April 30, 19

Mr. Donald Schnell
Senior Vice President - Nuclear
Union Electric Company
Post Office Box 149
St. Louis, Missouri 63166

SUBJECT: AMENDMENT NO. 109 TO FACILITY OPERATING LICENSE NO. NPF-30 - CALLAWAY PLANT, UNIT 1 (TAC NO. M93704)

Dear Mr. Schnell:

The Commission has issued the enclosed Amendment No. 109 to Facility Operating License No. NPF-30 for the Callaway Plant, Unit 1. The amendment consists of changes to the Technical Specifications (TS) in response to your application dated September 6, 1995, as supplemented by letters dated January 30, 1996, March 27, 1996, and April 2, 1996.

The amendment revises TS 5.3.1 to reflect a change in the maximum initial enrichment for reload fuel, subject to the integral fuel burnable absorber (IFBA) requirements, and a change in the maximum fuel enrichment not requiring IFBAs. The amendment also changes the maximum reference k_∞ in TS 5.6.1.1 for fuel storage in Region 1 of the spent fuel pool and revises TS Figure 3.9-1 to reflect a change to the maximum initial enrichment for fuel stored in Region 2 of the spent fuel pool.

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

Sincerely,

Original Signed By W. Bateman for

Kristine M. Thomas, Project Manager
Project Directorate IV-2
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosures: 1. Amendment No. 109 to NPF-30
2. Safety Evaluation

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

April 30, 1996

Mr. Donald Schnell
Senior Vice President - Nuclear
Union Electric Company
Post Office Box 149
St. Louis, Missouri 63166

SUBJECT: AMENDMENT NO. 109 TO FACILITY OPERATING LICENSE NO. NPF-30 - CALLAWAY PLANT, UNIT 1 (TAC NO. M93704)

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The amendment revises TS 5.3.1 to reflect a change in the maximum initial enrichment for reload fuel, subject to the integral fuel burnable absorber (IFBA) requirements, and a change in the maximum fuel enrichment not requiring IFBAs. The amendment also changes the maximum reference k_∞ in TS 5.6.1.1 for fuel storage in Region 1 of the spent fuel pool and revises TS Figure 3.9-1 to reflect a change to the maximum initial enrichment for fuel stored in Region 2 of the spent fuel pool.

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Sincerely,

William H. Bateman for

Kristine M. Thomas, Project Manager
Project Directorate IV-2
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosures: 1. Amendment No. 109 to NPF-30
2. Safety Evaluation

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

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 109
License No. NPF-30

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

   A. The application for amendment by Union Electric Company (UE, the licensee) dated September 6, 1995, as supplemented by letters dated January 30, 1996, March 27, 1996, and April 2, 1996, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's regulations set forth in 10 CFR Chapter I;

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

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

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

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

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. NPF-30 is hereby amended to read as follows:

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 109 and the Environmental Protection Plan contained in Appendix B, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

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

FOR THE NUCLEAR REGULATORY COMMISSION

Kristine M. Thomas

Kristine M. Thomas, Project Manager
Project Directorate IV-2
Division of Reactor Projects III/IV
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: April 30, 1996

ATTACHMENT TO LICENSE AMENDMENT

AMENDMENT NO. 109 TO FACILITY OPERATING LICENSE NO. NPF-30

DOCKET NO. 50-483

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. The corresponding overleaf pages are also provided to maintain document completeness.

REMOVE	INSERT
3/4 9-15*	3/4 9-15
3/4 9-16	3/4 9-16
5-6	5-6
5-7	5-7

*No changes were made to this page. Reissued as an overleaf page.

3/4.9.12 SPENT FUEL ASSEMBLY STORAGE

LIMITING CONDITION FOR OPERATION

3.9.12 Spent fuel assemblies stored in Region 2 shall be subject to the following conditions:

a. The combination of initial enrichment and cumulative exposure shall be within the acceptable domain of Figure 3.9-1, and

b. No spent fuel assemblies shall be placed in Region 2, nor shall any storage location be changed in designation from being in Region 1 to being in Region 2, while refueling operations are in progress.

APPLICABILITY: Whenever irradiated fuel assemblies are in the spent fuel pool.

