TVA

Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

September 26, 2013

10 CFR 50.36

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

Watts Bar Nuclear Plant, Unit 2
NRC Docket No. 50-391

Subject: **Watts Bar Nuclear Plant Unit 2 – Submittal of Revised Section 4.3.1, "Criticality" Developmental Revision G of the Unit 2 Technical Specification**

References:

1. TVA letter to NRC dated July 30, 2013, "Watts Bar Nuclear Plant (WBN) Unit 1 – Application to Modify Technical Specification 4.3.1, 'Criticality' (WBN-TS-2012-03)" (ADAMS Accession No. ML13213A018)

2. TVA letter to NRC dated June 5, 2012, "Watts Bar Nuclear Plant (WBN) Unit 2 – Submittal of Revised Section 4.3, 'Fuel Storage', Developmental Revision G of the Unit 2 Technical Specification (TS)" (ADAMS Accession No. ML12160A063)

The purpose of this letter is to revise the wording of Watts Bar Nuclear Plant (WBN) Unit 2 Technical Specification (TS) 4.3.1 to match the WBN Unit 1 wording submitted by Reference 1. WBN has a common spent fuel pool that is shared by both Unit 1 and Unit 2. The spent fuel pool criticality analysis that forms the basis for the TS criteria is not unit specific. Therefore, TS 4.3.1 should be the same for both units.

The proposed Unit 1 TS 4.3.1 wording closely matches the Unit 2 wording submitted by Reference 2. The non-editorial wording changes were discussed with the NRC in a June 19, 2013 phone call. A minor editorial change is also being made to TS 4.3.1.1.d.3 to correct a typographical error. Enclosure 1 provides revised wording with the changes identified. Enclosure 2 provides the revised wording in final form.

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Enclosure 3 provides the related wording change to TS Bases 3.7.15, "Fuel Storage" in marked-up form. Enclosure 4 provides the final typed version of TS Bases 3.7.15. Enclosure 5 provides a revision to FSAR Section 4.2.7 to match the TS wording. The revised wording was incorporated in WBN Unit 2 FSAR Amendment 110.

There are no new commitments in this letter. If you have any questions, please contact me at (423) 365-1260 or Gordon Arent at (423) 365-2004.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 26th day of September, 2013.

Respectfully,

R.A. Hruby, Jr.

Raymond A. Hruby, Jr.
General Manager, Technical Services
Watts Bar Unit 2

Enclosures:

1. TS 4.3.1 Changes (Mark-Up) for WBN, Unit 2
2. TS 4.3.1 Changes (Final Typed) for WBN, Unit 2
3. TS Bases 3.7.15 (Mark-Up) for WBN Unit 2
4. TS Bases 3.7.15 (Final Typed) for WBN Unit 2
5. Revised FSAR Section 4.3.2.7 Pages

cc (Enclosures):

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ENCLOSURE 1

TS 4.3.1 Changes (Mark-Up) for WBN, Unit 2

4.0 DESIGN FEATURES

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The spent fuel storage racks (shown in Figure 4.3-1) are designed and shall be maintained with:

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent **(wt%)**;

b. $k_{eff} \leq 0.95$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Sections 4.3.2.7 and 9.1 of the FSAR;

c. Distances between fuel assemblies are a nominal 10.375 inch center-to-center spacing in the twenty-four flux trap rack modules.

d. Fuel assemblies with initial enrichments less than a maximum of 5 ~~percent~~ **wt% U-235** enrichment (nominally 4.95 ± 0.05 ~~percent~~ **wt% U-235**) may be stored in the spent fuel racks in **any** one of four arrangements with specific limits as identified below:

1. ~~New and spent f~~ **F**uel assemblies may be stored in the racks in an all cell arrangement provided the burnup of each assembly is in the acceptable domain identified in Figure 4.3-3, depending upon the specified initial enrichment.

2. New and spent fuel assemblies may be stored in a checkerboard arrangement of 2 new and 2 spent assemblies~~;~~**,** provided that each spent fuel assembly has accumulated a minimum burnup in the acceptable domain identified in Figure 4.3-4.

3. New fuel assemblies may be stored in 4-cell arrays with 1 of the 4 cells remaining empty of fuel (i.e. containing only water or water with up to 75 percent by volume of non-fuel bearing material**)**.

4. New fuel assemblies with a minimum of 32 integral fuel burnable absorber (IFBA) rods may be stored without further restriction, provided the loading of ZrB_2 in the coating of each IFBA rod is minimum of 1.25x (1.9625mg/in).

