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Donald F. Schnell
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December 19, 1986

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton: ULNRC-1422

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
REVISION TO TECHNICAL SPECIFICATION FIGURE 3.9-1
AND SECTIONS 5.3.1, 5.6.1.1
CONCERNING SPENT FUEL POOL STORAGE

Reference 1: ULNRC-1416, dated December 10, 1986
Reference 2: ULNRC-1192, dated October 15, 1985

Union Electric herewith transmits three (3) original and forty (40) conformed copies of an application for amendment to Facility Operating License No. NPF-30 for Callaway Plant, Unit 1.

This amendment request replaces Technical Specification Figure 3.9-1 with corrected curves for Westinghouse optimized fuel (OFA) or standard fuel. Figure 3.9-1 also incorporates a curve for Westinghouse Vantage Fuel (V5) which overlays the OFA curve with an extension to 4.25 w/o U-235. Technical Specification sections 5.3.1 and 5.6.1.1 are revised to reflect a maximum enrichment of 4.25 w/o U-235 for fuel storage. A detailed discussion of the corrections to Figure 3.9-1 and the impact on our compliance to regulatory requirements were submitted in reference 1. Reference 2 presented the results of extensive analyses performed to verify the storage of 4.2 w/o U235 fuel. The current work to verify the storage of 4.25 w/o U235 fuel supplements reference 2.

The amendment request is complete for supporting the storage of non-depleted Westinghouse V5 fuel. However the results of the thermal-hydraulic, structural, and environmental analyses to support the storage of depleted V5 fuel will be a part of the reload amendment request to be submitted for approval prior to startup of cycle 3. V5 fuel will be introduced into the Callaway cycle 3 core.

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In addition, supplemental criticality analyses were performed to verify the storage of 4.25 w/o U235 fuel in the new fuel storage racks. The results confirm that reload fuel with enrichments up to 4.25 w/o U235 can be safely stored in the new fuel storage racks without exceeding criticality safety limits. The results of these analyses are not included in this amendment request since the Technical Specifications do not address storage in the new fuel racks.

Union Electric's date of June 1, 1987 for reload fuel on site and the effective date for implementation of the proposed Technical Specification changes are subject to NRC approval.

Enclosed is a check for the $150.00 application fee required by 10 CFR 170.21.

Very truly yours,

for Donald F. Schnell

DJW/plh

Enclosures: 1 - Safety Evaluation
2 - Significant Hazards Considerations
3 - Marked Technical Specification Pages

STATE OF MISSOURI)
)   S S
CITY OF ST. LOUIS)

Robert J. Schukai, of lawful age, being first duly sworn upon oath says that he is General Manager-Engineering (Nuclear) for Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By Robert J. Schukai
Robert J. Schukai
General Manager-Engineering
Nuclear

SUBSCRIBED and sworn to before me this 22 day of December 1986

Diane F. Strawhun

DIANE F. STRAWHUN
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SAFETY EVALUATION

This amendment requests: that Technical Specification Figure 3.9-1 be replaced with corrected curves for OFA and SFA; that V5 fuel be represented in Figure 3.9-1, since the V5 curve would overlay the OFA curve with an extension from 4.2 w/o to 4.25 w/o; and that Technical Specification sections 5.3.1 and 5.6.1.1 be revised to reflect a maximum enrichment of 4.25 w/o for fuel storage.

Callaway's first reload core (cycle 2) contains both Westinghouse Standard Fuel Assemblies (SFA) and Optimized Fuel Assemblies (OFA). The next reload core (Cycle 3) will introduce the Westinghouse Vantage 5 Fuel (V5) option as a mix with the SFA and OFA designs. Use of the V5 design requires increasing the maximum enrichment limit for stored fuel from 4.2 w/o to 4.25 w/o. As discussed in WCAP 10444, the V5 option offers five improved fuel design features as a modification of the SFA and OFA fuel assembly designs. Based on these facts, supplemental criticality analyses were performed to support storage of 4.25 w/o fuel, and additional assessments were made to determine the impact of using the V5 option on spent fuel pool design criteria.