ACTION:

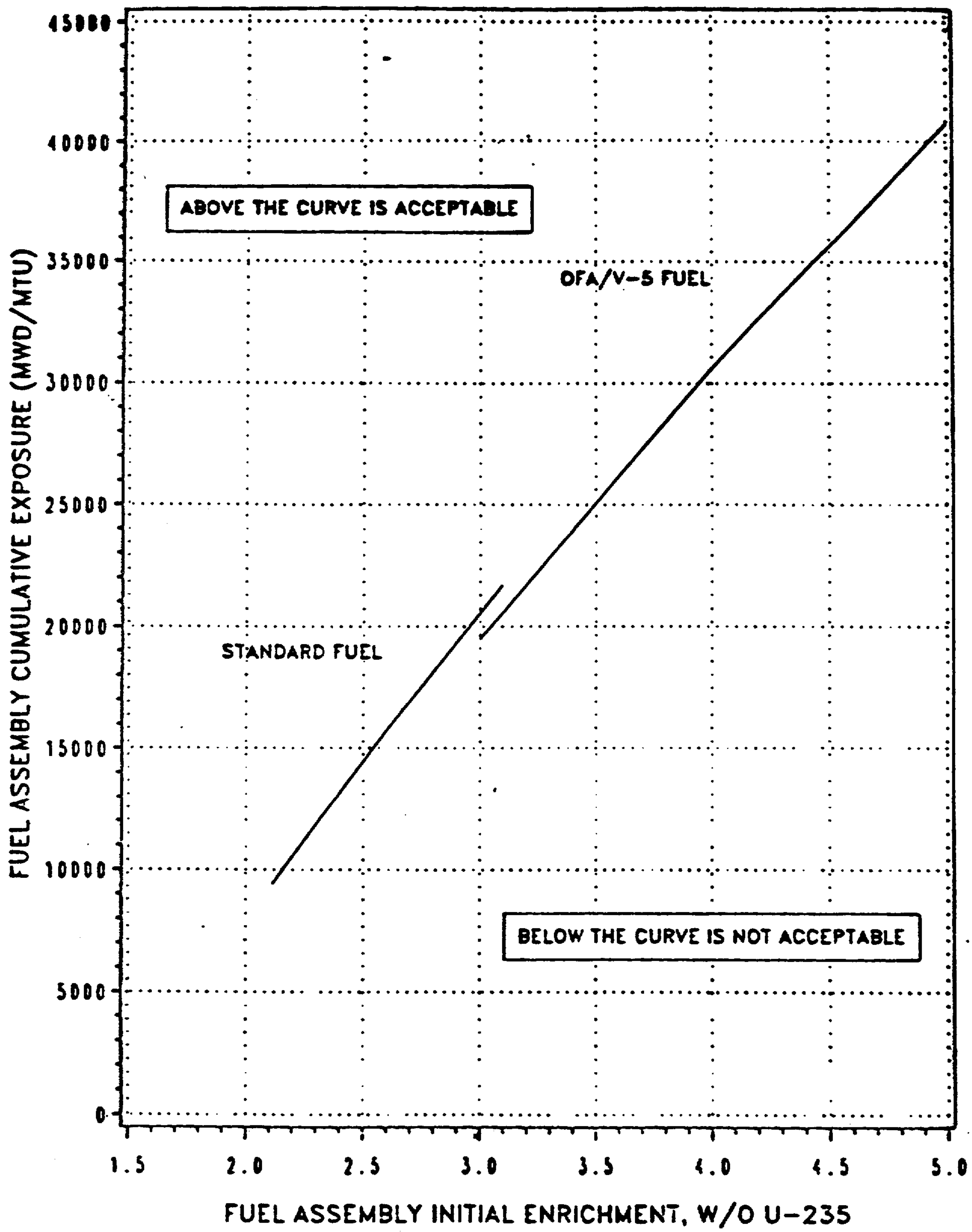
a. With the requirements of the above specification not satisfied, suspend all other movement of fuel assemblies and crane operations with loads in the fuel storage areas and move the non-complying fuel assemblies to Region 1. Until these requirements of the above specification are satisfied, boron concentration of the spent fuel pool shall be verified to be greater than or equal to 2000 ppm at least once per 8 hours.

b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.9.12 The burnup of each spent fuel assembly stored in Region 2 shall be ascertained by analysis of its burnup history and independently verified, prior to storage in Region 2. A complete record of such analysis shall be kept for the time period that the spent fuel assembly remains in Region 2 of the spent fuel pool.

