

January 14, 1997

Mr. C. Randy Hutchinson
Vice President, Operations ANO
Entergy Operations, Inc.
1448 S. R. 333
Russellville, AR 72801

SUBJECT: ISSUANCE OF AMENDMENT NO. 178 TO FACILITY OPERATING LICENSE
NO. NPF-6 - ARKANSAS NUCLEAR ONE, UNIT NO. 2 (TAC NO. M96478)

Dear Mr. Hutchinson:

The Commission has issued the enclosed Amendment No. 178 to Facility Operating License No. NPF-6 for the Arkansas Nuclear One, Unit No. 2 (ANO-2). This amendment consists of changes to the Technical Specifications (TSs) in response to your application dated August 23, 1996.

The amendment modifies portion of the ANO-2 TSs pertaining to fuel enrichments in the spent fuel pool racks. This change allows the fuel to be received at the site, stored in the fresh and spent fuel pools and operated in the reactor core to have an increase in enrichment from 4.1% to 5.0%.

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

Sincerely,
ORIGINAL SIGNED BY:
Kombiz Salehi, Acting Project Manager
Project Directorate IV-1
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosures: 1. Amendment No. 178 to NPF-6
2. Safety Evaluation

cc w/encls: See next page

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LKopp

Document Name: AR96478.AMD *See previous concurrence

OFC	(A)PM/PD4-1	(A)LA/PD4-1	D/PD4-1	RE/SRXB*	OGC	PERB
NAME	KSalehi/vw	CHawes <i>cmh</i>	WBeckner <i>WD</i>	LKopp <i>LK</i>	<i>S. Hill</i>	<i>Grimes</i>
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signed by [unclear]
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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

Sincerely,

A handwritten signature in black ink, appearing to read "Kombiz Salehi".

Kombiz Salehi, Acting Project Manager
Project Directorate IV-1
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-368

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2. Safety Evaluation

cc w/encls: See next page

Mr. C. Randy Hutchinson
Entergy Operations, Inc.

Arkansas Nuclear One, Unit 2

cc:

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

ENERGY OPERATIONS, INC.

DOCKET NO. 50-368

ARKANSAS NUCLEAR ONE, UNIT NO. 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 178
License No. NPF-6

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by Entergy Operations, Inc. (the licensee) dated August 23, 1996, 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 license 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-6 is hereby amended to read as follows:

2. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 178, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. The license amendment is effective as of its date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Kombiz Salehi, Acting Project Manager
Project Directorate IV-1
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical
Specifications

Date of Issuance: January 14, 1997

ATTACHMENT TO LICENSE AMENDMENT NO. 178

FACILITY OPERATING LICENSE NO. NPF-6

DOCKET NO. 50-368

Revise the following pages of the Appendix "A" Technical Specifications with the attached pages. The revised pages are identified by Amendment number and contain vertical lines indicating the area of change. The corresponding overleaf pages are also provided to maintain document completeness.

REMOVE PAGES

3/4 9-14
3/4 9-16
B 3/4 9-3
5-5

INSERT PAGES

3/4 9-14
3/4 9-16
B 3/4 9-3
5-5

REFUELING OPERATIONS

SURVEILLANCE REQUIREMENTS (Continued)

2. Verifying within 31 days after removal that laboratory analysis of a representative carbon sample obtained in accordance with Regulatory Position C.6.b of Regulatory Guide 1.52, Revision 2, March 1978, meets the laboratory testing criteria of Regulatory Position C.6.a of Regulatory Guide 1.52, Revision 2, March 1978.
 3. Verifying a system flow rate of 39,700 cfm \pm 10% during system operation when tested in accordance with ANSI N510-1975.
- b. After every 720 hours of charcoal adsorber operation by verifying within 31 days after removal that a laboratory analysis of a representative carbon sample obtained in accordance with Regulatory Position C.6.b of Regulatory Guide 1.52, Revision 2, March 1978, meets the laboratory testing criteria of Regulatory Position C.6.a of Regulatory Guide 1.52, Revision 2, March 1978.
 - c. At least once per 18 months by verifying that the pressure drop across the combined HEPA filters and charcoal adsorber banks is < 6 inches Water Gauge while operating the system at a flow rate of 39,700 cfm \pm 10%.
 - d. After each complete or partial replacement of a HEPA filter bank by verifying that the HEPA filter banks remove \geq 99% of the DOP when they are tested in-place in accordance with ANSI N510-1975 while operating the system at a flow rate of 39,700 cfm \pm 10%.
 - e. After each complete or partial replacement of a charcoal adsorber bank by verifying that the charcoal adsorbers remove > 99.95% of a halogenated hydrocarbon refrigerant test gas when they are tested in-place in accordance with ANSI N510-1975 while operating the system at a flow rate of 39,700 cfm \pm 10%.

