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SUBJECT: Forwards justification for continued operation of facility, addressing concern re end-of-cycle moderator temp coefficient. Concern reported to NRC on 860410. LER will be submitted by 860512.

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April 23, 1986

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. John F. Stolz, Project Director
PWR Project Directorate No. 6

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Sir:

Attached for your information is a justification for continued operation for the Oconee Nuclear Station which addresses the end-of-cycle moderator temperature coefficient concern. The concern arose when recent measurements at Oconee indicated that the end-of-cycle hot full power moderator temperature coefficient may be more negative than the design value of $-3.0 \times 10^{-4}$ $\Delta k/k/^{\circ}F$ in FSAR.

This concern was reported to the NRC on April 10, 1986 as required by 10 CFR 50.72. Duke Power Company is preparing a Licensee Event Report describing in detail the subject concern which will be submitted by May 12, 1986.

Duke Power Company has reviewed the FSAR Chapter 15 licensing basis transients in order to determine their sensitivity to this parameter. The results of this review and subsequent analysis indicate that operation with a hot full power end-of-cycle moderator temperature coefficient as negative as $-3.5 \times 10^{-4}$ $\Delta k/k/^{\circ}F$ is acceptable and will not result in more adverse consequences for any of the design basis FSAR Chapter 15 transients.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

MAH:slb

Attachment

xc: Dr. J. Nelson Grace, Regional Administrator
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Mr. J. C. Bryant
NRC Resident Inspector
Oconee Nuclear Station

Oconee Nuclear Station
Moderator Temperature Coefficient Concern
Justification for Continued Operation

Recent measurements at Oconee indicated that the end-of-cycle (EOC) hot full power (HFP) moderator temperature coefficient (MTC) may be more negative than the design value of $-3.0 \times 10^{-4}$ Δk/k/°F. The Final Safety Report Chapter 15 licensing basis transients were reviewed in order to determine their sensitivity to this parameter. Four transients were identified which assume a boundingly negative end of cycle MTC: cold water accident, control rod misalignment, rod ejection, and steam line break. These four transients were evaluated to determine the acceptability of a more negative HFP EOC MTC.

Cold Water Accident (FSAR Section 15.5)

The design basis cold water accident was analyzed with a moderator temperature coefficient of $-3.5 \times 10^{-4}$ Δk/k°F. The RETRAN02-MOD003 computer code was used to calculate the system response. For the worst case transient the core thermal power does not exceed 100%, so departure from nucleate boiling will not occur. Therefore the consequences of the cold water accident are no more severe than the same transient with a MTC of $-3.0 \times 10^{-4}$ Δk/k°F.

Control Rod Misalignment Accidents (FSAR Section 15.7)

The most severe control rod misalignment accident - dropped rod with no Integrated Control System (ICS) action - was analyzed with moderator temperature coefficients of $-3.0 \times 10^{-4}$ Δk/k°F and $-3.5 \times 10^{-4}$ Δk/k/°F. A bounding dropped rod worth of 0.4% Δk/k was assumed. The Reactor Coolant System response was analyzed using the RETRAN02-MOD003 computer code. Boundary conditions from the system analysis were used to calculate the flux peaking in the core. The system response and the power peaking analyses provided boundary conditions for a hot channel analysis. The minimum departure from nucleate boiling ratio (DNBR) was calculated to be identical and greater than the correlation limit for both MTC cases. Therefore the consequences of the accident are acceptable and shown to be insensitive to the MTC.

Rod Ejection Accident (FSAR Section 15.12)

The base case for the rod ejection accident is the ejection of a 0.65% Δk/k rod from the core while at rated power at beginning-of-cycle (BOC) conditions. Sensitivity studies were performed which indicate that more rapid power excursions occur at end-of-cycle that at BOC (FSAR Figure 15.12-3). This, however, is due to the reduction of β-effective with burnup, which increases the impact of the ejected rod reactivity. The peak neutron power actually decreases with a more negative MTC as shown on FSAR Figure 15.12-8. Based on these analyses, a more negative EOC MTC will not increase the consequences of the design basis rod ejection accident.

## Steam Line Break Accident (FSAR Section 15.13)

The MTC is a key parameter in the steam line break accident. As the assumed MTC becomes more negative, added positive reactivity feedback occurs due to the primary system overcooling. The base case FSAR steam line break transient (with ICS and operator action) has a minimum subcriticality margin of 0.4% Δk/k with an assumed MTC of $-3.0 \times 10^{-4}$ Δk/k/°F (FSAR Table 15.13). A more negative MTC rasies the potential that the core could achieve recriticality during the transient. In the past the hot full power MTC has been compared to the analysis assumption to verify the applicability of the design basis analysis. However, the appropriate value for comparison to the analysis assumption is the hot zero power (AZP) EOC MTC. An examination of Table 15.13-1 in the Oocnee FSAR shows why the HZP value is appropriate. The table contains the following information:

| | |
|---|---|
| Moderator temperature coefficient | $-3.0\times10^{-4}$ Δk/k/°F |
| Doppler coefficient | $-1.2\times10^{-5}$ Δk/k/°F |
| Tripped rod worth (highest worth rod stuck out of the core) | 3.46% Δk/k |
| Initial average fuel temperature | 1400°F |

The core reactivity following the break, reactor trip, and cooldown to 532°F (hot zero power temperature) is calculated below:

$$\rho_{532} = \rho_{579} + \rho_r + \rho_m + \rho_D$$

$\rho_{532}$ = core reactivity at 532°F
$\rho_{579}$ = initial core reactivity at hot full power (579°F)
$\rho_r$ = tripped rod worth
$\rho_m$ = feedback from moderator temperature change
$\rho_D$ = feedback from fuel temperature change

The initial reactivity is zero, since the accident occurs from steady-state full power.

$$\rho_{532} = 0 + 3.46\% + (-3.0 \times 10^{-4})(100)(579-532) + (-1.2 \times 10^{-5})(100)(1400-532)$$

$$\rho_{532} = 1.0\%\ \Delta k/k$$

At Oconee, the core design methodology requires at least 1.0% Δk/k shutdown margin at HZP. In practice the actual EOC shutdown margin greatly exceeds the required 1% margin. Therefore the core will be shut down by at least 1% Δk/k with the RCS at 532°F irrespective of the MTC. For the rest of the cooldown it is apparent that the HZP MTC should be used to calculate moderator feedback instead of the hot full power (HFP) value, since the postulated conditions of the core are essentially at HZP, all rods in, not HFP with all rods out.

The effect of a more negative hot full power end-of-cycle moderator temperature coefficient has been analyzed for the Oconee Nuclear Station. A HFP MTC of $-3.5 \times 10^{-4}$ $\Delta k/k/°F$ (as opposed to the current $-3.0 \times 10^{-4}$ $\Delta k/k/°F$) will not result in more adverse consequences for any of the design basis FSAR Chapter 15 transients. Therefore operation with a HFP EOC MTC as negative as $-3.5 \times 10^{-4}$ $\Delta k/k/°F$ is acceptable. The hot zero power EOC MTC should be maintained more positive than $-3.0 \times 10^{-4}$ $\Delta k/k/°F$ in order to ensure that the assumptions of the licensing basis steam line break accident remain valid.