FIGURE 3.9-1
MINIMUM REQUIRED FUEL ASSEMBLY BURNUP AS A FUNCTION
OF INITIAL ENRICHMENT TO PERMIT STORAGE IN REGION 2



5.3 REACTOR CORE

FUEL ASSEMBLIES

5.3.1 The core shall contain 193 fuel assemblies with each fuel assembly normally containing 264 fuel rods clad with Zircaloy-4, except that limited substitution of fuel rods by filler rods consisting of Zircaloy-4 or stainless steel or by vacancies may be made if justified by a cycle-specific reload analysis. Each fuel rod shall have a nominal active fuel length of 144 inches and contain a maximum total weight of 1766 grams uranium. Reload fuel shall be similar in physical design to the initial core loading and shall have a maximum enrichment of 5.00 weight percent U-235. Fuel with enrichments greater than 4.10 weight percent of U-235 shall contain sufficient integral fuel burnable absorber such that the requirements of Specification 5.6.1.1 are met.

CONTROL ROD ASSEMBLIES

5.3.2 The core shall contain 53 full-length and no part-length control rod assemblies. The full-length control rod assemblies shall contain a nominal 142 inches of absorber material. All control rods shall be hafnium, silver-indium-cadmium, or a mixture of both types. All control rods shall be clad with stainless steel tubing.

5.4 REACTOR COOLANT SYSTEM

DESIGN PRESSURE AND TEMPERATURE

5.4.1 The Reactor Coolant System is designed and shall be maintained:

a. In accordance with the Code requirements specified in Section 5.2 of the FSAR, with allowance for normal degradation pursuant to the applicable Surveillance Requirements,

b. For a pressure of 2485 psig, and

c. For a temperature of 650°F, except for the pressurizer which is 680°F.

VOLUME

5.4.2 The total volume of the Reactor Coolant System, including pressurizer and surge line, is 12,135 ± 100 cubic feet at a nominal T_{avg} of 557°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

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

a. A k_{eff} equivalent to less than or equal to 0.95 when flooded with unborated water, which includes an allowance for uncertainties as described in Section 9.1 of the FSAR. This is based on fresh fuel with the maximum initial enrichment of U-235 in Region 1 and on spent fuel with combination of initial enrichment and discharge exposures, shown in Figure 3.9-1, in Region 2, and

b. A nominal 9.24 inch center-to-center distance between fuel assemblies placed in the storage racks, and

c. A maximum reference fuel assembly K_∞ less than or equal to 1.480 at 68°F for storage in Region 1.

5.6.1.2 The k_{eff} for new fuel for the first core loading stored dry in the spent fuel storage racks shall not exceed 0.98 when aqueous foam moderation is assumed.

DRAINAGE

5.6.2 The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 2040 feet.

CAPACITY

5.6.3 The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than 1344 fuel assemblies.

5.7 COMPONENT CYCLIC OR TRANSIENT LIMIT

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.

(Next page is 5-9)

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 109 TO FACILITY OPERATING LICENSE NO. NPF-30

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

1.0 INTRODUCTION

By letter dated September 6, 1995, as supplemented by letters dated January 30, 1996, March 27, 1996, and April 2, 1996, Union Electric Company (UE), requested changes to the Technical Specifications (Appendix A to Facility Operating License No. NPF-30) for the Callaway Plant, Unit 1. The proposed amendment would allow for the storage of fuel with an enrichment not to exceed a nominal 5.0 weight percent (w/o) U-235, subject to certain integral fuel burnable absorber (IFBA) requirements or discharge exposures, in the spent fuel pool storage racks. Plant operation using the higher enriched fuel will be demonstrated to be acceptable by a cycle specific reload safety evaluation performed prior to each fuel loading. TS 5.3.1, TS 5.6.1.1 and TS Figure 3.9-1 would be revised to incorporate the above changes.

The January 30, 1996, March 27, 1996, and April 2, 1996, supplemental letters provided additional clarifying information and did not change the original no significant hazards consideration determination published in the Federal Register on November 8, 1995 (61 FR 56372).