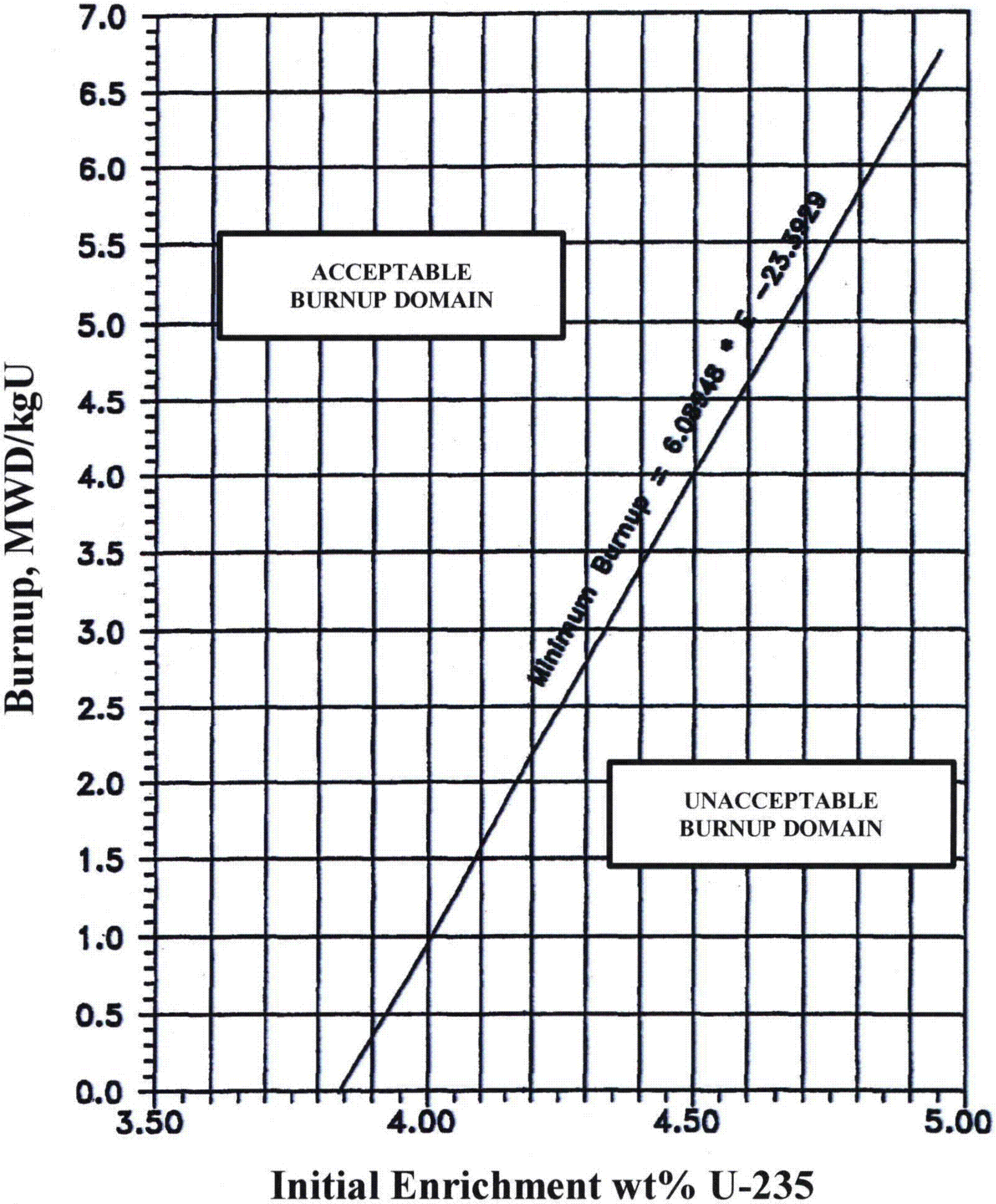

FIGURE 4.3-3

MINIMUM REQUIRED BURNUP FOR UNRESTRICTED STORAGE
OF ~~NEW AND SPENT~~ FUEL OF VARIOUS INITIAL ENRICHMENTS

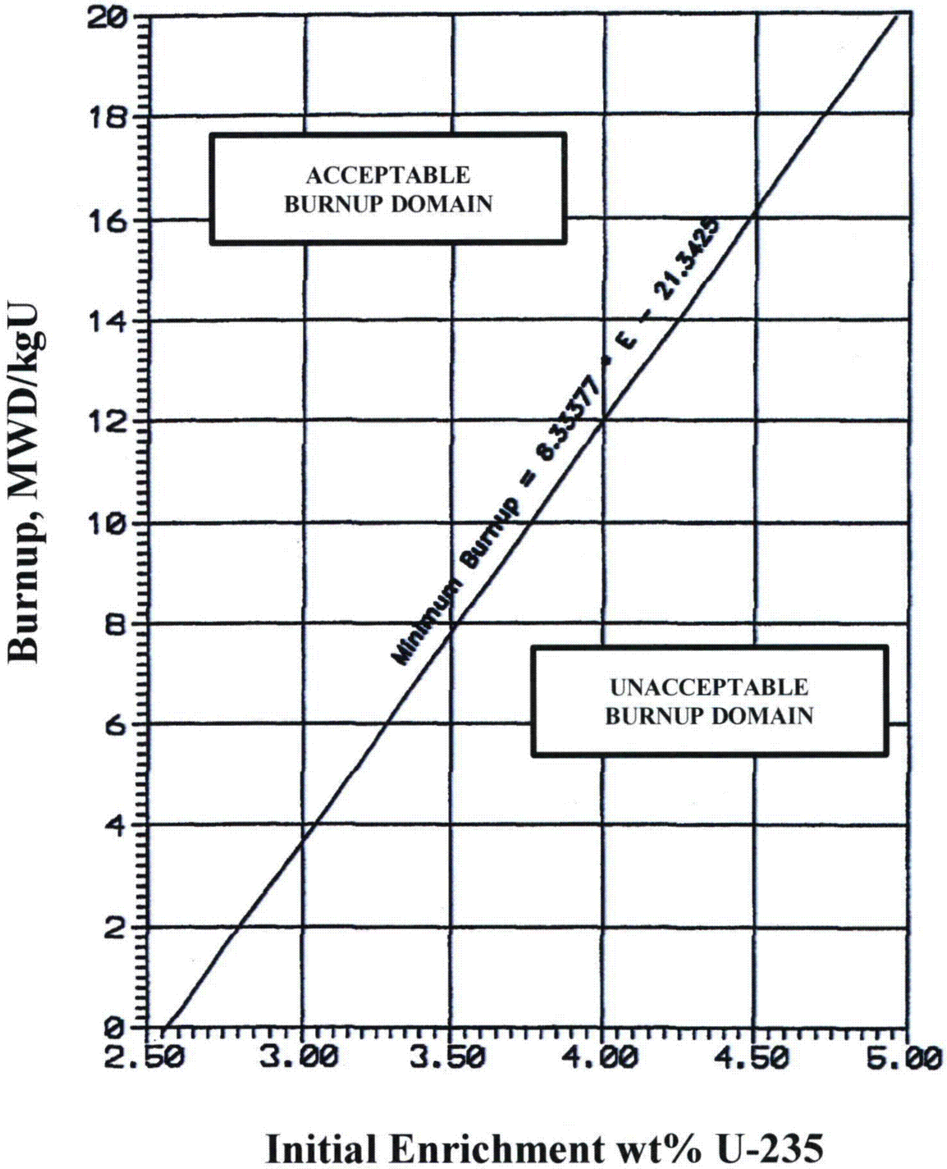

FIGURE 4.3-4

MINIMUM REQUIRED BURNUP FOR A CHECKERBOARD ARRANGEMENT OF 2 SPENT AND 2 NEW ASSEMBLIES OF 5 wt% U-235 ENRICHMENT (MAXIMUM).

ENCLOSURE 2

TS 4.3.1 Changes (Final Typed) for WBN, Unit 2

4.0 DESIGN FEATURES

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The spent fuel storage racks (shown in Figure 4.3-1) are designed and shall be maintained with:

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent (wt%);

b. $k_{eff} \leq 0.95$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Sections 4.3.2.7 and 9.1 of the FSAR;

c. Distances between fuel assemblies are a nominal 10.375 inch center-to-center spacing in the twenty-four flux trap rack modules.

d. Fuel assemblies with initial enrichments less than a maximum of 5 wt% U-235 enrichment (nominally 4.95 ± 0.05 wt% U-235) may be stored in the spent fuel racks in any one of four arrangements with specific limits as identified below:

1. Fuel assemblies may be stored in the racks in an all cell arrangement provided the burnup of each assembly is in the acceptable domain identified in Figure 4.3-3, depending upon the specified initial enrichment.

2. New and spent fuel assemblies may be stored in a checkerboard arrangement of 2 new and 2 spent assemblies, provided that each spent fuel assembly has accumulated a minimum burnup in the acceptable domain identified in Figure 4.3-4.

