U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-334/85-01

Docket No. 50-334

License No. DPR-66 Priority - Category C

Licensee: Duquesne Light Company
Post Office Box 4
Shippingport, Pennsylvania 15077

Facility Name: Beaver Valley 1

Inspection At: Shippingport, Pennsylvania

Inspection Conducted: January 7-11, 1985

Inspectors: L E Briggs for P. C. Wen, Reactor Engineer — 2/4/85 date

Approved by: L E Briggs for L. H. Bettenhausen, Chief, Test Program Section, DETP — 2/4/85 date

Inspection Summary:
Routine Unannounced Inspection on January 7-11, 1985 (Inspection Report No. 50-334/85-01)

Areas Inspected: Routine, unannounced inspection of startup physics testing following refueling of Unit 1, Cycle 5. The inspection included the testing program, pre-critical tests, and post-critical tests. The inspection involved 39 hours onsite by one region-based inspector.

Results: In the areas inspected, no items of noncompliance were identified.

DETAILS

1. Persons Contacted

A. Brunner, Refueling Supervisor
A. R. Burger, Nuclear Operations Engineer
R. F. Collins, Nuclear Operations Engineer
*C. E. Ewing, Manager, Quality Assurance
S. C. Fenner, Director of Operations Quality Control
*D. Hunkele, Director of Quality Assurance
R. W. Huston, Nuclear Operations Engineer
J. Kane, Nuclear Operations Engineer
*W. S. Lacey, Plant Manager
*G. E. McCorkle, Nuclear Operations Engineer
M. Rafeew, Senior Test Engineer
L. Schad, Nuclear Operations Supervisor
*G. S. Sovick, Senior Compliance Engineer
*T. G. Zyra, Testing and Plant Performance Supervisor

USNRC

*W. Troskoski, Senior Resident Inspector
*D. Johnson, Resident Inspector

*Denotes those present at the exit interview on January 11, 1985.

The inspector also contacted other licensee employees in the course of the inspection.

2. Cycle 5 Reload Safety Evaluation and Core Verification

The Cycle 5 reactor core is comprised of 157 fuel assemblies. During the Cycle 4/5 refueling, 76 fuel assemblies were replaced with Region 7 fresh fuel. The reload safety evaluation (RSE) performed to support this cycle's operation concluded that there was no unreviewed safety question involved. The result was presented to the Onsite Safety Committee (Meeting No. 60-84) and subsequently received its approval on September 21, 1984. The basic assumption used in the RSE was Cycle 4 burnup of 11,100-13,100 MWD/MTU. The inspector verified the actual Cycle 4 burnup to be 12,433 MWD/MTU. The assumption is thus valid.

The inspector reviewed Refueling Procedure FP-DLW-R4. This procedure was used for the Cycle 4/5 refueling activities. It contained QC hold up points for QC verification. The inspector selectively compared the required loading configuration to the "as loaded" condition which was recorded on the video tapes used for final core verification.

No unacceptable conditions were identified.

3. Cycle 5 Startup Testing Program

The startup test program was conducted according to test procedures BVT 1.5-2.2.1, Initial Approach to Criticality After Refueling, Issue 1, Rev. 0, dated November 14, 1984 and BVT 1.5-2.2.2, Core Design Check Test, Issue 1, Rev. 0, dated November 20, 1984. The test sequence outlined the steps in the testing program, set initial conditions and prerequisites, specified calibration or surveillance procedures at appropriate points in the test sequence, and referenced detailed test procedures and data collections in appendices. Initial criticality of Cycle 5 was achieved on January 2, 1985. Zero Power Physics Tests (ZPPT) were completed on January 3, 1985. The inspector reviewed the thermal power surveillance performed during ZPPT and verified that the frequency of evaluation and thermal power levels were within the requirements of Technical Specifications (TS). During the inspection period (1/7-1/11/85), the unit power was restricted below 75% rated thermal power (RTP) due to secondary side water chemistry problems. The remaining Power Ascension Test (PAT) will be conducted when the unit reaches an appropriate power level.