2.0 EVALUATION

2.1 Criticality Review

The Callaway spent fuel pool (SFP) is divided into two separate and distinct regions. Region 1 contains unpoisoned racks and is designed to accommodate fresh (unirradiated) fuel assemblies in a two-out-of-four checkerboard array. Therefore, from a criticality viewpoint, any type of fuel from the Callaway core can be stored in Region 1. Region 2 is designed to accommodate only irradiated fuel assemblies which have attained sufficient burnup.

The analysis of the reactivity effects of fuel storage in the SFP storage racks was performed with the three-dimensional multi-group Monte Carlo computer code, KENO-5a, using neutron cross sections generated by the NITAWL code package from the 27 energy group SCALE data library. The two-dimensional transport theory code, CASMO-3, was also used to determine a reference k_∞ which can be used as an alternate approach for determining the acceptability of a fuel assembly for storage in the Region 1 racks. These codes are widely used for the analysis of fuel rack reactivity and have been benchmarked against results from numerous critical experiments. These experiments simulate the Callaway fuel storage racks as realistically as possible with respect to parameters important to reactivity such as enrichment and assembly spacing. The intercomparison between two independent methods of analysis (KENO-5a and CASMO-3) also provides an acceptable technique for validating calculational methods for nuclear criticality safety. To minimize the statistical uncertainty of the KENO-5a reactivity calculations, a sufficient number of neutron histories were accumulated in each calculation to assure convergence of KENO-5a reactivity calculations. Based on the above, the staff concludes that the analysis methods used are acceptable and capable of predicting the reactivity of the Callaway spent fuel storage racks with a high degree of confidence.

The spent fuel racks are normally fully flooded by water borated to at least 2000 ppm of boron and verified weekly by plant procedures. However, to meet the criterion stated in Section 9.1.2 of the NRC Standard Review Plan (SRP), k_{eff} must not exceed 0.95 with the racks fully loaded with fuel of the highest anticipated reactivity and flooded with unborated water. The maximum calculated reactivity must include a margin for uncertainties in reactivity calculations and in manufacturing tolerances such that the true k_{eff} will not exceed 0.95 at a 95/95 probability/confidence level.

The spent fuel storage racks in Region 1 were analyzed for fresh Westinghouse 17x17 Vantage-5 (V-5) fuel assemblies enriched to 4.1 w/o U-235 with no IFBA rods and moderated by pure water at 68 degrees F with a density of 1.0 gm/cc, which results in the highest reactivity. For the nominal storage cell design in Region 1, uncertainties due to tolerances in fuel enrichment and density, storage cell spacing, and stainless steel thickness were accounted for. These uncertainties were appropriately determined at the 95/95 probability/ confidence level. In addition, calculational and methodology biases and uncertainties due to the KENO-5a statistics and benchmarking were included. The resulting spent fuel rack k_{eff} was 0.9481, including biases and uncertainties at the 95/95 level. This meets the NRC acceptance criterion of 0.95 and is, therefore, acceptable.

To enable the storage of fuel assemblies with nominal enrichments greater than 4.1 w/o U-235, the concept of reactivity equivalencing was used. In this technique, which has been previously approved by the NRC, credit is taken for the reactivity decrease due to the IFBA material coated on the outside of the UO_2 pellet. Based on these calculations, 21 IFBA rods are required to maintain k_{eff} no greater than 0.95 for fuel initially enriched to 5.0 w/o U-235. Since current Westinghouse IFBA patterns are limited to 16 or 32 rods per assembly, the actual limit for assemblies with enrichments greater than 4.1 w/o U-235 and less than 4.8 w/o U-235 is 16 IFBA rods, and is 32 IFBA rods for assemblies with enrichments greater than 4.8 w/o U-235. The calculations included uncertainties on the boron-10 (B-10) loading tolerance, the IFBA stack length tolerance and IFBA rod position. Although the boron concentration in the IFBA rods decreases with fuel depletion, calculations have shown that for the number of IFBA rods considered in this analysis, the fuel assembly reactivity decreases more rapidly. Therefore, the reactivity equivalencing calculations were performed at zero burnup, resulting in the maximum fuel rack reactivity.