REFUELING OPERATIONS

FUEL STORAGE

LIMITING CONDITION FOR OPERATION

3.9.12.a Storage in the spent fuel pool shall be restricted to fuel assemblies having initial enrichment less than or equal to 5.0 w/o U-235. The provisions of Specification 3.0.3 are not applicable.

3.9.12.b Storage in Region 1 or Region 2 (as shown on Figure 3.9.1) of the spent fuel pool shall be further restricted by the limits specified in Figure 3.9.2. In the event a cross-hatch storage configuration is deemed necessary for a portion of either Region 1 or Region 2, vacant spaces diagonal to the four corners of any fuel assembly or vacant spaces on two opposite faces of any fuel assembly shall be physically blocked before any such fuel assembly may be placed in that region. Also, the Region 1 storage cells adjacent to the Region 2 interface are restricted to fuel assemblies that are outside of the area of the graph enclosed by Curve A on Figure 3.9.2. In the event a checkerboard storage configuration is deemed necessary for a portion of Region 2, vacant spaces adjacent to the four faces of any fuel assembly shall be physically blocked before any such fuel assembly may be placed in Region 2. The provisions of Specification 3.0.3 are not applicable.

3.9.12.c The boron concentration in the spent fuel pool shall be maintained (at all times) at greater than 1600 parts per million.

APPLICABILITY: During storage of fuel in the spent fuel pool.

ACTION:

Suspend all actions involving the movement of fuel in the spent fuel pool if it is determined a fuel assembly has been placed in an incorrect location until such time as the correct storage location is determined. Move the assembly to its correct location before resumption of any other fuel movement.

Suspend all actions involving the movement of fuel in the spent fuel pool if it is determined the pool boron concentration is less than 1601 ppm, until such time as the boron concentration is increased to 1601 ppm or greater.