In the course of performing supplemental calculations to verify criticality limits for V5 fuel storage, discrepancies were identified between the current work and that provided in 1985. The discrepancies were reviewed and the source of errors were identified. The errors rendered incorrect both the SFA and OFA curves currently presented in Figure 3.9-1 of the Callaway Technical Specifications. The detailed discussion of the errors, their correction, and their lack of impact on our compliance to regulatory requirements were submitted in ULNRC-1416 dated December 10, 1986. Calculations were redone to correct the OFA and SFA curves.

The analyses and evaluations performed to support the storing of higher enriched fuel, such as V5 fuel, and to correct the SFA and OFA curves of Figure 3.9-1 conclude that: (1) spent fuel criticality limits are maintained when storing fuel to a maximum initial enrichment of 4.25 w/o; (2) existing safety margins are more than adequate for storage of fuel at the higher enrichment of 4.25 w/o; and (3) FSAR analyses for the seismic response and criticality related accident scenarios bound storage considerations for V5 fuel.

A reanalysis of the thermal-hydraulic behavior, spent fuel pool structural design bases, or environmental considerations (including the postulated dropped bundle accident) is not required to assure the safe storage of non-depleted V5 fuel in the spent fuel pool. However, these reanalyses are required for the storage of depleted V5 fuel. The results of these analyses will be submitted via an amendment request prior to the startup of Cycle 3, and depleted V5 fuel will not be stored in the spent fuel pool until the amendment request has been incorporated into the Callaway Technical Specifications.

Description of the Callaway Spent Fuel Pool

The Callaway spent fuel pool utilizes the maximum density rack (MDR) design concept. Under this concept, the spent fuel pool is divided into two separate and distinct regions which for the purpose of criticality considerations may be considered as separate pools. Suitability of this design assumption regarding pool separability is assured through appropriate design restrictions at the boundaries between Region 1 and Region 2. Region 1 of the pool is designed on the basis of conservative criteria which allow for the safe storage of a number of fresh unirradiated fuel assemblies and a full core unloading if that should prove necessary. Region 2 is designed to safely store irradiated fuel assemblies in large numbers. The only change in criteria between Region 1 and Region 2 is the recognition of actual fuel and fission product inventory accompanied by a system for verifying fuel burnup prior to moving any fuel assembly from Region 1 to Region 2. In both Region 1 and 2, subcriticality (K_{eff} < 0.95) is maintained during all normal, abnormal, or accident conditions.

The spent fuel pool is a reinforced concrete structure with a stainless steel liner. Fuel storage rack modules are constructed with square boxes which form a honeycomb structure. The rack modules are freestanding on the floor liner plate of the pool. The pool is filled with borated water with a boron concentration of 2000 ppm. The fuel pool cooling and cleanup system consists of two 100 percent capacity cooling trains. This system functions to limit the pool temperature to 135°F with one train operating during normal plant conditions; removes impurities for visual clarity; and limits the radiation dose to operating personnel during normal and refueling operations.

Description of the Callaway Plant Fuel Designs

The physical characteristics of OFA, SFA, and V5 fuel assemblies are similar. The designs employ 17 X 17 fuel rod arrays and the fuel rods are zircaloy clad. The OFA and V5 designs, however, utilize a smaller fuel rod diameter with chamfered pellets and employ zircaloy rather than inconel mixing vane spacer grids. The V5 fuel utilizes intermediate flow mixer grids which are nonstructural zircaloy grids installed between the three uppermost zircaloy grids. Thus the V5 fuel is conservatively represented by the OFA fuel design which does not contain the intermediate flow mixing grids (also neutron absorbing members). With respect to all other components in the active fuel region, the OFA and V5 fuel types are neutronically the same. The OFA and V5 fuel types contain the same fuel weight (UO_2). However V5 fuel utilizes initial enrichments slightly greater than the 4.2 w/o used in the criticality analyses. For this reason supplemental criticality analyses were performed to confirm the extension of the comprehensive analyses for OFA fuel (4.2 w/o enrichment) to a slightly higher enrichment of 4.25 w/o U-235.