As an alternative method for determining the acceptability of fuel storage in Region 1, a reference k_∞ calculation was performed using CASMO-3. The calculation used the nominal 4.10 w/o V-5 fuel assembly with no burnable absorbers in the Callaway reactor geometry at a temperature of 68 degrees F. The resulting k_∞ was 1.480 and included the 1 percent reactivity bias to account for calculational uncertainties. Thus, fuel assemblies which are to be stored in the Callaway Region 1 spent fuel racks must either meet the initial enrichment versus IFBA requirements previously described, or have a reference k_∞ less than or equal to 1.480, to ensure that the final k_{eff} of the Callaway Region 1 spent fuel racks will be no greater than 0.95.

Most abnormal storage conditions will not result in an increase in the k_{eff} of the racks. However, it is possible to postulate events, such as the misloading of an assembly with an enrichment and IFBA combination outside of the acceptable area, which could lead to an increase in reactivity for Region 1. However, for such events, credit may be taken for the presence of approximately 2000 ppm of boron in the pool water since 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. Therefore, the staff criterion of k_{eff} no greater than 0.95 for any postulated accident is met.

Previously approved analyses performed for the Region 2 racks showed that acceptable criticality limits are maintained when storing fuel enriched to a maximum of 5.0 w/o U-235, provided that the fuel burnups meet the prescribed limits. However, due to thermal-hydraulic constraints, fuel enrichments only up to 4.45 w/o U-235 were allowed. These constraints have been resolved and the current spent fuel pool heat load methodology can be used to support storage of fuel up to a maximum initial enrichment of 5.0 w/o U-235.

2.2 Thermal/Hydraulic Analysis of Spent Fuel Pool

2.2.1 Licensing Bases

Details of the Callaway licensing bases are located in Section 9.1.2, Section 9.1.3 and Appendix 9.1A of the Final Safety Analysis Report (FSAR). These are: Case 1 - Coolant temperature limit of 140 degrees F[1], assuming placement of approximately 80 spent fuel assemblies in the spent fuel pool 100 hours after shutdown, and Case 2 - Coolant temperature of 160 degrees F, assuming placement of the entire core in the spent fuel pool 196.5 hours after shutdown. In both cases it is assumed that only one train of two available fuel pool cooling system trains is operating to cool the water in the SFP.

For the design basis calculation, the licensee selected the SFP coolant temperatures for Case 1 (140 degrees F) and Case 2 (160 degrees F), and then calculated the decay heat generated in the SFP which would result in those

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1 Changed from 135°F in Amendment 54 to accommodate fuel loading of 4.45 weight percent U-235.

temperatures when operating only one of the two trains of the SFP cooling system. The resultant decay heat values for those conditions were found to be 26.40 E06 BTU/HR and 41.48 E06 BTU/HR, respectively. The maximum anticipated heat load to be removed by the fuel pool cooling system is based on the decay heat generated by a full core removed from the reactor and stored in the SFP 196.5 hours following a reactor shutdown, while spent fuel assemblies from previous refuelings remain in the SFP. The 196.5 hours consist of 100 hours to cool down the reactor and 96.5 hours to transport the full core to the SFP (1/2 hour per assembly). Technical Specification 3.9.3 requires that the reactor be subcritical for at least 100 hours before irradiated fuel in the core may be moved.

The licensing bases of 140 degrees F and 160 degrees F were found to be acceptable in previous licensing documents, including license amendment 54. These continue to be acceptable.

2.2.2 Decay Heat

The licensee indicated that the decay heat loads which were calculated for the partial and full core offloads, assuming the use of 5.0 w/o enriched fuel, are 19.948 E06 BTU/HR and 39.466 E06 BTU/HR, respectively, which are less than the licensing values of 26.40 E06 and 41.48 E06 BTU/HR. For the purpose of calculation, it was assumed that an additional 84 spent fuel elements remain in the SFP at the end of each refueling period. The licensee also assumed, for the purpose of calculation, that the SFP is filled with spent fuel elements.

Certain decay heat generation rates calculated by the licensee were verified by the staff using values located in ANSI 5.1. The staff's results were within 1 percent of the licensee's results. Since the licensee's calculations were less than those found in making the licensing bases calculations and the staff's calculations were in agreement with the licensee's, the licensee's calculations for decay heat are acceptable.

