative manner. The condition of the Boraflex panels in the racks has been and will continue to be determined using the industry standard EPRI RACKLIFE methodology, which uses fuel pool silica in conjunction with the gamma exposure history of each panel. The RACKLIFE model is regularly benchmarked to Boraflex blackness measurements obtained using the EPRI-developed BADGER system. The BADGER system inserts a neutron source and detector on opposite sides of a panel and measures the areal density of the B-10 in the panel by comparing the number of neutrons reaching the detector (count rate) with results obtained from a similarly constructed test standard containing a known areal density of B-10. The underlying Westinghouse and GNF analyses apply NRC approved methods and account for appropriate modeling biases and uncertainties.

This evaluation concludes that Technical Specification 4.3.1.1.b (5% subcriticality requirements) is currently met for all storage cells in both Peach Bottom fuel pools, and will continue to be met at least until such time as individual Boraflex panels contain a minimum B-10 areal density of 0.01155 gm/cm^2. This evaluation is based on a conservative assessment of reactivity as a function of B-10 areal density in the racks. The most significantly degraded panel in either Peach Bottom fuel pool, as evaluated by the RACKLIFE methodology, is currently operating with an areal density of 0.0146 gm/cm^2. To proactively preserve margin, any panel which is determined by RACKLIFE to have an areal density of 0.01155 gm/cm^2 will be administratively removed from service.

Conservatisms with the analysis/Tech-Eval (IR 864431, A15, Rev 3) include the following:

1) As described in the Tech Eval (pg. 8) the Delta-K to B-10 loading relationship is a conservative treatment of the Westinghouse 95/95 uncertainty band. It results in a more conservative relationship (steeper curve) yielding a 0.1177% Delta-K to B-10 loading relationship compared to the original Westinghouse slope of 0.0756%. Therefore, for every 1% B-10 density loss the reactivity (% Delta-K) is approximately doubled. This conservatism is uniformly applied to all B-10 density loss terms.

2) Based on BADGER testing performed in 2001, 2006, & 2010, the areal density measured has been consistently greater than that predicted by RACKLIFE. The lowest measured

areal density of any panel in either fuel pool was 0.0169 gm/cm^2 (U2 panel 2D61North, in 2006) compared to the required 0.01155 gm/cm^2.

3) The Boraflex panels that have been tested in multiple years have not shown an increase in the degradation rate.

4) All fuel assemblies are considered to have a peak K_{inf} of < 1.26; while the maximum peak reactivity for a bundle in either Unit 2 or 3 fuel pool is 1.2344.

5) Typical discharge bundle burnup is beyond the point of peak reactivity. Therefore, the reactivity of bundles stored in the pool is well below their peak.

Given the aforementioned conservatisms and available margin, continued operation of the Peach Bottom spent fuel pool storage racks is acceptable within the constraints designated below:

1. A fuel rack storage location will be administratively removed from service when RACKLIFE indicates the associated Boraflex panel B-10 average areal density does not meet the minimum 0.01155 gm/cm^2.

2. The maximum K_{inf} of any stored fuel is limited to ≤ 1.260

	YES	NO
2.4 Are compensatory measures and/or corrective actions required?	[X]	[ ]

If 2.4 = YES, complete section 3.0 (if NO, N/A section 3.0).

2.5 Reference Documents

2.5.1 Technical Specifications Sections:

2.5.1.1 Section 4.3.1, "Criticality"

2.5.2 UFSAR Section:

2.5.2.1 Chapter 10.3 4.1.1.2, "Neutron Absorbing Material"

2.5.2.2 Appendix Q.2.2, "Boraflex Management Activities (T04330)"

2.5.3 Other:

2.5.3.1 IR 864431-15, "Peach Bottom Boraflex Degradation Technical Evaluation, Revision 3"

2.5.3.2 EC 357424, "LaSalle Unit 2 SFP Criticality Analyses Impact from Boraflex Degradation"

2.5.3.3 EC 366864, "LaSalle Unit 2 SFP Criticality Analyses Impact from Boraflex BADGER Testing"

2.5.3.4 10 CFR 50.68, "Criticality Accident Requirements"

2.5.3.5 NUREG 0800, Chapter 9.1.1, Standard Review Plan, "Criticality Safety of Fresh and Spent Fuel Storage and Handling"

2.5.3.6 NUREG 0800, Chapter 9.1.2, Standard Review Plan, "New and Spent Fuel Storage"

2.5.3.7 10 CFR 50, Appendix A, General Design Criterion (GDC) 61 "Fuel storage and handling and radioactivity control" and GDC 62, "Prevention of Criticality in Fuel Storage and Handling"

2.5.3.8 Peach Bottom Atomic Power Station Units 2 &3 Spent Fuel Storage Capacity Modification Safety Analysis Report, Docket Nos. 50-277 and 50-278, Revision 2, Philadelphia Electric Company, December 1985.

2.5.3.9 WNEP 8542, "Design Report of High Density Spent Fuel Storage Racks for Philadelphia Electric Company, Peach Bottom Atomic Power Station Units 2 & 3"

2.5.3.10 GENE-512-92073, "Peach Bottom Atomic Power Station Spent Fuel Pool Storage K_{inf} Conversion Analysis"

3.0 ACTION ITEM LIST:

Compensatory Measure #1: Develop method for ensuring new fuel design is limited to a maximum K_{inf} of 1.26 for PBAPS Units 2 & 3.

