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

Clinton Power Station, Unit 1
Renewed Facility Operating License No. NPF-62
NRC Docket No. 50-461

Subject: Clinton 1 Cycle 21 Startup Test Report Summary

Enclosed for your information is the Clinton Power Station (CPS) Unit 1 Cycle 21 Startup Test Report. This report is submitted in accordance with Operational Requirements Manual Section 6.9.1.

Clinton Power Station Unit 1 Cycle 21 began operation on October 25th, 2021, following a refueling and maintenance outage. The Unit 1 Cycle 21 core loading consisted of 268 fresh Global Nuclear Fuel GNF-3 fuel bundles, 266 once-burned Global Nuclear Fuel GNF-2 fuel bundles, and 90 twice-burned Global Nuclear Fuel GNF-2 fuel bundles. Also installed in the Unit 1 Cycle 21 reactor were 33 new GE NA-250 Local Power Range Monitors (LPRMs), 1 new GE Source Range Monitor (SRM), 8 new General Electric Ultra HD Control Rod blades, and 1 new General Electric Ultra MD Control Rod blade.

Attached are the evaluation results from the following tests:

- Reactor Core Verification
- Control Rod Drive Timing
- Shutdown Margin Test (In-sequence critical)
- Reactivity Anomaly Calculation (Critical and Full Power)
- Scram Insertion Times
- Core Power Distribution Symmetry Analysis
- Core Flow Calibration

All test data was reviewed in accordance with the applicable test procedures, and exceptions to any results were evaluated to verify compliance with Technical Specification limits and to ensure the acceptability of subsequent test results.

There are no regulatory commitments in this letter. Should you have any questions concerning this report, please contact Mr. Garrett Sanders, Regulatory Assurance Manager, at (217) 937-2803.

Respectfully,

Thomas D. Chalmers
Site Vice President
Clinton Power Station

Attachment

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Clinton Power Station

Reactor Core Verification

Purpose

The purpose of this test is to visually verify that the core is loaded as intended for Unit 1 Cycle 21 operation.

Criteria

The as loaded core must conform to the cycle core design used by the Core Management Organization (GNF & Nuclear Fuels) in the reload licensing analysis. Any discrepancies discovered in the loading will be promptly corrected and the affected areas re-verified to ensure proper core loading prior to unit startup.

Conformance to the cycle core design will be documented by a permanent core serial number map signed by the audit participants.

Results and Discussion

Core verification was performed per the guidance in NF-AA-330-1001, “Core Verification Guideline.” The Unit 1 Cycle 21 core verification consisted of a core height, assembly orientation, assembly location, and assembly seating check. Bundle serial numbers and orientations were recorded during the video recorded scans for comparison to the appropriate core loading map and Cycle Management documentation. The core was verified as being properly loaded and consistent with the Clinton 1 Cycle 21 Core Loading Plan, Revision 13. Core verification was completed on October 15, 2021, documented in Attachment 5 of NF-AA-330-1001, and retained by reactor engineering.

Control Rod Drive Timing

Purpose

The purpose of this test is to check and set the insert and withdrawal speeds of the Control Rod Drives (CRDs).

Criteria

CPS 3304.03, “Control Rod Timing (RD),” preferred beginning of cycle acceptance criteria for the withdraw times (full-in to full-out) is between 40 and 58 seconds and insert times (full-out to full-in) is between 40 and 58 seconds.

Results and Discussion

Control rod withdrawal timing per CPS 3304.03 was performed satisfactorily for all 145 CRDMs and is documented in CPS 3304.03D001, 3304.03D002, and retained by reactor engineering. Additionally, insert timing was performed on all control rods associated with Hydraulic Control Unit (HCU) or Control Rod Drive Mechanism (CRDM) maintenance during the refueling outage, as well as all control rods with observable adjustments needed for insertion. After adjustment, none of the rod insert or withdrawal speeds were faster or slower than the CPS 3304.03 preferred criteria.

Shutdown Margin Test

Purpose

The purpose of this test is to demonstrate, from a normal in-sequence critical, that the core loading has been limited such that the reactor will remain subcritical throughout the operating cycle with the strongest worth Control Rod in the full-out position and all other rods fully inserted.

Criteria

In accordance with CPS 9811.01, “Shutdown Margin Determination” and Technical Specifications, if a shutdown margin (SDM) of 0.38% Δk/k + R cannot be demonstrated with the strongest worth Control Rod fully withdrawn, the core loading must be altered to meet this margin. R is the reactivity difference between the core's beginning of cycle SDM and the minimum SDM for the cycle. The R value for Cycle 21 is 0.004% Δk/k per the Clinton Unit 1 Cycle 21 Cycle Management Report, Revision 7, so a SDM of 0.384% Δk/k must be demonstrated.

Results and Discussion

The beginning of cycle SDM was successfully determined from the initial critical data. The initial Cycle 21 critical occurred on October 25th, 2021, on Control Rod 20-33 at position 20, using an A2 sequence. The moderator temperature was 159 ºF and the reactor period was 350 seconds. Using CPS 9811.01 and the Clinton Unit 1 Cycle 21 Cycle Management Report, Revision 7, the SDM was determined to be 1.28% Δk/k. This was documented in CPS 9811.01D001 and WO# 04995996-01. The SDM was greater than the minimum 0.38% Δk/k that is required to satisfy the Technical Specifications.