2.2.3 Coolant Temperatures

The licensee stated that the maximum SFP coolant temperatures with the increase in fuel enrichment of 5.0 w/o U-235 would be less than the design basis temperatures of 140 degrees F for a partial offload and 160 degrees F for a full core offload because the decay heat loads (19.948 E06 and 39.466 E06 BTU/HR) were less than those established for the licensing bases (26.4 E06 and 41.48 E06 BTU/HR). Since SFP bulk coolant temperatures would not reach 140 degrees F for the partial offload case or 160 degrees F for the full core offload case, the temperatures (less than 140 degrees F and less than 160 degrees F), are acceptable.

At the staff's request, the licensee conducted an analysis that involved using the input parameters for Case 2 with the exception that two SFP cooling trains, instead of one, were assumed to be in operation. The bulk SFP coolant temperature calculated for that case was 133 degrees F. The results of the calculation indicate that in the event of necessity, the licensee can reduce the bulk temperature of the SFP coolant below the 160 degree F limit established for Case 2 when both cooling trains are available.

2.2.4 Coolant Bulk Boiling

The licensee calculated the time it would take for the bulk coolant to boil starting at 140 degrees F and 160 degrees F, using the decay heat generation rates calculated for the licensing cases of partial and full core offload, respectively. The resultant elapsed times to reach boiling conditions are 8.78 hours for the partial offload and 4.03 hours for the full core offload case. Since in both cases, time would be available to utilize some source to restore the cooling process or to replace coolant which has evaporated should no other cooling source be available, this is acceptable.

2.2.5 Fuel Cladding Temperature

The licensee calculated the maximum surface heat flux for a hot assembly in the case of full core offload. The maximum cladding temperature resulting from this calculation (237.6°F) is acceptable since it is much lower than the normal cladding temperature occurring during operation in the core.

2.2.6 Local Coolant Boiling

The licensee noted that local boiling would not occur in the spent fuel assemblies since the saturation temperatures at the locations of maximum heat flux exceeded the temperatures attained by the spent fuel cladding. The licensee also noted that even if local boiling were to occur, the net result would be a decrease in reactivity because of the presence of boron dissolved in the spent fuel pool coolant to the extent of a minimum concentration of 2000 ppm. This is acceptable.

2.2.7 Spent Fuel Pool Cleanup System

The SFP cleanup system contains a demineralizer with resins to purify the SFP coolant. The resins are the most temperature sensitive components of the SFP cleanup system and could become degraded at temperatures in excess of 140 degrees F. In order to protect the demineralizing system against high temperatures, an annunciator is sounded in the control room when the temperature of the SFP coolant reaches 130 degrees F, at which time operating procedures require that the cleanup pumps be shut down and manual isolation valves leading to and from the cleanup system be closed so that coolant with temperatures of 140 degrees F or greater will not enter the system spent fuel pool cleanup system. The application of the annunciator and operating procedures to protect the deionizer resins in case of high coolant temperatures is acceptable.

2.3 Summary of Results

The following technical specification changes have been proposed as a result of the requested enrichment increase.

(1) TS 5.3.1 has been revised to reflect a change in the maximum initial enrichment to 5.0 w/o U-235 for reload fuel, subject to the IFBA requirements determined above, and to increase the maximum fuel enrichment not requiring IFBAs from 3.85 to 4.10 w/o U-235.

(2) TS 5.6.1.1 has been revised to increase the maximum reference K_∞ from 1.455 to 1.480 for storage in Region 1.

(3) TS Figure 3.9-1 has been revised to reflect a maximum initial enrichment of 5.0 w/o U-235 for storage in Region 2.

Based on the review discussed above, the staff finds the criticality aspects of the proposed enrichment increase to the Callaway SFP storage racks to be acceptable. The increase meets the requirements of General Design Criterion 62 for the prevention of criticality in the fuel storage and handling. The staff also finds the thermal/hydraulic analysis of the SFP to be acceptable for storage of fuel in the SFP with an initial enrichment up to 5.0 w/o U-235.

3.0 STATE CONSULTATION

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

4.0 ENVIRONMENTAL CONSIDERATION

Pursuant to 10 CFR 51.21, 51.32 and 51.35, an environmental assessment and finding of no significant impact was published in the Federal Register on March 25, 1996 (61 FR 12112).

Accordingly, based upon the environmental assessment, the Commission has determined that issuance of this amendment will not have a significant effect on the quality of the human environment.

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

Principal Contributors: L. Kopp
N. Wagner

Date: April 30, 1996