ATTACHMENT 1

TECHNICAL SPECIFICATION CHANGES

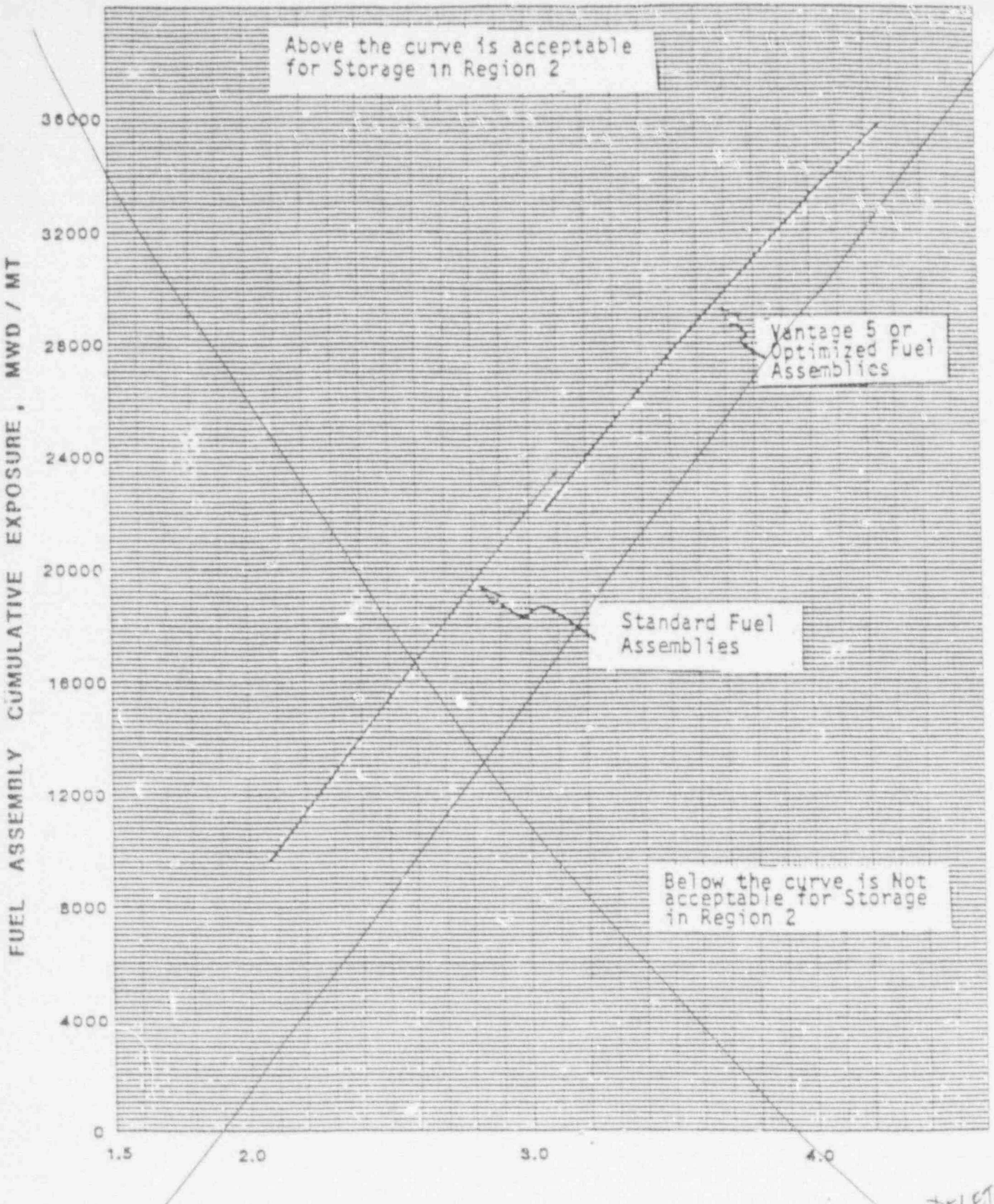

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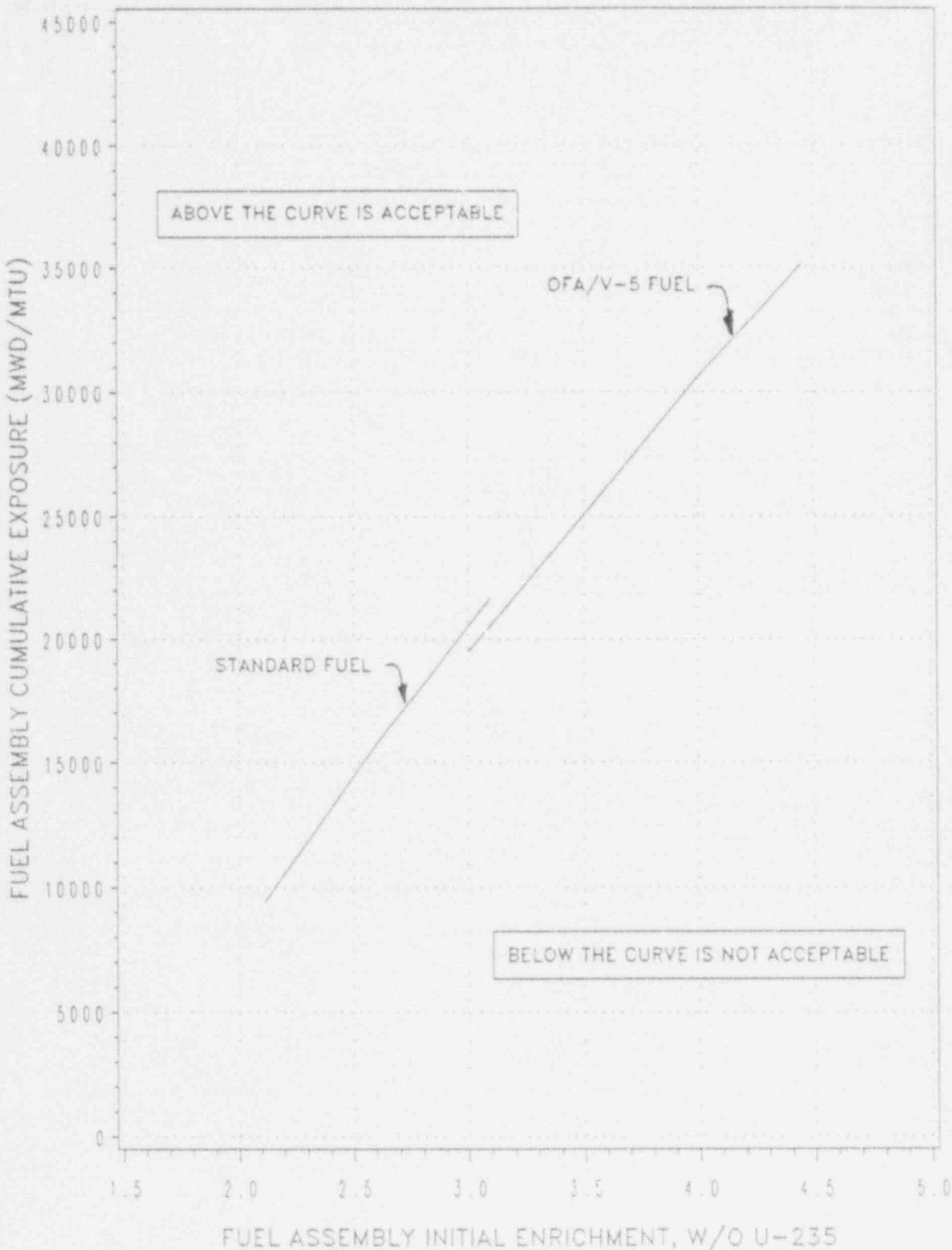
FIGURE 3.9-1

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

REPLACEMENT FIGURE

FIGURE 3.9-1
MINIMUM REQUIRED FUEL ASSEMBLY BURNUP AS A FUNCTION
OF INITIAL ENRICHMENT TO PERMIT STORAGE IN REGION2



ATTACHMENT 2

SAFETY EVALUATION

SAFETY EVALUATION

This amendment request is in support of Callaway Refuel 6. During Refuel 6, fuel with a maximum initial enrichment of 4.40 w/o U235 will be discharged. This amendment requests that Technical Specification section 3.9.12 be revised to reflect a maximum initial enrichment of 4.45 w/o U-235 for fuel storage in Region 2.

