Grand Gulf Nuclear Station Unit 1

Cycle 6

Startup Physics Test Summary

Grand Gulf Nuclear Station (GGNS) resumed commercial operation for Cycle 6 on June 9, 1992 following a Refueling/Maintenance Outage. The Cycle 6 reload consisted of replacing 272 Advanced Nuclear Fuels (ANF) 8X8 fuel assemblies with 272 Siemens Nuclear Power (SNP) 9X9 fuel assemblies. These startup tests were performed during RFO5 and while attaining full power after RFO5 and are summarized in this report:

1) Core Loading Verification

2) Control Rod Functional Testing

3) Shutdown Margin Determination

4) TIP Asymmetry

In addition to the above startup physics tests, the startup test program included: Core Monitoring System Verification, Neutron Monitoring System Response, Recirculation System Calibration, and other surveillance testing as required by GGNS Technical Specifications. The additional test results are available at the site on request.

Startup Physics Test #1

Core Loading Verification

Purpose

Ensure each reactor fuel assembly is:

- in its correct core location,
- oriented properly,
- and seated properly in its support piece.

Criteria

The reactor core is visually checked to verify conformance to the vendor supplied core loading pattern. Fuel assembly serial numbers, orientations, and core locations are recorded. A height check is performed to verify all assemblies are properly seated.

Results

The SNP Cycle 6 core loading pattern was modified after discovering three bundles with cladding defects. Two once-burned bundles were repaired. One twice-burned bundle was replaced by a discharged bundle that had a similar exposure history.

The as-loaded core was verified for proper fuel assembly serial numbers, locations, orientation, and seating in accordance with the modified SNP Cycle 6 core loading pattern. The core verification procedure was successfully completed on May 16, 1992.

Startup Physics Test #2

Control Rod Functional Testing

Purpose

Verify operability of each control rod by:

- normal withdrawals and insertions,
- ensuring it is latched to its control rod drive,
- and moves at design speeds without excessive friction.

Criteria

Functional testing of each control rod is performed to ensure proper operability. This testing includes withdrawal and insertion timing, coupling verification, friction testing where required and scram time testing.

Results

Each control rod was verified operable before the Reactor Vessel Operational Hydro Test.

A control rod coupling check was performed in accordance with GGNS Technical Specification surveillance requirement 4.1.3.4 each time a control rod was fully withdrawn.

Each individual control rod was timed during a normal withdrawal and insertion sequence. Control rods with stroke times outside the tolerance of normal stroke time ± 20% were readjusted to within normal stroke time ± 10%. This was in accordance with GE recommendations.

Twenty-two control rod drives were replaced during RF05. Each of these control rods were tested for excessive friction. None of the control rods indicated abnormal friction.

Each control rod was scram time tested during the Operational Hydro Test or reactor startup in accordance with GGNS Technical Specification surveillance requirement 4.1.3.2. All of the control rod scram times were within the allowable limits.

Startup Physics Test #3

Shutdown Margin Determination

Purpose

To ensure:

- the reactor can be made subcritical from all operating conditions,
- the reactivity transients associated with postulated accident conditions are controllable within acceptable limits,
- the reactor will be maintained sufficiently subcritical to preclude inadvertent criticality in the shutdown condition.

Criteria

The subcritical demonstration verifies the reactor remains subcritical with the analytically determined strongest worth control rod withdrawn.

The in-sequence rod withdrawal shutdown margin calculation begins by withdrawing control rods in their standard sequence until criticality is achieved. The shutdown margin of the core is determined from calculations based on the critical rod pattern, the reactor period, and the moderator temperature. To ensure no reactivity anomaly exists, the actual critical control rod positions will be verified to be within 1% delta k/k of the predicted critical control rod position.

Results

The subcritical demonstration was performed on May 24, 1992.

The in-sequence critical shutdown margin surveillance procedure was completed on June 4, 1992.

The shutdown margin (SDM) at the beginning-of-cycle (BOC) was calculated to be 0.9926% delta k/k. The Cycle 6 "R" value is equal to 0.2% delta k/k, therefore, the Cycle 6 minimum shutdown margin is 0.7926% delta k/k which is well within GGNS Technical Specification 3.1.1 requirement of 0.38% delta k/k.

The calculated reactivity difference between the actual and predicted SDM was 0.0874% delta k/k which was well within GGNS Technical Specification 3.1.2 requirement of 1% delta k/k.

Startup Physics Test #4

TIP Asymmetry Check

Purpose

Verification that the observed variance in integral MICROBURN-calculated TIP responses at GGNS is statistically consistent with the variance of the integral TIP measurements used in SNP's Neutronics Methods for Design and Analysis.

Criteria

A gross asymmetry check is performed as part of a detailed statistical uncertainty evaluation of the TIP System. A complete set of TIP data is obtained at steady state conditions while greater than 85% rated power. A total average deviation or uncertainty is determined for all symmetric TIP pairs as well as the maximum absolute deviation. The results will be evaluated to assure proper operation of the TIP System and symmetry of the core loading.

Results

The TIP Reproducibility and Symmetry Uncertainty calculations were performed on June 16, 1992 at 100% core thermal power. A total of four Chi-squared tests were performed. The first consistency test examined the variance in the combined measured and calculated integal TIP data. The second consistency test evaluated variance in the measured integral TIP responses for symmetric locations. The third and fourth test repeated the first two tests on a planar basis by renormalizing the nodal TIP distribution to unity within each plane separately for both the measured and calculated TIP distributions.

The results of the four tests are as follows:

Test	Chi-Squared Value	Critical Value
1	10.53	60.48
2	3.38	30.14
3	184.01	950.13
4	56.36	426.46

All of the Chi-squared values were much less than the Critical values indicating no TIP Assymmetry exists.

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