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YANKEE ATOMIC ELECTRIC COMPANY

B.3.2.1
PC-163-2

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WYR 78-99

November 21, 1978

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Office of Nuclear Reactor Regulation
Dennis L. Ziemann, Chief
Operating Reactors Branch #2
Division of Operating Reactors

References: (a) License No. DPR-3 (Docket No. 50-29)
(b) YAEC letter to USNRC dated September 8, 1978
Proposed Change No. 163
(c) NRC letter to YAEC dated November 8, 1978

Dear Sir:

Subject: Additional Information - Core XIV Refueling

The additional information requested in Reference (c) is enclosed. The responses supplement the data presented in the core performance analysis report submitted as YAEC-1162 in Reference (b).

As a result of the NRC questions in Reference (c), a change to the technical specifications is required, which will be submitted shortly.

We trust you will find this additional information satisfactory; however, should you desire additional information, feel free to contact us.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

D E Vandenburgh

D. E. Vandenburgh
Senior Vice President

RJC/em

Enclosure

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Question 1

At what value of burnup would the Exxon fuel in Yankee Rowe undergo clad flattening?

Response

The fuel design bases for Exxon fuel in Yankee Rowe including those relating to cladding collapse have been presented in the Yankee Rowe Core XI-XII Refueling Submittal (P.C. 125; July 14, 1975; WYR75-74) and are applicable to Yankee Rowe Core XIV operation. The design basis calculation of cladding creep collapse demonstrates that creep collapse should not occur prior to the anticipated maximum lifetime design exposure of the fuel. An additional calculation demonstrates that creep collapse should not occur prior to an exposure time which is approximately ten (10) percent greater than the design exposure time.

The calculational methodology employs numerous conservative assumptions to assure that the fuel is designed to preclude cladding collapse during operation. The design basis input values for this calculation are representative of those for the limiting fuel rod with respect to creep collapse for Yankee Rowe Core XIV.

In addition, the fuel has been designed to decrease the occurrence of fuel stack separation and the effects of densification and thereby to further reduce the potential for cladding collapse.

Question 2

Demonstrate that during the boron dilution accident at hot standby 16.4 min. is a sufficiently long time for the operator to terminate the dilution before criticality would occur. This time is considerably shorter than the comparable time in the Cycle XI analysis. (41 min.)

Response

The transient analyzed is based on the situation of three charging pumps operating (100 gpm) in a feed and bleed mode (unborated water in - borated water out). A feed and bleed operation of this magnitude is almost never used. If it did exist, however, close surveillance would be required and the possibility of feeding unborated water at 100 gpm is very unlikely.

Assuming that this situation did occur, however, the operator would have a minimum of four alarms which would indicate the situation. These alarms are the following:

1) high flux recorder alarm,
2) high level alarm in the low pressure surge tank,
3) high pressure alarm in the low pressure surge tank, and
4) high temperature alarm in the low pressure surge tank.

In addition, it is probable that the following alarms would occur:

1) radiation alarm on the bleed line, and
2) reactor coolant pump cooling flow alarm since increased component cooling to the low pressure surge tank in response to item 4) above would result in a decrease in coolant flow to the reactor coolant pumps.

Since the event can be terminated easily from the control room, 16.4 minutes is sufficiently long to terminate the event.

Question 3

Elaborate on your statement and give quantitative justification showing that the less negative value of doppler coefficient and the more negative value of moderator coefficient used in the bounding analysis for loss of load incident would not affect significantly the conservatism of the analysis.

Response

As stated in recent telephone conversations with the NRC the loss of load incident is relatively insensitive to reactor kinetics parameters for Yankee Rowe for the following reasons:

1) The reference analysis had in excess of 200 psia margin to the overpressure limit of 2750 psia (110% of 2500 psia).

2) The maximum pressure attained in the reference analysis was sufficiently low such that only the first of two pressurizer code safety valves opened. Thus, a second code safety valve of equal capacity with a set pressure of 2575 psia would be available to alleviate any loss of load incident resulting in a more significant system expansion and hence a higher reactor coolant system pressure.