3. New fuel assemblies may be stored in 4-cell arrays with 1 of the 4 cells remaining empty of fuel (i.e. containing only water or water with up to 75 percent by volume of non-fuel bearing material).

4. New fuel assemblies with a minimum of 32 integral fuel burnable absorber (IFBA) rods may be stored without further restriction, provided the loading of ZrB_2 in the coating of each IFBA rod is minimum of 1.25x (1.9625mg/in).

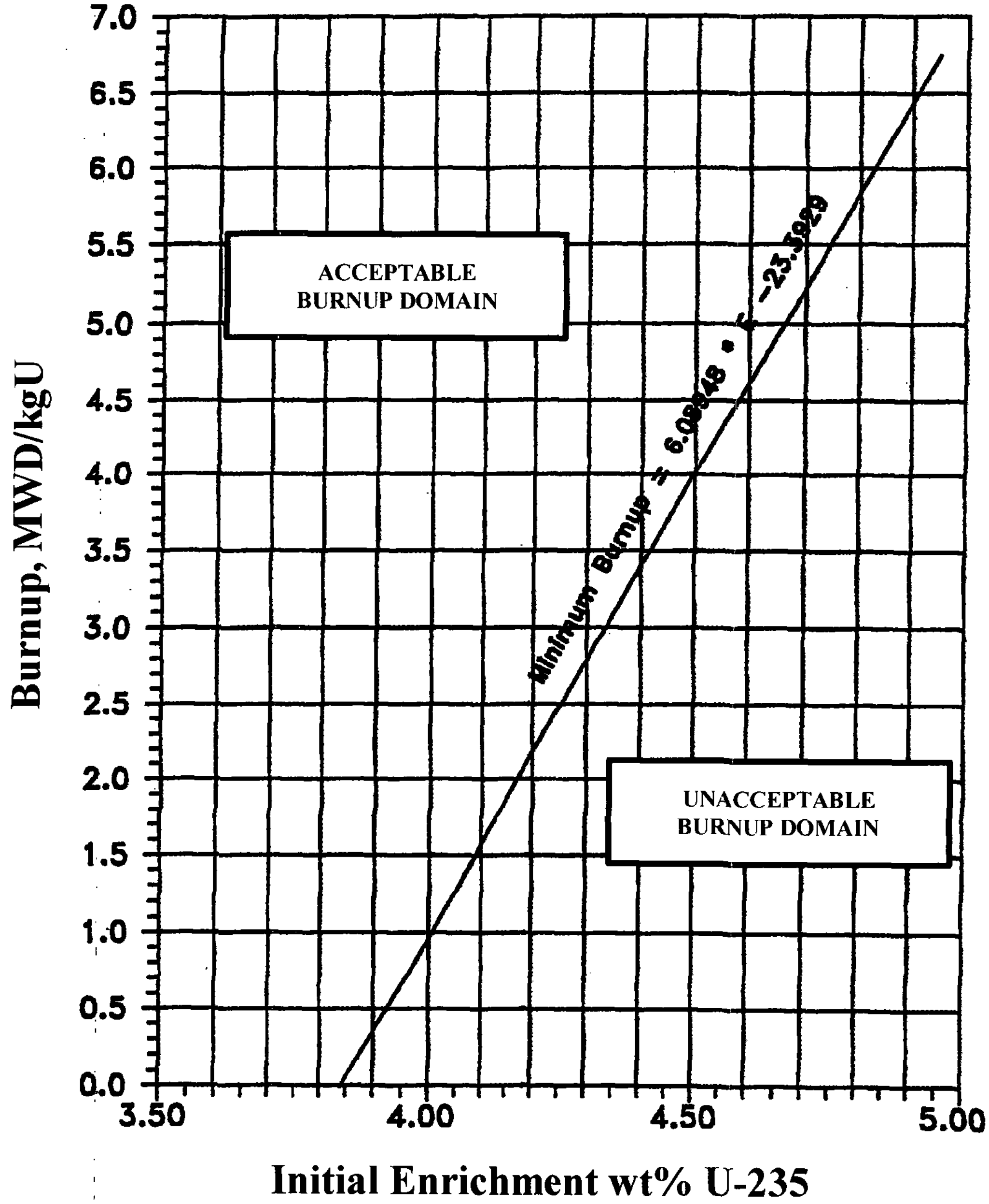

FIGURE 4.3-3

MINIMUM REQUIRED BURNUP FOR UNRESTRICTED STORAGE
OF FUEL OF VARIOUS INITIAL ENRICHMENTS

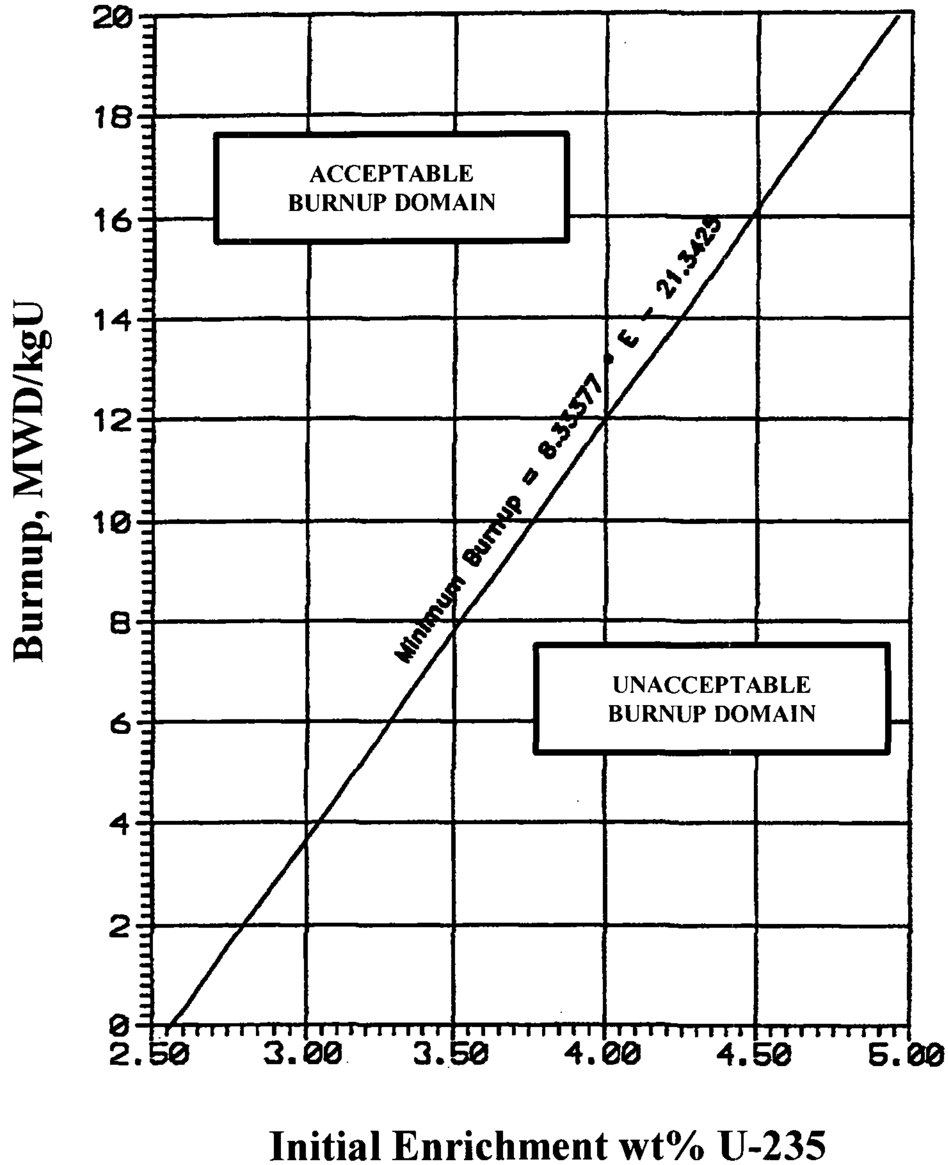

FIGURE 4.3-4

MINIMUM REQUIRED BURNUP FOR A CHECKERBOARD ARRANGEMENT OF 2 SPENT AND 2 NEW ASSEMBLIES OF 5 wt% U-235 ENRICHMENT (MAXIMUM).

ENCLOSURE 3

TS Bases 3.7.15 Changes (Mark-Ups) for WBN, Unit 2

B 3.7 PLANT SYSTEMS

B 3.7.15 Spent Fuel Assembly Storage

BASES

BACKGROUND

The spent fuel pool contains flux trap rack modules with 1386 storage positions ~~and~~ **that** are designed to accommodate new fuel with **a maximum** enrichment **of 4.95 ± 0.05 weight percent U-235 and fuel of various initial enrichments when stored in accordance with paragraph 4.3.1.1 in Section 4.3, Fuel Storage.**

~~as high as 3.8 weight percent U-235 without restrictions. Storage of fuel assemblies with enrichment between 3.8 and 5.0 weight percent requires either fuel burnup in accordance with paragraph 4.3.1.1 or placement in storage locations which have face adjacent storage cells containing either water or fuel assemblies with accumulated burnup of at least 20.0 MWD/KgU in accordance with Specification 4.3.1.1.~~