SURVEILLANCE REQUIREMENTS

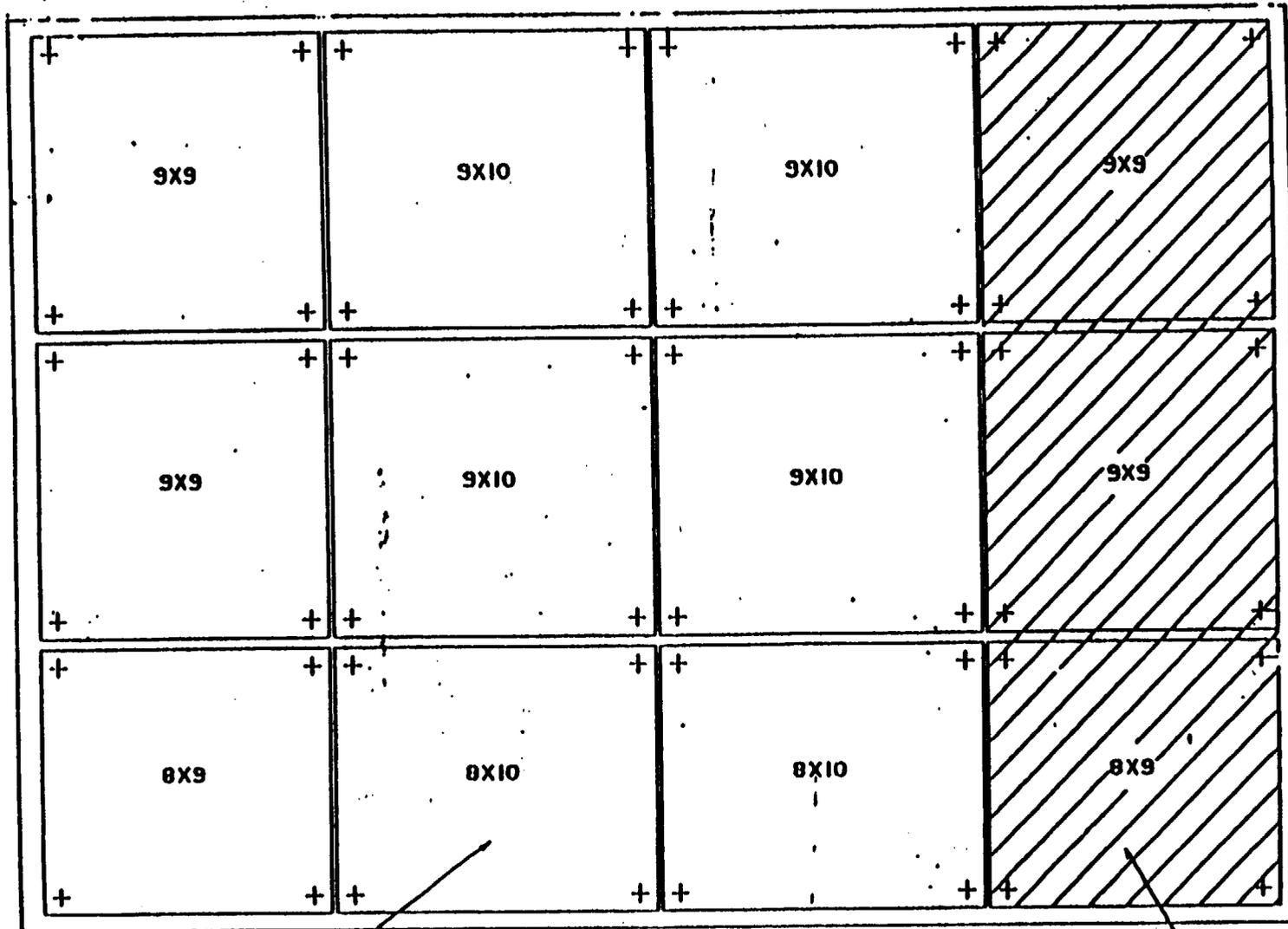
4.9.12.a Verify all fuel assemblies to be placed in the spent fuel pool have an initial enrichment of less than or equal to 5.0 w/o U-235 by checking the assemblies' design documentation.

4.9.12.b Verify all fuel assemblies to be placed in the spent fuel pool are within the limits of Figure 3.9.2 by checking the assemblies' design and burnup documentation.

4.9.12.c Verify at least once per 31 days the spent fuel pool boron concentration is greater than 1600 ppm.

