February 20, 1998

Mr. C. K. McCoy
Vice President
Southern Nuclear Operating
Company, Inc.
Post Office Box 1295
Birmingham, Alabama 35201

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SUBJECT: ISSUANCE OF AMENDMENTS - VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2 (TAC NOS. M99421 AND M99422)

Dear Mr. McCoy:

The Nuclear Regulatory Commission has issued the enclosed Amendment No. 99 to Facility Operating License NPF-68 and Amendment No. 77 to Facility Operating License NPF-81 for the Vogtle Electric Generating Plant (VEGP), Units 1 and 2. The amendments consist of changes to the Technical Specifications (TS) in response to your application dated August 8, 1997, as supplemented October 10, 1997, January 16, 23, and 27, 1998.

The amendments change VEGP TS 3.7.17, "Fuel Storage Pool Boron Concentration," TS 3.7.18, "Fuel Assembly Storage in the Fuel Storage Pool," and TS 4.3, "Fuel Storage," to credit soluble boron in the spent fuel pool for maintenance of subcriticality associated with spent fuel storage.

A copy of the related Safety Evaluation is also enclosed. A Notice of Issuance will be included in the Commission's biweekly Federal Register notice.

Sincerely,
ORIGINAL SIGNED BY L. OLSHAN FOR:
David Jaffe, Senior Project Manager
Project Directorate II-2
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket Nos. 50-424 and 50-425

Enclosures:
1. Amendment No.99 to NPF-68
2. Amendment No.77 to NPF-81
3. Safety Evaluation

DF01

cc w/encl: See next page

DOCUMENT NAME:G:\VOGTLE\VOG99421.AMD

***see previous concurrences**

OFFICE	PDII-2/PM	PDII-2/LA	BC:SPLB *	BC:SRXB *	OGC *	PDII-2/D
NAME	D.JAFFE:cn	L.BERRY	L.MARSH	T.COLLINS	APH	H.BERKOW
DATE	2/19/98	2/ /98	2/5/98	2/9/98	2/11/98	2/19/98
COPY	YES	YES	YES	YES NO	YES NO	YES NO

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001
February 20, 1998

Mr. C. K. McCoy
Vice President
Southern Nuclear Operating
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Post Office Box 1295
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cc w/encl: See next page

Vogtle Electric Generating Plant

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SOUTHERN NUCLEAR OPERATING COMPANY, INC.

GEORGIA POWER COMPANY

OGLETHORPE POWER CORPORATION

MUNICIPAL ELECTRIC AUTHORITY OF GEORGIA

CITY OF DALTON, GEORGIA

VOGTLE ELECTRIC GENERATING PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 99
License No. NPF-68

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

   A. The application for amendment to the Vogtle Electric Generating Plant, Unit 1 (the facility) Facility Operating License No. NPF-68 filed by the Georgia Power Company and Southern Nuclear Operating Company, Inc. (Southern Nuclear), acting for themselves, Oglethorpe Power Corporation, Municipal Electric Authority of Georgia, and City of Dalton, Georgia (the licensees), dated August 8, 1997, as supplemented October 10, 1997, January 16, 23, and 27, 1998, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;

   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 hereby amended by page 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-68 is hereby amended to read as follows:

   Technical Specifications and Environmental Protection Plan

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 99 , and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. Southern Nuclear shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of its date of issuance and shall be implemented within 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Herbert N. Berkow

Herbert N. Berkow, Director
Project Directorate II-2
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Attachment:
Technical Specification
Changes

Date of Issuance: February 20, 1998

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SOUTHERN NUCLEAR OPERATING COMPANY, INC.

GEORGIA POWER COMPANY

OGLETHORPE POWER CORPORATION

MUNICIPAL ELECTRIC AUTHORITY OF GEORGIA

CITY OF DALTON, GEORGIA

VOGTLE ELECTRIC GENERATING PLANT, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 77
License No. NPF-81

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

   A. The application for amendment to the Vogtle Electric Generating Plant, Unit 2 (the facility) Facility Operating License No. NPF-81 filed by the Georgia Power Company and Southern Nuclear Operating Company, Inc. (Southern Nuclear), acting for themselves, Oglethorpe Power Corporation, Municipal Electric Authority of Georgia, and City of Dalton, Georgia (the licensees), dated August 8, 1997, as supplemented October 10, 1997, January 16, 23, and 27, 1998, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;

   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 hereby amended by page 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-81 is hereby amended to read as follows:

   Technical Specifications and Environmental Protection Plan

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 77 , and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. Southern Nuclear shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of its date of issuance and shall be implemented within 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Herbert N. Berkow

Herbert N. Berkow, Director
Project Directorate II-2
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Attachment:
Technical Specification
Changes

Date of Issuance: February 20, 1998

ATTACHMENT TO LICENSE AMENDMENT NO. 99

FACILITY OPERATING LICENSE NO. NPF-68

DOCKET NO. 50-424

AND

TO LICENSE AMENDMENT NO. 77

FACILITY OPERATING LICENSE NO. NPF-81

DOCKET NO. 50-425

Replace the following pages of the Appendix "A" Technical Specifications with the enclosed pages. The revised pages are identified by Amendment number and contain vertical lines indicating the areas of change.

Remove	Insert
v	v
viii	viii
-	ix
-	3.7-39
-	3.7-40
-	3.7-41
-	3.7-42
-	3.7-43
4.0-2	4.0-2
4.0-3	4.0-3
-	4.0-3a*
-	4.0-3b
-	4.0-4
-	4.0-5
-	4.0-6
-	4.0-7
-	4.0-8
-	4.0-9
-	4.0-10
-	4.0-11
-	4.0-12
Bases iv	Bases iv
-	B 3.7-92
-	B 3.7-93
-	B 3.7-94

Remove	Insert
-	B 3.7-95
-	B 3.7-96
-	B 3.7-97
-	B 3.7-98
-	B 3.7-99
-	B 3.7-100*

*no change

(continued)

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LIST OF TABLES

LIST OF FIGURES

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3.7 PLANT SYSTEMS

3.7.17 Fuel Storage Pool Boron Concentration

LCO 3.7.17 The fuel storage pool boron concentration shall be ≥ 2000 ppm.

APPLICABILITY: When fuel assemblies are stored in the fuel storage pool.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Fuel storage pool boron concentration not within limit.	-------------NOTE------------ LCO 3.0.3 is not applicable. -----------------------------	
	A.1 Suspend movement of fuel assemblies in the fuel storage pool.	Immediately
	AND	
	A.2.1 Initiate action to restore fuel storage pool boron concentration to within limit.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.7.17.1 Verify the fuel storage pool boron concentration is within limit.	7 days

3.7 PLANT SYSTEMS

3.7.18 Fuel Assembly Storage in the Fuel Storage Pool

LCO 3.7.18 The combination of initial enrichment burnup and configuration of fuel assemblies stored in the fuel storage pool shall be within the Acceptable Burnup Domain of Figures 3.7.18-1 (Unit 1), 3.7.18-2 (Unit 2), or in accordance with Specification 4.3.1.1.

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Requirements of the LCO not met.	A.1 ---------NOTE--------- LCO 3.0.3 is not applicable. --------------------- Initiate action to move the noncomplying fuel assembly to an acceptable storage location.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.18.1	Verify by a combination of visual inspection and administrative means that the initial enrichment, burnup, and storage location of the fuel assembly is in accordance with Figures 3.7.18-1 (Unit 1), 3.7.18-2 (Unit 2), or Specification 4.3.1.1.	Prior to storing the fuel assembly in the fuel storage pool location.

