QUAD-CITIES NUCLEAR POWER STATION

UNIT 2 CYCLE 13

STARTUP TEST RESULTS

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1. Shutdown Margin Demonstration and Control Rod Functional Checks

Purpose

The purpose of this test is to demonstrate for this core loading in the most reactive condition during the operating cycle, that the reactor is subcritical with the strongest control rod full out and all other rods fully inserted.

Criteria

If a shutdown margin of 0.300% $\Delta K$ (=0.25% + R + $B_4C$ settling penalty) cannot be demonstrated with the strongest control rod fully withdrawn, the core loading must be altered to achieve this margin. The core reactivity has been calculated to be at a maximum at the beginning of cycle and R is given as 0.000% $\Delta K$. The control rod $B_4C$ settling penalty for Unit Two is 0.05% $\Delta K$.

Results and Discussion

On May 5, 1993, control rod E-13 was fully withdrawn to demonstrate that the reactor would remain subcritical with the strongest rod out. This rod was calculated by GE to have the highest worth with the core fully loaded at the beginning of the cycle. The strongest rod out maneuver was performed to allow single control rod withdrawals for CRD testing.

Control Rod functional subcritical checks were performed as part of control rod friction testing. No unexpected reactivity insertions were observed when any of the 177 control rods were withdrawn.

Nuclear Fuel Services (NFS) provided rod worth information for the two strongest diagonally adjacent rods D-12 and F-12 with rod E-13 fully withdrawn. This method provided an adequate reactivity insertion to demonstrate the desired shutdown margin. On May 24, 1993, a diagonally adjacent shutdown margin demonstration was successfully performed. Using the NFS supplied rod worth for E-13 (the strongest rod) and diagonally adjacent rod D-12, it was determined that with E-13 at position 48, and D-12 at position 20, a moderator temperature of 113°F, and the reactor subcritical, a shutdown margin of 1.082% $\Delta K$ was demonstrated. The NFS calculated shutdown margin with E-13 withdrawn and 68°F reactor water temperature was 2.164% $\Delta K$ at the beginning of Cycle 13.

NFS's ability to determine rod worth was demonstrated by the accuracy of their in-sequence criticality prediction. The $\Delta K$ difference between the expected critical rod pattern and the actual critical rod pattern was determined to be 0.4632% $\Delta K$ after correcting for temperature and period. This initial critical demonstrated that the actual shutdown margin at the beginning of cycle 13 was 2.6272% $\Delta K$.

2. Core Verification

Purpose

The purpose of this test is to verify proper core location and orientation for each core fuel assembly.

Criteria

Prior to reactor startup, the actual core configuration shall be verified to be identical to the planned core configuration.

Results and Discussion

The Unit Two Cycle 13 core was verified on May 4th, 1993. Fuel assembly orientation, seating, and ID serial number were verified for each assembly. Two inspection passes were made over each assembly. The first pass was made to verify orientation and seating of assemblies. The second pass was made to verify bundle ID numbers. A video camera was used during the inspection. All assemblies were found to be properly seated and orientated in their designated locations.

On May 7, 1993, 4 fuel assemblies were reverified due to the unload and reload of 4 fuel assemblies for control rod J-15 drive replacement. Two passes were again made for orientation, seating and ID verification. All 4 assemblies were found to be properly seated and orientated in their designated location.

The bundle ID numbers are shown in Figure 1.

3. Initial Critical Prediction

Purpose

The purpose of this test is to demonstrate Nuclear Fuel Services' (NFS) ability to calculate control rod worths and shutdown margin by predicting the insequence critical.

Criteria

NFS prediction for the critical rod pattern must agree within 1% $\Delta K$ to actual rod pattern. A discrepancy greater than 1% $\Delta K$ will be cause for an On-Site Review and investigation by Nuclear Fuel Services.

Results and Discussion

On May 26, 1993, at 0902 hours the reactor was brought critical with reactor water temperature at the time of criticality of 184°F. The $\Delta K$ difference between the expected critical rod pattern at 68°F and the actual critical rod pattern at 184°F was 0.005832 from rod worth tables supplied by NFS. The temperature effect was -0.00008 $\Delta K$ from NFS supplied corrections. The excess reactivity yielding the 196 second positive period was 0.0004 $\Delta K$. These reactivities resulted in a 0.004632 $\Delta K$ difference (0.4632% $\Delta K$) between the expected critical rod pattern and the actual rod pattern. This is within the 1% $\Delta K$ required in the criteria of this test, and NFS's ability to predict control rod worth is, therefore, successfully demonstrated.

4. Core Power Distribution Symmetry Analysis

Purpose

The purpose of this test was to determine the magnitude of indicated core power distribution asymmetries using data (TIP traces and OD-1) collected in conjunction with the CMC update.

Criteria

A. The total TIP uncertainty (including random noise and geometric uncertainties obtained by averaging the uncertainties for all data sets) must be less than 9%.

B. The gross check of TIP signal symmetry should yield a maximum deviation between symmetrically located pairs of less than 25%.

Results and Discussion

Due to a forced outage and load demands, this portion of the test has not been completed. A supplement to this report will be issued upon completion of the test.

The expected issuance date of the supplement will be October 29, 1993.