February 11, 2002

Mr. L. W. Myers
Senior Vice President
FirstEnergy Nuclear Operating company
Beaver Valley Power Station
Post Office Box 4
Shippingport, PA 15077

SUBJECT: BEAVER VALLEY POWER STATION, UNIT NO. 2 - ISSUANCE OF AMENDMENT RE: CREDIT FOR SOLUBLE BORON IN THE SPENT FUEL POOL (TAC NO. MB1578)

Dear Mr. Myers:

The Commission has issued the enclosed Amendment No. 128 to Facility Operating License No. NPF-73 for the Beaver Valley Power Station, Unit 2. This amendment consists of changes to the Technical Specifications (TSs) in response to your application dated March 28, 2001, as supplemented by letter dated September 25, 2001.

The amendment revises the TSs to reflect crediting soluble boron for reactivity control in the BVPS-2 spent fuel pool. The spent fuel pool criticality analysis is revised to support this change.

A copy of the related safety evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Daniel S. Collins, Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-412

Enclosures: 1. Amendment No. 128 to NPF-73
2. Safety Evaluation

cc w/encls: See next page

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* Concur on the SE dated
*See previous concurrence
ACCESSION NO. **ML020020373**
**No major changes made to SE input

OFFICE	PDI-1/PM	PDI-1/LA	SPSB/SC	RTSB/BC	EMCB/DE
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NAME	BThomas**	FAkstulewicz*	AHodgdon	PTam for JMunday
DATE	12/12/01	1/29/02	2/7/02	2/8/02

OFFICIAL RECORD COPY

Beaver Valley Power Station, Units 1 and 2

Mary O'Reilly, Attorney
FirstEnergy Nuclear Operating Company
FirstEnergy Corporation
76 South Main Street
Akron, OH 44308

FirstEnergy Nuclear Operating Company
Regulatory Affairs/Corrective Action Section
Larry R. Freeland, Manager (2 Copies)
Beaver Valley Power Station
Post Office Box 4, BV-A
Shippingport, PA 15077

Commissioner James R. Lewis
West Virginia Division of Labor
749-B, Building No. 6
Capitol Complex
Charleston, WV 25305

Director, Utilities Department
Public Utilities Commission
180 East Broad Street
Columbus, OH 43266-0573

Director, Pennsylvania Emergency
Management Agency
2605 Interstate Dr.
Harrisburg, PA 17110-9364

Ohio EPA-DERR
ATTN: Zack A. Clayton
Post Office Box 1049
Columbus, OH 43266-0149

Dr. Judith Johnsrud
National Energy Committee
Sierra Club
433 Orlando Avenue
State College, PA 16803

L. W. Pearce, Plant Manager (BV-IPAB)
FirstEnergy Nuclear Operating Company
Beaver Valley Power Station
Post Office Box 4
Shippingport, PA 15077

Bureau of Radiation Protection

ATTN: Larry Ryan
P O Box 2063
Harrisburg, PA 17120

Mayor of the Borough of
Shippingport
P O Box 3
Shippingport, PA 15077

Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Resident Inspector
U.S. Nuclear Regulatory Commission
Post Office Box 298
Shippingport, PA 15077

FirstEnergy Nuclear Operating Company
Beaver Valley Power Station
ATTN: R. E. Donnellon, Director
Projects and Scheduling (BV-IPAB)
Post Office Box 4
Shippingport, PA 15077

Mr. J. A. Hultz, Manager
Projects & Support Services
FirstEnergy Corporation
76 South Main Street
Akron, OH 44308

FirstEnergy Nuclear Operating Company
Beaver Valley Power Station
Mr. B. F. Sepelak
Post Office Box 4, BV-A
Shippingport, PA 15077

PENNSYLVANIA POWER COMPANY

OHIO EDISON COMPANY

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

THE TOLEDO EDISON COMPANY

FIRSTENERGY NUCLEAR OPERATING COMPANY

DOCKET NO. 50-412

BEAVER VALLEY POWER STATION, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 128
License No. NPF-73

