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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 138 TO FACILITY OPERATING LICENSE NO. DPR-50

METROPOLITAN EDISON COMPANY
JERSEY CENTRAL POWER & LIGHT COMPANY
PENNSYLVANIA ELECTRIC COMPANY
GPU NUCLEAR CORPORATION

THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

DOCKET NO.: 50-289

1.0 INTRODUCTION

By letter of January 12, 1988 (Ref. 1) GPU Nuclear Corporation (GPU) requested a revision to the Technical Specifications (TS) for Three Mile Island Unit 1 (TMI-1). The TS changes relate to a proposed increase in the U-235 enrichment of fuel which may be placed in various storage racks at TMI for use in TMI-1 operations. There are no proposed changes to the racks.

The TS changes revise the enrichment limit of relevant specifications and also the requirements for the density of boron in the pool water in some of the affected storage areas. The proposal presents criticality analyses for the storage racks to demonstrate compliance with NRC requirements. These analyses were performed for GPU by Stanley Turner (Holtec International) who has been the analyst for a number of fuel storage revision criticality analyses previously reviewed and approved by the staff.

There are four storage areas involved in the enrichment increase. They are (1) the new fuel (NF) storage racks, (2) the Fuel Transfer Canal (FTC) racks, (3) Spent Fuel Pool "A", and (4) Spent Fuel Pool "B". The new fuel area is dry and the other three are flooded. These storage areas are currently licensed for 3.5 percent U-235 enrichment. The request is to change the limit to 4.3 percent. The analysis for the four areas has been done for this enrichment to demonstrate that NRC criteria are met when certain restrictions on the storage are met. The restrictions involve the requirement for at least 600 ppm of boron in the water of the "A" and Fuel Transfer Canal pools, and some required vacant storage spaces in the new fuel racks.

2.0 EVALUATION

2.1 Storage Racks and Fuel

Three of the four storage areas, "A", FTC and NF, have the same rack (square) storage cell lattice configuration and spacing, a 21.125 inch center to center array, and have similar reactivity status (k-effective) for flooded conditions. The largest of these arrays is the "A" rack. Criticality calculations for the "A" system, with minimum neutron leakage, conservatively apply to the FTC and

NF racks for similar pool water density conditions. However, since the "A" and FTC racks are in pool areas, water density near 1.00 conditions are applicable for meeting NRC criticality criteria, while for the normally dry NF racks it is also necessary to examine low density water moderation conditions.

The "B" racks have a smaller center to center array spacing of 13.625 inches, and each fuel assembly is within a 0.187 inch thick stainless steel box which supplies some neutron absorption. The smaller spacing is designed to achieve a higher storage density and results in the "B" racks providing the limiting value for enrichment, 4.3 percent. The analyses indicate that the other racks could contain higher enrichments, but the present analysis is limited to 4.3 percent.

The fuel to be stored, and that analyzed for this submittal is the standard Babcock & Wilcox 15x15 fuel assembly (with no burnable poison). Minor variations in design may be accommodated via a few sensitivity studies included in the analysis.

2.2 Criticality Analysis Criteria

The current TMI-1 fuel storage system enrichment limits were based on a criterion requiring the k-effective result of criticality analyses to be less than 0.90 with no explicit consideration of uncertainties in the calculation. The current TMI-1 TS 5.4.1 requires a limit of no more than 0.90. Currently, and for over a decade (see NUREG-75/087, 1975, or later editions, NUREG-0800, NRC Standard Review Plan, Sections 9.1.1 and 9.1.2) the NRC storage criterion for spent fuel pools (in flooded conditions) is 0.95, and for new fuel racks (i.e., dry storage) is 0.95 flooded and 0.98 with optimum low density moderation (e.g., from fire fighting sprays). These limits are interpreted as including all relevant uncertainties at a 95/95 (probability/confidence) level. No credit is given for boron in the pool in meeting these limits. Credit may be taken for boron in the pool for analyses of accident conditions (e.g., dropped fuel assembly), however, and such accident events are not considered in combination with optimum moderator conditions in new fuel (dry) storage. The new TMI-1 analyses for the proposed enrichment increase now follow these NRC criteria and positions and are acceptable.

2.3 Analytical Methods

The criticality analyses for the storage areas have used four methodologies (neutronics and cross section packages):

(1) AMPEX-KENO, a Monte Carlo code using the 123 group GAM-THERMOS cross section library and the Nordheim treatment in NITAWL for U-238 resonances.

(2) AMPEX-KENO, using the 27 group SCALE cross sections and the Nordheim treatment.

(3) CASMO-2E, a multigroup transport theory method.

(4) NULIF-PDQ-7, a diffusion theory method with the cross section generation code NULIF.

Method (1) was used only for the low moderator density calculations for the NF racks.

Method (2) was used primarily as a check of CASMO calculations and indicated that CASMO gives conservative values for k-effective for the "A" and "B" pool configurations.