To quantitatively justify the above statements a sensitivity study on the loss of load incident of changes in moderator temperature and doppler coefficients of reactivity was performed. The same method of analysis used in the reference analysis was again utilized. Table 7-14 provides a summary of the cases examined and the resulting maximum reactor coolant system pressure attained.

The results provided in Table 7-14 show that the transient is not highly sensitive to either moderator temperature coefficient (MTC) or doppler coefficient. The MTC and doppler coefficient values used in Cases 1 and 2 bound those provided in Table 7-3 for the reload cycle. The lower bound on the doppler coefficient ($-1.0\times10^{-5}\Delta\rho/^{o}F$) used in Cases 1 and 2 is conservative due to the non-negative values of MTC used. A doppler coefficient value of $-1.0\times10^{-5}\Delta\rho/^{o}F$ provides in excess of 25% conservatism to the calculated minimum value of doppler coefficient ($-1.42\times10^{-5}\Delta\rho/^{o}F$).

For all cases analyzed, the minimum DNBR remains significantly greater than 1.3 and the maximum fuel temperatures significantly less than allowable limits.

Table 7-14

Summary of Loss of Load Incident
Parametric Analyses

Case Number	Moderator Temperature Coefficient ($x10^{-4}\Delta\rho/^{o}F$)	Doppler Coefficient ($x10^{-5}\Delta\rho/^{o}F$)	Maximum Reactor Coolant System Pressure (psia)
1	0.0	-1.0	2575
2	0.5	-1.0	2552
3	-0.1	-1.7	2533
4	-0.1	-1.0	2519

Question 4

You make the statement that according to the results of your burnup sensitivity studies the most highly exposed recycled fuel rods and the highest powered recycled fuel rods are not limiting when the peak linear heat generation rate of the fresh fuel is maintained at or less than the value given in FIG. 7-1 in the reload submittal. This holds true even though at 16000 MWD/MTU burnup the calculated value of allowable peak linear heat generation rate (APLHGR) for the fresh fuel is higher than the corresponding values for the recycled fuel. Discuss the basis for your statement and provide the supporting evidence.

Response

Figure 7-2 provides a comparison of the Allowable Peak Linear Heat Generation Rate (APLHGR) for Core XIV versus that required for full power operation for each of the three fuel types (fresh, high power exposed (HPE), and highest exposed (HE)) as discussed in both Reference b and in recent telephone conversations with the NRC. The required peak linear heat generation rate (RPLHGR) is based on the definition provided in Yankee Rowe Technical Specification Section 4.2.1.2. The heat flux power peaking factor, F_q^N, used in determining the RPLHGR is that calculated for each of the three fuel types at the burnup points represented in Figure 7-2. Figure 7-2 shows that the APLHGR's analyzed bound that required for full power operation for each of the fuel types for the entire cycle length excepting the fresh fuel for the first 250 MWD/MTU of cycle average burnup (CABU).

Figure 7-3 provides a plot of the percent overpower margin (OPM) for each of the three fuel types as a function of CABU (OPM is defined as (APLHGR - RPLHGR)/RPLHGR x 100). From Figure 7-3 the following information can be obtained:

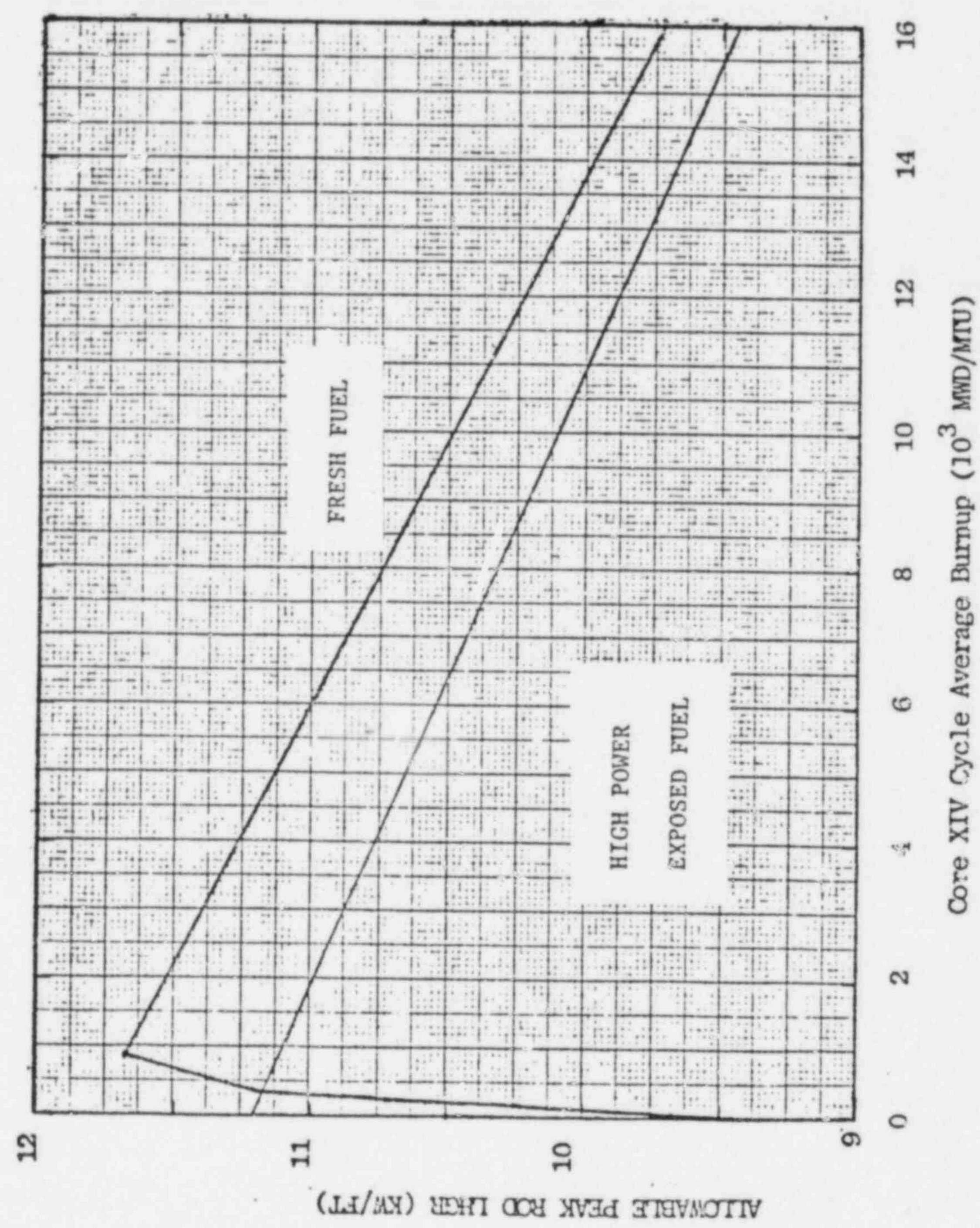
1) Full power operation is not attainable during the first $\sim$ 250 MWD/MTU CABU due to the limit on APLHGR for the fresh fuel.