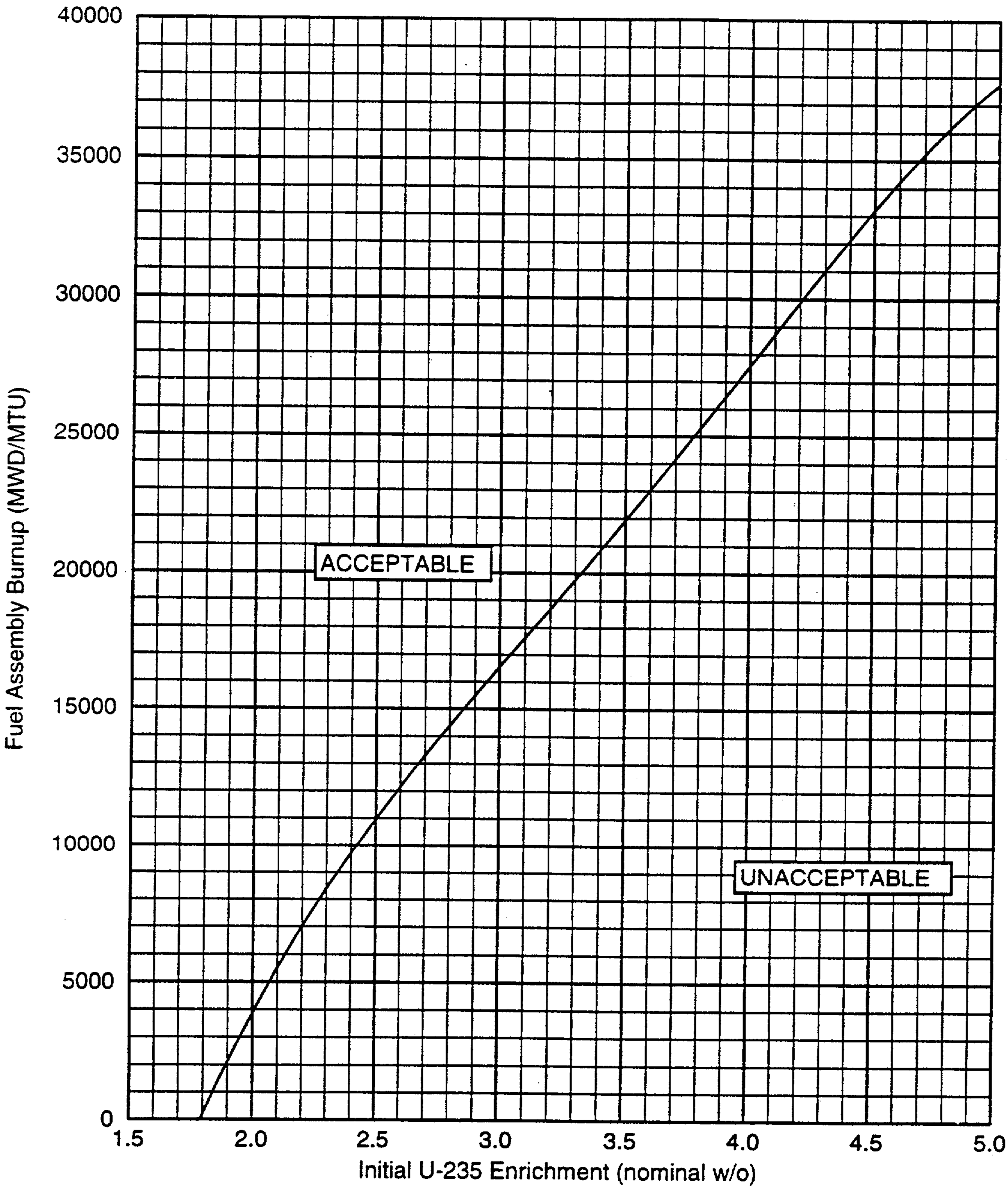


Figure 3.7.18-1 Vogtle Unit 1 Burnup Credit Requirements for All Cell Storage

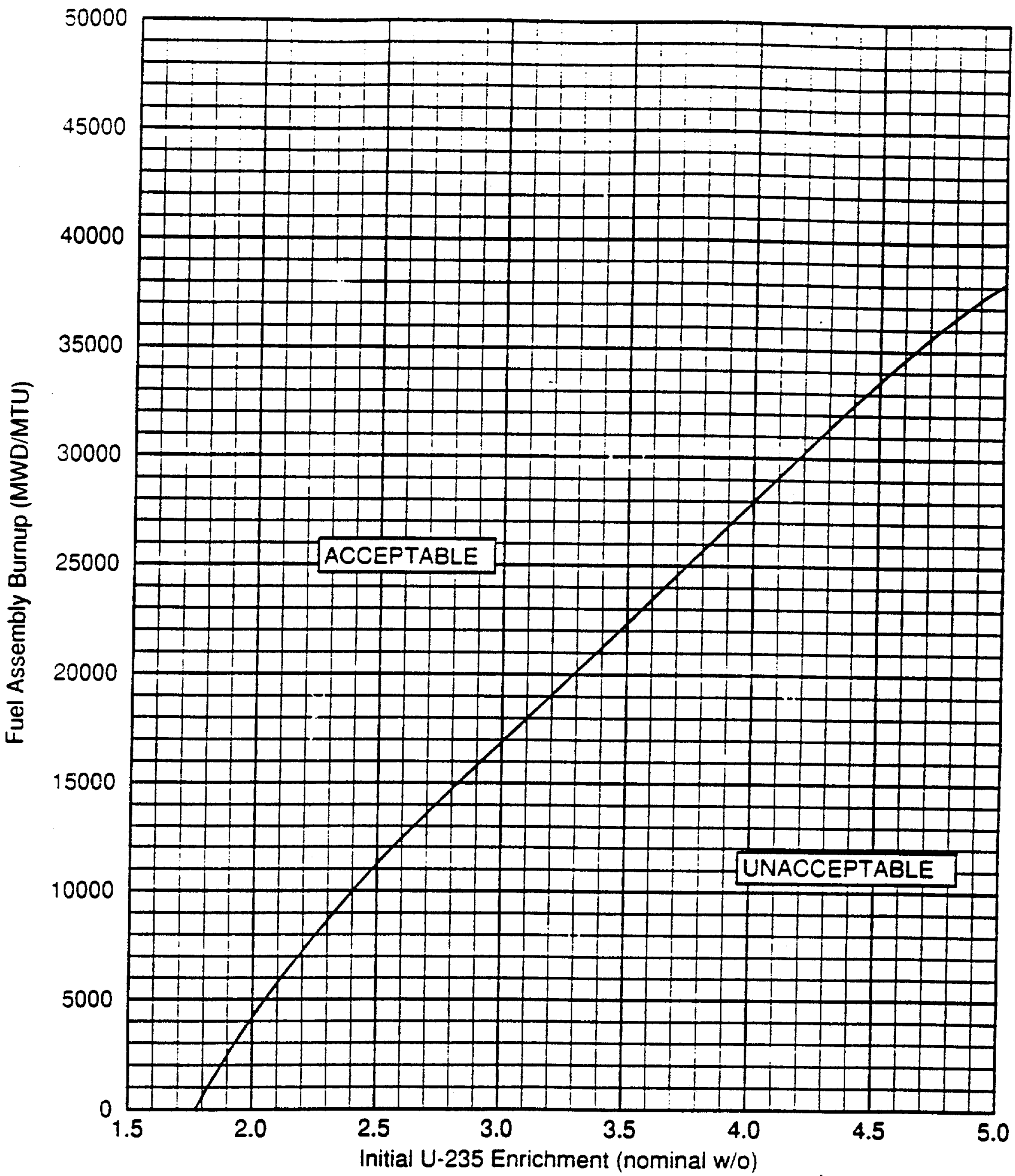


Figure 3.7.18-2 Vogtle Unit 2 Burnup Credit Requirements for All Cell Storage

4.0 DESIGN FEATURES (continued)

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

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

b. K_{eff} < 1.0 when fully flooded with unborated water which includes an allowance for uncertainties as described in Section 4.3 of the FSAR.

c. $k_{eff} \leq 0.95$ when fully flooded with water borated to 450 ppm (Unit 1) or 500 ppm (Unit 2), which includes an allowance for uncertainties as described in Section 4.3 of the FSAR;

d. New or partially spent fuel assemblies with a combination of burnup and initial nominal enrichment in the "acceptable burnup domain" of Figures 3.7.18-1 (Unit 1) or 3.7.18-2 (Unit 2) may be allowed unrestricted storage in the Unit 1 or Unit 2 fuel storage pool, respectively.

e. New or partially spent fuel assemblies with a combination of burnup and initial nominal enrichment in the "acceptable burnup domain" of Figure 4.3.1-1 may be stored in the Unit 1 fuel storage pool in a 3-out-of-4 checkerboard storage configuration as shown in Figure 4.3.1-4.

New or partially spent fuel assemblies with a maximum initial enrichment of 5.0 weight percent U-235 may be stored in the Unit 1 fuel storage pool in a 2-out-of-4 checkerboard storage configuration as shown in Figure 4.3.1-4.

Interfaces between storage configurations in the Unit 1 fuel storage pool shall be in compliance with Figures 4.3.1-6 and 4.3.1-7. "A" assemblies are new or partially spent fuel assemblies with a

(continued)

4.0 DESIGN FEATURES

4.3 Fuel Storage (continued)

combination of burnup and initial nominal enrichment in the "acceptable burnup domain" of Figure 3.7.18-1. "B" assemblies are new or partially spent fuel assemblies with a combination of burnup and initial nominal enrichment in the "acceptable burnup domain" of Figure 4.3.1-1. "C" assemblies are assemblies with initial enrichments up to a maximum of 5.0 weight percent U-235.

New or partially spent fuel assemblies with a combination of burnup and initial nominal enrichment in the "acceptable burnup domain" of Figure 4.3.1-2 may be stored in the Unit 2 fuel storage pool in a 3-out-of-4 checkerboard storage configuration as shown in Figure 4.3.1-4.

New or partially spent fuel assemblies with a maximum initial enrichment of 5.0 weight percent U-235 may be stored in the Unit 2 fuel storage pool in a 2-out-of-4 checkerboard storage configuration as shown in Figure 4.3.1-4.

New or partially spent fuel assemblies with a combination of burnup and initial nominal enrichment in the "acceptable burnup domain" of Figure 4.3.1-3 may be stored in the Unit 2 fuel storage pool as "low enrichment" fuel assemblies in the 3x3 checkerboard storage configuration as shown in Figure 4.3.1-5. New or partially spent fuel assemblies with initial nominal enrichments less than or equal to 3.20 weight percent U-235 or having a maximum reference fuel assembly K_{∞} less than or equal to 1.410 at 68°F may be stored in the Unit 2 fuel storage pool as "high enrichment" fuel assemblies in the 3x3 checkerboard storage configuration as shown in Figure 4.3.1-5.

Interfaces between storage configurations in the Unit 2 fuel storage pool shall be in compliance with Figures 4.3.1-6, 4.3.1-7, 4.3.1-8, and 4.3.1-9. "A" assemblies are new or partially spent fuel assemblies with a combination of burnup and

(continued)

4.0 DESIGN FEATURES

4.3 Fuel Storage (continued)

initial nominal enrichment in the "acceptable burnup domain" of Figure 3.7.18-2. "B" assemblies are new or partially spent fuel assemblies with a combination of burnup and initial nominal enrichment in the "acceptable burnup domain" of Figure 4.3.1-2. "C" assemblies are assemblies with initial enrichments up to a maximum of 5.0 weight percent U-235. "L" assemblies are new or partially spent fuel assemblies with a combination of burnup and initial nominal enrichment in the "acceptable burnup domain" of Figure 4.3.1-3. "H" assemblies are new or partially spent fuel assemblies with initial nominal enrichments less than or equal to 3.20 weight percent U-235 or having a maximum reference fuel assembly K_{∞} less than or equal to 1.410 at 68°F.

f. A nominal 10.6 inch center to center pitch in the Unit 1 high density fuel storage racks; and

g. A nominal 10.58-inch center to center pitch in the north-south direction and a nominal 10.4-inch center to center pitch in the east-west direction in the Unit 2 high density fuel storage racks.

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

a. Fuel assemblies having a maximum U-235 enrichment of 5.05 weight percent;

b. $k_{eff} \leq 0.95$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 4.3 of the FSAR;

c. $k_{eff} \leq 0.98$ if moderated by aqueous foam, which includes an allowance for uncertainties as described in Section 4.3 of the FSAR; and

d. A nominal 21-inch center to center distance between fuel assemblies placed in the storage racks.

4.0 DESIGN FEATURES

4.3 Fuel Storage (continued)

4.3.2 Drainage

The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 194 foot-1 1/2 inch.

4.3.3 Capacity

The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than 288 fuel assemblies in the Unit 1 storage pool and no more than 2098 fuel assemblies in the Unit 2 storage pool.