Corrections to the Criticality Analyses for SFA and OFA fuel and Corrections to Technical Specification Figure 3.9-1

In 1985 an extensive criticality reanalysis was performed to support the storage of OFA fuel in both the spent fuel pool and the new fuel storage pits. These analyses provided the bases for the Technical Specification Amendment Request submitted in ULNRC-1192, dated October 15, 1985. The results presented for the new fuel storage racks; the spent fuel storage racks for Region 1 of the spent fuel pool; and the majority of the spent fuel storage rack analyses for Region 2, including sensitivity analysis, accident analysis, and calculations of uncertainties remain valid as presented in ULNRC-1192. However, in the course of providing supplemental criticality analyses to extend the analysis for storing V5 fuel, errors were found that rendered both the SFA and OFA curves presented in Figure 3.9-1 incorrect.

The discrepancy in the OFA curve was caused by an error in a correction factor used for the detailed modeling of changes in the fission product absorption cross sections with fuel depletion. The error caused an overestimation of fission product absorption and therefore resulted in an underestimation of the required burnup levels. The curve was recalculated using the correct factors on fission product absorption. On the average, the difference between the incorrect and correct OFA curves is approximately 2000 MWD/MTU.

The discrepancy in the SFA curve was attributed to an incorrect transcription of data from the original SFA calculated curves which were being used as the base for extending the SFA curve for the 1985 analysis. A review of the original calculation confirmed their correctness. The SFA curve calculated as part of the 1985 analysis was redone again to assure the use of correct values. The differences between the incorrect and correct SFA curves is on the average approximately 1800 MWD/MTU. The correct SFA curve also yields required burnup levels above the previously underestimated values.

Both OFA and SFA curve discrepancies involved errors in implementation of the same modeling techniques and computer codes previously validated, approved, and used in all prior criticality analyses. The considerable amounts of margin in the analyses preclude any violations of regulatory limits whether using the incorrect or the correct curve. In addition, if credit is given for 2000 ppm soluble boron in the spent fuel pool water, then loading Region 2 to the maximum allowed density with fresh fuel at an enrichment of 4.2 w/o would yield a multiplication factor equal to approximately 0.89 and well below the regulatory limit.

Thus the corrections that were required to the curves of Technical Specification Figure 3.9-1 affected the depleted fuel portions of the 1985 analysis and did not impact the results based on fresh fuel calculations. Therefore, the criticality limit results reported in the referenced letter for Region 1 of the spent fuel pool, for the new fuel storage pit and for accident considerations remain valid. Furthermore, all spent fuel has been stored in the Region 1 configuration, and administrative procedures were implemented to require that spent fuel be stored in the Region 1 configuration until the corrected curves are incorporated into the Technical Specifications.

Based on the above discussion, the proposed corrections to Figure 3.9-1 do not adversely affect or endanger the health or the safety of the general public and do not involve an unreviewed safety question.

SUPPLEMENTAL CRITICALITY ANALYSES FOR STORAGE OF 4.25 W/O WESTINGHOUSE OFA AND V5 FUEL

Extensive analyses were performed in 1985 to support the storage of both SFA and OFA fuel assemblies under both normal and postulated accident conditions and to store the fuel up to a maximum initial enrichment of 4.20 w/o U-235. ULNRC-1192 dated October 15, 1985 presented the results of these analyses. The OFA and V5 fuel types are neutronically the same in the active fuel region and they contain the same fuel weight of UO_2. The OFA design conservatively represents the V5 design in terms of the neutronic effects from the addition of the intermediate flow mixing grids to the V5 design. Since the fuel designs are neutronically the same, supplemental criticality analyses were performed to provide confirmation of the extension of the comprehensive analyses to include the slightly higher enrichment of 4.25 w/o U-235. The supplemental analyses were performed using the same calculational methodology, computer codes, and cross-section libraries as used in the prior analyses. The effects from calculational biases, tolerances, and uncertainties remain applicable to the extended analyses. Thus the maximum multiplication factor was calculated for the various problem configurations using conservative inputs (for example, use of an expected maximum fuel pellet density). The multiplication factor was then adjusted by adding the values for the total biases and uncertainties determined from the prior analyses. The results were then compared to the critical limit of Keff < 0.95.