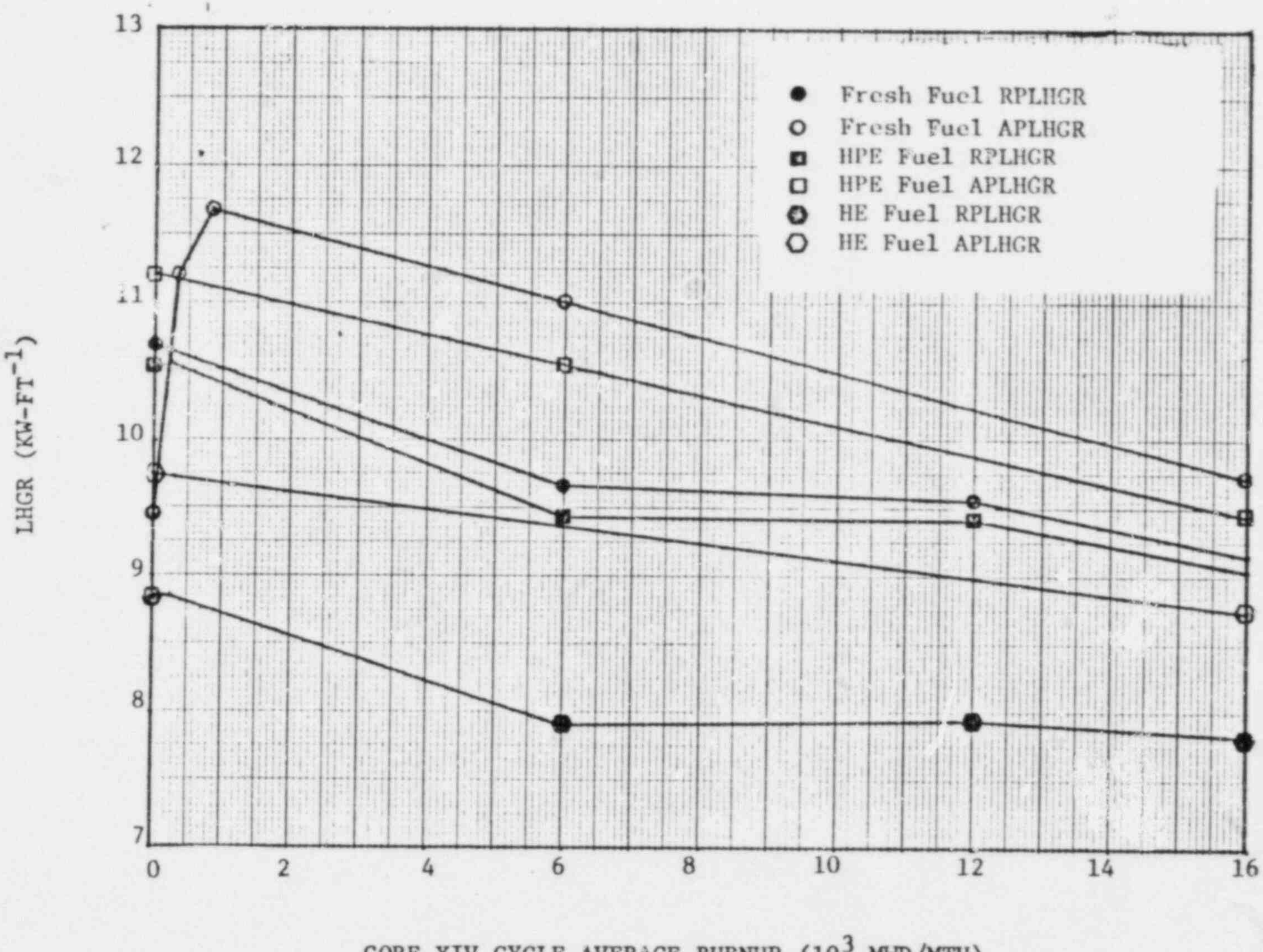
2) The highest exposed fuel has significantly more OPM for the entire cycle than either the fresh or the high power exposed fuel.

3) After $\sim$ 500 MWD/MTU CABU, the high power exposed fuel is the fuel type calculated to have the minimum available OPM.

Based on these statements, plant operation within the limits defined by the LOCA analyses performed for Cycle XIV can be maintained by using two curves of APLHGR versus CABU. The two curves are 1) APLHGR versus CABU for the fresh fuel and 2) APLHGR versus CABU for the high power exposed fuel. The attached Figure 7-1 provides this information.