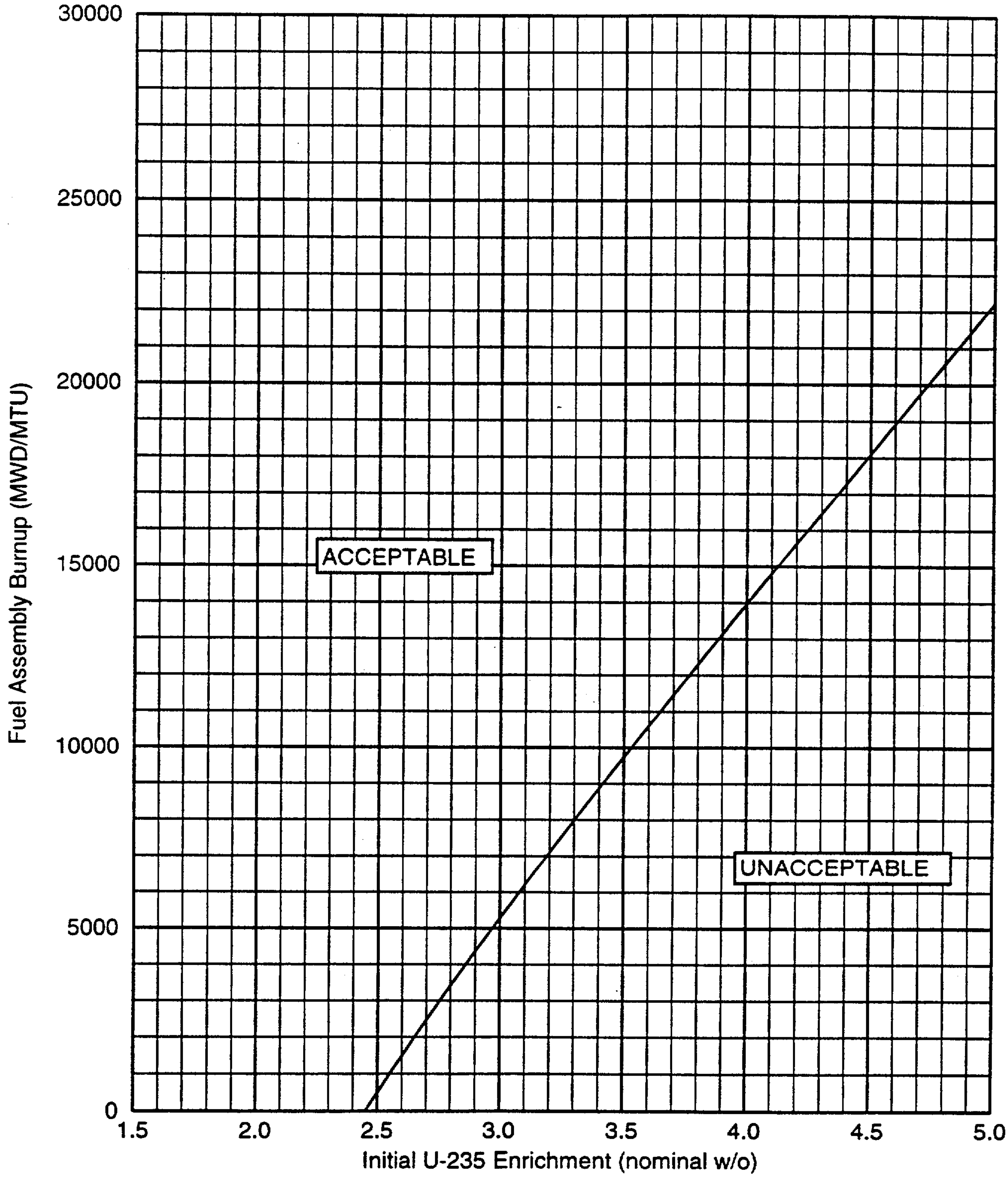


Figure 4.3.1-1 Vogtle Unit 1 Burnup Credit Requirements for 3-out-of-4 Storage

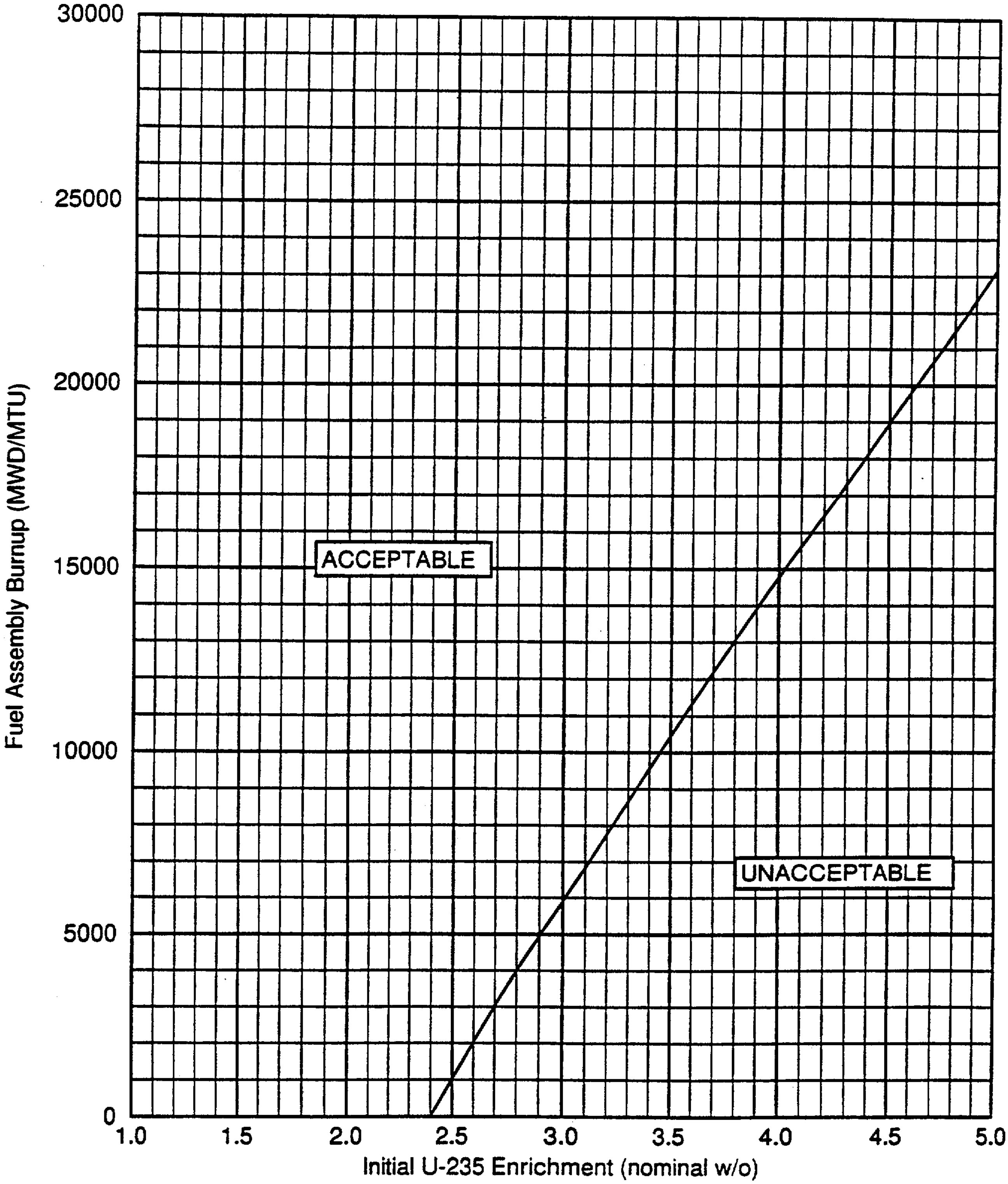


Figure 4.3.1-2 Vogtle Unit 2 Burnup Credit Requirements for 3-out-of-4 Storage

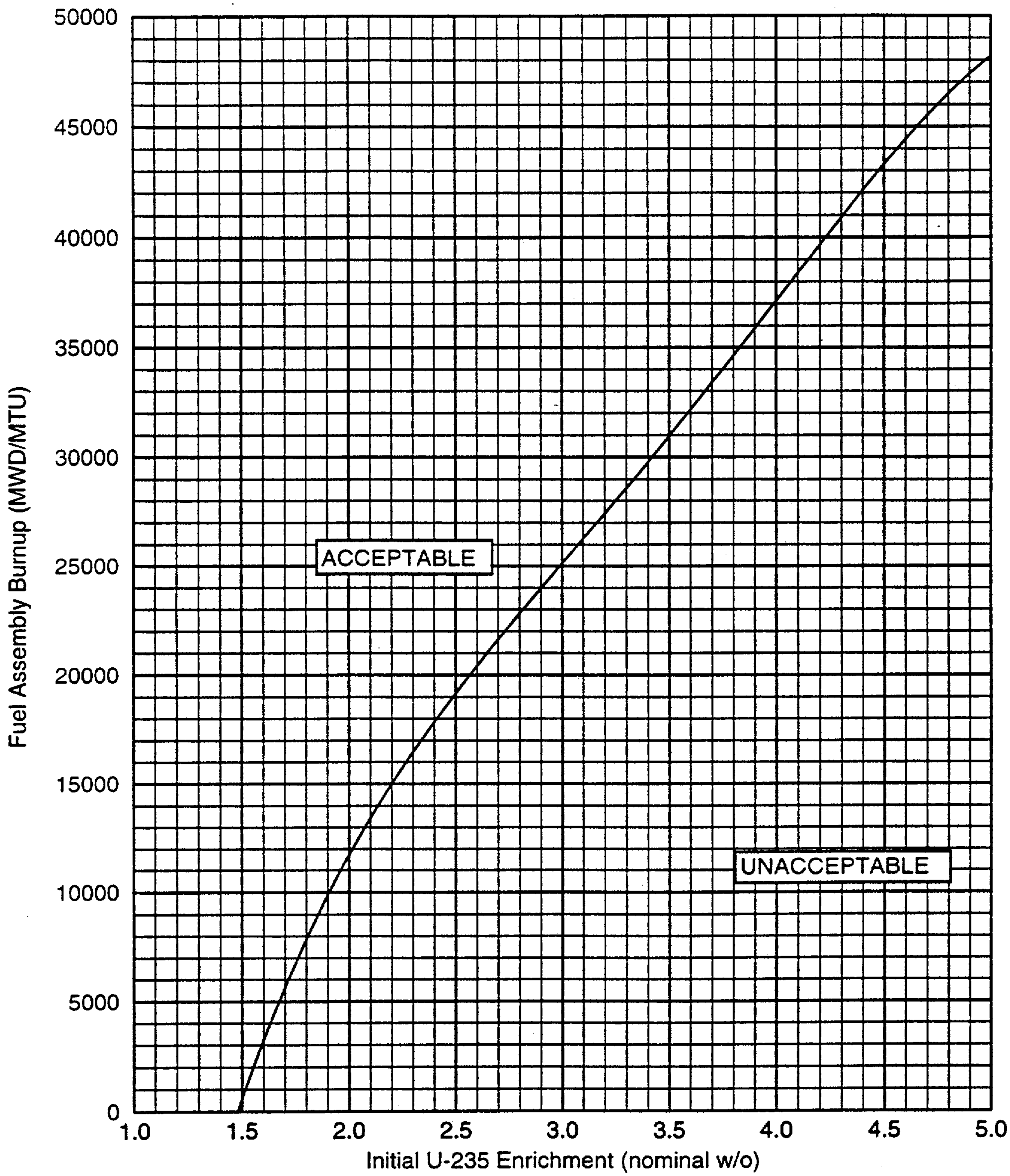


Figure 4.3.1-3 Vogtle Unit 2 Burnup Credit Requirements for 3x3 Storage

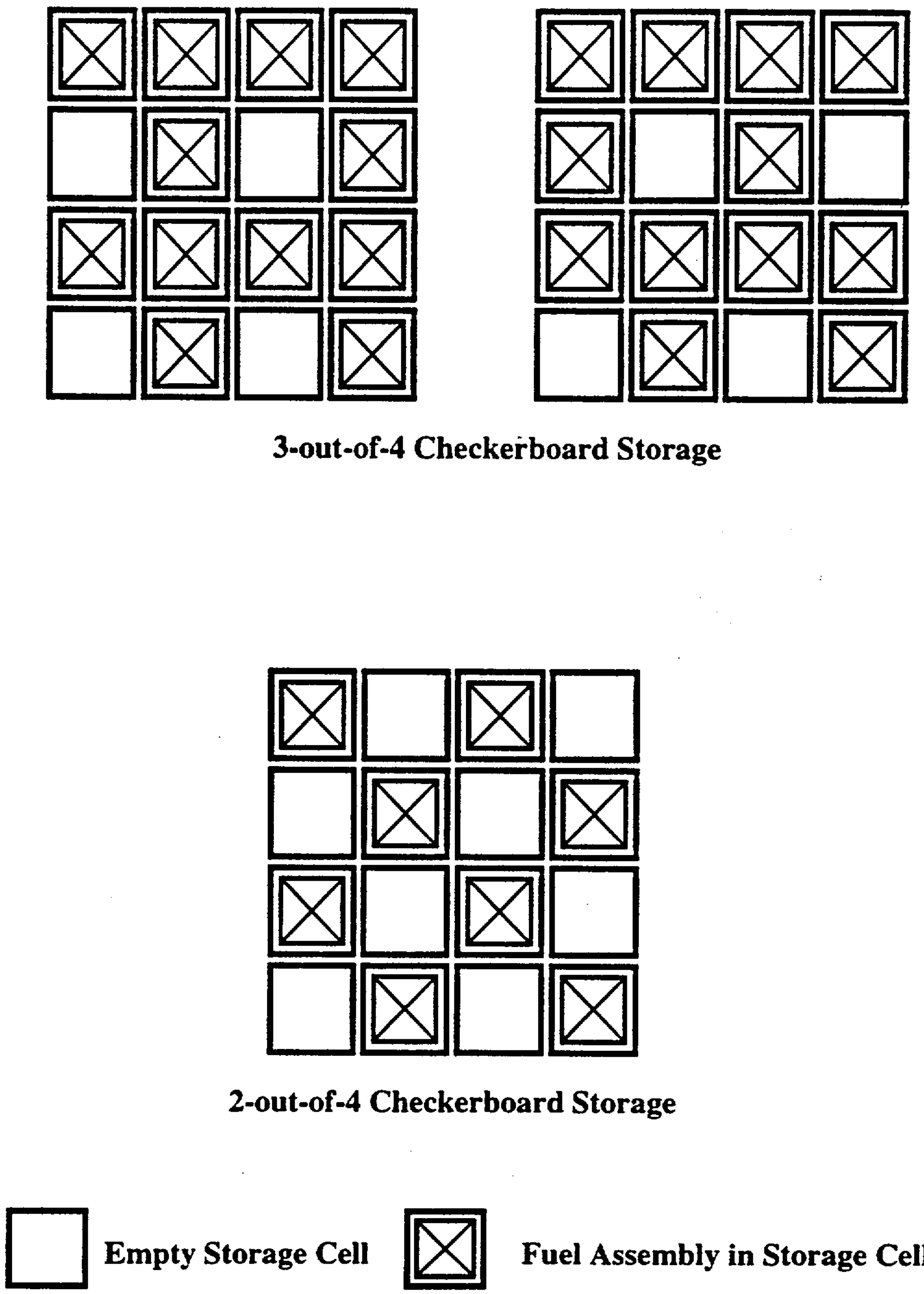


Figure 4.3.1-4 Vogtle Units 1 and 2 Empty Cell Checkerboard Storage Configurations

