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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 25 TO FACILITY OPERATING LICENSE NO. DPR-3

YANKEE ATOMIC ELECTRIC COMPANY

YANKEE NUCLEAR POWER STATION (YANKEE-ROWE)

DOCKET NO. 50-29

Introduction

By application dated May 11, 1976, and supplements dated May 11, 17 and 19, 1976, Yankee Atomic Electric Company (the licensee) proposed a change to the Technical Specifications appended to License No. DPR-3 for the Yankee-Rowe reactor. The proposal involves a change to the set pressure for the Low Pressure Safety Injection Accumulator, specified in Section D.2.c(4), from 410 psig to 337 psig $\pm$ 10 psig.

Discussion

During a previous refueling outage, the licensee measured the accumulator flow rate to confirm minimum ECCS flow. Recently, in the course of a continuing review of ECCS design and performance, the licensee discovered that the actual accumulator flow rate was higher than was used in RELAP 4-EM code calculations for ECCS performance for Yankee-Rowe. The apparent cause of the lower calculated accumulator flow was a non-conservative input to the LOCA blowdown calculation.

Staff Evaluation

In a meeting on May 13, 1976, the licensee presented to the staff their evaluation of the effect of the difference between actual measured and calculated accumulator flow. They also presented their proposal for correcting this difference.

The licensee proposed a readjustment of the accumulator pressure downward such that accumulator flow would agree with the value in the current licensee's analyses. The NRC staff agrees that accumulator pressure should be readjusted downward to be consistent with the licensee's analysis. The staff believes this action is appropriate because of the design of ECCS cooling system of the Yankee-Rowe plant (particularly the accumulator injection system) and because the staff believes that to determine if higher accumulator flow rates are conservative would require extensive analysis.

Such a revision of the accumulator pressure will affect the ECCS performance evaluation for both the large and small breaks. They are discussed in the following sections.

1) Large Breaks

Primary coolant system depressurization is very rapid for large breaks and the time delay caused by initiating accumulator flow at 352 psia instead of 420 psia is insignificant. As such, it will not result in appreciably different reflood and heatup transients. The staff believes previously accepted large break analyses are still valid.

The Yankee-Rowe accumulator contains 700 ft^3 of water and has a constant nitrogen dome as a driving force. The method proposed by the licensee to reduce the flow is to reduce the accumulator pressure. An accumulator flow test was performed with a 30 ft. head of water above the core in the reactor vessel. The accumulator nitrogen overpressure was 382 psig. Flow was measured by monitoring accumulator level changes and by measuring the flow to each loop and the average flow was determined to be 5,375 gpm.

A simplified 6 Volume RELAP 4-EM model was constructed equivalent to the nodal representation used for the ECCS analysis for the Core XII LOCA submittal. A parametric study of large break ECCS flow versus accumulator pressure was performed over a range of accumulator pressures.

It was determined that an accumulator pressure of 352 psia will produce an ECCS flow rate in agreement with the Yankee-Rowe Core XII LOCA submittal. It was also shown that an uncertainty range of ± 10 psi on this pressure would maintain acceptable BOCREC, reflood rates, and accumulator empty times. These parameters versus accumulator pressure are shown below:

Reflood Rates (lb/sec)

Accumulator Pressure (psia)	BOCREC (sec)	Before Accumulator Empty	After Accumulator Empty	Effective Accumulator Empty Time (sec)
YR Core XII LOCA Submittal	102.49	534.0	221	114.79
342	103.80	541.5	221	118.67
352	102.83	550.2	221	115.87
362	102.50	558.7	221	113.88

2) Small Breaks

Small break analyses were performed by the licensee using the WFLASH code and submitted to the NRC on July 31, 1974. These analyses, considered 2, 3, and 4-inch diameter breaks. Results of these analyses indicated that the core never became uncovered for the 2" break. A peak clad

temperature (PCT) of approximately 750°F was calculated for the 3-inch break and occurred at 160 seconds after break initiation. The 4-inch break was determined to be limiting with a PCT of 1300°F occurring 235 seconds after break initiation.

The potential effect of the proposed change in accumulator pressure on the ECCS performance to mitigate the consequences of a small break was evaluated. The Core-XII LOCA analysis submitted to the NRC on October 10, 1975, predicted that for the 3-inch break the PCT occurred prior to the time that the reactor coolant pressure decreased to a value that permitted flow from the accumulator to the reactor coolant system; that is, for the 3-inch diameter break the accident was mitigated without the accumulator. Therefore, the staff concluded that the change in accumulator pressure would have no effect on ECCS performance for breaks of 3-inches or less.

