QUAD-CITIES NUCLEAR POWER STATION

UNIT TWO CYCLE FOURTEEN

STARTUP TEST RESULTS SUMMARY

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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condition during the operating cycle, that the reactor can be made subcritical with the strongest control rod fully withdrawn and all other rods fully inserted.

Criteria

If a shutdown margin of 0.420% Δk (0.25% + R + B_4C settling penalty) cannot be demonstrated with the strongest control rod fully withdrawn, the core loading must be altered to achieve this margin.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 6000 MWD/ST into the cycle and R is given as 0.120%Δk. The control rod B_4C settling penalty for Unit Two is 0.05%Δk.

Results and Discussion

On June 9, 1995 control rod B-8 was fully withdrawn to demonstrate that the reactor would remain subcritical with the strongest rod out. This rod was calculated by Nuclear Fuel Services (NFS) to have the highest worth with the core fully loaded. 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 No unexpected reactivity insertions were observed when any of the 177 control rods were withdrawn.

Compliance with the Shutdown Margin requirements of Specification 3.3.A.1 was demonstrated by the in-sequence criticality method on July 20, 1995. The demonstrated Shutdown Margin was 1.357% Δk. This includes allowance for the Strongest Rod (rod B-8) fully withdrawn, peak cycle reactivity ("R" described above), B_4C settling penalties, the difference between the predicted and actual Keff value at the time of criticality (critical eigenvalue), and corrections for reactor period and moderator temperature.

This value (1.357% Δk) significantly exceeded the minimum required margins for the existing Specification (.25% Δk plus the adders described above). A Tech Spec change has been submitted which will increase the required shutdown margin from 0.25% Δk to 0.38% Δk. The demonstrated shutdown margin will meet this new requirement when it becomes effective.

2. Core Verification

Purpose

The purpose of the core verification procedure is to verify proper core location and orientation for each 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 14 core verification was completed on June 9, 1995. Fuel assembly orientation, seating, and serial number were verified for each assembly.

The first inspection was made to verify orientation and seating of assemblies. A second pass was subsequently made to verify bundle serial numbers. The four assemblies in cell location 02-31 were found not to be properly seated. These assemblies were removed from the core and the fuel support piece at 02-31 was reseated. The four assemblies were then placed back into their proper locations and verified to be located and seated correctly.

3. Initial Critical Prediction

Purpose

The purpose of this test is to demonstrate that the reactivity difference between the actual critical rod configuration and the expected critical configuration has a reactivity equivalent of less than 1% Δk.

Criteria

The calculated (predicted) critical rod pattern must agree within 1% Δk to the actual critical rod pattern.

Results and Discussion

On July 20, 1995, at 0215 hours the reactor was brought critical with a reactor water temperature at the time of criticality of 154°F. The reactivity difference between the expected critical rod pattern (at 68°F) and the actual critical rod pattern was -0.0021 Δk from rod worth tables supplied by NFS. The temperature effect was -0.0017 Δk from NFS supplied corrections. The excess reactivity from the 176 second period was -0.00033 Δk. These reactivities sum to -0.00413 Δk difference (-0.413% Δk) between the expected critical rod pattern and the actual rod pattern. This is within the 1% Δk criteria of this test.

4. Core Power Distribution Symmetry Analysis

Purpose

The purpose of this test is 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

TIP sets were run on October 12 and 13, 1995 with Unit 2 at a steady state power level of approximately 87%. Unit power level was limited by an unrelated main turbine controls issue. For this test, an "octant symmetric" control rod pattern is established, including the rods symmetric to CRD K-7 which is inoperable and fully inserted and disarmed. The net effect of these differences from a "normal" full power rod pattern is expected to be minimal but conservative, since deviation between symmetric TIP traces when expressed as a percentage of value will be larger when the values themselves are lower (due to the lower local and core wide power levels).

The test results are summarized below:

	Oct 12 Test	Oct 13 Test	Average	Criteria
Total TIP Uncertainty	4.68%	4.28%	4.48%	≤ 9.0%
Symmetric Pair: Worst Pair	13.87%	15.94%	N/A	≤ 25%
Average Pair	3.81%	3.94%	N/A	N/A

The two worst pair readings were on the core periphery, and do not provide indication of possible fuel asymmetries beyond the test criteria or Core Monitoring Code uncertainty analysis basis assumptions. All test criteria were satisfied.