Callaway's second reload core (cycle 3) introduced the Westinghouse Vantage 5 Fuel (V-5) option as a mix with the Westinghouse Standard Fuel Assemblies (STD) and Optimized Fuel Assemblies (OFA). Beginning with Cycle 5, Callaway began utilizing only the V-5 fuel design. In order to achieve Union Electric's economic goals, fuel strategies were developed for Cycles 5 and beyond which required utilizing fuel enrichments of 4.40 w/o U-235, which exceeds the current enrichment limit of 4.25 w/o U-235 for stored fuel in Region 2. The analysis for the 4.25 w/o U-235 enrichment limit was performed by Pickard, Lowe, and Garrick, and did not encompass the higher enrichments. To extend the range of the burnup curve, substantial criticality analyses were performed by Union Electric to support storage of 4.45 w/o U-235 fuel (allowance for manufacturing tolerances on enrichment), and additional assessments were made to determine the impact of using the higher enrichment fuel on spent fuel pool design criteria.

The analyses and evaluations performed to support the storing of higher enrichment fuel in Region 2 concluded that spent fuel criticality limits are maintained when storing fuel to a maximum initial enrichment of 5.00 w/o U-235, provided that the fuel burnups meet the limits defined in the attached report. The proposed Technical Specification change only addresses fuel enrichments up to 4.45 w/o, due to current thermal/hydraulic constraints in the Callaway spent fuel pool.

A re-analysis of the thermal-hydraulic behavior, spent fuel pool structural design bases, and radiological and environmental considerations (including the postulated dropped bundle accident) was performed previously for the Region 1 re-analysis. This was due to the increase in fuel enrichment and increases in analyzed burnup in future cycles, and therefore fission product inventory increase, to ensure the higher enriched fuel could be safely discharged (reference ULNRC-2130, dated December 28, 1989).

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 allows storage of fuel assemblies in two out of 4 fuel rack locations, with the unused cells being used as water boxes to allow cooling water flow. Region 1 is designed on the basis of conservative 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, in a three out of four configuration. 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 boxes in which no fuel is stored are provided with lead-in guides which prevent insertion of fuel assemblies into the water box, while allowing cooling water to flow through the water box. The rack modules are free-standing on the floor liner plate of the pool. The pool is filled with borated water with a boron concentration of at least 2000 ppm. The fuel pool cooling and cleanup system functions to limit the pool temperature to 140°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.

<u>Description of the Callaway Plant Fuel Designs</u>

The physical characteristics of OFA, STD, and V-5 fuel assemblies are similar. The designs employ 17 X 17 fuel rod arrays and the fuel rods are Zircaloy clad. The OFA and V-5 designs, however, utilize a smaller fuel rod diameter with chamfered pellets and employ Zircaloy rather than Inconel mixing vane spacer grids. The V-5 fuel utilizes intermediate flow mixer grids which are nonstructural Zircaloy grids installed between the three uppermost Zircaloy grids. Thus the V-5 fuel is conservatively represented by the OFA fuel design which does not contain the intermediate flow mixing grids (also neutron absorbing members). The V-5 design also incorporates Integral Fuel Burnable Absorbers (IFBA's), which consist of a thin zirc diboride coating on the outside of the fuel pellet. As a result, the IFBA is a non-removable and thus integral part of the fuel assembly once it has been manufactured. With respect to all other components in the active fuel region, the OFA and V-5 fuel

types contain approximately the same fuel weight (UO_2). The V-5 weight will be slightly different due to incorporation of natural uranium axial blankets, however the analysis assumed full length enriched fuel for conservatism. Enrichments used for Cycle 5 exceed the 4.25 w/o U-235 used in the previous criticality analyses. For this reason the criticality analyses was re-performed to extend the burnup curve to 5.0 w/o even though the current Region 1 limit is 4.45 w/o U-235, due to thermal/hydraulic constraints.

Criticality Analysis

Extensive analyses have been previously performed to support the storage of both STD and OFA/V-5 fuel assemblies under both normal and postulated accident conditions and to store the fuel up to a maximum initial enrichment of 4.25 w/o U-235. To increase the maximum allowable enrichment for the Callaway Region 2 storage, a complete re-analysis was performed.

The analysis used two different and independent sets of code packages. To determine the enrichment/burnup curve the CASMO and GRPDQ codes were utilized since the CASMO code has burnup capabilities. In addition, the SCALE-4 code package, which includes NITAWL and KENO-Va, was used to verify the results of CASMO/GRPDQ and determine the final k-infinity value for determining the burnup versus enrichment curves.