Region 1 calculations assumed an infinite array of unirradiated 4.25 w/o OFA, V5 design assemblies arranged in the Region 1 rack configuration. The maximum Keff including biases and uncertainties was calculated to be 0.9436. This value compares with a Keff value of 0.9387 for the prior calculation using 4.2 w/o fuel. No credit was given for the 2000 ppm borated water in the pool; however, including this reactivity effect (determined in the prior analysis) would reduce the maximum Keff to approximately 0.691. These calculations clearly confirm that extending the maximum enrichment to 4.25 w/o U-235 would still allow the higher enriched fuel to be stored safely in Region 1 of the pool.

Region 2 depletion calculations were redone to correct the prior SFA and OFA fuel work as described above. For example, the corrected Region 2 calculations at 36,000 MWD/MTU for 3.556 w/o OFA fuel in the Region 2 configuration yielded a multiplication factor with a value of 0.8852, which includes the total biases and uncertainties. Supplemental calculations were performed to extend the OFA/V5 curve to include the higher 4.25 w/o enrichment. Using the corrected depletion cases for SFA and OFA fuel, and including cases depleted at 4.25 w/o enrichment, curves were developed for all three fuel types to provide criteria, in terms of minimum allowed burnup levels and initial enrichment, for selecting depleted bundles to be safely stored in the Region 2 configuration. The curves are developed through an iterative process of calculating the reactivities for various initial enrichments at various exposure points for the SFA, OFA, and V5 fuel designs. Since the same calculational methods are employed for the various fuel types and since the major contributor to the total uncertainty is the calculational uncertainty, the same value of the multiplication factor can be used by all fuel types as criterion to assure compliance with 0.95 regulatory limit.

Based on the prior analyses, the maximum combined biases and uncertainties yielded a value of 0.0322 $\Delta K/K$. Using the 0.0322 $\Delta K/K$, a multiplication factor including uncertainties would be less than 0.95 at the 95% confidence level if the computed multiplication factor is less than 0.9203. The computed value of 0.9203 can be used as the required criterion for all the fuel types. However as done in the previous analyses, this criterion was conservatively lowered to a multiplication factor of 0.9150. This provides additional margin to account for possible interpolation errors in developing the final curves. Using the limit of 0.9150, the various enrichment/burnup curves were used to interpolate or extract those points having multiplication factors below 0.9150. The reusulting families of curves were used to generate the curves for Figure 3.9-1. Compliance to Figure 3.9-1 assures that depleted fuel can be safely stored in the Region 2 configuration.

OTHER CONSIDERATIONS FOR STORAGE OF V5 FUEL IN THE SPENT FUEL POOL

The following additional considerations address storage of fuel to a maximum enrichment of 4.25 w/o U235 and storage considerations for V5 fuel:

(a) A reanalysis of the thermal-hydraulic behavior of the spent fuel pool storage racks is not needed to assure safe storage of non-depleted V5 assemblies. Unirradiated, new fuel assemblies generate no decay heat; therefore, the adequate cooling of the new fuel is not a concern. Additionally, the new fuel does not affect the adequacy of fuel building HVAC performance, since new fuel does not contribute to the fuel building heat load.

The thermal-hydraulic analysis of the spent fuel pool will require an evaluation or reanalysis to assure that depleted V5 assemblies can be stored in the spent fuel pool with adequate cooling and without adverse impact on fuel building HVAC performance. This evaluation or reanalysis will be performed prior to the discharge of any spent V5 assemblies to the spent fuel pool and will be submitted prior to startup of Cycle 3.

(b) As reported in the seismic analysis in Chapter 9.1A of the Callaway FSAR, the stresses in the spent fuel pool rack were found to be well below allowable values. This conclusion was based on fuel assemblies weighing 1620 lbs. OFA (1365 lbs) and V5 (1366 lbs) fuel assemblies weigh approximately 15% less than the analyzed assemblies.