The 4-inch break was reanalyzed using the ENC WREM based evaluation model. The results of this re-analysis were included in the licensee's October 10, 1975, application for a license amendment for authorizing operation of Yankee-Rowe with Core XII. The calculated PCT during the period of core uncovery was determined to be 1400°F and to occur at 230 seconds. However, a PCT of about 1850°F was calculated to occur at about 9 seconds, before the core was uncovered, due to a momentary flow stagnation.

It was determined that the accumulator would begin delivery to the main coolant system at 230 seconds (380 psia). With a reduced accumulator pressure of 352 psia, injection will be delayed to ~ 252 seconds (312 psia). Assuming the adiabatic heatup, which started at 215 seconds, continues to 252 seconds, the second peak would be expected to increase from 1400°F to about 1680°F. This value is well below the 2200°F limit of 10 CFR Part 50.46 and is significantly less than the initial peak PCT of 1850°F. As such, the change in the accumulator pressure does not significantly increase the overall PCT for the 4" break.

The licensee has not submitted analyses for small breaks larger than 4-inches in diameter and contends that the larger small breaks (i.e., 5-inch or larger) are not limiting and will result in lower PCTs. This contention is based on the argument that larger breaks result in faster system depressurization and more rapid injection of ECC Coolant which in turn results in the core being uncovered for a shorter period of time.

During its review, the staff determined that the Yankee Rowe coolant injection rate is much greater than the H.B. Robinson plant (for which a complete small break spectrum exists). H.B. Robinson, which had previously been reviewed by the staff, had a maximum small break PCT occuring for an 8-inch diameter break, but exhibited the same trend as expected for Yankee-Rowe, that is, a decrease in PCT for break sizes greater than the small break limiting break size before an increase again occurs in the large break region. Because of a substantially faster depressurization rate and a much higher coolant injection rate, Yankee-Rowe would be expected to have the maximum PCT for small breaks

occuring at a substantially smaller size break than for H.B. Robinson.

A comparison was made between the WREM analysis submitted on October 10, 1975; the July 31, 1974 WFLASH analysis; and a small break analysis conducted with the SLAP code and submitted in 1971. The staff considers the SLAP code to be less refined than more recent codes, but considers that for small break pressure decay, the behavior should give reasonable answers. From reviewing these results, it was found that for the pressure transient in the pressure range of ECC injection, excellent agreement was obtained between SLAP and WFLASH calculations for the 3-inch diameter break which was the only case for which analyses for both codes was performed for Yankee Rowe. A 5-inch diameter break analyzed with SLAP indicates that the core never uncovers. Therefore, the SLAP results indicate that the 5" break is not limiting.

The staff believes that the SLAP pressure decays approximate the results that would be calculated by current blowdown analyses with both WFLASH and RELAP 4-EM (ENC Version). Since the ECC injection rates and initiation pressures are the same for all analyses, it is reasonable to expect that prediction of liquid level in the core would be comparable. Although it is recognized that the SLAP Code models the entire primary system as only one or two volumes, the total volumes are the same regardless of the analytical model used.

As noted above, the 4-inch diameter break size has an initial PCT of 1850 and a second peak of 1400°F (which can be extrapolated to approximately 1680°F with the lower accumulator

pressure). The limiting large break PCT is 1896°F. Therefore, in the event that breaks slightly above or below 4 inches turned out to be the limiting small break, reasonable assurance exists that the PCT criterion of 10 CFR 50.46 is not exceeded. The staff also concludes that there is reasonable assurance that the calculated PCT does not significantly increase over the entire break spectrum as a result of the accumulator pressure decrease.

The staff therefore concludes that the 5-inch diameter break is likely to be less limiting than the 4-inch diameter break.

The licensee has stated that he will confirm that the most limiting small break has been identified without relying on comparison with the SLAP calculations. The additional analyses to be performed by the licensee will, as a minimum, evaluate a 4-inch, a 5-inch, and a 10-inch diameter break and will utilize the revised accumulator pressure.

Findings

The staff concludes that adjusting accumulator pressure to match previous ECCS calculation values is acceptable for large break sizes and that no further analysis is required for these breaks. Also, regarding large breaks, the staff further believes that the licensee has properly determined the accumulator set pressure and that the predicted differences in blowdown times and reflood rates shown in the table contained therein are acceptably close to those determined from the Yankee-Rowe Core XII ECCS submittal.

The staff also concludes that the analyses performed by the licensee are adequate to provide reasonable assurance that the requirements of 10 CFR Part 50.46 are satisfied for small breaks. However, for the small breaks, the staff agrees with the licensee that it is desirable to perform additional

analyses to further verify that the small break spectrum has been completely analyzed for the revised accumulator press re and to better quantify the PCT predicted to occur following various size pipe breaks.

The staff has also determined that the amendment does not authorize a change in effluent types or total amounts, nor an increase in power level, and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and pursuant to 10 CFR § 51.5(d)(4) that an environmental statement, negative declaration, or environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the change does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the change does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) 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.

Date: May 19, 1976