Responsible Dept./Supv.: NF/ Tusar

Action Due: 12/31/10

Action Tracking #: 1127773, A04

Effects of compensatory action: Controls one of the critical parameters (K_{inf} of < 1.26) supporting this op-eval.

Compensatory Measure #2: Revise RT-R-004-990-2/3 (BORAFLEX Surveillance Using The RACKLIFE Program) to include acceptance criteria sufficient to ensure that the minimum B-10 areal density of any in service panel is > 0.01155 gm/cm^2.

Responsible Dept./Supv.: PSOR / Hesse

Action Due: 02/01/2011

Action Tracking #: 1127773, A05

Effects of compensatory action: Controls one of the critical parameters (minimum B-10 areal density of any panel is > 0.01155 gm/cm^2) supporting this Op-eval.

Compensatory Measure #3: Revise RT-R-004-995-2/3 (Boraflex Surveillance Using The BADGER Test Device) to include acceptance criteria sufficient to ensure that the minimum B-10 areal density of any in service panel is > 0.01155 gm/cm^2.

Responsible Dept./Supv.: PSOR/ Hesse

Action Due: 02/01/2011

Action Tracking #: 1127773, A06

Effects of compensatory action: Controls one of the critical parameters (minimum B-10 areal density of any panel is > 0.01155 gm/cm^2) supporting this Op-eval.

Compensatory Measure #4: Develop a procedure to administratively remove any fuel rack storage cell from service which includes a Boraflex panel that does not meet the minimum B-10 areal density of 0.01155 gm/cm^2. This procedure will require a 10 CFR 50.59 review per OP-AA-108-115, paragraph 4.5.18.3.

Responsible Dept./Supv.: PSOR / Hesse

Action Due: 4/01/2011

Action Tracking #: 1127773, A07

Effects of compensatory action: Provides the administrative controls required to ensure fuel pool K_{eff} remains less than or equal to 0.95.

Corrective Action #1: : Submit License Amendment request (LAR) supporting installation of borated rack inserts, supporting criticality analysis, and associated Tech Spec. changes as a permanent repair/solution for Boraflex degradation. LAR to include criteria for when rack inserts are required to be installed.

Responsible Dept./Supv.: NF/Dunlap

Action Due: 11/04/2011

Action Tracking #: 1127773, A08

Basis for timeliness of corrective action: This due date supports the preparation and review of the updated criticality analysis and having a permanent repair in place prior to having a significant number of panels with less than the required Boraflex areal density, based on projected panel degradation rates.

Corrective Action #2: Revise tech specs to limit K_{inf} for new fuel to a maximum of 1.26.

Responsible Dept./Supv.: Regulatory Assurance / Armstrong

Action Due: 11/04/2013

Action Tracking #: 1127773, A09

Basis for timeliness of corrective action: This due date supports the goal of having a permanent repair in place prior having a significant number of panels with less than the required Boraflex areal density, based on projected panel degradation rates. The due date also considers the maximum time for regulatory review.

Corrective Action #3: Develop a procedure and process after CA #1 and CA #2 are completed to repair panels with a B-10 areal density less than the minimum required (0.01155 gm/cm^2) to support the current fuel rack criticality analysis.

Responsible Dept./Supv.: PSOR / Hesse

Action Due: 5/1/2014

Action Tracking #: 1127773, A10

Basis for timeliness of corrective action: This procedure cannot be implemented until after CA's 1 & 2 are complete.

4.0 SIGNATURES:

4.1 Preparers Brian Kleback and Dan Thomas (mentor) 11/03/10

Interfacing Reviews:

Rx. Engineering Steve Hesse, Jeff Holley and Alex Psaros 11/03/10

Reg. Assurance Dave Foss 11/03/10

4.2 Reviewer Mike Hoffman 11/03/10

Corporate Engr. Andy Olson 11/03/10

Nuclear Fuels/ ITPR Rosanne Carmean 11/03/10

QRT Skip Breidenbaugh, Bill Reynolds and Dave Henry 11/03/10

4.3 Sr. Manager Design Eng/Designee Concurrence: M Weidman 11/5/10

4.4 Operations Shift Management Approval: J. Murphy 11/03/10

4.5 Ensure the completed form is forwarded to the OEPM for processing and Action Tracking entry as appropriate.

4.0 Revision 1 SIGNATURES:

4.1 Preparers Dan Thomas 11/05/10

Interfacing Reviews:

Rx. Engineering Alex Psaros 11/05/10

4.2 Reviewer Mike Hoffman 11/05/10

4.3 Sr. Manager Design Eng/Designee Concurrence: M Weidman 11/05/10

4.4 Operations Shift Management Approval: M. Saare 11/05/10

5.0 OPERABILITY EVALUATION CLOSURE:

5.1 Corrective actions are complete, as necessary, and the OpEval is ready for closure

________________________ Date ____________
(OEPM)

5.2 Operations Shift Management Approval ________________________ Date ____________

5.3 Ensure the completed form is forwarded to the OEPM for processing, Action Tracking entry, and cancellation of any open compensatory measures, as appropriate.