Arkansas-Unit 2
Amendment No. 43

3/4 9-15



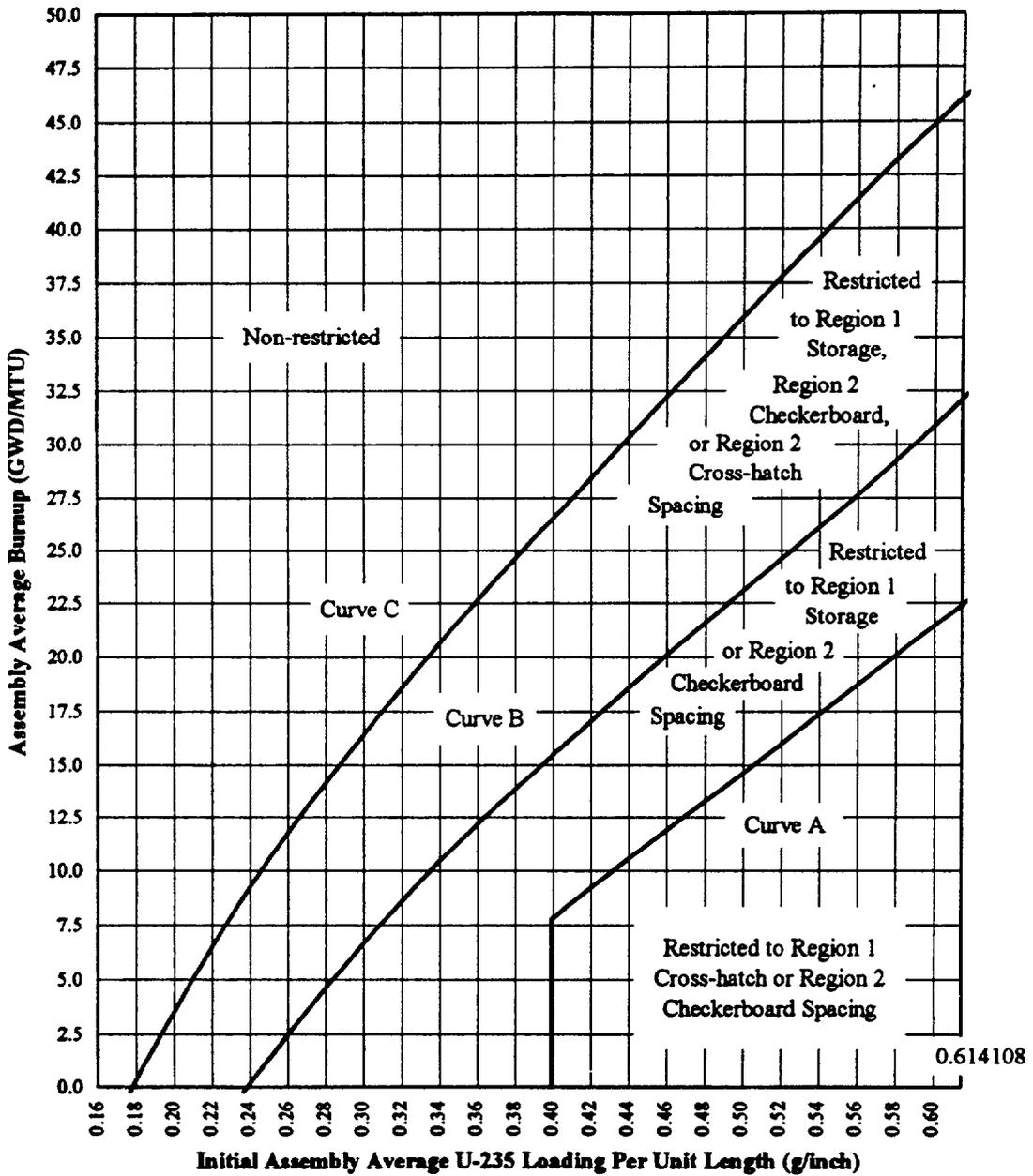
REGION-2
754 LOCATIONS (26 X 29)

REGION-1
234 LOCATIONS (9 X 26)

SPENT FUEL POOL ARRANGEMENT UNIT #2

Figure 3.9.1

FIGURE 3.9.2
 MINIMUM BURNUP VS. INITIAL ASSEMBLY AVERAGE U-235 LOADING



Curve A = $68.008x - 19.366$ when $x > 0.399181$
 Curve B = $239.01x^3 - 347.75x^2 + 243.18x - 41.452$
 Curve C = $-714.35x^4 + 1335.80x^3 - 946.44x^2 + 394.52x - 47.040$

REFUELING OPERATIONS

BASES

3/4.9.9 and 3/4.9.10 WATER LEVEL-REACTOR VESSEL AND SPENT FUEL POOL WATER LEVEL

The restrictions on minimum water level ensure that sufficient water depth is available to remove 99% of the assumed 12% iodine gap activity released from the rupture of an irradiated fuel assembly. The minimum water depth is consistent with the assumptions of the accident analysis.