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by FirstEnergy Nuclear Operating Company, et al. (the licensee) dated March 28, 2001, as supplemented by letter dated September 25, 2001, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-73 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 128, and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated in the license. FENOC shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 60 days.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA by PTam for JMunday/

Joel T. Munday, Acting Chief, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: February 11, 2002

ATTACHMENT TO LICENSE AMENDMENT NO. 128

FACILITY OPERATING LICENSE NO. NPF-73

DOCKET NO. 50-412

Replace the following pages of the Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Remove	Insert
IX	IX
XIII	XIII
3/4 9-15	3/4 9-15
3/4 9-16	3/4 9-16
----	3/4 9-17
5-1	5-1
5-2	5-2

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 128 TO FACILITY OPERATING LICENSE NO. NPF-73

PENNSYLVANIA POWER COMPANY

OHIO EDISON COMPANY

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

THE TOLEDO EDISON COMPANY

FIRSTENERGY NUCLEAR OPERATING COMPANY

BEAVER VALLEY POWER STATION, UNIT NO. 2

DOCKET NO. 50-412

1.0 INTRODUCTION

By letter dated March 28, 2001 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML010950282), as supplemented by letter dated September 25, 2001 (ADAMS Accession No. ML012750130), the FirstEnergy Nuclear Operating Company, et al., (FENOC, the licensee) submitted a request for changes to the Beaver Valley Power Station, Unit No. 2 (BVPS-2), Technical Specifications (TSs). The proposed changes would revise the TS requirements to reflect the crediting of soluble boron for reactivity control in the spent fuel pool. The Boraflex that is contained in the BVPS-2 spent fuel pool storage racks would no longer be credited for reactivity control in the spent fuel pool criticality analysis.

Specific TS changes associated with the revised spent fuel pool criticality analysis and the crediting of soluble boron in the spent fuel pool include the following:

- The requirements in TS 3/4.9.14, "FUEL STORAGE - SPENT FUEL STORAGE POOL," would be separated into a new TS 3/4.9.14, "SPENT FUEL POOL STORAGE," which would provide controls for fuel assembly enrichment and burnup in the spent fuel pool, and a new TS 3/4.9.15, "FUEL STORAGE POOL BORON CONCENTRATION," which would provide controls for soluble boron requirements in the spent fuel pool (these changes provide consistency with the guidance contained in NUREG-1431, "Standard Technical Specification - Westinghouse Plants, Revision 1," and technical specification traveler form (TSTF) Nos. 70 and 255),

- Table 3.9-1, "FUEL ASSEMBLY MINIMUM BURNUP VS. U-235 NOMINAL ENRICHMENT FOR STORAGE IN SPENT FUEL RACK REGIONS 1, 2, 3," would be revised consistent with the assumptions of the spent fuel pool criticality analysis regarding the spent fuel pool storage configurations,

- An increase in the maximum enrichment from 4.85 weight percent (w/o) to 5.0 w/o will be reflected in TS 3/4.9.14 (in Table 3.9-1),

- TS 5.3, "FUEL STORAGE," would be revised to add a new design criterion stating, in part, that "...the spent fuel storage racks are designed and shall be maintained with k_{eff} less than 1.0 if fully flooded with unborated water, which includes an allowance for uncertainties...,"

- TS 5.3 design criterion currently designated as "b" (new design criteria "c") would be revised to reflect the minimum boron concentration of 450 parts-per-million (ppm) that limits K_{eff} to less than 0.95 (this is consistent with the revised spent fuel pool criticality analysis), and,

- Editorial and administrative changes to the Index and TS 5.3 design criteria "letter designation" are also proposed for consistency.

In support of the TS changes proposed, the licensee submitted its spent fuel pool criticality analysis in the March 28, 2001, letter, using the methodology contained in WCAP-14416-NP-A, "Westinghouse Spent Fuel Rack Criticality Analysis Methodology," Revision 1, dated November 1996 (WCAP-14416). In its letter dated September 25, 2001, the licensee also provided plant-specific information to account for a nonconservatism in the WCAP-14416 methodolgy regarding axial burnup biases. This criticality analysis credits soluble boron in the spent fuel pool for reactivity control and evaluated various spent fuel pool storage configurations and fuel enrichments (up to 5.0 w/o). Evaluations of a possible boron dilution event and fuel assembly misload accident were also included in the licensee's submittals.