The affect of reduced loading decreases both the vertical and horizontal calculated stresses resulting from seismic and static forces. Hence, the original FSAR analyses envelope OFA and/or V5 loaded fuel racks.

(c) An environmental evaluation, including the postulated dropped bundle scenario, is not required for the storage of non-depleted V5 fuel. Unirradiated, new fuel assemblies would not provide the inventory release, if dropped, that would provide hazardous doses to personnel or to the general public. These analyses are required for the storage of depleted V5 fuel. Thus the results of the reanalysis will be submitted via an amendment request prior to startup of Cycle 3. Until the amendment request is incorporated in the Callaway Technical Specification, depleted V5 fuel will not be stored in the spent fuel pool.

(d) Again because of the conservative techniques and assumptions used to evaluate the maximum possible neutron multiplication factor, there is more than reasonable assurance that no significant hazards based on criticality safety under both normal and postulated accident conditions are involved in storing fuel assemblies up to and including 4.25 w/o U-235.

Based on the above discussions, the proposed Technical Specification changes do not adversely effect or endanger the health or the safety of the general public and do not involve an unreviewed safety question.

SIGNIFICANT HAZARDS CONSIDERATIONS

This amendment request replaces Technical Specification Figure 3.9-1 with corrected curves for the Westinghouse Optimized Fuel Assemblies (OFA) and Standard Fuel Assemblies (SFA); represents Vantage 5 fuel (V5) in Figure 3.9-1 by the fact that the V5 curve would overlay the OFA curve with an extension from 4.2 w/o to 4.25 w/o U-235; and revises Technical Specification sections 5.3.1 and 5.6.1.1 to reflect a maximum enrichment limit of 4.25 w/o U-235 for storage of fuel at Callaway.

The Safety Evaluation supporting this amendment request provides the bases for concluding that the proposed changes are consistent with the licensing bases of the spent fuel pool and verify that the proposed changes do not alter safe operation of spent fuel pool systems nor violate pool criticality safety limits. Physically the Callaway fuel designs are similar. The designs employ 17 X 17 fuel rod arrays, and the fuel rods are zircaloy clad. The fuel assemblies dimensional envelope, skeletal structure, and internal grid locations are essentially the same, except that the V5 fuel contains additional intermediate flow mixing grids which are non-structural zircaloy grids installed between the three uppermost zircaloy grids. Even with the addition of the intermediate flow mixing grids, the difference in total assembly weight between the OFA and V5 fuel types is negligible. In addition, OFA and V5 fuel designs, when compared to SFA, fuel utilize a smaller rod diameter with chamfered pellets and employ zircaloy rather than inconel mixing vane spacer grids. The V5 fuel is conservatively represented by the OFA fuel neutronic design which does not contain the intermediate flow mixing grids (also neutron absorbing members). With respect to all other components in the active fuel region, the OFA and V5 fuel types are neutronically the same. The OFA and V5 fuel types contain the same fuel weight of UO_2; however, V5 fuel employs initial enrichments slightly greater than 4.2 w/o but bounded by 4.25 w/o.

In essence, the Technical Specification changes incorporate corrections to errors in the calculational analyses and the development of the limiting curves in Figure 3.9-1. The corrected changes are clearly within all acceptable criteria with respect to system operation and regulatory limits set for spent fuel pool storage. In addition, the increase to a maximum enrichment limit from 4.2 w/o to 4.25 w/o is required for a nuclear reactor core reloading where the reload fuel assemblies are not significantly different from those previously found acceptable to the NRC. WCAP 10444 sets forth the Vantage 5 fuel design, and this WCAP has been reviewed and approved by the NRC.