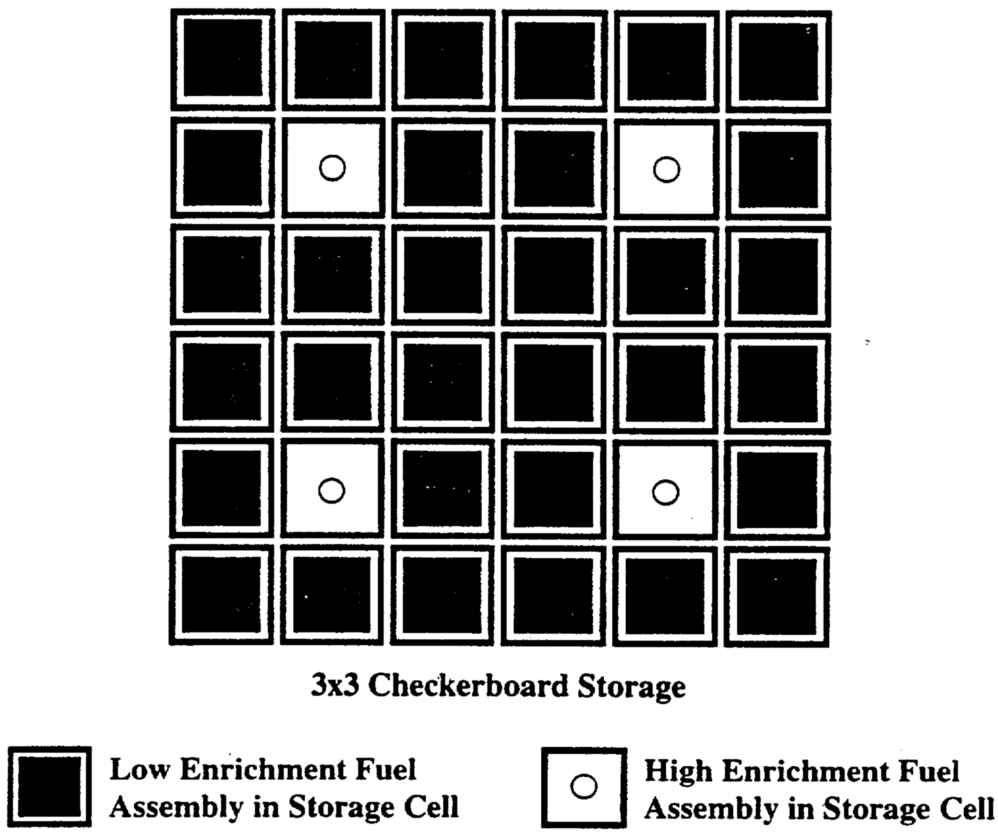
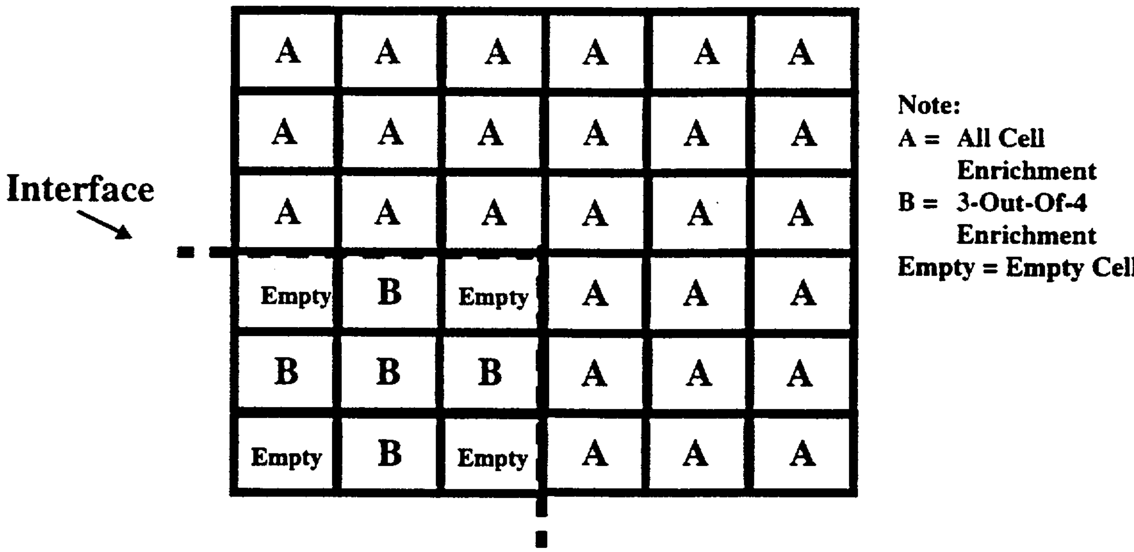
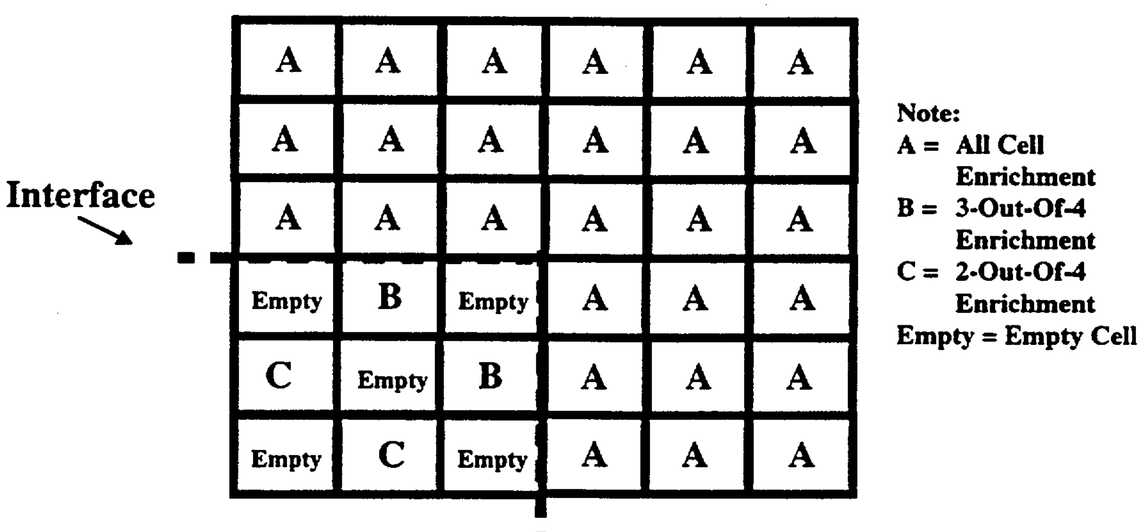


Figure 4.3.1-5 Vogtle Unit 2 3x3 Checkerboard Storage Configuration



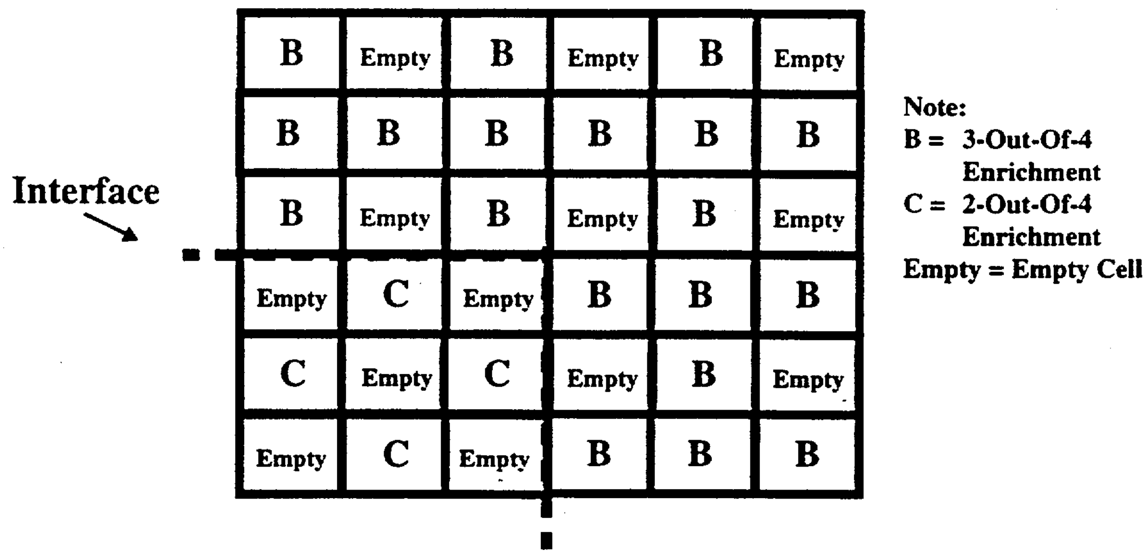
Boundary Between All Cell Storage and 3-out-of-4 Storage



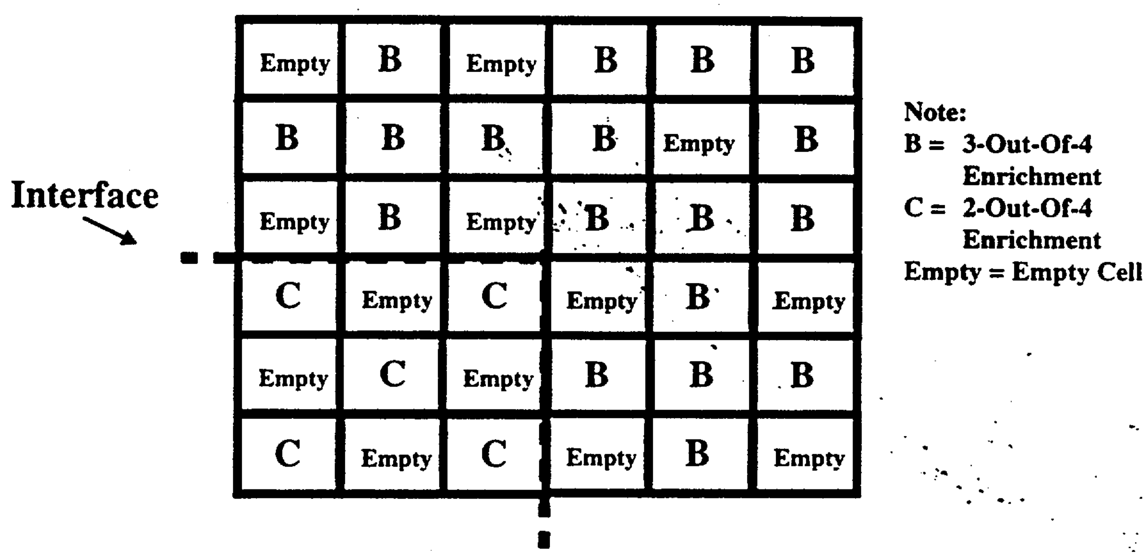
Boundary Between All Cell Storage and 2-out-of-4 Storage

Note:
1. **A row of empty cells can be used at the interface to separate the configurations.**
2. **It is acceptable to replace an assembly with an empty cell.**

Figure 4.3.1-6 Vogtle Units 1 and 2 Interface Requirements (All Cell to Checkerboard Storage)