Consistent with the previous BVPS-2 spent fuel pool criticality analysis that credited the Boraflex in the racks for reactivity control, and in response to concerns associated with Boraflex degradation, the licensee commited to periodically sample the Boraflex in the spent fuel pool storage racks. This commitment was made in a letter dated October 24, 1996 (Nuclear Documents System [NUDOCS] Accession No. 9610310098), in response to Generic Letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks." Since the licensee proposes to take credit for soluble boron in the spent fuel pool and not the Boraflex, the licensee proposes to discontinue this commitment upon approval of this amendment request.

The September 25, 2001, letter provided clarifying information that did not change the initial proposed no significant hazards consideration determination or expand the scope of the original *Federal Register* notice.

2.0 BACKGROUND

2.1 Spent Fuel Pool Criticality

General Design Criterion (GDC) 62 states that "criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations." The Nuclear Regulatory Commission (NRC) has established a five-percent subcriticality margin (k_{eff} less than or equal to 0.95) to comply with GDC 62.

Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.68, "Criticality accident requirements," states that "[i]f credit is taken for soluble boron, the k-effective [k_{eff}] of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and the k-effective must remain below 1.0 (subcritical), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water."

The BVPS-2 spent fuel pool contains spent fuel storage racks that incorporate a fixed neutron poison known as Boraflex. Boraflex contains boron, a thermal neutron absorber. Boraflex is manufactured in sheet form and incorporated into the sides of the spent fuel storage racks. The current BVPS-2 spent fuel pool criticality analysis credits the boron contained in the Boraflex for maintaining the spent fuel pool subcritical. The spent fuel pool also contains borated water, which is currently not credited for reactivity control in the spent fuel pool.

The spent fuel pool criticality analysis is currently analyzed for storage of fuel assemblies with a maximum enrichment of uranium 235 (U-235) of 4.85 w/o. In the criticality analysis submitted for this amendment request, the licensee proposes to revise this maximum enrichment to 5.0 w/o (various geometric storage configurations are also evaluated to facilitate maintaining subcriticality). Increasing maximum enrichment could also impact the calculated doses resulting from postulated design-basis accidents. The licensee has already incorporated the possible effects of the increase in enrichment to 5.0 w/o U-235 on these calculated doses by its license amendment requests dated May 1, and May 12, 2000 (ADAMS Accession Nos. ML003713111 and ML003717014, respectively), which requested NRC review and approval of revised design-basis accident radiological dose consequence analyses as described in the BVPS-2 Updated Final Safety Analysis (UFSAR). These amendment requests were approved by the NRC staff on September 28, 2000, and March 22, 2001 (ADAMS Accession Nos. ML003749558 and ML010610212, respectively) in License Amendment Nos. 116 and 119, respectively, to License No. NPF-73.

With respect to the methodology utilized by the licensee regarding its spent fuel pool criticality analysis, the licensee referenced WCAP-14416, which documented the generic methodology developed by the Westinghouse Owners Group. The NRC staff, in a safety evaluation (SE) dated October 25, 1996 (NUDOCS Accession No. 9610290282), accepted WCAP-14416 for referencing in licensing applications where licensees propose to take credit for soluble boron in spent fuel pool criticality analyses. The review and acceptance of WCAP-14416 focused on the methodology whereby credit could be taken for soluble boron in the spent fuel pool to meet the NRC-recommended criterion that the spent fuel pool multiplication factor (k_{eff}) be less than or equal to 0.95, at a 95-percent probability, 95-percent confidence level. The SE stipulated that any licensee proposing to use this methodology for soluble boron credit should identify potential events which could dilute the spent fuel pool soluble boron concentration below that required to maintain the 0.95 k_{eff} limit and should quantify the time span of these dilution events to show that sufficient time is available to enable adequate detection and suppression of any dilution event.