The water in the spent fuel storage pool normally contains soluble boron, which results in large subcriticality margins under actual operating conditions. However, the NRC guidelines, based upon the accident condition in which all soluble poison is assumed to have been lost, specify that the limiting k_{eff} of 0.95 be evaluated in the absence of soluble boron. Hence, the design is based on the use of unborated water, which maintains the storage racks in a subcritical condition during normal operation with the racks fully loaded. The double contingency principle discussed in ANSI N-16.1-1975, and the April 1978 NRC letter (Reference 1) allows credit for soluble boron under other abnormal or accident conditions, since only a single accident need be considered at one time. For example, an abnormal scenario could be associated with the improper loading of a relatively high enrichment, low exposure fuel assembly. This could potentially increase the criticality of the storage racks. To mitigate these postulated criticality-related events, boron is dissolved in the pool water. Safe operation of the spent fuel storage design with no movement of assemblies may therefore be achieved by controlling the location of each assembly in accordance with the accompanying LCO. Prior to movement of an assembly in the pool, it is necessary to perform SR 3.9.9.1.

ENCLOSURE 4

TS Bases 3.7.15 Changes (Final Typed) for WBN, Unit 2

B 3.7 PLANT SYSTEMS

B 3.7.15 Spent Fuel Assembly Storage

BASES

BACKGROUND

The spent fuel pool contains flux trap rack modules with 1386 storage positions that are designed to accommodate new fuel with a maximum enrichment of 4.95 $\pm$ 0.05 weight percent U-235 and fuel of various initial enrichments when stored in accordance with paragraph 4.3.1.1 in Section 4.3 Fuel Storage.

The water in the spent fuel storage pool normally contains soluble boron, which results in large subcriticality margins under actual operating conditions. However, the NRC guidelines, based upon the accident condition in which all soluble poison is assumed to have been lost, specify that the limiting k_{eff} of 0.95 be evaluated in the absence of soluble boron. Hence, the design is based on the use of unborated water, which maintains the storage racks in a subcritical condition during normal operation with the racks fully loaded. The double contingency principle discussed in ANSI N-16.1-1975, and the April 1978 NRC letter (Reference 1) allows credit for soluble boron under other abnormal or accident conditions, since only a single accident need be considered at one time. For example, an abnormal scenario could be associated with the improper loading of a relatively high enrichment, low exposure fuel assembly. This could potentially increase the criticality of the storage racks. To mitigate these postulated criticality-related events, boron is dissolved in the pool water. Safe operation of the spent fuel storage design with no movement of assemblies may therefore be achieved by controlling the location of each assembly in accordance with the accompanying LCO. Prior to movement of an assembly in the pool, it is necessary to perform SR 3.9.9.1.

ENCLOSURE 5

Revised FSAR Section 4.3.2.7 Pages

Analytical Technique and Results

The criticality analysis for the WBN racks were performed primarily with KENO5a, a three-dimensional Monte Carlo computer code, using the 238-group SCALE crosssection library and the Nordheim integral treatment for resonance shielding effects found in NITAWL. Depletion analyses were performed using CASMO4, a two-dimensional transport theory code incorporating approximately 40 of the most important fission products.

Analysis of the spent fuel racks confirmed that the racks can safely and conservatively accommodate storage of fuel up to 5 wt% U-235 enrichment with the following storage conditions:

~~*(1)* Fuel Assemblies with 3.84 WT% or less U-235 Initial enrichment may be stored without restrictions.~~

*(~~2~~ **1**)* Fuel assemblies with initial enrichment ~~greater than 3.84 wt% U-235 and~~ less than a maximum of 5.0 wt% **U-235** (4.95 ± 0.05 **wt% U-235**) may be stored in **any** one of four arrangements with the limits specified below.

(A) Fuel assemblies may be stored in the racks ~~without further restrictions~~ **in an all cell arrangement** provided the burnup of each assembly is in the acceptable domain identified in Figure 4.3-46, depending on the specified initial enrichment.

(B) New and spent fuel assemblies may be stored in a checkerboard arrangement of 2 new and 2 spent assemblies, provided the accumulated burnup of each spent assembly is in the acceptable domain identified in Figure 4.3-47, depending on the specified initial enrichment.

(C) New fuel assemblies may be stored in 4-cell arrays with 1 of the 4 cells remaining empty of fuel (containing only water or water with up to 75 percent by volume of non-fuel bearing material).