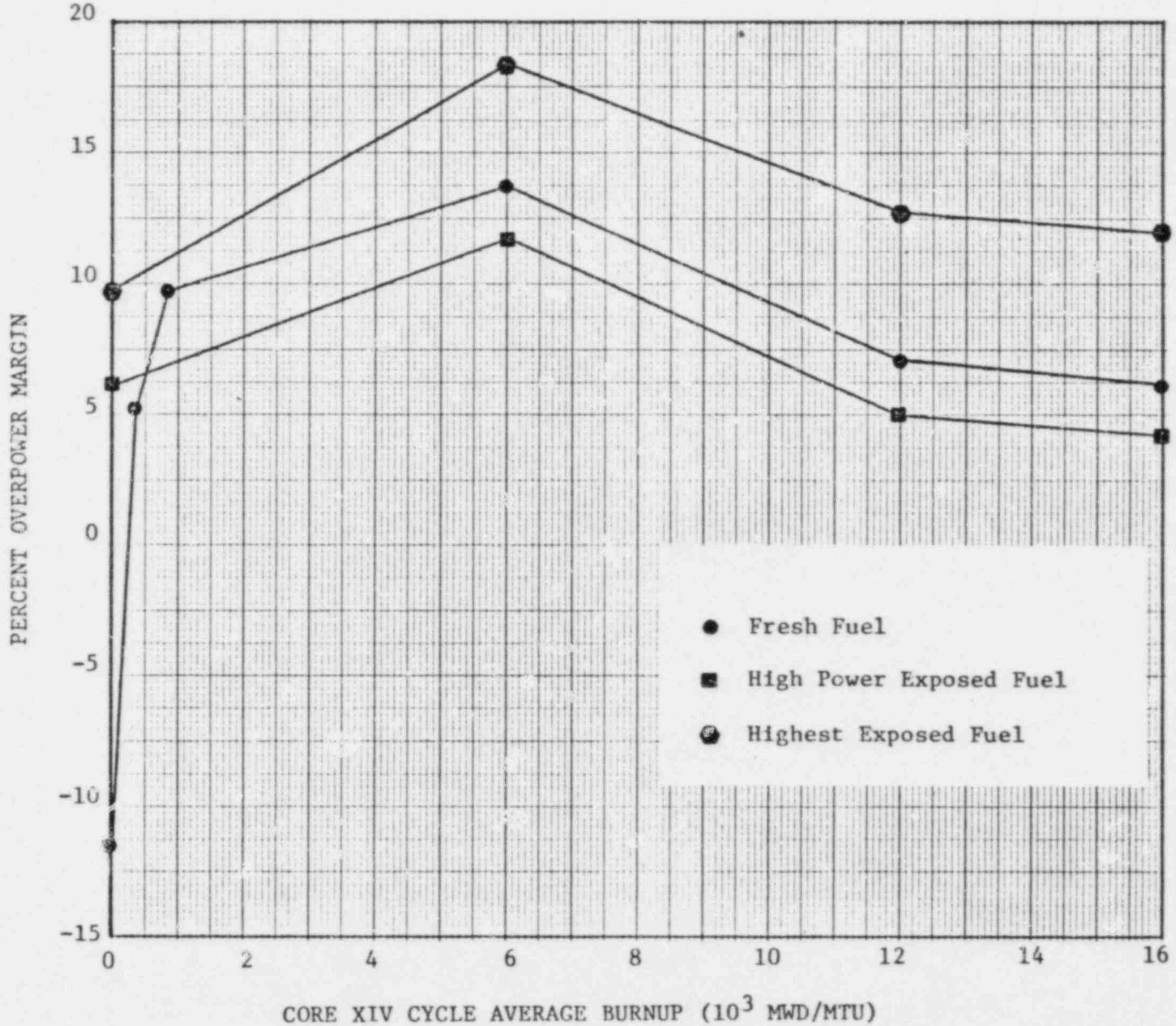
FIGURE 7-1
Core XIV Allowable Peak Rod LHGR
Versus Cycle Burnup





F I G U R E 7-2

COMPARISON OF APLHGR AND RPLHGR VERSUS CORE XIV CYCLE AVERAGE BURNUP



F I G U R E 7-3

OVERPOWER MARGIN FOR THE THREE FUEL TYPES VERSUS CORE XIV CYCLE AVERAGE BURNUP

Question 5

Give the quantitative basis for the change of the accumulator timer's set point from 4.0 ± 0.75 sec. to 11.85 ± 0.23 sec.