Method (3) was the primary calculation methodology used in the analyses of flooded racks.

Method (4) was used as a third independent methodology and was used to investigate some accident conditions.

All of these methods and associated cross section sets are industry standards, commonly used in criticality calculations. The selection of methods for the various TMI-1 calculations is appropriate. The submittal presents the background material and the benchmarking process and results for these calculations. From these results values for calculational biases and uncertainty have been determined. The benchmarking has investigated the appropriate critical experiments normally investigated for each methodology and application. The results are within ranges to be expected. The review concludes that the methods used for the TMI-1 calculations are thus satisfactory and acceptable.

2.4 Uncertainty and Base Calculation Results

In addition to the calculation method uncertainties, the analyses have investigated the uncertainties associated with the material and geometrical variations of the fuel and rack systems. These have been translated into reactivity increments and have been statistically combined for each of the rack geometries to provide a 95/95 uncertainty value to be added to the base reactivity status calculations. These investigations have examined appropriate variables of the system components and the resulting values and combinations are reasonable and acceptable.

For the "B" racks the CASMO base result was a k-effective of 0.9436 at a pool temperature of 120° C (saturation temperature at the assembly level pool depth), the peak reactivity as a function of temperature found in a sensitivity study. The uncertainty was 0.0056 for a total of 0.9492, within the criterion. The KENO and PDQ-7 results confirmed the base CASMO results.

The "A" rack results, which also apply to the FTC and flooded NF racks, give a value of 0.936 at 20° C (the maximum temperature for that spacing) for the 4.3 percent fuel, and could thus meet the criterion with a larger enrichment if such an analysis were performed.

The NF survey calculations at various low densities using KENO (127) gave a maximum total k-effective of 0.928 at a density of about 7.5 percent for 4.3 percent fuel. For these calculations, however, as a result of preliminary estimates, two rows of storage locations in the racks were assumed to be empty in order to get results under 0.95. As a result a corresponding restriction on keeping these spaces empty is a part of the TMI-1 TS submitted for these racks. This specification is acceptable. However, it is also required, as indicated in Standard Review Plan 9.1.1, and has been emphasized in staff reviews in recent years, that the empty storage spaces should be blocked to keep accidental access to these spaces to a minimum.

The calculation results and uncertainty analyses for the four storage systems are reasonable and meet the required criteria. They are acceptable.

2.5 Abnormal and Accident Conditions

The submittal examined the reactivity status of conditions considered to be abnormal or accidents in the "A", "B" and FTC storage areas. This included abnormal pool temperature conditions and misplacement (dropping) of a fuel assembly in an improper location. For the NF racks there are no criticality problems possible for such events unless there is also simultaneously near optimum moderation or full flooding. These combinations are not considered by the staff to be sufficiently creditable to be design requirements.

For the "A", "B" and FTC racks the optimum temperature (moderator density) was examined as part of the base calculations and the maximum selected. For a fuel assembly on top of the racks there is sufficient separation so that there is no significant neutronic interaction or reactivity effect. There is insufficient space to place a "misplaced" assembly adjacent to the "B" racks and thus no problem for these racks. For the "A" and FTC racks calculations were done for an assembly immediately adjacent to the rack and a required amount of boron in the pool water to meet the 0.95 requirement was determined. This provided the boron concentration of 600 ppm for the 4.3 percent enrichment submitted for the proposed TS changes.

This analysis of accident conditions and TS requirements is acceptable.

2.6 Technical Specifications

The primary TS changes for this enrichment increase are to TS 5.4.1, "New Fuel Storage" and 5.4.2, "Spent Fuel Storage" (pages 5-6 and 7). The changes involve the replacement of the former reactivity criterion and enrichment limit by 0.95 k-effective and 4.3 percent U-235 respectively. The TS also includes statements on the storage cell separation distances, the geometrical configuration and required vacant spaces of the NF racks, and the requirements for 600 ppm boron in the "A" and FTC pools when fuel is stored or moved. The specification on the limit for the linear weight of U-235 in a stored fuel assembly is also increased to 57.8 gm/cm to match the 4.3 percent enrichment. These changes have been previously discussed in this review and are acceptable.

Also changed is Table 4.1-3 (page 4-10) and the Bases for TS 4.1 (involving pages 4-1 and 2). These introduce the surveillance of the 600 ppm boron concentration into Section 4, "Surveillance Standards". The additions are acceptable.

3.0 ENVIRONMENTAL CONSIDERATION

This 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. We have 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. 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.

4.0 CONCLUSION

GPU has proposed TS changes for TMI-1 providing for increased U-235 enrichment of fuel in new and spent fuel storage racks. The TS are in accord with staff positions and previous TS approvals. Our review has concluded that appropriate material has been submitted and the TS changes are acceptable. However, it will be necessary to block the vacant storage spaces used in the criticality analysis of the new fuel storage racks.

We have 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, and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated: April 25, 1988

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