CORRECTIONS TO TECHNICAL SPECIFICATION FIGURE 3.9-1

In the course of performing supplemental calculations to verify criticality limits for V5 fuel storage, discrepancies were identified between the current work and that provided in 1985. The discrepancies were reviewed and the source of errors were identified. The errors rendered incorrect both the SFA and OFA curves currently presented in Figure 3.9-1 of the Callaway Technical Specifications. The detailed discussion of the errors, their correction, and their lack of impact on our compliance to regulatory requirements were submitted in ULNRC-1416 dated December 10, 1986. Calculations were redone to correct the OFA and SFA curves presented in Technical Specification Figure 3.9-1. The corrections to Figure 3.9-1 for SFA and OFA fuel types do not represent a significant hazard in that:

1. The corrections do not involve a significant increase in the probability or consequence of an accident or other adverse condition over previous evaluations. The results of the previous evaluations were presented in ULNRC-1192 dated October 15, 1985. The corrections applied to the detailed modeling of fission product absorption in depleted OFA fuel. The accident scenarios were conservatively based upon the assumption of fresh fuel in the analyses. Use of the higher enriched OFA fuel conservatively bounded accident considerations using fresh SFA fuel.

2. The corrections do not create the possibility of a new or different kind of accident or condition over previous evaluations. The corrections associated with Figure 3.9-1 do not involve modeling techniques or software problems. The corrections merely address the implementation of incorrect values in the calculational analyses which support the resulting curves. Using correct values does not introduce a new or different kind of accident or condition.

3. The corrections do not involve a significant reduction in a margin of safety. The considerable amounts of margin in the analyses precluded any violations of regulatory limits whether using the incorrect or correct curves. If credit were given for 2000 ppm borated water in the spent fuel pool, loading Region 2 to the maximum allowed density with fresh OFA fuel would yield a multiplication factor value of 0.89. This value is well below the regulatory limit and does not result in a significant reduction in margin.

INCREASE IN MAXIMUM ENRICHMENT TO 4.25 W/O FOR FUEL STORAGE IN THE SPENT FUEL POOL

Extensive analyses were performed to support storage of OFA and SFA to maximum enrichments of 4.2 w/o. The results of these analyses were submitted in amendment request ULNRC-1192 dated October 15, 1985. Since the V5 fuel is neutronically similar to the OFA fuel, supplementary criticality analyses were performed to extend the comprehensive analyses to the slightly higher enrichment of 4.25 w/o U-235. Extending the OFA/V5 curve to 4.25 w/o and increasing the maximum enrichment limit to 4.25 w/o for allowed storage in the spent fuel pool does not represent a significant hazard in that:

1. An increase to a maximum enrichment of 4.25 w/o does not involve a significant increase in the probability or consequence of an accident or other adverse condition over previous evaluations. Because of the conservative techniques and assumptions used to evaluate the maximum possible neutron multiplication factor, there is more than reasonable assurance that no significant hazards based on criticality safety is involved in storing fuel assemblies of up to and including 4.25 w/o in the spent fuel storage racks under both normal and postulated accident conditions. For example ignoring the 2000 ppm soluble boron in the spent fuel pool calculations results in conservative values of the multiplication factor. Storing fresh fuel in the Region 1 configuration at an enrichment of 4.25 w/o would result in a maximum multiplication factor of 0.9436 including all uncertainties. Adherence to the curves generated for Figure 3.9-1 would assure fuel storage in Region 2 to be at or below the limit of 0.9150 multiplication factor (includes uncertainties and additional margins). In the extreme case of loading Region 2 with fresh 4.25 w/o fuel, for example, and taking credit for 2000 ppm soluble boron results in a maximum multiplication factor of approximately 0.8923. In all cases the values of multiplication factor are below the required limit of 0.95.

2. An increase to a maximum enrichment level of 4.25 w/o does not create the possibility of a new or different kind of accident or condition over previous evaluations. An increase to the enrichment level of 4.25 w/o from 4.2 w/o involved extending the previous evaluations to cover the slight increase in enrichment. The same calculational techniques and computer codes were used.

3. An increase in the maximum enrichment level to 4.25 w/o does not involve a significant reduction in a margin of safety. As discussed above, in all cases the multiplication factors for worst case assumptions fall considerably below the regulatory limit and do not represent significant reductions in margin.

Enclosure 3
ULNRC -1422
December 19, 1986

MARKED TECHNICAL SPECIFICATION PAGES

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(b)	Section 5.3.1	page 5 - 6
(c)	Section 5.6.1.1	page 5 - 7