Response:

The timer setpoint is based on the criteria that full pressurization of the accumulator occur not earlier than 14.0 seconds or later than 16.1 seconds following the initiation of a LOCA. This window on full pressurization of the accumulator is consistent with the assumptions made in the LOCA analyses performed for Yankee Rowe. The lower bound (14.0 seconds) is the time at which spillage from the accumulator at full pressure begins, and the upper bound (16.1 seconds) is the earliest time following a large break that ECCS water could be injected into the intact cold legs since this is the time at which the intact cold leg presure decreases below the accumulator full pressurization pressure.

The timer setpoint was changed to account for the change in the SIAS sensor signal location (Reference b). The change in location will result in an earlier SIAS and hence an increase in the timer setpoint is necessary to assure that the window in time discussed above is bounded. Table 7-15 provides the quantitative basis for the 11.85 ± 0.23 second timer setpoint. The result shows that the revised timer setpoint conservatively bounds the time window discussed above and hence assures the analyses performed for Yankee Rowe remain valid.

TABLE 7-15

Accumulator Pressurization Timing Sequence

Event	Earliest Time (Seconds)	Latest Time (Seconds)
1) Rupture occurs	0.0	0.0
2) SIAS occurs and Timer actuated	0.0	0.25
3) Timer run time	11.85 - .23 = 11.62	11.85 + .23 = 12.08
4) Timer fires (2 + 3)	11.62	12.33
5) Δ Time to Begin Pressurization	2.05	2.38
6) Time at which Pressurization Begins (4 + 5)	13.67	14.71
7) Δ Time to Fully Pressurize	1.20	1.28
8) Time that Full Pressurization Occurs (6 + 7)	14.87	15.99

Question 6

The physics startup test program as described in Section 8 of the reload submittal is nearly complete as far as the number and kind of tests to be performed. However, some additional information is needed.

1) Please provide the acceptance criteria for each test to be performed. Also, please provide for each test the actions to be taken if the acceptance criteria are not met.

Response

The acceptance criteria for the prediction of key core parameters is defined in Table 8-1. The permissible deviation from predicted values are selected to insure the adequacy of the safety analysis. In these tests, the nominal measured value is compared to the nominal calculated value. Corrections are made for any difference between the measurement and calculational conditions.

If the criteria in Table 8-1 are not met, the deviations are evaluated relative to the assumptions in the safety analysis for the given core parameters. The Plant Operations Review Committee reviews the evaluation prior to power operation.

Question 6

2) You state that the power distribution will be measured at a steady state power between 50% and 75% power. Please confirm that a power distribution map will also be taken at a very low power level.

Response

A power distribution map will be taken at low power to check for gross quadrant tilt only.

Table 8-1

Yankee Rowe Core 14
Startup Test Acceptance Criteria

	Measurement	Conditions	Criteria
1.	Control Rod Drop time	Operating temperature.	Drop times no greater than 2.5 seconds
2.	Critical Boron Concentration	Hot zero power, near all rods out	Measurement within $\pm$10% of predicted value
3.	Control Rod Group Worths	Hot zero power, Groups C, A and B	Worth of each group within $\pm$7.5% of the predicted value
4.	Control Rod Group Worths	Hot zero power, Groups C, A and B	If the criteria in Measurement (3) is not met, the total worth of all Groups measured must be within $\pm$7.5% of the predicted value.
5.	Isothermal Temperature Coefficient	Hot zero power, near all rods out	Measurement within $\pm 0.5 \times 10^{-4} \Delta\rho/^{o}F$ of predicted value
6.	Ejected Control Rod Worth	Hot zero power, two pre-ejection conditions: from Group C near full insertion and from Groups A and C near full insertion	Ejected control rod worth no more than 15% greater than the predicted value
7.	Power Coefficient	At greater than 50% power with Group C greater than 75 inches withdrawn	Measurement within 25% of predicted value
8.	Radial Power Distribution	Above 50% power with all rod groups greater than 75 inches withdrawn	The measured reaction rates within $\pm$5% of the predicted value