In 1999, while performing analyses to support a license amendment, another licensee identified nonconservatisms in the axial burnup biases utilized in WCAP-14416. Westinghouse informed its customers about the nonconservatisms and described actions that licensees could take to assure that their analyses are conservative. Westinghouse's approach to resolving this issue was to seek to identify conservative reactivity margins to compensate for the nonconservatisms in calculated burnup bias and to re-analyze (calculate) the axial burnup biases on a

plant-specific basis. Because of large conservatisms used in other aspects of the methodology, the NRC staff does not view the nonconservatisms in the calculated biases as a safety concern. However, in a letter dated July 27, 2001 (ADAMS Accession No. ML012080337), from the NRC to Westinghouse, the staff stated that "[a]lthough this approach may lead to sufficient margin to account for the identified non-conservatism(s) on a plant specific basis, it departs from the Westinghouse methodology of WCAP-14416. Therefore, WCAP-14416 can no longer be relied upon as an 'approved methodology' by the NRC staff or the licensees. For future licensing actions, licensees will need to submit plant-specific criticality calculations for spent fuel pool configurations that include technically supported margins."

2.2 Generic Letter 96-04

Generic Letter (GL) 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks," was issued by the staff on June 26, 1996 (NUDOCS Accession No. 9606240132) due to concerns related to gamma radiation-induced shrinkage, gap formation, and dissolution of the Boraflex poison material in the spent fuel pool storage racks. The NRC staff requested in the GL that all licensees of power reactors with installed racks containing Boraflex provide an assessment of the physical condition of the Boraflex and state whether the subcritical margin of 5 percent could be maintained for the racks in unborated water. In addition, the licensees were requested to submit a description of any proposed actions to monitor or confirm that this subcriticality margin could be maintained for the lifetime of the storage racks and to describe any corrective actions in the event that it could not be maintained.

The description of the GL 96-04 commitment for BVPS-2 was provided in a letter dated October 24, 1996. The BVPS-2 Boraflex surveillance program provides for condition monitoring of the Boraflex through inspection of Boraflex sample coupons. The program includes accelerated and long-term surveillance assemblies. The accelerated assembly is relocated during each refueling outage and is surrounded by freshly discharged fuel. Coupons from this assembly are removed and analyzed every 2 years. The long-term surveillance assembly remains in a permanent location with no movement of nearby fuel for the duration of the program. The coupons from this assembly are removed and analyzed every 4 years.

3.0 <u>EVALUATION</u>

3.1 Spent Fuel Pool Criticality Analysis

The spent fuel pool criticality analysis has been revised to reflect storage of various Westinghouse 17X17 fuel assemblies with a maximum enrichment of 5.0 w/o U-235 in three configurations based on a four-cell 2X2 matrix. These 3 configurations are "4-out-of-4," i.e., a spent fuel assembly in each of the 4 cells, "3-out-of-4 Checkerboard," i.e., a spent fuel assembly in 3 of the 4 cells, and "2-out-of-4 Checkboard," i.e., a spent fuel assembly in 2 of the 4 cells. Fuel assemblies with enrichments up to 5.0 w/o U-235 may be stored in all 4 cells, i.e., "4-out-of-4," provided the burnup limits specified in the proposed TS 3/4.9.14 (as listed in proposed Table 3.9-1) are met. Fuel assemblies with enrichments up to 5.0 w/o U-235 may be stored in "3-out-of-4 Checkerboard" storage configurations provided the burnup limits specified in the proposed TS 3/4.9.14 are met, and fuel assemblies with enrichments up to 5.0 w/o U-235 may be stored in "2-out-of-4 Checkerboard" storage configuration without any restriction on

burnup (Table 3.9-1 minimum burnup requirement is 0 megawatt days/per megatons uranium (MWD/MTU) for this configuration).

The purpose of this license amendment request is to reflect the revision of the criticality analysis and fuel storage rack utilization schemes for BVPS-2 assuming no credit for Boraflex and taking credit for the presence of soluble boron in the spent fuel pool water. The BVPS-2 spent fuel pool criticality analysis was evaluated using the methodology contained in WCAP-14416 (additional plant-specific information regarding the potential nonconservatism surrounding the axial burnup bias was submitted by letter dated September 25, 2001). This methodology requires conformance with the following acceptance criteria for preventing criticality outside the reactor, e.g., in the spent fuel pool:

1) k_{eff} shall be less than 1.0 if fully flooded with unborated water, which includes an allowance for uncertainties at a 95-percent probability, 95-percent confidence (95/95) level; and

2) k_{eff} shall be less than or equal to 0.95 if fully flooded with borated water, which includes an allowance for uncertainties at a 95/95 level.

