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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 140 TO FACILITY OPERATING LICENSE NO. DPR-20

CONSUMERS POWER COMPANY

PALISADES PLANT

DOCKET NO. 50-255

1.0 INTRODUCTION

By letter dated October 28, 1991, Consumers Power Company (the licensee) requested amendment to the Technical Specifications (TS) appended to Facility Operating License No. DPR-20 for the Palisades Plant. The proposed amendment would change the maximum enrichment specified in new fuel storage TS 5.4.1 to an assembly planar average of 4.20 weight percent (w/o) U-235 for fuel assemblies with 216 UO_2, Gd_2O_3-UO_2 fuel rods or metal rods. In TS 5.4.2.c, the maximum enrichment for fuel stored in the Region I (NUS) spent fuel storage racks would be increased to an assembly planar average U-235 enrichment of 4.40 w/o. A sentence would also be added which requires spent fuel assemblies having enrichment above 3.27 w/o U-235 to contain 216 UO_2, Gd_2O_3-UO_2 or solid metal rods. TS 5.4.2.e, which specifies the maximum w/o U-235 in the spent fuel stored in the spent fuel pool without regard to the regions in the pool, would be deleted. In support of these requested changes, the licensee also submitted the criticality analyses for the Palisades new and spent fuel storage racks prepared by Siemens Nuclear Power Corporation, the nuclear fuel supplier for Palisades. These analyses were contained in two reports, "Criticality Safety Analysis for the Palisades New Fuel Storage Array" (EMF-91-1421NP) and "Criticality Safety Analysis for the Palisades Spent Fuel Storage Pool NUS Racks" (EMF-91-174NP).

2.0 EVALUATION

The Palisades spent fuel pool is divided into two areas, the main pool area and the north (spare) tilt pit area. Each of these areas (main pool and north tilt pit) is divided into two regions specified as Region I and Region II. Region I of either area is that area which contains storage racks manufactured by NUS Corporation having at least a 10.25-inch center-to-center spacing and using B_4C in a carbon matrix as a neutron absorber. Region II contains racks manufactured by the Westinghouse Corporation having a 9.17-inch center-to-center spacing and using Boraflex as the neutron absorber. Because of the construction and smaller spacing of the Region II racks, TS 5.4.2.d requires that spent fuel must have a minimum burnup before it can be stored in Region II.

The new (fresh) fuel racks are located in a dry pit in the same room as the spent fuel pool and are mounted in a 24 x 3 array 15 feet above the bottom of the pit. Alternate storage positions are filled with stainless steel box beams in a checkerboard pattern which leaves 36 positions for new fuel storage.

The reactivity calculations were performed with the KENO Va code, a three-dimensional Monte Carlo theory program. In addition, the CASMO depletable, two-dimensional, transport theory code was used for burnup dependent and sensitivity reactivity calculations. The analytical methods and models used in the reactivity analysis have been benchmarked against experimental data for fuel assemblies similar to those for which the Palisades racks are designed and have been found to adequately reproduce the critical values. This experimental data is 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 finds these methods and models to be acceptable.

The design basis for preventing criticality outside the reactor is that, including uncertainties, there is a 95 percent probability at a 95 percent confidence level (95/95 probability/confidence) that the effective multiplication factor (k-eff) of the fuel assembly array will be no greater than 0.95. This k-eff limit applies to both the new (fresh) and spent fuel racks under all conditions, except for the new fuel rack under low water density (optimum moderation) conditions, where the k-eff limit is 0.98.

The resulting maximum k-eff for the Palisades (NUS) spent fuel storage racks was 0.9131 and included all appropriate biases and uncertainties at a 95/95 probability/confidence level. The analyses conservatively assumed a fuel assembly average enrichment of 4.40 w/o U-235. The effect of the 0.05 w/o U-235 manufacturing enrichment uncertainty was included with other appropriate uncertainties as mentioned below. The 15 x 15 fuel rod array assumed 216 fuel rods, 8 guide bars, and 1 instrument tube. The major assumptions made in the analysis were: no burnable poisons in fuel assemblies, no soluble poison in pool water, water temperature at 20 deg C (higher temperatures would result in lower values of k-eff), and minimum allowed width and thickness of B_4C absorber plates. In addition, the effect of manufacturing tolerances in enrichment, pellet density, pellet diameter, cladding outer diameter, inner can wall thickness, outer can wall thickness, and cell pitch as well as a fuel and temperature decrease to 4 deg C, were combined with the method bias uncertainty and KENO standard deviation to calculate the 95/95 upper limit of k-eff. Based on this, the staff concludes that the NRC criticality criterion of k-eff no greater than 0.95 under fully flooded conditions with unborated water would be met for 4.40 w/o U-235 fuel in the 15 x 15 fuel rod array specified above stored in the Region I (NUS) racks of the Palisades spent fuel pool.