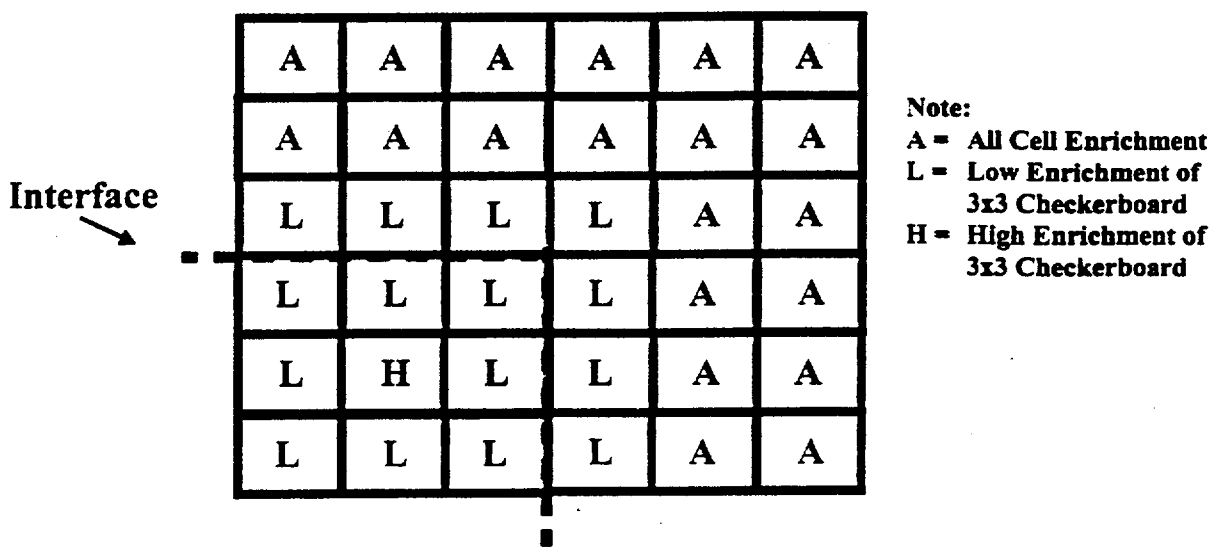
Boundary Between 2-out-of-4 Storage and 3-out-of-4 Storage



Boundary Between 2-out-of-4 Storage and 3-out-of-4 Storage

Note:
1. A row of empty cells can be used at the interface to separate the configurations.
2. It is acceptable to replace an assembly with an empty cell.

Figure 4.3.1-7 Vogtle Units 1 and 2 Interface Requirements (Checkerboard Storage Interface)



Note:
1. A row of empty cells can be used at the interface to separate the configurations.
2. It is acceptable to replace an assembly with an empty cell.

Figure 4.3.1-8 Vogtle Unit 2 Interface Requirements (3x3 Checkerboard to All Cell Storage)

Interface

B	B	B	B	B	B*
Empty	B	Empty	B	Empty	B
L	L	L	L	B	B
L	L	L	L	Empty	B
L	H	L	L	B	B
L	L	L	L	Empty	B

Note:
B = 3-Out-Of-4 Enrichment
L = Low Enrichment of 3x3 Storage
H = High Enrichment of 3x3 Storage
Empty = Empty Cell

Boundary Between 3x3 Storage and 3-out-of-4 Storage

Interface

C	Empty	C	Empty	C	Empty
Empty	B	Empty	B	Empty	C
L	L**	L	L**	B	Empty
L	L	L	L	Empty	C
L	H	L	L**	B	Empty
L	L	L	L	Empty	C

Note:
B = 3-Out-Of-4 Enrichment
L = Low Enrichment of 3x3 Storage
H = High Enrichment of 3x3 Storage
C = 2-Out-Of-4 Enrichment
Empty = Empty Cell

Boundary Between 3x3 Storage and 2-out-of-4 Storage

Note:

1. A row of empty cells can be used at the interface to separate the configurations.
2. It is acceptable to replace an assembly with an empty cell.
3. For the 3-out-of-4 configuration, the row beyond the Low enrichment can swap empty and B assemblies, however the next outer row must change the indicated assembly (*) to an empty cell.
4. For the 2-out-of-4 configuration, the row beyond the Low enrichment can swap empty and B assemblies, however the next outer row of empty and C assemblies must also swap locations.
5. If empty cells are in indicated locations (**), then the face adjacent B assemblies can be C assemblies.

Figure 4.3.1-9 Vogtle Unit 2 Interface Requirements (3x3 to Empty Cell Checkerboard Storage)

(continued)

B 3.7 PLANT SYSTEMS

B 3.7.17 Fuel Storage Pool Boron Concentration

BASES

BACKGROUND

Fuel assemblies are stored in high density racks. The Unit 1 spent fuel storage racks contain storage locations for 288 fuel assemblies, and the Unit 2 spent fuel storage racks contain storage locations for 2098 fuel assemblies. Westinghouse 17x17 fuel assemblies with initial enrichments of up to and including 5.0 weight percent U-235 can be stored in any location in the Unit 1 or Unit 2 fuel storage pool provided the fuel burnup-enrichment combinations are within the limits that are specified in Figures 3.7.18-1 (Unit 1) or 3.7.18-2 (Unit 2) of the Technical Specifications. Fuel assemblies that do not meet the burnup-enrichment combination of Figures 3.7.18-1 or 3.7.18-2 may be stored in the storage pools of Units 1 or 2 in accordance with checkerboard storage configurations described in Figures 4.3.1-1 through 4.3.1-9. The acceptable fuel assembly storage configurations are based on the Westinghouse Spent Fuel Rack Criticality Methodology, described in WCAP-14416-NP-A, Rev. 1, (Reference 4). This methodology includes computer code benchmarking, spent fuel rack criticality calculations methodology, reactivity equivalencing methodology, accident methodology, and soluble boron credit methodology.

The Westinghouse Spent Fuel Rack Criticality Methodology ensures that the multiplication factor, K_{eff}, of the fuel and spent fuel storage racks is less than or equal to 0.95 as recommended by ANSI 57.2-1983 (Reference 3) and NRC guidance (References 1, 2 and 6). The codes, methods, and techniques contained in the methodology are used to satisfy this criterion on K_{eff}.

The methodology of the NITAWL-II, XSDRNPM-S, and KENO-Va codes is used to establish the bias and bias uncertainty. PHOENIX-P, a nuclear design code used primarily for core reactor physics calculations is used to simulate spent fuel storage rack geometries.

(continued)

BASES

BACKGROUND (continued)

Reference 4 describes how credit for fuel storage pool soluble boron is used under normal storage configuration conditions. The storage configuration is defined using K_{eff} calculations to ensure that the K_{eff} will be less than 1.0 with no soluble boron under normal storage conditions including tolerances and uncertainties. Soluble boron credit is then used to maintain K_{eff} less than or equal to 0.95. The Unit 1 pool requires 450 ppm and the Unit 2 pool requires 500 ppm to maintain K_{eff} less than or equal to 0.95 for all allowed combinations of storage configurations, enrichments, and burnups. The analyses assumed 19.9% of the boron atoms have atomic weight 10 (B-10). The effects of B-10 depletion on the boron concentration for maintaining $K_{eff} \leq 0.95$ are negligible. The treatment of reactivity equivalencing uncertainties, as well as the calculation of postulated accidents crediting soluble boron is described in WCAP-14416-NP-A, Rev. 1.

This methodology was used to evaluate the storage of fuel with initial enrichments up to and including 5.0 weight percent U-235 in the Vogtle fuel storage pools. The resulting enrichment, and burnup limits for the Unit 1 and Unit 2 pools, respectively, are shown in Figures 3.7.18-1 and 3.7.18-2. Checkerboard storage configurations are defined to allow storage of fuel that is not within the acceptable burnup domain of Figures 3.7.18-1 and 3.7.18-2. These storage requirements are shown in Figures 4.3.1-1 through 4.3.1-9. A boron concentration of 2000 ppm assures that no credible dilution event will result in a K_{eff} of > 0.95.

APPLICABLE SAFETY ANALYSES

Most fuel storage pool accident conditions will not result in an increase in K_{eff}. Examples of such accidents are the drop of a fuel assembly on top of a rack, and the drop of a fuel assembly between rack modules, or between rack modules and the pool wall.

From a criticality standpoint, a dropped assembly accident occurs when a fuel assembly in its most reactive condition is dropped onto the storage racks. The rack structure from a criticality standpoint is not excessively deformed. Previous accident analysis with unborated water showed that the dropped assembly which comes to rest horizontally on top of the rack has sufficient water separating it from the

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APPLICABLE SAFETY ANALYSES (continued)

active fuel height of stored assemblies to preclude neutronic interaction. For the borated water condition, the interaction is even less since the water contains boron, an additional thermal neutron absorber.

However, three accidents can be postulated for each storage configuration which could increase reactivity beyond the analyzed condition. The first postulated accident would be a change in pool temperature to outside the range of temperatures assumed in the criticality analyses (50°F to 185°F). The second accident would be dropping a fuel assembly into an already loaded cell. The third would be the misloading of a fuel assembly into a cell for which the restrictions on location, enrichment, or burnup are not satisfied.

An increase in the temperature of the water passing through the stored fuel assemblies causes a decrease in water density which would normally result in an addition of negative reactivity. However, since Boraflex is not considered to be present and the fuel storage pool water has a high concentration of boron, a density decrease causes a positive reactivity addition. The reactivity effects of a temperature range from 32°F to 240°F were evaluated. The increase in reactivity due to the increase in temperature is bounded by the misload accident.

For the accident of dropping a fuel assembly into an already loaded cell, the upward axial leakage of that cell will be reduced, however, the overall effect on the rack reactivity will be insignificant. This is because the total axial leakage in both the upward and downward directions for the entire fuel array is worth about 0.003 Δk. Thus, minimizing the upward-only leakage of just a single cell will not cause any significant increase in reactivity. Furthermore, the neutronic coupling between the dropped assembly and the already loaded assembly will be low due to several inches of assembly nozzle structure which would separate the active fuel regions. Therefore, this accident would be bounded by the misload accident.

The fuel assembly misloading accident involves placement of a fuel assembly in a location for which it does not meet the requirements for enrichment or burnup, including the placement of an assembly in a location that is required to be left empty. The result of the misloading is to add positive reactivity, increasing K_{eff} toward 0.95. The

(continued)

BASES (continued)

APPLICABLE SAFETY ANALYSES (continued)

maximum required additional boron to compensate for this event is 1250 ppm for Unit 2, and 1150 ppm for Unit 1 which is well below the limit of 2000 ppm.

The concentration of dissolved boron in the fuel storage pool satisfies Criterion 2 of the NRC Policy Statment.

LCO

The fuel storage pool boron concentration is required to be ≥ 2000 ppm. The specified concentration of dissolved boron in the fuel storage pool preserves the assumptions used in the analyses of the potential criticality accident scenarios as described in reference 5. The amount of soluble boron required to offset each of the above postulated accidents was evaluated for all of the proposed storage configurations. That evaluation established the amount of soluble boron necessary to ensure that K_{eff} will be maintained less than or equal to 0.95 should pool temperature exceed the assumed range or a fuel assembly misload occur. The amount of soluble boron necessary to mitigate these events was determined to be 1250 ppm for Unit 2 and 1150 ppm for Unit 1. The specified minimum boron concentration of 2000 ppm assures that the concentration will remain above these values. In addition, the boron concentration is consistent with the boron dilution evaluation that demonstrated that any credible dilution event could be terminated prior to reaching the boron concentration for a K_{eff} of > 0.95. These values are 450 ppm for Unit 1 and 500 ppm for Unit 2.

APPLICABILITY

This LCO applies whenever fuel assemblies are stored in the spent fuel storage pool.

ACTIONS

A.1, A.2.1, and A.2.2

The Required Actions are modified by a Note indicating that LCO 3.0.3 does not apply.

