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October 15, 1990

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Subject: Oconee Nuclear Station, Unit 1
Docket No. 50-269
Unit 1 Cycle 13 Startup Testing Report

Gentlemen:

By letter dated August 20, 1990 I provided the Oconee Unit 1 Cycle 13 Startup Testing Report pursuant to Oconee Nuclear Station Technical Specification 6.6.1.1. For your information, attached is an internal letter documenting the evaluation of control rod group 5 worth.

Very Truly Yours,

Hal B. Tucker MJS

Hal B. Tucker

PJN/9

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August 6, 1990

D. M. Hubbard
Oconee Performance

Subject: Oconee 1 Cycle 13
Zero Power Physics Tests
Control Rod Worth Measurements

During the Oconee 1 cycle 13 (O1C13) zero power physics tests (ZPPT) control rod groups (CRGP) 5 and 7 were measured to be abnormally high relative to predictions by core physics models. The core model used for the Physics Tests Manual (PTM) was reviewed for errors and none were found. All ZPPT predictions were repeated with a completely independent set of core physics models and the results were essentially the same. Therefore it was unlikely that a input error contributed to the discrepency. All core shuffle procedures were reviewed at Oconee and within Nuclear Design to insure that the core was loaded as designed. No tests are performed at HZP which provide information on core symmetry so a direct indication of broken or otherwise failed control rods was not available at this time. However, core reactivity was verified by the all rods out boron measurement and since the measured CRGP worths were high there was additional conservatism in all shutdown margin calculations. Also, as required by tests procedures, extra bank worths were measured until the average error in all measured CRGP's was less than 10%. Since the measured rod worths were conservative with respect to shutdown margin and there were no other reactivity concerns, it was judged acceptable to escalate power in order to utilize power distribution data from the incore detector system.

At 75 percent of full power with near all rods out a near equilibrium power distribution was carefully examined in an effort to explain the rod worth discrepency. The axial power shapes were plotted for rodded locations in an effort to identify possible brcken control rod fingers. The radial power distribution was examined for assymetries that would indicate a dropped control rod bank. There was no information to suggest a mechanical failure of any control rod. The radial power distribution measured by the incore detector system was in general lower than prediction in the central portion of the core and higher than prediction in the outer half of the core radius where CRGP 5 and 7 are located. This shift in radial power relative to prediction was slightly more than in past cores and was opposite in sign relative to O1C12. At this point it seemed likely that

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a deficiency in the core model's prediction of the radial power distribution had lead to the discrepency in control rod worths. Further investigations therefore focused on trying to explain the radial shift in the power distribution relative to prediction. Again a completely independent core model was executed which verified the design model used in the PTM. Beginning of cycle (BOC) assembly burnup estimates made by the operator aid computer and the design models were compared to determine if small errors were being carried along and magnified from cycle to cycle. The errors observed were demonstrated to have an insignificant impact on the power distributions predicted by the core models. Historical BOC power and burnup data from unit 1 was compared to past experience on units 2 and 3. Unit 1's recent past history demonstrated some unique behavior. Therefore an examination was conducted of the fuel shuffling strategies employed in unit 1 relative to units 2 and 3. The characteristics of the fuel assemblies placed in the center of the core was of particular interest. As postulated, recent cycles of unit 1 had been shuffled with a lesser degree of inside to outside mixing of assemblies than units 2 and 3.

There are also a number of uncertainties associated with the measurement of control rod worths. Acceptable reactimeter performance, appropriate and systematic interpretation of reactimeter traces, stable system flow and temperture conditions, proper detector performance, consistent and systematic execution of test procedures are all required for accurate measurement results. Reactor engineers reviewed all measurement hardware, procedures, and results. Nothing was found that would significantly compromise the precision of these measurements.

The exact cause of the rod worth errors in the 01C13 ZPPT has not been identified. Evidence indicates that the discrepancy between the predicted and measured radial power distributions is the root cause of the rod worth errors. It is possible, though not confirmed, that the fuel shuffling techniques used in recent cycles of unit 1 have tended to carry along small inaccuracies over several cycles. If this is true, one must postulate that the sum of these errors over several cycles has caused a radial power shift in the real core that is not predicted by the current core design models. The effect of this inaccuracy may be diluted by practicing shuffling techniques that more thoroughly mix the type of burned fuel that is placed in the center of the core.

Continued operation of 01C13 at full power is judged acceptable for the following reasons.

1. There is no evidence of mechanical failure of control rods.

2. The measured rod worths are higher than prediction. Thus the current shutdown margin and shutdown boron calculations are conservative.

3. There is no evidence of a reactivity problem of any kind. Reactivity letdown to date is well within acceptance criteria and better than most other cores.

4. The prediction of the hot assembly has always been and continues to be well within the uncertainty assumed in the development of the operating limits.

5. The shift in the measured radial power distribution relative to prediction has been self-correcting. The core is depleting in a manner consistent with design predictions.

J L Eller

J. L. Eller
Engineering Supervisor
Oconee Nuclear Design

cc: E. D. Price
K. S. Canady
G. A. Lareau