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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 97

TO FACILITY OPERATING LICENSE NO. DPR-21

NORTHEAST NUCLEAR ENERGY COMPANY

MILLSTONE NUCLEAR POWER STATION, UNIT 1

DOCKET NO. 50-245

1.0 INTRODUCTION

By letter dated May 2, 1996, as supplemented by letter dated August 30, 1996, Northeast Nuclear Energy Company (NNECO) requested changes to the Millstone Nuclear Power Station, Unit 1, Technical Specifications (TS) to remove Figure 5.1, which is used in maintaining k_{eff} values, and substitute in its place a defined requirement for the maximum k_{∞} for any fuel placed in the Millstone Unit 1 spent fuel pool. The fuel enrichment limit of 3.8 weight percent (w/o) U-235 has not been changed. Additional information was provided to the NRC staff on August 30, 1996, in response to the NRC's letter of June 4, 1996, that did not change the scope of the May 2, 1996, application and the initial proposed no significant hazards consideration determination.

2.0 EVALUATION

Millstone Unit 1 TS 5.5 requires k_{eff} of the spent fuel storage pool to be less than or equal to 0.90. The existing criticality analysis shows that fuel with a maximum reactivity equivalent to a k_{∞} of 1.35 (in the standard Millstone Unit 1 core geometry at 68°F) can be stored in the storage racks and meet the 0.90 k_{eff} criterion. However, as stated in Licensee Event Report (LER) 96-013-00, there exists an unreviewed safety question since the existence of gaps in the Boraflex, which were observed during blackness testing in September 1995, was not considered in the original criticality analysis. Therefore, a criticality analysis was performed for NNECO by Holtec International to include the reactivity effects of postulated gaps in every Boraflex panel.

The Holtec analysis evaluated various gap sizes to identify the largest mid-plane gap that would still maintain a maximum k_{eff} less than 0.90 in the spent fuel pool racks. The KENO5a Monte Carlo code was used in 3-dimensions to calculate the reactivity effect of the Boraflex gaps. Depletion calculations were performed with the CASMO3 transport theory code. These codes have been widely used for the analysis of fuel rack reactivity and have been benchmarked against results from numerous critical experiments. These experiments simulate the Millstone Unit 1 spent fuel racks as realistically as possible

with respect to parameters important to reactivity such as enrichment, assembly spacing, and absorber thickness. In addition, the KENO5a results were compared with the MCNP continuous energy Monte Carlo code and showed good agreement. The good agreement between these two independent methods of analysis (KENO5a and MCNP) is an acceptable technique for validating calculational methods for nuclear criticality safety. The staff concludes that the analysis methods used are acceptable and capable of predicting the reactivity of the Millstone Unit 1 storage racks with a high degree of confidence. The maximum reactivity of the fuel used in the spent fuel rack calculations was 1.25 (based on the reactivity of a fuel assembly in the standard Millstone Unit 1 core geometry at 68°F). Although Millstone Unit 1 has always received fuel with a k_∞ less than 1.24, an allowance of 0.01 Δk was included for uncertainty in the k_∞ calculation. This is consistent with previously approved uncertainty values and is acceptable. In addition to various gap sizes, the width of the Boraflex was reduced by 4% to allow for shrinkage in the storage rack calculations. This is consistent with the maximum shrinkage observed in industry-wide testing of Boraflex panels and is acceptable. The rack calculations also included a total uncertainty of ±0.0105 due to manufacturing tolerances and methodology uncertainties, as determined in the original licensing calculations and found to be acceptable by the NRC staff.

Depletion calculations performed with CASMO3 indicate that the limiting k_∞ of 1.25 for fuel initially enriched to 3.8 w/o U-235 occurs at a burnup of approximately 14.0 MWD/KgU and yields an equivalent fresh fuel enrichment of 2.46 w/o U-235. The calculations assumed no gadolinia in the fuel assemblies and thus were conservative since any gadolinia would result in lower reactivities and allow larger Boraflex gaps.

The calculated storage rack reactivity for 3.8 w/o fuel at the time of maximum cycle reactivity, and assuming a 5-inch gap at the mid-plane of each Boraflex panel, was 0.8959, thus meeting the acceptance criterion of k_{eff} no greater than 0.90. Similar calculations were made for the older 7x7 and 8x8 fuel assemblies with maximum initial enrichments of 2.60 w/o and 2.74 w/o U-235 stored at Millstone Unit 1. The results show that the reactivities for this older stored fuel also meet the k_{eff} criterion.

The results of the May 1996 blackness testing program at Millstone Unit 1 indicate that only four of the 274 Boraflex panels tested to date have gaps greater than 0.5 inch (0.8 to 0.9 inch). However, because about half of these gaps were at the mid-plane elevation where the outside edges of the Boraflex panels are open to water flow, the potential for future gap formation at the same elevation is of concern. There are too few observed gaps at this time to conclude whether future gap formation will be axially random or will tend to form at the mid-plane where the Boraflex is more open to water. Therefore, the assumption of a 5-inch gap at the mid-plane of every Boraflex panel, which results in the highest reactivity increase, is suitably conservative. In the future, blackness tests will be performed every 2 years to monitor Boraflex panel shrinkage and to confirm that the criticality analysis assumptions remain valid.

In order to minimize radiation induced damage to the Boraflex material, NNECO has implemented procedural controls (Procedure EN1067) to allow a minimum 1-year decay time for spent fuel before placement in the spent fuel racks which contain Boraflex. Since Millstone Unit 1 has other fuel storage racks in the spent fuel pool, which do not contain Boraflex, this 1-year decay time requirement can be easily implemented. The use of the 1-year decay time will allow for a significant delay in the gamma dose to the Boraflex, thereby minimizing the possibility of further gap formation due to shrinkage or gradual Boraflex thinning due to dissolution. In addition, the Boraflex coupon surveillance program is continuing and will monitor for thickness loss or boron-10 areal density reduction. Based on these actions, the staff concludes that any gradual thinning of the Boraflex will be identified in sufficient time to be bounded by the spent fuel pool criticality analysis.

3.0 STAFF CONCLUSION

The NRC staff has reviewed the proposed Millstone Unit 1 TS change and the supporting analysis and finds it acceptable. In addition, the results of the blackness tests performed in May of 1996 confirm that the Boraflex assumptions used in the analysis are acceptable. NNECO has implemented a 1-year decay time requirement to minimize gamma radiation damage to the Boraflex and has committed to a continuation of periodic blackness measurements of the actual Boraflex gap size to ensure the margin of safety is maintained.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Connecticut 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 installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC 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 the amendment involves no significant hazards consideration, and there has been no public comment on such finding (61 FR 37301 dated July 17, 1996). Accordingly, the 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 the amendment.

6.0 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.

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