For the fresh fuel racks, the criticality analyses evaluated the effects of varying moderator density and showed that the maximum rack k-eff is 0.945, including all appropriate biases and uncertainties at the 95/95 probability/confidence level, and occurs when the array is fully flooded with water. The analyses conservatively assumed an average planar enrichment of 4.25 w/o U-235, which includes a 0.05 w/o U-235 manufacturing enrichment uncertainty. The 15 x 15 fuel rod array assumed 216 fuel rods, 8 guide bars, and 1 instrument tube. In addition to postulating the fuel assemblies in the most adverse position with regard to criticality, other fuel assembly design parameters (clad thickness, pellet diameter, pellet density, dish volume and active fuel length) used in the analysis were set at conservative values within the manufacturing tolerances. Based on this, the staff concludes that the NRC criticality criteria of k-eff no greater than 0.98 under optimum moderation conditions and k-eff no greater than 0.95 for fully flooded racks would be met for 4.20 w/o U-235 fuel in a 15 x 15 fuel rod array stored in the Palisades fresh fuel racks.

It is possible to postulate events which could lead to an increase in storage rack reactivity. For example, in the spent fuel pool, the NUS fuel storage racks and the Westinghouse fuel storage racks are separated by a 2-inch water gap and potential neutron interaction between the two racks may be possible. However, calculations have shown that interaction between the two racks is negligible. If a fuel assembly were assumed to be dropped on the spent fuel rack and lay horizontally across the top of the rack, the assembly would be approximately 7 inches above the active portion of the stored assemblies. This distance is sufficient to neutronically decouple the dropped assembly from those stored in the racks. During cask loading, a Region II rack in the cask loading area of the fuel pool is removed to provide space for the cask and a space is opened adjacent to the Region II racks where a fuel assembly could be dropped. Therefore, Siemens Nuclear Power Corporation is performing an analysis of the criticality result of dropping a fuel assembly having a 4.40 w/o U-235 enrichment adjacent to the Region II (Westinghouse) racks in the space opened for cask loading by removal of the Region II rack. The licensee has made a commitment that no spent fuel racks will be removed from the spent fuel pool until that analysis is complete and the results confirm that k-eff does not exceed 0.95.

The fresh fuel racks are maintained in a dry environment under normal conditions. Therefore, the introduction of full density and low density (optimum moderation) water are the bounding reactivity events. For both cases, k-eff remains below the acceptance limits of 0.95 and 0.98, respectively.

3.0 CONCLUSION

Based on the above evaluation, the staff concludes that the Palisades fresh fuel storage racks can accommodate fuel assemblies enriched to 4.20 w/o U-235 with 216 UO_2, Gd_2O_3-UO_2 fuel rods or metal rods. The Region I (NUS) spent fuel storage racks can accommodate fuel assemblies enriched to 4.40 w/o U-235 provided that fuel assemblies having enrichment above 3.27 w/o U-235 contain 216 UO_2, Gd_2O_3-UO_2 or solid metal rods.

The licensee has made a commitment not to remove any spent fuel racks from the spent fuel pool until analyses confirm that the k-eff resulting from inadvertently dropping a 4.40 w/o fuel assembly into the space vacated by the rack does not exceed 0.95.

Although the Palisades TS have been modified to specify the above-mentioned fuel as acceptable for storage in the fresh or spent fuel racks, evaluations of reload core designs (using any enrichment) will, of course, be performed on a cycle-by-cycle basis as part of the reload safety evaluation process. Each reload design is evaluated to confirm that the cycle core design adheres to the limits that exist in the accident analyses and TS to ensure that reactor operation is acceptable.

4.0 STATE CONSULTATION

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

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and a change in a surveillance requirement. The 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 this amendment involves no significant hazards consideration and there has been no public comment on such finding (56 FR 64652). Accordingly, this 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.

6.0 CONCLUSION

The staff 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.

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Date: January 23, 1992

DATED: January 23, 1992

AMENDMENT NO. 140 TO FACILITY OPERATING LICENSE NO. DPR-20-PALISADES

Docket File
NRC & Local PDRs
PDIII-1 Reading
Palisades Plant File
B. Boger
J. Zwolinski
L. Marsh
P. Shuttleworth
B. Holian
OGC-WF
D. Hagan, 3302 MNBB
G. Hill (4), P-137
Wanda Jones, MNBB-7103
C. Grimes, 11/F/23
L. Kopp, 8/E/23
ACRS (10)
GPA/PA
OC/LFMB
W. Shafer, R-III

cc: Plant Service list