The data points for the enrichment versus burnup curve are calculated using the CASMO/GRPDQ codes. CASMO-3 is a multi-group, two-dimensional, transport theory code used for burnup calculations on PWR and BWR fuel assemblies. A 40 energy group nuclear data library based on data from ENDF/B-4 is used with CASMO. This library is a condensation from a 70 group library using typical LWR spectra for the various nuclides. CASMO is used to generate four group macroscopic cross section data for input into the diffusion theory GRPDQ code. GRPDQ is a modified version of PDQ-7 Version 2. The CASMO-3 code has been validated by comparisons with experiments where isotopic fuel composition has been examined following discharge from a reactor. In addition, an extensive set of benchmark critical experiments have been analyzed with CASMO/GRPDQ. Results of these experiments are given in the attached report, LFNF-92-02, Callaway Plant Region 2 Spent Fuel Rack Criticality Analysis, May 1992.

The NITAWL and KENO-Va codes from the SCALE 4 package are utilized to verify the results of CASMO/GRPDQ at an equivalent zero burnup enrichment, which yields the same reactivity as a burned assembly, since KENO-Va does not perform depletion calculations. The NITAWL code compiles selected cross sections from the 27 group master SCALE library in the format required by

the Monte Carlo theory code, KENO-Va. An extensive set of benchmark critical experiments has also been analyzed with NITAWL/KENO-Va. Results of these experiments are also given in the attached report.

The GRPDQ code is used for the final multiplication factor predictions of the Callaway spent fuel racks. The calculations are performed in four energy groups and take into account all of the details of the fuel assembly and fuel racks. The reference model geometry used for the calculations is a repeating array of 4 stainless steel boxes, three of which contain fuel assemblies, and the fourth which serves as a flux trap (water only). Calculations are performed to determine the required burnups as a function of initial U-235 enrichment for storage in Region 2.

The reference model calculations assumed a Westinghouse 17 X 17 V-5 design fuel assembly, with the fuel assembly being 4.0 w/o U-235 initial enrichment at a burnup of 33,000 MWD/MTU. This enrichment is typical of the enrichment utilized in current Callaway cores, and the burnup is the estimated burnup required for insertion in Region 2 of the spent fuel pool. The V-5 and OFA designs are considered to be neutronically similar.

The calculational approach is to use the reference model to calculate the reactivity of an infinite array of uniform spent fuel racks and to account for any deviations of the actual spent fuel rack array from this assumed infinite array as uncertainties on the calculated reactivity of the reference model. Calculational biases, manufacturing tolerances, and uncertainties are evaluated in terms of the reactivity changes to the reference model. For example, the reference calculation is performed with nominal dimensions on all the stainless steel boxes. Tolerances on the geometric array representing the racks are treated as uncertainties on the reference calculation. To ensure the calculations are performed at the most conservative fuel pool temperature, the effect of fuel pool temperature was taken into effect. The fuel pool temperature can vary from 68°F to 248°F. Calculations determined that the maximum reactivity for the basic cell occurred at a fuel pool temperature of 90°F; thus the principle calculations were performed at this temperature.

The manufacturing tolerances and uncertainties that must be taken into consideration are as follows: (1) fuel rack box spacing; (2) stainless steel thickness; (3) fuel density uncertainty; (4) fuel enrichment uncertainty; and (5) the depleted fuel uncertainty. In addition, the calculational method bias and uncertainty must be included. These tolerances and uncertainties can be combined statistically and then added to the results of the basic cell calculation. Thus the overall results ensure that the maximum k-effective will be less than 0.95 with a 95% probability at a 95% confidence level.

By application of the methodology described above, the Region 2 criticality analysis meets the requirements of General Design Criterion 62, "Prevention of criticality in fuel storage and handling," as it relates to the prevention of criticality by physical systems or processes utilizing geometrically safe configurations as referenced in acceptance criterion II.5 of Standard Review Plan 9.1.2, "Spent Fuel Storage." The Region 2 criticality analysis meets this criterion by conforming to position C.1 and C.4 of Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," Rev. 1, December 1975, and the appropriate paragraphs of ANS 57.2, "Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations," approved April 12, 1976.

Specifically, the center-to-center spacing between fuel assemblies and any strong fixed neutron absorbers in the storage racks is sufficient to maintain the array, when fully loaded and flooded with nonborated water, in a subcritical condition with a $K_{eff} \leq 0.95$. The design calculation includes supportable margin for uncertainty in reactivity calculations and manufacturing tolerances and considers reflections. The calculation is based on the maximum enrichment and fissile isotopic content of fuel to be cycled in the plant.