The analysis of the reactivity effects of fuel storage in the BVPS-2 spent fuel racks was performed with the three-dimensional Monte-Carlo code KENO-Va, with neutron cross-sections generated with NITAWL-II and XSDRNPM-S codes using the 227 group ENDF/B-V neutron cross section library. Since the KENO-Va code package does not have burnup capability, depletion analyses were made with the two-dimensional integral transport theory code, PHOENIX, which uses a 42-group energy group nuclear data library. The computer models used in the reactivity analysis have been benchmarked against experimental data for fuel assemblies similar to those for which the BVPS-2 racks are designed and have been found to adequately reproduce the critical values. The selected critical experiments included the Babcock & Wilcox experiments carried out in support of close proximity storage of power reactor fuel and the Pacific Northwest Laboratory program carried out in support of the design of fuel shipping and storage configurations. This experimental data is sufficiently diverse to establish that the method bias and uncertainty will apply to BVPS-2 storage rack conditions. The PHEONIX code and its cross section set have been used in the design of reload cores and extensively benchmarked against operating reactor history and test data. The NRC staff concludes that the analysis methods used are acceptable and capable of predicting the reactivity of the BVPS-2 storage racks with a high degree of confidence.

The criticality analysis performed on the spent fuel pool storage racks at BVPS-2 assumed pure water with a temperature of 68 °F and a density of 1.0 gram-per-cubic centimeter (gm/cc). The fuel assembly array was assumed to be infinite in lateral extent. A methodology bias (determined from benchmark calculations) as well as a reactivity bias to account for the effect of the normal range of spent fuel pool water temperatures (50°F to 185°F) were included. Uncertainties due to fuel assembly manufacturing tolerances, rack fabrication tolerances, and KENO methodology were also incorporated. These uncertainties were appropriately determined at the 95/95 level. These biases and uncertainties meet the previously stated NRC guidelines and are, therefore, acceptable.

To show that storage of fuel assemblies in the spent fuel storage racks satisfies the 0.95 k_{eff} criticality acceptance criteria, KENO-Va is used to establish a nominal reference reactivity using

fresh fuel assemblies. This reference reactivity is plant specific and, for BVPS-2, the enrichment required to maintain k_{eff} less than 1.0 was found to be 1.90 w/o U-235 with all the cells filled with Westinghouse 17X17 fuel assemblies and no soluble boron in the pool water. This calculation resulted in a k_{eff} of 0.96992. The 95/95 k_{eff} was then determined by adding the temperature and methodology biases and the statistical sum of independent tolerances and uncertainties to the nominal k_{eff} value. The addition of all these biases led to a 95/95 k_{eff} value of 0.99952. Since this 95/95 k_{eff} value is less than 1.0, the criterion for precluding criticality with no credit for soluble boron is met. The addition of 200 parts-per-million (ppm) soluble boron was then credited for bringing the 95/95 k_{eff} to below 0.95, thus maintaining the 5-percent subcritical margin (including all of the uncertainties).

To determine the k_{eff} for assemblies enriched to 5.0 w/o U-235, the licensee conducted a series of reactivity calculations (or reactivity equivalencing) to generate a set of enrichment versus assembly burnup ordered pairs, which yield an equivalent k_{eff} in the spent fuel pool storage racks. These ordered pairs represent combinations of fuel enrichment and discharge burnup, which yield the same rack k_{eff} as the rack loaded with fresh 1.90 w/o enriched fuel.