3/4.9.11 FUEL HANDLING AREA VENTILATION SYSTEM

The limitations on the fuel handling area ventilation system ensure that all radioactive materials released from an irradiated fuel assembly will be filtered through the HEPA filters and charcoal adsorbers prior to discharge to the atmosphere. The operation of this system and the resulting iodine removal capacity are consistent with the assumptions of the accident analyses.

3/4.9.12 FUEL STORAGE

Region 1 and Region 2 of the spent fuel storage racks are designed to assure fuel assemblies of less than or equal to 5.0 w/o U-235 enrichment that are within the limits of Figure 3.9.2 will be maintained in a subcritical array with $K_{eff} \leq 0.95$ in unborated water. These conditions have been verified by criticality analyses.

The requirement for 1600 ppm boron concentration is to assure the fuel assemblies will be maintained in a subcritical array with $K_{eff} \leq 0.95$ in the event of a postulated accident.

DESIGN FEATURES

VOLUME

5.4.2 The total water and steam volume of the reactor coolant system is 10,295 ± 400 cubic feet at a nominal T_{avg} of 545°F.

5.5 METEOROLOGICAL TOWER LOCATION

5.5.1 The meteorological tower shall be located as shown on Figure 5.1-1.

5.6 FUEL STORAGE

CRITICALITY - SPENT FUEL

5.6.1.1 The spent fuel racks are designed and shall be maintained so that the calculated effective multiplication factor is no greater than 0.95 (including all known uncertainties) when the pool is flooded with unborated water.

CRITICALITY - NEW FUEL

5.6.1.2 The new fuel storage racks are designed and shall be maintained with a nominal 26.0 inch center-to-center distance between new fuel assemblies such that K_{eff} will not exceed 0.98 when fuel having a maximum enrichment of 5.0 weight percent U-235 is in place and aqueous foam moderation is assumed and K_{eff} will not exceed 0.95 (including a conservative allowance for uncertainties) when the storage area is flooded with unborated water.

DRAINAGE

5.6.2 The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 399' 10½".

CAPACITY

5.6.3 The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than 988 fuel assemblies.

5.7 COMPONENT CYCLIC OR TRANSIENT LIMITS

5.7.1 The components identified in Table 5.7-1 are designed and shall be maintained within the cyclic or transient limits of Table 5.7-1.



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO AMENDMENT NO. 178 TO
FACILITY OPERATING LICENSE NO. NPF-6
ENERGY OPERATIONS, INC.
ARKANSAS NUCLEAR ONE, UNIT NO. 2
DOCKET NO. 50-368

1.0 INTRODUCTION

In a letter of August 23, 1996, Entergy Operations, Inc. (EOI), requested changes to the Arkansas Nuclear One, Unit 2 (ANO-2) Technical Specifications (TS) to reflect an increase in the U-235 enrichment of fuel stored in the fresh fuel storage racks or the spent fuel storage racks from 4.1 weight percent (w/o) U-235 to 5.0 w/o U-235.

The staff's evaluation of the criticality aspects of the proposed enrichment increase follows.

2.0 EVALUATION

The analysis of the reactivity effects of fuel storage in the ANO-2 fresh and spent fuel racks was performed with the SCALE-4 code package which included the BONAMI-S code, the NITAWL-S code, and the three-dimensional Monte Carlo code, KENO-Va. 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, CASMO-3. SIMULATE-3, a three-dimensional nodal simulator was also used to provide data for the evaluation of burnup distribution and spectral history effects. The SCALE-4 system used in the reactivity analysis has been benchmarked against experimental data for fuel assemblies similar to those for which the ANO-2 racks are designed and has been found to adequately reproduce the critical values. These experimental data are 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 concluded that the analytical method was acceptable and capable of predicting the reactivity of the ANO-2 storage racks.

The NRC acceptance criterion for preventing criticality outside the reactor, including uncertainties, assumes a 95% probability at a 95% confidence level (95/95 probability/confidence) that the effective neutron multiplication factor (k_{eff}) of the fuel assembly array will be no greater than 0.95. This k_{eff} limit applies to both the fresh and spent fuel racks under all conditions, except for the fresh fuel rack under low water density (optimum moderation) conditions, where the k_{eff} limit is 0.98.