Using the representative 4.0 w/o V-5 fuel assembly at 33,000 MWD/MTU, a k-infinity is calculated which includes the method bias and the various uncertainties. The calculated k-infinity is 0.9318. To provide an additional conservatism, a k-infinity of 0.925 is chosen for determining an equivalent zero burnup enrichment for input into NITAWL/KENO-Va.

The same approach is utilized for the standard fuel assembly burnup/enrichment curve. The calculated k-infinity is 0.9314. Again, to provide an additional conservatism, a k-infinity of 0.925 is chosen.

To ensure the CASMO/GRPDQ results are conservative, an equivalent zero burnup enrichment, which yields the same reactivity as a burned fuel assembly, is calculated for use in the NITAWL/ KENO-Va code set. To ensure a k-effective less than 0.95, a zero burnup enrichment of 1.59 w/o U-235 was calculated. Using CASMO/GRPDQ data, this equates to a k-infinity value of 0.921 for determining the burnup versus enrichment curves for storage of spent fuel in Region 2. The maximum k-effective for the Callaway Region 2 spent fuel racks was calculated to be 0.9480, including biases and uncertainties.

Thermal-Hydraulic and Fuel Building Ventilation Analysis

The thermal-hydraulic and fuel building ventilation analyses were performed as part of the change to the Region 1 enrichment, which was submitted in ULNRC-2130 dated December 28, 1989.

An increase in fuel enrichment of the V-5 fuel does not alter the normal performance of the fuel pool cleanup systems, fuel building ventilation or radiological control systems.

Design Bases

An increase in the maximum initial enrichment level to 4.45 w/o U-235 does not adversely affect the safety design bases, the power generation design bases or the evaluations contained in the FSAR for storage of fuel in Region 2 of the spent fuel pool. The design bases are summarized in FSAR Sections 9.1.2.1.1 and 9.1.2.1.2 for Spent Fuel Storage and Sections 9.1.3.1.1 and 9.1.3.1.2 for Fuel Pool Cooling and Cleanup Systems.

Evaluation

An increase to a maximum initial enrichment of 4.45 w/o U-235 does not involve an increase in the probability or consequences 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 reasonable assurance that criticality safety is maintained when storing fuel assemblies of up to an including 5.00 w/o U-235 in the spent fuel storage racks under both normal and postulated accident conditions. For example, the calculations ignored the 2000 ppm soluble boron in the spent fuel pool, resulting a conservative values of the multiplication factor. Storing fuel in the Region 2 configuration which meets the proposed burnup/enrichment curve results in a maximum multiplication factor of 0.9480, including all biases and uncertainties.

An increase to a maximum initial enrichment of 4.45 w/o U-235 does not create the possibility of a new or different kind of accident or condition over previous evaluations. An increase to an initial enrichment of 4.45 w/o U-235 involved performing extensive evaluations to develop the burnup/enrichment curves for both OFA/V-5 and STD fuel. Use of dual code packages ensures that the spent fuel pool Region 2 criticality limits are not exceeded.

An increase to a maximum initial enrichment of 4.45 w/o U-235 does not increase the probability or consequences of a malfunction of equipment important to safety previously evaluated in the FSAR or create the probability of a malfunction of equipment important to safety different than previously evaluated in the FSAR. An increase in the initial enrichment level of 4.45 w/o U-235 does not adversely impact operation of the various plant systems, i.e., HVAC, spent fuel pool cooling, or radiological control systems.

An increase to a maximum initial enrichment of 4.45 w/o U-235 does not involve a reduction in the margin of safety. As discussed above, in all cases the multiplication factors for worst case assumptions fall considerably below 0.95 and do not represent any reductions in margin. An increase to the initial enrichment level of 4.45 w/o U-235 does not adversely impact operation of the various plant systems, i.e., HVAC, spent fuel pool cooling, or radiological control systems.

Conclusion

Based on the above discussions and the attached report, the proposed Technical Specification change does not adversely affect or endanger the health or safety of the public and does not involve an unreviewed safety question as described in 10 CFR 50.59, nor an unreviewed environmental question.