The concept of reactivity equivalencing due to fuel burnup was used to define the conditions under which fresh and irradiated fuel assemblies are interchangeable on an overall reactivity basis. The NRC staff has previously accepted the use of reactivity equivalencing to equate an array of fresh fuel assemblies and their enrichments that have been shown to be acceptable for storage into an array of irradiated assemblies with different initial enrichments, decay times, and burnable absorber concentrations. To determine the amount of soluble boron required to maintain k_{eff} less than 0.95 for storage of fuel assemblies with enrichments higher than 1.90 w/o U-235 (up to 5.0 w/o U-235) for the “4-out-of-4” storage configuration, a series of reactivity calculations were performed to generate a set of enrichment versus fuel assembly discharge burnup ordered pairs (Attachment C, Figure 2 of the licensee’s letter dated March 28, 2001) which all yield an equivalent k_{eff} when stored in the spent fuel storage racks with fresh fuel 1.90 w/o U-235. Uncertainties associated with burnup credit include a reactivity uncertainty of 0.01 Δk at 30,000 MWD/MTU applied linearly to the burnup credit requirement to account for calculation and depletion uncertainties and 5 percent to the calculated burnup to account for burnup measurement uncertainty. The NRC staff concludes that these calculations conservatively reflect the uncertainties associated with burnup calculations and are, therefore, acceptable.

The amount of additional soluble boron that is needed to account for these reactivity equivalencing uncertainties is 250 ppm. Adding this to the soluble boron credit of 200 ppm required for k_{eff} to be less than or equal to 0.95 for the “4-out-of-4” storage configuration results in a total soluble boron credit of 450 ppm. This value is well below the minimum spent fuel pool boron concentration value of 2000 ppm required by proposed TS 3/4.9.15.

The spent fuel pool was also analyzed assuming a “3-out-of-4 Checkerboard” storage configuration containing 3 initially 2.60 w/o-enriched U-235 assemblies and an empty cell. This configuration resulted in an 95/95 k_{eff} of 0.99564 with no credit for soluble boron. The addition of 200 ppm of soluble boron reduced the k_{eff} to 0.94582, well within the 5-percent margin required by the NRC acceptance criterion. This results in a total of 400 ppm of boron to meet the 5-percent subcriticality limit, which is below the proposed TS 3/4.9.15 limit of 2000 ppm.

A separate criticality analysis was conducted for the “2-out-of-4 Checkerboard” storage configuration. The result of the unborated water analysis was a 95/95 K_{eff} of 0.94577. Consequently, a concentration of 0 ppm soluble boron is required to meet both acceptance criteria for the “2-out-of-4 Checkerboard” storage configuration. This value is well below the proposed TS 3/4.9.15 limit of 2000 ppm.

3.2 Accident Analysis

3.2.1 Fuel Assembly Misload Accident

An evaluation of various fuel misload scenarios indicated that the misplacement of a fresh fuel assembly enriched to 5.0 w/o U-235 in a corner interface of two racks modules results in the highest reactivity increase. This misplacement is more limiting than a misload within the storage rack. The results of the analyses of all the configurations show that the highest reactivity increase (0.16002 Δk) occurs in the “two out of four” case. A soluble boron concentration of 1400 ppm was found to be sufficient to maintain k_{eff} less than or equal to 0.95 for this reactivity increase. The minimum spent fuel pool boron concentration value of 2000 ppm required by TS 3/4.9.15 is more than sufficient to maintain k_{eff} less than or equal to 0.95 for this reactivity increase. By virtue of the double contingency principle of ANSI/ANS 8.1-1983, which has been endorsed by the staff, two unlikely independent and concurrent events are beyond the scope of the required analysis. Therefore, credit for the presence of the entire 2000 ppm of soluble boron may be assumed in evaluating other accident conditions such as a fuel misplacement. Therefore, with respect to the potential misplacement of a fuel assembly, the TS changes are acceptable.

3.2.2 Boron Dilution Analysis

In order to ensure that the design basis k_{eff} of 0.95 was not exceeded due to potential dilution events, the licensee determined that a boron concentration of 450 parts per million (ppm) would provide a k_{eff} of 0.95. The licensee then evaluated plant systems that could potentially dilute the spent fuel pool in accordance with the topical report.