When the concentration of boron in the fuel storage pool is less than required, immediate action must be taken to preclude the occurrence of an accident or to mitigate the consequences of an accident in progress. This is most

(continued)

BASES

ACTIONS (continued)

efficiently achieved by immediately suspending the movement of fuel assemblies. Immediate action to restore the concentration of boron is also required simultaneously with suspending movement of fuel assemblies. This does not preclude movement of a fuel assembly to a safe position.

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

SURVEILLANCE REQUIREMENTS

SR 3.7.17.1

This SR verifies that the concentration of boron in the fuel storage pool is within the required limit. As long as this SR is met, the analyzed accidents are fully addressed. The 7 day Frequency is appropriate because no major replenishment of pool water is expected to take place over such a short period of time. The gate between the Unit 1 and Unit 2 fuel storage pool is normally open. When the gate is open the pools are considered to be connected for the purpose of conducting the surveillance.

REFERENCES

1. USNRC Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, LWR Edition. NUREG-0800, June 1987.

2. USNRC Spent Fuel Storage Facility Design Bases (for Comment) Proposed Revision 2, 1981. Regulatory Guide 1.13.

3. ANS, "Design Requirements for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations," ANSI/ANS-57.2-1983.

4. WCAP-14416 NP-A, Rev. 1, "Westinghouse Spent Fuel Rack Criticality Analysis Methodology," November 1996.

5. Vogtle FSAR, Section 4.3.2.

6. Nuclear Regulatory Commission, Letter to All Power Reactor Licensees from B. K. Grimes, "OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications," April 14, 1978.

B 3.7 PLANT SYSTEMS

B 3.7.18 Fuel Assembly Storage in the Fuel Storage Pool

BASES

BACKGROUND

The Unit 1 spent fuel storage racks contain storage locations for 288 fuel assemblies, and the Unit 2 spent fuel storage racks contain storage locations for 2098 fuel assemblies.

Westinghouse 17X17 fuel assemblies with an enrichment of up to and including 5.0 weight percent U-235 can be stored in the acceptable storage configurations that are specified in Figures 3.7.18-1 (Unit 1), 3.7.18-2 (Unit 2), and 4.3.1-1 through 4.3.1-9. The acceptable fuel assembly storage locations are based on the Westinghouse Spent Fuel Rack Criticality Methodology, described in WCAP-14416-NP-A, Rev. 1 (reference 1). Additional background discussion can be found in B 3.7.17.

Westinghouse 17x17 fuel assemblies with nominal enrichments no greater than 1.79 w/o^{235}U may be stored in all storage cell locations of the Unit 1 pool. Fuel assemblies with initial nominal enrichment greater than 1.79 w/o^{235}U must satisfy a minimum burnup requirement as shown in Figure 3.7.18-1.

Westinghouse 17x17 fuel assemblies with nominal enrichments no greater than 2.45 w/o^{235}U may be stored in a 3-out-of-4 checkerboard arrangement with empty cells in the Unit 1 pool. Fuel assemblies with initial nominal enrichment greater than 2.45 w/o^{235}U must satisfy a minimum burnup requirement as shown in Figure 4.3.1-1.

Westinghouse 17x17 fuel assemblies with nominal enrichments no greater that 5.0 w/o^{235}U may be stored in a 2-out-of-4 checkerboard arrangement with empty cells in the Unit 1 or Unit 2 pool. There are no minimum burnup requirements for this configuration.

Westinghouse 17x17 fuel assemblies with nominal enrichments no greater than 1.77 w/o^{235}U may be stored in all storage cell locations of the Unit 2 pool. Fuel assemblies with initial nominal enrichment greater than 1.77 w/o^{235}U must satisfy a minimum burnup requirement as shown in Figure 3.7.18-2.

(continued)

BASES

BACKGROUND (continued)

Westinghouse 17x17 fuel assemblies with nominal enrichments no greater than 2.40 w/o ^{235}U may be stored in a 3-out-of-4 checkerboard arrangement with empty cells in the Unit 2 pool. Fuel assemblies with initial nominal enrichment greater than 2.40 w/o ^{235}U must satisfy a minimum burnup requirement as shown in Figure 4.3.1-2.

Westinghouse 17x17 fuel assemblies may be stored in the Unit 2 pool in a 3x3 array. The center assembly must have an initial enrichment no greater than 3.20 w/o ^{235}U. Alternatively, the center of the 3x3 array may be loaded with any assembly which meets a maximum infinite multiplication factor (K_∞) value of 1.410 at 68°F. One method of achieving this value of K_∞ is by the use of IFBAs. The surrounding fuel assemblies must have an initial nominal enrichment no greater than 1.48 w/o ^{235}U or satisfy a minimum burnup requirement for higher initial enrichments as shown in Figure 4.3.1-3.

APPLICABLE SAFETY ANALYSIS

Most fuel storage pool accident conditions will not result in an increase in K_{eff}. Examples of such accidents are the drop of a fuel assembly on top of a rack and the drop of a fuel assembly between rack modules or between rack modules and the pool wall. However, accidents can be postulated for each storage configuration which could increase reactivity beyond the analyzed condition. A discussion of these accidents is contained in B 3.7.17.

The configuration of fuel assemblies in the fuel storage pool satisfies Criterion 2 of the NRC Policy Statement.

LCO

The restrictions on the placement of fuel assemblies within the fuel storage pool ensure the K_{eff} of the fuel storage pool will always remain < 0.95, assuming the pool to be flooded with borated water.

The combination of initial enrichment and burnup are specified in Figures 3.7.18-1 and 3.7.18-2 for all cell storage in the Unit 1 and Unit 2 pools, respectively. Other acceptable enrichment burnup and checkerboard combinations are described in Figures 4.3.1-1 through 4.3.1-9.

(continued)

BASES (continued)

APPLICABILITY

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

ACTIONS

A.1

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

When the configuration of fuel assemblies stored in the fuel storage pool is not in accordance with the acceptable combination of initial enrichment, burnup, and storage configurations, the immediate action is to initiate action to make the necessary fuel assembly movement(s) to bring the configuration into compliance with Figures 3.7.18-1 (Unit 1), 3.7.18-2 (Unit 2), or Specification 4.3.1.1.

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

SURVEILLANCE REQUIREMENTS

SR 3.7.18.1

This SR verifies by administrative means that the initial enrichment and burnup of the fuel assembly is within the acceptable burnup domain of Figures 3.7.18-1 (Unit 1) or 3.7.18-2 (Unit 2). For fuel assemblies in the unacceptable range of Figures 3.7.18-1 and 3.7.18-2, performance of this SR will also ensure compliance with Specification 4.3.1.1.

Fuel assembly movement will be in accordance with preapproved plans that are consistent with the specified fuel enrichment, burnup, and storage configurations. These plans are administratively verified prior to fuel movement. Each assembly is verified by visual inspection to be in accordance with the preapproved plan prior to storage in the fuel storage pool. Storage commences following unlatching of the fuel assembly in the fuel storage pool.

(continued)

BASES (continued)

REFERENCES

1. WCAP-14416-NP-A, Revision 1, "Westinghouse Spent Fuel Rack Criticality Analysis Methodology," November 1996.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 99 TO FACILITY OPERATING LICENSE NPF-68

AND AMENDMENT NO. 77 TO FACILITY OPERATING LICENSE NPF-81

SOUTHERN NUCLEAR OPERATING COMPANY, INC., ET AL.

VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2

DOCKET NOS. 50-424 AND 50-425

1.0 INTRODUCTION

By letter dated August 8, 1997, as supplemented October 10, 1997, January 16, 23, and 27, 1998, Southern Nuclear Operating Company, Inc., et al. (the licensee, SNC) proposed license amendments to change the Technical Specifications (TS) for Vogtle Electric Generating Plant (VEGP), Units 1 and 2. The proposed changes would revise VEGP TS 3.7.17, "Fuel Storage Pool Boron Concentration," TS 3.7.18, "Fuel Assembly Storage in the Fuel Storage Pool," and TS 4.3, "Fuel Storage," to credit soluble boron in the spent fuel pool for maintenance of subcriticality associated with spent fuel storage. The supplements dated January 16, 23, and 27, 1998, provided clarifying information that did not change the scope of the August 8, 1997, application and the initial proposed no significant hazards determination.

2.0 EVALUATION

The VEGP spent fuel storage facility utilizes spent fuel racks that incorporate a fixed neutron poison, which is referred to as "Boraflex." Boraflex, an elastomer that contains boron, is manufactured in sheet form and contained in the sides of the spent fuel racks, and is credited for reduction of the reactivity associated with spent fuel. The VEGP, Units 1 and 2, spent fuel pools normally contain borated water, which has not previously been credited in the reduction of reactivity associated with spent fuel. The spent fuel racks are described in Section 9.1.2, "Spent Fuel Storage" of the VEGP Final Safety Analysis Report.

The August 8, 1997, application and supplements provide analyses that would support the crediting of the borated water in the spent fuel pool for reduction of reactivity associated with the spent fuel. The licensee has provided a criticality analysis to demonstrate that the borated water in the spent fuel pools provides criticality control that meets NRC staff requirements for spent fuel storage without crediting the poison effects of the Boraflex in the spent fuel storage racks. In addition, since the borated water in the spent fuel storage pools is subject to dilution, an analysis of the effects of boron dilution of the spent fuel pools' water was also provided by the licensee. Finally, the licensee has proposed changes to the VEGP TS that assure the assumptions of the spent fuel pool storage analyses remain valid.

2.1 Spent Fuel Criticality

In its letter of August 8, 1997 (Ref. 1), SNC requested changes to the VEGP, Units 1 and 2, TS to allow the use of credit for soluble boron in the spent fuel pool criticality analyses. These criticality analyses were performed using the methodology developed by the Westinghouse Owners Group (WOG) and described in WCAP-14416-NP-A, "Westinghouse Spent Fuel Rack Criticality Analysis Methodology" (Ref. 2).

The VEGP spent fuel storage racks were analyzed using the Westinghouse methodology, which has been reviewed and approved by the NRC (Ref. 3). This methodology takes partial credit for soluble boron in the fuel storage pool criticality analyses and requires conformance with the following NRC acceptance criteria for preventing criticality outside the reactor:

(1) k_{eff} shall be less than 1.0 if the pool is fully flooded with unborated water, which includes an allowance for uncertainties at a 95% probability, 95% confidence (95/95) level as described in WCAP-14416-NP-A; and

(2) k_{eff} shall be less than or equal to 0.95 if the pool is fully flooded with borated water, which includes an allowance for uncertainties at a 95/95 level as described in WCAP-14416-NP-A.

The analysis of the reactivity effects of fuel storage in the VEGP spent fuel racks was performed with the three-dimensional Monte Carlo code, KENO-Va, with neutron cross sections generated with the NITAWL-II and XSDRNPM-S codes using the 227 group ENDF/B-V cross-section library. Since the KENO-Va code package does not have burnup capability, depletion analyses and the determination of small reactivity increments due to manufacturing tolerances were made with the two-dimensional transport theory code, PHOENIX-P, which uses a 42 energy group nuclear data library. The analytical methods and models used in the reactivity analysis have been benchmarked against experimental data for fuel assemblies similar to those for which the VEGP racks are designed and have been found to adequately reproduce the critical values. This experimental data is sufficiently diverse to establish that the method bias and uncertainty will apply to rack conditions which include close proximity storage and strong neutron absorbers. The staff concludes that the analysis methods used are acceptable and capable of predicting the reactivity of the VEGP storage racks with a high degree of confidence.

The VEGP spent fuel storage racks have previously been qualified for storage of various Westinghouse 17 x 17 fuel assembly types with maximum enrichments up to 4.55 weight percent (w/o) U-235. The maximum enrichment is based on a nominal value of 4.50 w/o U-235 plus a manufacturing tolerance of 0.05. The spent fuel rack Boraflex absorber panels were considered in this previous analysis. Because of the Boraflex deterioration that has been observed in many spent fuel pools, the VEGP spent fuel storage racks have been reanalyzed neglecting the presence of Boraflex to allow storage of all 17 x 17 fuel assemblies with nominal enrichments up to 5.0 w/o U-235 (enrichment tolerance of ±0.05 w/o U-235) using credit for checkerboarding, burnup, burnable absorbers, and soluble boron.