For the fresh fuel racks, the analyses conservatively assumed the most reactive fuel type in use or stored at ANO-2 and a U-235 enrichment of 5.0 w/o over the entire length of each fuel rod. The criticality analyses evaluated the effects of varying moderator density and showed that the optimum moderation condition occurs at a density of 0.065 gm/cc and results in a k_{eff} of 0.976, including uncertainties at a 95/95 probability/confidence level. Since k_{eff} is less than 0.98, the acceptance criterion for criticality under optimum moderation conditions is met. For the fully flooded accident scenario, the 95/95 k_{eff} is 0.916 and meets the acceptance criterion of 0.95.

The ANO-2 spent fuel storage pool is categorized into two regions, referred to as Region 1 and Region 2. The Region 1 storage racks contain Boraflex panels held in place by a stainless steel wrapper plate. The Region 2 racks contain no neutron absorbers.

For the nominal storage cell design, the moderator was assumed to be pure water at a density of 1.0 gm/cc and a temperature of 68°F which conservatively bounds the range of normal pool water temperatures. Uncertainties due to tolerances in U-235 enrichment and density, fuel inner and outer diameter, guide tube thickness, stainless steel thickness, and assembly position were accounted for including a method bias and uncertainty. These uncertainties were appropriately determined at least at the 95/95 probability/confidence level. In addition, an allowance for uncertainty in depletion history and isotopic calculations for those cases where burnup credit was used, were included. These biases and uncertainties met the previously stated NRC requirements and were, therefore, acceptable.

In the Region 1 calculations, additional assumptions were made to consider the increase in reactivity due to Boraflex gap or shrinkage. The results of reported blackness tests performed on other Westinghouse racks were used to determine a maximum shrinkage of 4.1%. Three scenarios were considered to determine the most conservative assumption: 1) all panels have gaps, 2) all panels have end shrinkage, and 3) 65% of the panels have gaps and 35% have end shrinkage. The location and size of the gaps and/or end shrinkage were based on Boraflex test results reported by the Electric Power and Research Institute (EPRI) and were acceptable. The most limiting configuration for the ANO-2 rack design was the case where all Boraflex panels have end shrinkage. Also, the minimum design B-10 loading and physical dimensions were assumed as well as a 4.1% shrinkage in panel width. These were acceptable conservative assumptions based on existing industry-wide test results. In response to NRC Generic Letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks," the licensee stated that pool silica levels indicated some Boraflex degradation due to water ingress may be occurring. However, since the ANO-2 configuration only allows minimal water flow around the Boraflex panels, substantial degradation due to water erosion is not immediately expected.

The licensee's analysis using the acceptable methods discussed above has shown that fuel assemblies with enrichments up to 5.0 w/o U-235 can be stored in Region 1 as long as each assembly is adjacent to two water holes or located diagonally from four water holes. This configuration is called "Configuration A". The calculated 95/95 k_{eff} value for this configuration is 0.938.

Credit for fuel assembly burnup was used to allow storage of assemblies with enrichments up to 5.0 w/o U-235 in an arrangement utilizing all of the rack cells. This is called "Configuration B", and the allowable burnup versus initial enrichment (in terms of average U-235 loading per unit length) is shown in TS Figure 3.9.2. (The upper limit of 0.614108 gm U-235 per inch is equivalent to 5.0 w/o U-235). The calculated 95/95 k_{eff} value for this configuration is 0.942.

There are three allowed storage configurations for Region 2 which are called A, B and C. Configuration A utilizes a checkerboard array to allow storage of assemblies with enrichments up to 5.0 w/o U-235. Each assembly must be adjacent to four water holes. The calculated 95/95 k_{eff} for this configuration is 0.926.

For Configurations B and C in Region 2, credit for assembly burnup is used to allow storage of assemblies enriched to 5.0 w/o U-235. In Configuration B, fuel assemblies meeting the Configuration B burnup versus initial U-235 loading curve shown in TS Figure 3.9.2 can either be stored adjacent to two water holes or in diagonal locations from the four water holes. The calculated 95/95 k_{eff} value for Configuration B is 0.944.