BVPS-2 spent fuel pool (SFP) has a water inventory of 269,000 gallons. The volume required to dilute the spent fuel pool is 401,255 gallons, which corresponds to a minimum SFP soluble boron concentration of 450 ppm. The various events that were considered included dilution from: (1) the primary water system, (2) demineralized water system, (3) component cooling water system, (4) hot water heating system, (5) service water system, and (6) the fire protection system. Other events, such as seismic events, pipe break, and loss of offsite power were also considered.

Based on events evaluated, there were only four water storage sources that could provide the 401,255 gallons of water needed to dilute the spent fuel pool. The first source is the demineralized water system - demineralized water storage tank which has a volume of 600,000 gallons. The demineralized water storage tank is connected to the spent fuel pool cooling return header by a 2-inch connection capable of delivering 70 gallons per minute (gpm) to the spent fuel pool. However, at a rate of 70 gpm it would take 96 hours to dilute the spent fuel pool.

The second source is the hot water heating system that has six 270 gallon surge tanks. The demineralized water storage tank (600,000 gallons) is the makeup source for the hot water heating system surge tanks. Because the system is not seismically qualified an earthquake could rupture the supply and return lines causing the system to blow down into the spent fuel pool. The most rapid dilution would occur from the 6 surge tanks at a rate of 5,771 gpm. Consequently, the tanks would empty their contents in a few seconds. Once the surge tanks have emptied their contents to the spent fuel pool, the flow rate is limited to 460 gpm through a 3-inch makeup connection to the demineralized water storage tank. This event requires 15 hours to dilute the spent fuel pool soluble boron concentration to 450 ppm.

The Ohio River is considered an infinite source of makeup to the spent fuel pool and is capable of providing the 401,255 gallons needed to dilute the spent fuel pool. The river interfaces with the spent fuel pool via the service water system and fire protection system. The service water system dilution rate of 3000 gpm would take 2 hours to dilute the spent fuel pool, while the fire protection system at a rate of 200 gpm would take 33 hours to dilute the spent fuel pool soluble boron concentration to 450 ppm. The service water system provides the largest flow rate and the shortest time to dilute the spent fuel pool soluble boron concentration. However, alignment of the system requires significant operator involvement and is not considered a credible event.

All other dilution events evaluated take well over 8 hours to dilute the spent fuel pool and would be detected by plant personnel during required rounds every 8 hours. Additionally, the licensee has administrative procedures in place to detect, mitigate and suppress potential spent fuel pool dilution events. In addition to the administrative requirements, the licensee samples the spent fuel pool every 7 days to detect low-flow, long-term dilution events. This frequency is consistent with the standard TS for Westinghouse plants and TSTF-70, and is considered appropriate for this plant.

The licensee concluded that an unplanned or inadvertent event that would dilute the spent fuel pool (SFP) is not credible for BVPS-2. The NRC staff finds that the combination of the large volume of water required for a dilution event, the significant operator involvement required for the limiting event, flow rates and dilution times, licensee administrative requirements, and TS-controlled SFP concentration and 7-day sampling requirement adequate to detect a dilution event prior to k_{eff} reaching 0.95. Therefore, the staff agrees with the licensee's evaluation and finds that a SFP dilution event is not credible at BVPS-2.

3.3 Increased Fuel Enrichment Effects on the SFP Cooling System

The staff evaluated the effects of the proposed fuel enrichment from 4.85 to 5.0 weight percent on the decay heat removal capacity of the SFP cooling system. The SFP cooling system is designed to maintain water clarity and remove decay heat from the SFP. The determination of the decay heat load is primarily a function of the operational power and burnup and is not affected by the initial fuel enrichment. The licensee is not proposing to change the power level of BVPS-2 or the length of its operating cycle. Consequently, the decay heat load on the SFP cooling system is unchanged. Therefore, the NRC staff finds that the increase in fuel enrichment will have an insignificant or no impact on the SFP cooling system with regard to performing its design-basis function.

3.4 Evaluation Summary and TS Changes

The NRC staff finds that the revised SFP criticality analysis meets the criteria of maintaining the 95/95 k_{eff} (1) less than 1.0 when the SFP is fully flooded with unborated water, and (2) less than or equal to 0.95 when fully flooded with borated water. The NRC staff also finds that appropriate uncertainties have been incorporated into the analysis.