The moderator was assumed to be pure water at a temperature of 68 °F and a density of 1.0 gm/cc and the array was assumed to be infinite in lateral extent. Uncertainties due to tolerances in fuel enrichment and density, storage cell inner diameter, storage cell pitch, stainless steel thickness, assembly position, calculational uncertainty, and methodology bias uncertainty were accounted for. These uncertainties were appropriately determined at the 95/95 probability/confidence level. 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. These biases and uncertainties meet the previously stated NRC requirements and are, therefore, acceptable.

For Unit 1, an enrichment of 1.79 w/o U-235 was found to be adequate to maintain k_{eff} less than 1.0 with all cells filled with Westinghouse 17 x 17 fuel assemblies and no soluble boron in the pool water. This resulted in a nominal k_{eff} of 0.94250. 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} values, as described in Reference 2. This resulted in a 95/95 k_{eff} of 0.99784. For Unit 2, a maximum initial nominal enrichment of 1.77 w/o U-235 resulted in a 95/95 k_{eff} of 0.99851. Since these values are less than 1.0 and were determined at a 95/95 probability/confidence level, they meet the NRC criterion for precluding criticality with no credit for soluble boron and are acceptable.

Soluble boron credit is used to provide safety margin by maintaining the effective multiplication factor, k_{eff}, less than or equal to 0.95 including 95/95 uncertainties. The soluble boron credit calculations assumed the all cell storage configuration moderated by water borated to 200 ppm (Unit 1) and 150 ppm (Unit 2). As previously described, the individual tolerances and uncertainties, and the temperature and methodology biases, were added to the calculated nominal k_{eff} to obtain a 95/95 value. The resulting 95/95 k_{eff} was 0.93457 for fuel enriched to 1.79 w/o U-235 in Unit 1 and 0.94998 for fuel enriched to 1.77 w/o U-235 in Unit 2. Since k_{eff} is less than 0.95 with 200 ppm (Unit 1) and 150 ppm (Unit 2) of boron and uncertainties at a 95/95 probability/confidence level, the NRC acceptance criterion for precluding criticality is satisfied. These values are well below the minimum spent fuel pool boron concentration value of 2000 ppm required by proposed TS 3.7.17 and are, therefore, acceptable.

The concept of reactivity equivalencing due to fuel burnup was used to achieve the storage of fuel assemblies with enrichments higher than 1.79 w/o U-235 (Unit 1) or 1.77 w/o U-235 (Unit 2) for the all cell storage configuration. The NRC has previously accepted the use of reactivity equivalencing predicated upon the reactivity decrease associated with fuel depletion. To determine the amount of soluble boron required to maintain $k_{eff} \leq 0.95$ for storage of fuel assemblies with enrichments up to 5.0 w/o U-235, a series of reactivity calculations were performed to generate a set of enrichment versus fuel assembly discharge burnup ordered pairs, which all yield an equivalent k_{eff} when stored in the VEGP spent fuel storage racks. These are shown in proposed TS Figure 3.7.18-1 for Unit 1 and proposed TS Figure 3.7.18-2 for Unit 2 and represent combinations of fuel enrichment and discharge burnup, which yield the same rack k_{eff} as the rack loaded with fresh 1.79 w/o fuel (Unit 1) or 1.77 w/o fuel (Unit 2). 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 calculational and depletion uncertainties and 5% on the calculated burnup to account for burnup measurement uncertainty.

The NRC staff concludes that these uncertainties conservatively reflect the uncertainties associated with burnup calculations and are acceptable. The amount of additional soluble boron, above the value required above, that is needed to account for these uncertainties is 250 ppm in Unit 1 and 200 ppm in Unit 2. This results in a total soluble boron credit for the all cell configuration of 450 ppm (Unit 1) and 350 ppm (Unit 2). These values are well below the minimum spent fuel pool boron concentration value of 2000 ppm required by proposed TS 3.7.17 and are, therefore, acceptable.

The VEGP spent fuel pool was also analyzed assuming a 3-out-of-4 checkerboard storage configuration containing three initially enriched 2.45 w/o U-235 assemblies (Unit 1) and three initially enriched 2.40 w/o U-235 assemblies (Unit 2) and an empty cell. This resulted in a 95/95 k_{eff} of 0.99578 for Unit 1 and 0.99464 for Unit 2 with no credit for soluble boron or Boraflex. These values meet the NRC criterion of k_{eff} less than 1.0 with no credit for boron. The same configurations were then analyzed to obtain the required 5% subcritical margin assuming 200 ppm of soluble boron. The resulting 95/95 k_{eff} was 0.93777 (Unit 1) and 0.93716 (Unit 2). Since these k_{eff} values are less than 0.95, including soluble boron credit and uncertainties at a 95/95 probability/confidence level, the NRC acceptance criterion is met for the 3-out-of-4 cells storage configuration in Units 1 and 2.

Burnup reactivity equivalencing, as previously described, was also used to determine the allowed storage of fuel assemblies with enrichments higher than 2.45 w/o (Unit 1) and 2.40 w/o (Unit 2) but no greater than 5.0 w/o U-235 in the 3-out-of-4 configuration. The amount of soluble boron needed to account for the additional uncertainties associated with burnup credit in both Units was 150 ppm. This is additional boron above the 200 ppm required above, resulting in a total soluble boron requirement of 350 ppm. This is well below the minimum spent fuel pool boron concentration value of 2000 ppm required by proposed TS 3.7.17 and is, therefore, acceptable.

A separate criticality analysis for a 2-out-of-4 checkerboard storage configuration in unborated water resulted in a 95/95 k_{eff} of 0.95741 for Unit 1 and 0.96067 for Unit 2. The soluble boron credit calculations yielded a 95/95 k_{eff} of 0.93835 with the presence of 100 ppm of boron for Unit 1 and 0.94737 with the presence of 50 ppm of boron for Unit 2.

A final configuration was analyzed for Unit 2 which consisted of a 3x3 checkerboard arrangement of cells containing one 3.20 w/o assembly in the center surrounded by 1.48 w/o U-235 enriched assemblies. This configuration resulted in a 95/95 k_{eff} of 0.99911 in unborated water, thereby meeting the subcriticality acceptance criterion of less than 1.0 with no credit for boron. The amount of soluble boron required to maintain $k_{eff} \leq 0.95$ was 200 ppm, which resulted in a 95/95 k_{eff} of 0.94047.

Storage of assemblies with enrichments higher than 1.48 w/o U-235 in the peripheral cells of the 3x3 checkerboard configuration was determined using burnup reactivity equivalencing. Combinations of initial fuel enrichment and discharge burnup, which yield the same storage rack k_{eff} as the rack containing 1.48 w/o U-235 assemblies at zero burnup (proposed TS Figure 4.3.1-3) required an additional 300 ppm of boron to account for the uncertainties associated with burnup credit.

Storage of assemblies with enrichments higher than 3.20 w/o U-235 in the center cell of the 3x3 checkerboard configuration in the VEGP Unit 2 storage racks was determined by crediting the reactivity decrease associated with the addition of integral fuel burnable absorbers (IFBAs). The IFBAs consist of neutron absorbing material applied as a thin ZrB_2 coating on the outside of the UO_2 pellet. The fuel assembly is modeled at its most reactive point in life. This includes any time in life when the IFBA has depleted and the fuel assembly becomes more reactive. As with burnup credit, for IFBA credit reactivity equivalencing, a series of reactivity calculations are performed to generate a set of IFBA rod number versus initial enrichment ordered pairs which all yield the equivalent k_{eff} when the fuel is stored in the 3x3 checkerboard configuration analyzed for the VEGP spent fuel racks in Unit 2. Uncertainties associated with IFBA credit include a 5% manufacturing tolerance and a 10% calculational uncertainty on the B-10 loading of the IFBA rods. The staff finds these uncertainties adequately conservative and acceptable. The amount of additional soluble boron needed to account for these uncertainties is bounded by the 300 ppm required for burnup credit in the 3x3 checkerboard configuration.

Therefore, with the above reactivity equivalencing, fuel assemblies with nominal enrichments up to 5.0 w/o U-235 can be stored in the center of a 3x3 checkerboard configuration by taking credit for a total additional amount of soluble boron of 300 ppm. When added to the 200 ppm required without reactivity equivalencing, this results in a total boron requirement of 500 ppm, which is more than the amount required for any of the other storage configurations. However, this is well below the minimum spent fuel pool boron concentration value of 2000 ppm required by proposed TS 3.7.17 and is, therefore, acceptable.

As an alternative method for determining the acceptability of fuel assembly storage based on IFBA loading, the infinite multiplication factor, k_∞, was used as a reference reactivity value. When k_∞ is used as a reference reactivity point, the need to specify an acceptable enrichment versus number of IFBA rods correlation is eliminated. Fuel assemblies with a reference k_∞ of 1.410 in the VEGP core geometry at 68 °F have been shown to result in a maximum $k_{eff} \leq 0.95$ when stored in the VEGP spent fuel storage racks. Therefore, the center assembly in the 3x3 checkerboard configuration must have an initial nominal enrichment less than or equal to 3.20 w/o U-235, or satisfy a minimum IFBA requirement for higher initial enrichments to maintain the reference fuel assembly k_∞ less than or equal to 1.410 at 68 °F in the VEGP core geometry.

Although most accidents will not result in a reactivity increase, three accidents can be postulated for each storage configuration, which would increase reactivity beyond the analyzed conditions. The first would be a loss of fuel pool cooling system and a rise in pool water temperature from 185 °F to 240 °F. The second accident involves a misloading of an assembly into a cell for which the restrictions on location, enrichment, or burnup are not satisfied. Calculations have shown that the misloaded assembly accident in the Unit 2 2-out-of-4 checkerboard results in the highest reactivity increase. The reactivity increase requires an additional 1200 ppm of soluble boron to maintain $k_{eff} \leq 0.95$. However, for such events, the double contingency principle can be applied. This states that the assumption of two unlikely, independent, concurrent events is not required to ensure protection against a criticality accident. Therefore, the minimum amount of boron required by proposed TS 3.7.17

(2000 ppm) is more than sufficient to cover any accident and the presence of the additional boron above the concentration required for normal conditions and reactivity equivalencing (500 ppm maximum) can be assumed as a realistic initial condition since not assuming its presence would be a second unlikely event.

Based on the review previously described, the staff finds the criticality aspects of the proposed VEGP license amendment request are acceptable and meet the requirements of General Design Criterion 62 for the prevention of criticality in fuel storage and handling. The analysis assumed credit for soluble boron, as allowed by WCAP-14416-NP-A, but no credit for the Boraflex neutron absorber panels. The required amount of soluble boron for each analyzed storage configuration is shown in Table 1 of this safety evaluation.

2.2 Proposed TS Associated with Criticality Analysis

The TS changes proposed as a result of the revised criticality analysis are consistent with the changes stated in the NRC Safety Evaluation (SE) for WCAP-14416-P (Ref. 3). Westinghouse submitted a revised topical report, WCAP-14416-NP-A, Rev. 1, which incorporated the changes stated in the NRC SE. Also, since the staff disagreed with the proprietary finding of the original WCAP-14416-P, Westinghouse's revised topical report was submitted as a nonproprietary version.