(D) New fuel assemblies with a minimum of 32 integral fuel burnable absorber (IFBA rods may be stored in the racks without further restrictions provided the loading of ZrB2 in the coating of each IFBA rod is a minimum of 1.25 x (1.9625 mg/in).

A water cell is less reactive than any cell containing fuel and therefore may be used at any location in the loading arrangements. A water cell is defined as a cell containing water or non-fissile material with no more than 75 percent of the water displaced.

The Technical Specifications include curves defining the limiting burnup for fuel of various initial enrichments for both unrestricted storage and checkerboard arrangements assuming the fresh fuel region is enriched to 4.95 ± 0.05 wt% U-235. The calculated maximum reactivity is 0.948, which is within the regulatory limit of keff of 0.95. This maximum reactivity includes calculational uncertainties and manufacturing tolerances (95% probability at the 95% confidence level), an allowance for uncertainty in depletion

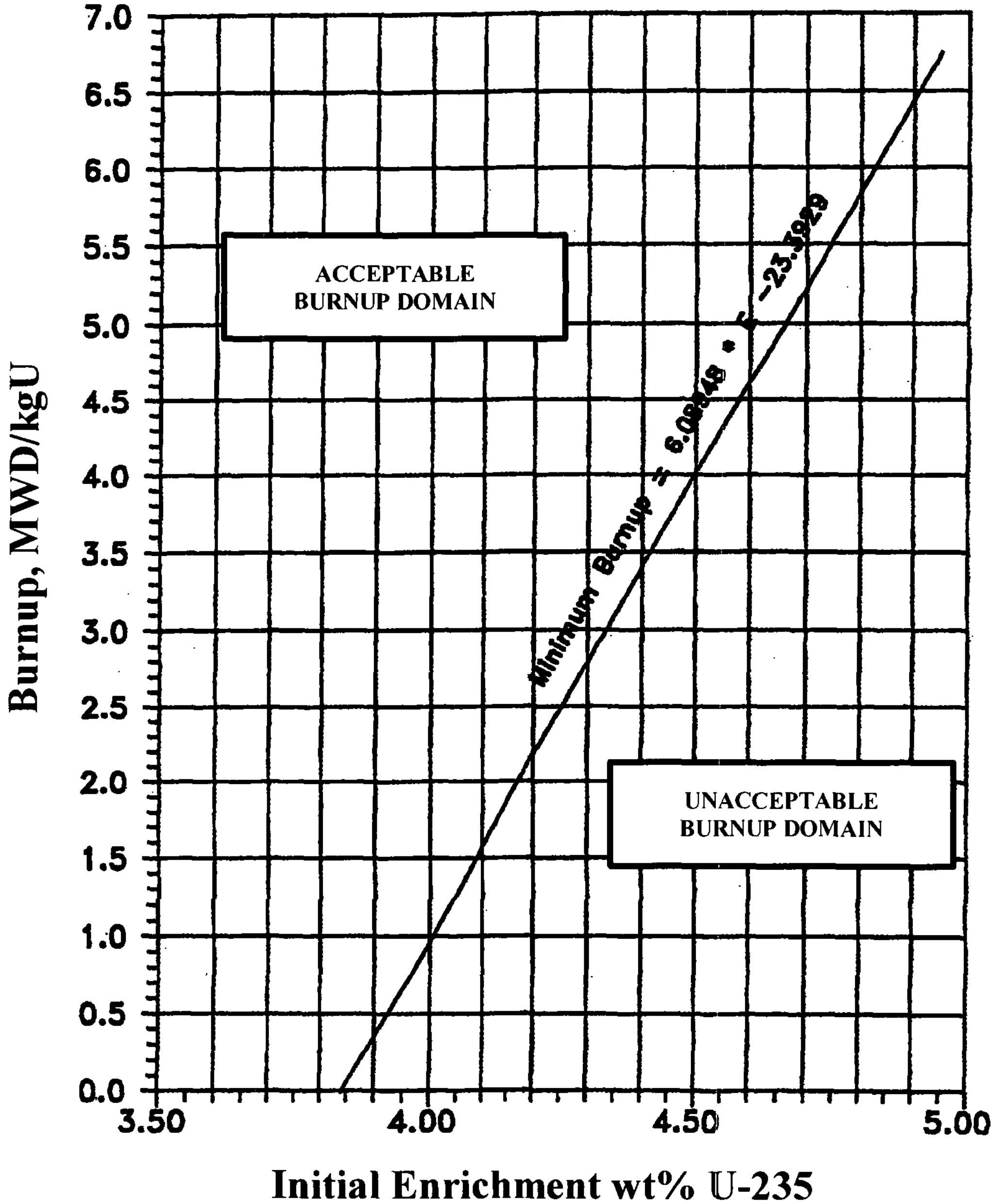

FIGURE 4.3-46 MINIMUM REQUIRED BURNUP FOR UNRESTRICTED STORAGEOF FUEL OF VARIOUS INITIAL ENRICHMENTS

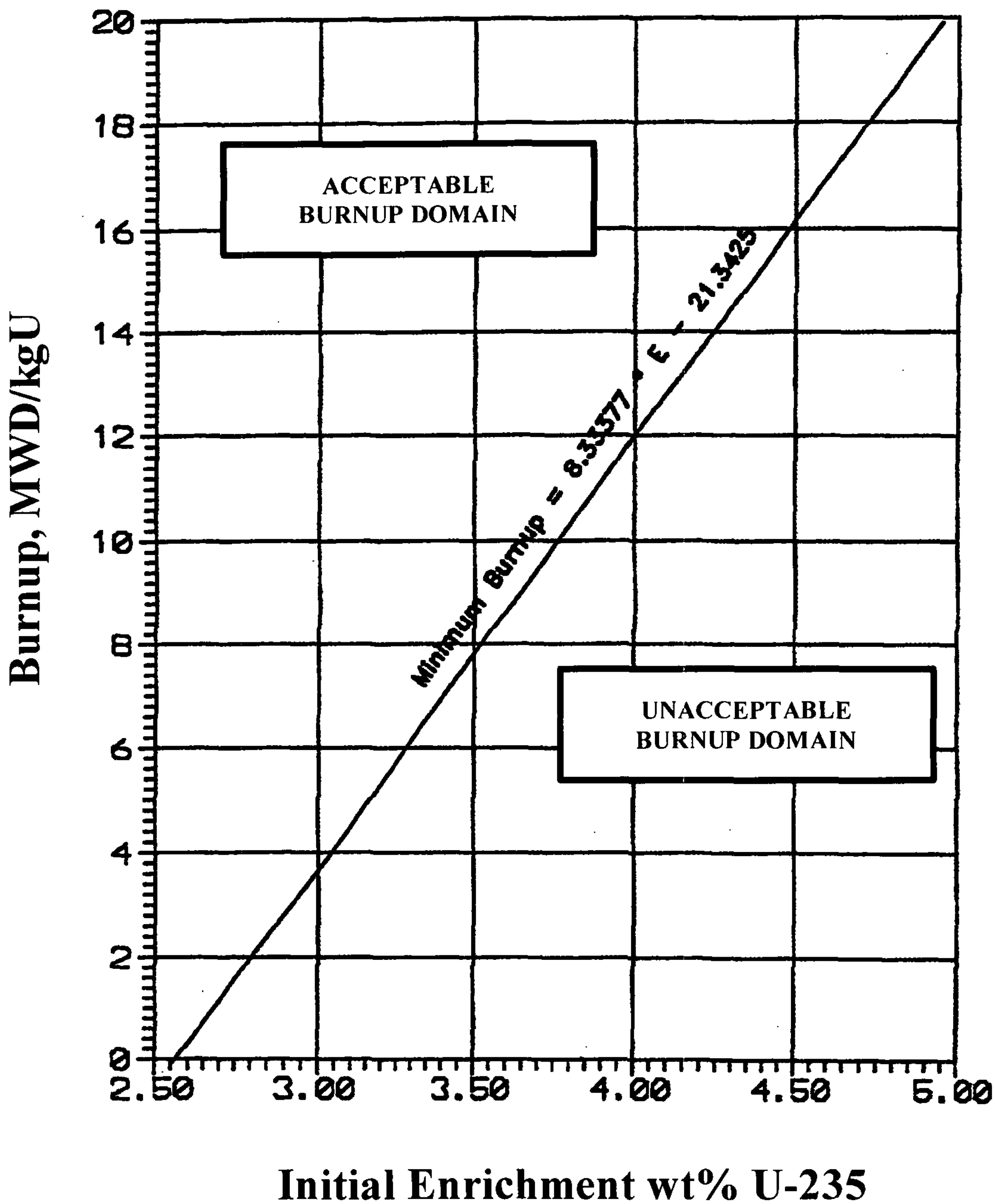

FIGURE 4.3-47 MINIMUM REQUIRED BURNUP FOR A CHECKERBOARD ARRANGEMENT OF 2 SPENT AND 2 NEW ASSEMBLIES OF 5 wt% U-235 ENRICHMENT (MAXIMUM)