ATTACHMENT 3

SIGNIFICANT HAZARDS EVALUATION

SIGNIFICANT HAZARDS EVALUATION

This amendment request is in support of Callaway Refuel 6. During Refuel 6, fuel with a maximum initial enrichment of 4.40 w/o U235 will be discharged. This amendment requests that Technical Specification section 3.9.12 be revised to reflect a maximum initial enrichment of 4.45 w/o U-235 for fuel storage in Region 2.

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 the spent fuel pool systems nor violate pool criticality safety limits. The reevaluations further demonstrate that an increase in maximum initial enrichment for Region 2 storage can be up to 4.45 w/o U-235. Since the criticality safety analysis confirm that the original criteria are met, the possibility of a new or different kind of accident or condition over previous evaluations is not credible. Physically all three fuel types are similar. OFA and V-5 fuel are geometrically compatible with STD. The fuel assembly dimensional envelope, skeletal structure, and internal grid locations are essentially the same. The structural differences, for OFA/V-5 fuel versus Standard fuel, are a smaller fuel rod outer diameter and Zircaloy spacer grids rather than Inconel. Neutronic differences between the two fuel designs have been analyzed and determined to not alter spent fuel pool criticality safety limits. Basically, the Technical Specification change incorporates an increase in maximum initial enrichment for Region 2 storage to 4.45 w/o U-235, provided the fuel meets the required burnup limit. The change to Vantage 5 has been previously approved for Callaway. WCAP 10444 sets forth the Vantage 5 fuel design, and this WCAP has been reviewed and approved by the NRC.

INCREASE IN MAXIMUM INITIAL ENRICHMENT TO 4.45 W/O U-235 FOR FUEL STORAGE IN REGION 2 OF THE SPENT FUEL POOL

Extensive analyses were previously performed to support storage of V-5 fuel to maximum enrichments of 4.45 w/o U-235 in Region 1 of the spent fuel pool. The results of these analyses were submitted in amendment request ULNRC-2130 dated December 28, 1989. Increasing the maximum enrichment limit to 4.45 w/o U-235 for storage in Region 2 of the spent fuel pool does not represent a significant hazard in that:

1. An increase to a maximum initial enrichment of 4.45 w/o U-235 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 reasonable assurance that criticality safety is maintained when storing fuel assemblies of up to and including 5.00 w/o U-235 in the spent fuel storage racks under both normal and postulated accident conditions. For example, the calculations ignore the 2000 ppm soluble boron in the spent fuel pool calculations, thus resulting in conservative values of the multiplication factor. Storing fuel in the Region 2 configuration which meets the burnup/ enrichment curve results in a maximum multiplication factor of 0.9480, including all biases and uncertainties.

2. An increase to a maximum initial enrichment level of 4.45 w/o U-235 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 4.45 w/o U-235 involved performing extensive evaluations to develop the burnup/enrichment curves for both OFA/V-5 and STD fuel. Use of dual code packages ensures that the spent fuel pool Region 2 criticality limits are not exceeded.

3. An increase in the maximum initial enrichment level to 4.45 w/o U-235 does not involve a significant reduction in the margin of safety. As discussed above, in all cases the multiplication factors for worst case assumptions fall considerably below 0.95 and do not represent any reductions in margin. An increase to the initial enrichment level of 4.45 w/o U-235 does not adversely impact operation of the various plant systems, i.e., HVAC, spent fuel pool cooling, or radiological control systems.

ATTACHMENT 4

ENVIRONMENTAL CONSIDERATION

ENVIRONMENTAL CONSIDERATION

This amendment application requests a revision to Table 3.9-1 of Technical Specification Section 3/4.9.12 to reflect a maximum initial enrichment of 4.45 w/o U-235 for fuel storage in Region 2 of the Callaway spent fuel pool.

An evaluation of the environmental impact was performed as part of the change to the Region 1 enrichment which was submitted previously (Reference 1).

The proposed amendment involves changes with respect to the use of facility components located within the restricted area as defined in 10 CFR 20, and changes a surveillance requirement. Union Electric has determined that the proposed amendment does not involve:

1) A significant hazard consideration, as discussed in Attachment 3 of this amendment application;

2) A significant change in the types or significant increase in the amounts of any effluents that may be released offsite;

3) A significant increase in individual or cumulative occupational radiation exposure.

Accordingly the proposed 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 this amendment.

Reference:

1. ULNRC-2130, December 28, 1989

ATTACHMENT 5

LFNF-92-02, "Callaway Region 2 Spent Fuel Rack Criticality Analysis"