SAFETY EVALUATION BY THE RESEARCH AND POWER REACTOR SAFETY BRANCH

DIVISION OF REACTOR LICENSING

IN THE MATTER OF

YANKEE ATOMIC ELECTRIC COMPANY

PROPOSED CHANGE NO. 63

DOCKET NO. 50-29

Introduction

Pursuant to the provisions of Section 50.59 of the Commission's regulations, Yankee Atomic Electric Company, in Proposed Change No. 63 dated June 9, 1965, requested authorization of a change in the Technical Specifications of License No. DPR-3. The proposed change would authorize the loading configuration of Core V, and the irradiation of two test assemblies containing 417 fuel rods clad with Zircaloy-4, and five fuel rods clad with Zircaloy-1% Chromium.

Discussion

Core V is a continuation of the multiregion loading pattern of Core IV. The central region (Region A) will contain four elements from the middle region (Region B) of Core IV which have been irradiated to a total of 11,000 MWD/T in cores III and IV. The middle region will contain the 36 elements from the peripheral region (Region C) of Core IV which have been irradiated to approximately 5400 MWD/T. The peripheral region is to contain 34 fresh fuel assemblies of 4.94% enrichment plus the two test assemblies containing the Zircaloy clad fuel rods.

Core V will be operated with borated coolant as was Core IV. The excess reactivity of Core V will be greater due to the increase in enrichment of the peripheral fuel elements from 4.1% to 4.94%. However, no increase in the current authorized limit of 1300 ppm boron (above 15 MW(e)) will be required. The calculated hot shutdown margins during operation are 5% with all rods in and 2.8% with the highest worth rod out (the license requirements are a minimum of 4% and 2%, respectively). Boron concentration during refueling will be maintained at sufficient levels to provide at least 7% shutdown margin as required by the license. Consequently, we believe that the reactivity control provided for Core V is satisfactory.

The licensee has evaluated the thermal capabilities of Core V. DNB ratios, heat fluxes, and hot channel temperatures were analyzed as a function of rod position and power level. Hot channel factors were found to improve substantially as control rods were withdrawn from the core. While the minimum DNB ratio and the maximum coolant temperature at the hot channel outlet remain essentially the same as for Core IV, the maximum heat flux in Core V will be reduced to approximately 90% of the maximum heat flux in Core IV. As a result, Core V will be able to be operated in a more conservative manner than previous Yankee cores.

Since the thermal conditions in Core V will in general be less severe than in the previous cores, the licensee concludes, and we agree, that a detailed reanalysis of accidents and transients with respect to the basic stainless steel fuel rod design is not necessary. The licensee has reviewed reactivity transients with respect to the Zirconium clad test assemblies, and concludes, and we agree, that the transient behavior of the core is not affected by their presence.

The effect of a loss of coolant flow on the two Zircaloy clad test assemblies has been evaluated by the licensee. For the one or two pump loss, the maximum cladding temperature in the test assemblies would not rise above the normal operating temperature of 640 degrees F, and for a four pump loss would not go above 1000 degrees F. These values are well below the 1800 degree F temperature at which a Zr-water reaction may start and do not present a potential safety problem.

The licensee reports that a Zr-water reaction could occur in the event of a total loss of coolant caused by a double ended 20-inch pipe break. Under these conditions, the hottest Zirconium clad rod would reach 1800 degrees F in about 20 seconds after the break, and some of the cladding could melt before the reaction is terminated by the safety injection system in approximately 110 seconds. However, even if all of the Zirconium in the test assemblies were to react, and if all of the hydrogen thus liberated were to recombine, the resultant energy added to the vapor container would be 0.94×10^6 BTU compared to the 92×10^6 BTU from the primary coolant, and the resultant vapor container pressure increment would be less than 0.5 psig. We believe that Yankee has adequately considered the potential consequences of reactor operation with Zircaloy clad fuel elements and that no additional significant safety problems are presented.

Conclusion

On the basis of the foregoing considerations, we have concluded that the proposed change does not present significant hazards considerations not described or implicit in the hazards summary report, and that there is reasonable assurance that the health and safety of the public will not be endangered.

Original signed by:
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Date: JUL 1 3 1965