Reactivity Anomaly Determination

Purpose

The purpose of this test is to compare the actual and predicted critical rod configurations to detect any unexpected reactivity trends.

Criteria

In accordance with CPS 2202.04 “Estimated Critical Position Determination,” CPS 9812.01 “Reactivity Anomaly,” and Technical Specifications, the reactivity equivalence of the difference between the actual critical Control Rod configuration and the predicted critical Control Rod configuration and the difference between the actual and predicted reactivity of the Control Rod configuration at full power steady state conditions shall not exceed 1% Δk/k. If the difference exceeds 1% Δk/k, the cause of the anomaly must be determined, explained, and corrected for continued operation of the unit.

Results and Discussion

Two reactivity anomaly calculations were successfully performed during the Unit 1 Cycle 21 Startup Test Program. One reactivity anomaly calculation is from the in-sequence critical and the other is from steady state, equilibrium conditions at approximately 100% full power.

The initial Cycle 21 critical occurred on October 25th, 2021, on Control Rod 20-33 at position 20, using an A2 sequence. The moderator temperature was 159 ºF and the reactor period was 350 seconds. The expected k_{eff} supplied by Nuclear Fuels was 0.9990. The actual k_{eff} was 1.0008. The resulting anomaly was 0.18% Δk/k. The anomaly determined is within the 1% Δk/k required for BOC conditions as stated in CPS 2202.04. This was documented in CPS 2202.04D002.

The reactivity anomaly calculation for full power steady state operation was performed. The data used was from 98.8% power at a cycle exposure of 135.4 MWD/sT at equilibrium conditions. The expected k_{eff} supplied by Nuclear Fuels was 1.0085. The actual k_{eff} was 1.0093. The resulting anomaly was 0.08% Δk/k. This value is within the 1% Δk/k criteria of Technical Specifications. This was documented in 9812.01C001, and WO# 05190672-01.

Scram Insertion Times

Purpose

The purpose of this test is to demonstrate that the Control Rod scram insertion times are within the operating limits set forth by the Technical Specifications.

Criteria

In accordance with CPS 9813.01, “Control Rod Scram Time Testing,” and Technical Specifications, the maximum scram insertion time of each Control Rod from the fully withdrawn position (48) to notch position 13, based on de-energization of the scram pilot valve solenoids as time zero, shall not exceed 7.0 seconds. Also, no more than 12 OPERABLE Control Rods shall be “slow” in accordance with the below table. In addition, no more than 2 Operable Control Rods that are “slow” shall occupy adjacent locations.

When the scram insertion time of an operable Control Rod from the fully withdrawn position (48), based on de-energization of the scram pilot valve solenoids as time zero, exceeds any of the following, that Control Rod is considered “slow”:

Notch Position	Scram Time to Notch @ 0 PSIG (seconds)	Scram Time to Notch @ 950 PSIG (seconds)	Scram Time to Notch @ 1050 PSIG (seconds)
43	-	0.3	0.31
29	-	0.78	0.84
13	0.95	1.4	1.53

Results and Discussion

Scram testing was performed per WO# 04996543. Once Scram Timing was complete, no rods with valid TT data were considered slow. However, valid TT data could not be obtained for control rod 36-25. During Scram timing, rod 36-25 inserted in less than 7 seconds per stopwatch and was declared operable. As such, rod 36-25 was administratively declared slow, and was the only control rod to be declared slow. These results also meet the “Option B” Scram Speeds referenced in the Unit 1 Cycle 21 Core Operating Limits Report.

Core Power Distribution Symmetry Analysis

Purpose

The purpose of this test is to verify the core power symmetry.

Criteria

In accordance with NF-AB-707, “3D Monicore – Operation and Maintenance,” the TIP uncertainty value must be less than 6%.

Results and Discussion

Core power symmetry calculations were obtained based upon data obtained from a full core TIP set (OD1) at approximately 98.5% power. The TIP uncertainty value was 3.12%. This was documented in WO# 05173638-01.

Core Flow Calibration

Purpose

The purpose of this test is to collect sufficient data at the beginning of cycle to calculate calibration data for the core flow instrumentation using the differential pressure across the jet pumps as a basis for determining core flow.

Criteria

In accordance with CPS 2206.01 “Core Flow Calibration” and Technical Specifications, this procedure is to ensure that 100% recirculation drive flow corresponds to 100% core flow. The actual recirculation drive flow needed to obtain rated core flow varies over the life of the plant as power changes, core internal resistance increases, and component aging occurs. Both jet pump loop summer gain adjustment factors (GAFs), as well as the total flow GAF must be within 0.99 and 1.01.

Results and Discussion

Reactor Recirculation data was collected during the C1R20 startup. Data was obtained from computer points for all the points of interest to evaluate the RR system performance and perform a core flow calibration. The jet pump loop A GAF was 1.003891 and the jet pump loop B GAF was 1.000218. The total flow GAF was 0.99892. This is documented in CPS 2206.01D001 and retained by reactor engineering.