For Configuration C in Region 2, any assembly meeting the burnup requirements shown in TS Figure 3.9.2 may be stored in any Region 2 rack location. The 95/95 k_{eff} value is 0.9498.

Since the Region 1 racks are not separated from the Region 2 racks by additional water spacing, calculations were performed to determine if any limits should exist for the region 1 cells at the Region 2 interface. These calculations show that 5.0 w/o assemblies should be restricted from storage in the first row of Region 1 cells at the Region 1 - Region 2 rack interface. Region 1 Configuration B assemblies may be placed in the first row. Therefore, no restrictions are placed on the storage of Region 1 assemblies which meet the burnup versus initial U-235 loading requirements of Configuration B (Region 1).

Criticality analyses were also performed for the fuel transfer upender and the containment temporary storage rack. These analyses indicated that two assemblies with enrichments up to 5.0 w/o U-235 could be transported using the fuel upender while maintaining k_{eff} less than the 0.95 limit assuming no credit for soluble boron. Assemblies with enrichments up to 5.0 w/o U-235 could be stored in the containment temporary storage racks while maintaining k_{eff} less than 0.95 for both normal and accident conditions.

Although the k_{eff} limit of either the fresh fuel or the spent fuel storage racks will not be exceeded under abnormal storage conditions, it is possible to postulate events, such as flooding the dry fuel storage racks or the inadvertent misloading of an assembly in the spent fuel storage racks with an unacceptable burnup and enrichment combination causing an increase in reactivity. Flooding of the fresh fuel racks with full density rack or optimum moderation conditions would allow the limiting k_{eff} of 0.95 and 0.98,

respectively to be met. For the spent fuel pool accidents, credit was taken for the presence of soluble boron in the pool water, which is assured by TS 3.9.12.c. This is because the staff does not require the assumption of two unlikely, independent, concurrent events to ensure protection against a criticality accident (Double Contingency Principle). The reduction in k_{eff} caused by the boron more than offsets the reactivity addition caused by credible accidents.

The following TS changes have been proposed as a result of the requested enrichment increase. Based on the above evaluation, the staff finds these changes acceptable as well as the associated Bases changes.

- 1) TS 3.9.12.a is being revised to allow fuel assemblies containing enrichments of up to 5.0 w/o U-235 to be stored in the spent fuel pool.
- 2) TS 3.9.12.b and Figure 3.9.2 are being revised to provide alternate storage configurations in the spent fuel pool in order to accommodate the higher enrichment fuel.
- 3) TS 5.6.1.2 is being revised to allow fuel assemblies containing a maximum U-235 enrichment of up to 5.0 w/o to be stored in the fresh fuel storage racks.

Although the licensee did not address a specific higher fuel burnup value in this amendment, the staff evaluated the consequences of operation at a bounding value (60,000 MWD/T) because the licensee's reference to the use of highly enriched fuel (up to 5.0 weight percent U-235). The fuel handling accident doses associated with extended burnup in the SER for Amendment No. 111 for ANO-2, dated November 27, 1990, bounds this request. The staff concludes that the radiological consequences associated with this accident are within the acceptance criteria set forth in 10 CFR Part 100 and the control room operator dose criteria specified in GD-19 of Appendix A, to 10 CFR Part 50 and are acceptable.

3.0 STATE CONSULTATION

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

4.0 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 (61 FR 52964). 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.

5.0 CONCLUSION

Based on the review described above, the staff finds the criticality aspects of the proposed increase in the fuel enrichment limit of fuel that can be stored in the ANO-2 fresh and spent fuel pool storage racks are acceptable and meet the requirements of General Design Criterion 62 for the prevention of criticality in fuel storage and handling. The proposed TS changes correctly state the evaluated enrichment, burnup, and storage configuration requirements and are acceptable.

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 Contributor: Larry Kopp

Date: January 14, 1997