Proposed TS 3.7.17, "Fuel Storage Pool Boron Concentration," requires that a minimum boron concentration of 2000 ppm be maintained in the spent fuel storage pool. The 2000 ppm concentration is consistent with the criticality analysis and is acceptable. Similarly, the licensee has proposed a limit of k_{eff} <1.0, when the spent fuel racks are flooded with unborated water (in accordance with proposed TS 4.3.1.1b) and a $k_{eff} \leq .95$ when flooded with water borated to 450 ppm (for Unit 1) or 500 ppm (for Unit 2) in accordance with proposed TS 4.3.1.1c. These limits on k_{eff} are consistent with the criticality analysis and the proposed TS are acceptable.

Proposed TS 3.7.18, "Fuel Assembly Storage in the Fuel Storage Pool," and proposed TS 4.3, "Fuel Storage," describe allowable spent fuel storage configurations. The following storage configurations and U-235 enrichment limits for Westinghouse 17 x 17 fuel assemblies were determined to be acceptable:

For VEGP Unit 1:

Assemblies with initial nominal enrichments no greater than 1.79 w/o U-235 can be stored in any cell location. Fuel assemblies with initial nominal enrichments greater than 1.79 w/o U-235 and up to 5.0 w/o U-235 must satisfy a minimum burnup requirement as shown in proposed TS Figure 3.7.18-1, "Vogtle Unit 1 Burnup Credit Requirements for All Cell Storage."

Assemblies with initial nominal enrichments no greater than 2.45 w/o U-235 can be stored in a 3-out-of-4 checkerboard arrangement. Fuel assemblies with initial nominal enrichments greater than 2.45 w/o U-235 and up to 5.0 w/o U-235 must satisfy a minimum burnup requirement as shown in proposed TS Figure 4.3.1-1, "Vogtle Unit 1 Burnup Credit Requirements for 3-out-of-4 Storage."

Assemblies with initial nominal enrichments no greater than 5.0 w/o U-235 can be stored in a 2-out-of-4 checkerboard arrangement as shown in proposed TS Figure 4.3.1-4, "Vogtle Units 1 and 2 Empty Cell Checkerboard Storage Configuration."

For VEGP Unit 2:

Assemblies with initial nominal enrichments no greater than 1.77 w/o U-235 can be stored in any cell location. Fuel assemblies with initial nominal enrichments greater than 1.77 w/o U-235 and up to 5.0 w/o U-235 must satisfy a minimum burnup requirement as shown in proposed TS Figure 3.7.18-2, "Vogtle Unit 2 Burnup Credit Requirements for All Cell Storage."

Assemblies with initial nominal enrichments no greater than 2.40 w/o U-235 can be stored in a 3-out-of-4 checkerboard arrangement as shown in proposed TS Figure 4.3.1-4. Fuel assemblies with initial nominal enrichments greater than 2.40 w/o U-235 and up to 5.0 w/o U-235 must satisfy a minimum burnup requirement as shown in proposed TS Figure 4.3.1-2, "Vogtle Unit 2 Burnup Credit Requirements for 3-out-of-4 Storage."

Assemblies with initial nominal enrichments no greater than 5.0 w/o U-235 can be stored in a 2-out-of-4 checkerboard arrangement as shown in proposed TS Figure 4.3.1-4.

Assemblies can be stored in a 3x3 checkerboard arrangement consisting of a center assembly with an initial nominal enrichment no greater than 3.20 w/o U-235 surrounded by assemblies with initial nominal enrichments no greater than 1.48 w/o U-235, as shown in propose TS Figure 4.3.1-5, "Vogtle Unit 2 3x3 Checkerboard Storage Configuration." Fuel assemblies with initial enrichments greater than 1.48 w/o U-235 and up to 5.0 w/o U-235 must satisfy a minimum burnup requirement as shown in proposed TS Figure 4.3.1-3 or must satisfy a minimum IFBA requirement that maintains a maximum reference fuel assembly k_∞ less than or equal to 1.410 at 68 °F.

In order to prevent an undesirable increase in reactivity, the boundaries between the different storage configurations were analyzed. The interface requirements are shown in proposed TS Figures as follows: TS Figure 4.3.1-6, "Vogtle Units 1 and 2 Interface Requirements (All Cell to Checkerboard Storage)," TS Figure 4.3.1-7, "Vogtle Units 1 and 2 Interface Requirements (Checkerboard Storage Interface)," TS Figure 4.3.1-8, "Vogtle Unit 2 Interface Requirements (3x3 Checkerboard to All Cell Storage)," and TS Figure 4.3.1-9, "Vogtle Unit 2 Interface Requirements (3x3 to Empty Cell Checkerboard Storage)." These interface requirements are consistent with the criticality analysis and are acceptable.

Based on this consistency with the approved methodology and on the preceding evaluation, the staff finds the proposed TS changes, associated with the criticality analysis, acceptable. The proposed associated Bases changes adequately describe these TS changes and are also acceptable.

TABLE 1

Summary of Soluble Boron Credit Requirements for Vogtle Units 1 and 2

Storage Configuration	Soluble Boron Required for $k_{eff} \leq 0.95$ (ppm)	Soluble Boron Required for Reactivity Equivalencing (ppm)	Total Soluble Boron Credit Required Without Accidents (ppm)
Unit 1 All Cells	200	250	450
3-out-of-4 Checkerboard	200	150	350
2-out-of-4 Checkerboard	100	N/A	100
2-out-of-4 Checkerboard	50	N/A	50
3x3 Checkerboard	200	300	500

2.4 Boron Dilution Analysis

In accordance with the NRC SE (Ref. 3) of the Westinghouse methodology described in WCAP-14416-NP-A (Ref. 2), the licensee performed a boron dilution analysis to ensure that sufficient time is available to detect and mitigate the dilution prior to exceeding the 0.95 k_{eff} design basis. The licensee provided boron dilution analyses by letters dated August 8, 1997 (Ref. 1), and January 16, 1998 (Ref. 4). Potential events were quantified to show that sufficient time is available to enable adequate detection and suppression of any dilution event.

Deterministic dilution event calculations were performed for VEGP to define the dilution times and volumes necessary to dilute the spent fuel pool from the minimum TS boron concentration of 2000 ppm to a soluble boron concentration of 600 ppm. This concentration of 600 ppm is conservative with respect to the criticality analysis, which indicated that a soluble boron credit of 500 ppm is sufficient to maintain k_{eff} less than or equal to 0.95. Unit 1 and Unit 2 spent fuel pools have a combined volume of 772,000 gallons and are normally connected. However, no controls exist to ensure this configuration. Therefore, for the analysis, the spent fuel pools are assumed to be separated because it is a more limiting configuration for a boron dilution event. The volume required to dilute 386,000 gallons in one spent fuel pool from the TS limit of 2000 ppm to 600 ppm is 465,000 gallons. The various events that were considered included dilution from the utility water, chilled water, demineralized water system, fire protection system, component cooling water system, and chemical volume and control system, and other events that may affect the boron concentration of the pool, such as seismic events, pipe break, and loss of offsite power.

The licensee's evaluation concluded that the most limiting event was a random pipe break of the 6-inch fire protection line. This fire protection line provides the largest flow rate of the possible dilution sources. Additionally, the water in the fire protection tanks, which contain 600,000 gallons, is sufficient to dilute the spent fuel pool to 600 ppm without replenishment. A break in the 6-inch fire protection line would take approximately 3 hours at the pump's design flow rate of 2500 gpm to dilute the spent fuel pool to 600 ppm. The fire protection piping in the spent fuel pool area is not seismically qualified, but is seismically supported. As such, in accordance with the mechanical engineering and plant systems branch technical positions (BTP) 3-1, it is not required to assume a full break for moderate energy, seismically supported lines. Therefore, the use of the pump design flow rate is a conservative value for this application and is acceptable. In addition to the spent fuel pool level alarms, the fire pump running and low fire protection tank level alarms would provide indication of the event for plant personnel. It is expected that the addition of the large volume of water in the spent fuel pool area for this dilution event would be detected by alarms or plant personnel and terminated prior to reaching 600 ppm.

For VEGP, a seismic event is a concern for the dilution of the spent fuel pool. The licensee determined that a seismic event could dilute the spent fuel pool in approximately 9 hours. This is a concern because the dilution could occur in the time between personnel rounds (every 12 hours). Nonseismic piping located in the spent fuel pool room includes the fire protection lines, demineralized water line, chiller water line, and utility water line. Like the fire protection lines discussed herein, these lines are not seismically qualified, but are seismically supported.

The licensee postulated a through wall crack in the fire protection line with a flow of 168 gpm and a full break in all other nonseismic piping. The licensee followed mechanical engineering BTP 3-1 to determine the crack flow rate. It would take approximately 9 hours at a rate of 1413 gpm for 15 minutes and then 813 gpm thereafter to dilute the spent fuel pool to 600 ppm. Also, the licensee will revise plant procedures to instruct personnel to specifically check the spent fuel pool room for piping damage following a seismic event. It is expected that plant personnel would detect the addition of the water in the spent fuel pool area prior to reaching 600 ppm following a seismic event and the dilution would be, subsequently, terminated.

Other evaluated dilution events take longer than 12 hours to reach the minimum boron concentration. These events would be detected by plant personnel during required rounds every 12 hours. To detect low flow, long-term dilution events, the licensee will sample its spent fuel pool every 7 days in accordance with proposed TS 3.7.17. This frequency is consistent with the standard TS for Westinghouse plants and is considered adequate for VEGP.

The licensee concluded that an event that would dilute the spent fuel pool boron concentration from 2000 ppm to 600 ppm is not credible. The staff finds that the combination of the large volume of water required for a dilution event, TS-controlled spent fuel pool concentration and 7-day sampling requirement, spent fuel pool alarms and other alarms, plant personnel rounds, and other administrative controls, such as procedures, should adequately detect a dilution event prior to k_{eff} reaching 0.95 (600 ppm) and, therefore, the analysis and proposed technical specification controls are acceptable for the boron dilution aspects of the request.

Additionally, the criticality analysis for the spent fuel storage pool shows that k_{eff} would remain less than 1.0 at a 95/95 probability/confidence level even if the pool were completely filled with unborated water. Therefore, even if the spent fuel storage pool was diluted to zero ppm, the racks are expected to remain subcritical.

Based on the review previously described, the staff finds the boron dilution aspects of the proposed VEGP license amendment request to be acceptable.

2.4 Proposed TS Associated with Boron Dilution

The proposed TS 3.7.17 boron concentration of 2000 ppm and 7-day surveillance requirement, together with the proposed remedial action requirements, are acceptable to ensure that sufficient time is available to detect and mitigate the dilution of a VEGP spent fuel pool prior to exceeding the design basis k_{eff} of 0.95. Accordingly, proposed TS 3.7.17 is acceptable.

3.0 STATE CONSULTATION

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

4.0 ENVIRONMENTAL CONSIDERATION

The amendments change requirements with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and change surveillance requirements. The NRC staff has determined that the amendments involve 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 amendments involve no significant hazards consideration, and there has been no public comment on such finding (62 FR 68136 dated December 31, 1997). Accordingly, the amendments meet 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 amendments.

5.0 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 amendments will not be inimical to the common defense and security or to the health and safety of the public.

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REFERENCES

1. C. K. McCoy, SNC, letter to U.S. Nuclear Regulatory Commission, "Vogtle Electric Generating Plant, Response to Request for Additional Information, Revised Request to Revise Technical Specifications, Credit For Boron And Enrichment Increase For Fuel Storage," August 8, 1997.

2. W. D. Newmyer, "Westinghouse Spent Fuel Rack Criticality Analysis Methodology," Westinghouse Electric Corporation, WCAP-14416-NP-A, November 1996.

3. T. E. Collins, NRC, letter to T. Greene, WOG, "Acceptance for Referencing of Licensing Topical Report WCAP-14416-P, Westinghouse Spent Fuel Rack Criticality Analysis Methodology" (TAC No. M93254), October 25, 1996.

4. C. K. McCoy, SNC, letter to U.S. Nuclear Regulatory Commission, "Vogtle Electric Generating Plant, Additional Information Fuel Storage Pool Boron Dilution," January 16, 1998.