The NRC staff finds that, based on the information provided by the licensee, the bounding condition for the SFP criticality analyses, including various uncertainties, for normal spent fuel storage configurations is the "4-out-of-4" storage configuration. A minimum soluble boron concentration of 450 ppm is necessary for this configuration to ensure that the resultant k_{eff} (1) less than 1.0 when the SFP is fully flooded with unborated water, and (2) less than or equal to 0.95 when fully flooded with borated water. This boron concentration is less than the minimum boron concentration requirement of 2000 ppm in proposed TS 3/4.9.15.

The bounding accident condition affecting this analysis is the mistaken loading of a fresh fuel assembly enriched to 5 w/o U-235 in a corner interface of two racks modules. The minimum soluble boron concentration for this scenario is 1400 ppm which is less than the minimum boron concentration requirement of 2000 ppm in proposed TS 3/4.9.15.

The NRC staff also finds that a SFP boron dilution accident is not credible given the boron concentration limit in proposed TS 3/4.9.15 and the long duration of such an event.

The NRC staff finds that the revised SFP criticality analysis conservatively incorporates the assumption of storage of fuel assemblies enriched up to 5.0 w/o (with the burnup and storage configuration restrictions as required by the proposed TS 3/4.9.14 (Table 3.9-1)). The dose consequence effects of the increase to the fuel enrichment up to 5.0 w/o U-235 have already been incorporated in License Amendment Nos. 116 and 119 to License No. NPF-73. Additionally, there is little to no impact on the SFP cooling system. Therefore, the NRC staff finds the increase in fuel assembly enrichment from 4.85 w/o U-235 to 5.0 w.o U-235 acceptable.

The NRC staff finds the changes to TS 5.3 and the Index are necessary given the changes made to the SFP criticality analysis and, therefore, are acceptable.

Based on the acceptability of the revised SFP criticality analysis, the NRC staff finds the following TS changes, as proposed in the licensee's letters dated March 28, and September 25, 2001, acceptable:

- Revised TS 3/4.9.14, "FUEL STORAGE - SPENT FUEL STORAGE POOL," which provides controls for fuel assembly enrichment and burnup in the SFP (this includes reference to a revised Table 3.9-1, "FUEL ASSEMBLY MINIMUM BURNUP VS. U-235 NOMINAL ENRICHMENT FOR STORAGE IN SPENT FUEL RACK REGIONS 1, 2, 3, that lists acceptable combinations of burnup limitations and nominal enrichments up to and including 5.0 w/o U-235 for various storage configurations),

- New TS 3/4.9.15, "FUEL STORAGE POOL BORON CONCENTRATION," which provides controls for soluble boron requirements in the SFP including a minimum boron concentration of 2000 ppm,

- New design criterion 5.3.1.1.a is added to TS 5.3, “FUEL STORAGE,” and requires that “[t]he spent fuel storage racks are designed and shall be maintained with $k_{eff} < 1.0$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in UFSAR Section 9.1,”

- Other previously existing TS 5.3 design criteria are re-lettered to reflect the additions of new design criterion 5.3.1.1.a (keeping the same sequence as before).

- Design criterion now designated as 5.3.1.1.c is revised to require that “[t]he spent fuel storage facks are designed and shall be maintained with $k_{eff} \leq 0.95$ if fully flooded with water borated to 450 ppm which includes an allowance for uncertainties as described in UFSAR Section 9.1,”

- The Index is revised to reflect the addition of TS 3/4.9.15 and the new title of TS 3/4.9.14.

3.5 GL 96-04 Commitment

Since the proposed SFP criticality analysis methodology has been found acceptable as discussed above and does not take credit for Boraflex, the NRC staff concludes that the GL 96-04 commitment of periodically sampling the Boraflex is no longer necessary and the discontinuation of this commitment is acceptable for BVPS-2.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Pennsylvania State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and changes surveillance requirements. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (66 FR 41620). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the

Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributors: A. Attard, C. Lauron, G. Hatchett

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