The inspector independently verified that the predicted values and acceptance criteria were obtained from "The Nuclear Design and Core Management of the Beaver Valley Unit 1 Power Plant Cycle 5", WCAP-10660. The inspector witnessed portions of the PAT and reviewed test results and documents described in this report to ascertain that startup testing was conducted in accordance with technically adequate procedures and as required by TS. The details and findings of the review are described in Sections 4 and 5.

4. Pre-Critical Tests

The inspector reviewed calibration and functional test results to verify the following:

- Procedures were provided with detailed instructions;
- Technical content of procedure was sufficient to result in satisfactory component calibration and test;
- Instruments and calibration equipment used were traceable to the National Bureau of Standards;
- Acceptance and operability criteria were observed in compliance with TS.

The following tests were reviewed:

4.1 Control Rod Checks and Tests

The rod drop measurement was performed in accordance with procedure BVT 1.1-1.1.1, Issue 2, Rev. 1. The inspector verified performance by review of the test results obtained on December 31, 1984. The drop times for all 48 rods were less than 2.2 seconds as required by the TS. The inspector also reviewed several visicorder traces and verified that the drop times had been interpreted correctly from these selected traces.

No unacceptable conditions were identified.

4.2 Control Rod Position Indication System Tests

During last cycle's operation, the licensee kept track of primary voltage and position signal variations. This information was analyzed and all RPI channels were calibrated according to the information per test procedure BVT 1.3-1.1.6, Rod Position Indication System Calibration, Issue 1, Rev. 3. Prior to criticality, the RPI system calibration including RPI indicator, Rod Bottom Bistable and Pulse-to-Analog Bank Bypass Bistable were verified per test procedure BVT 1.3-1.1.7, Issue 1, Rev. 4. All rods met test acceptance criteria. During the inspection period, the inspector toured the control room and observed that the RPI readings agreed with group demand counters as required by the TS.

No items of noncompliance were identified.

4.3 Reactivity Computer Setup/Verification

The reactivity computer was set up and calibrated according to procedure BVT 1.5-2.2.2, Appendix A. The reactivity computer was adjusted with the correct inputs of delayed neutron fractions (betas) and decay constants (lambdas). An exponential test signal was fed into the reactivity computer. The dynamic response was then compared with predicted values which were derived from point reactor kinetics. The results of this calibration check were satisfactory.

The reactivity computer was further checked when reactor reached criticality. Comparisons of predicted and measured reactivities based on doubling time measurement were acceptable with maximum deviation of only 1.82%.

No unacceptable conditions were identified.

5. Cycle 5 Startup Testing - Post-Critical Tests

5.1 The inspector observed and reviewed selected test programs to verify the following:

-- The test programs were implemented in accordance with Cycle 5 Core Design Check Test Procedure;

-- Step-wise instructions of test procedures were adequately provided including Precautions, Limitations and Acceptance Criteria in conformance with the requirements of the TS;

-- Provisions for recovering from anomalous conditions were provided;

-- Methods and calculations were clearly specified and the tests were performed accordingly;

-- Review, approval, and documentation of the results were in accordance with the requirements of the TS and the licensee's administrative controls.

5.2 Boron Endpoint Determination

The licensee measured the just critical boron concentration in accordance with BVT 1.5-2.2.2. The inspector reviewed the data and noted the following results:

Configuration	Predicted Value (ppm)	Test Result (ppm)
All Rods Out (ARO)	1525 ± 50	1576
Control Bank B In	1399 ± 210	1420

The measured ARO critical boron concentration differs from the design prediction value by 51 ppm which is just over the review criteria. The licensee consulted the fuel vendor (Westinghouse) on this matter, and reached a conclusion that there were no safety or TS implications. Judging from the rest of the zero power test results which all met test acceptance criteria, the inspector agreed with this conclusion.

No items of noncompliance were identified.

5.3 Isothermal Temperature Coefficient

Isothermal temperature coefficient was measured in accordance with procedure BVT 1.5-2.2.2, Appendix C. The inspector noted the following result:

Configuration	Predicted Value (pcm/°F)	Measured Value (pcm/°F)
All Rods Out	- 2.1 ± 3	- 2.66

Test result was within acceptance criterion. The corresponding ARO Moderator Temperature Coefficient (MTC) was determined to be - 0.66 pcm/°F. This result met the TS requirement.

5.4 Control Rod Worth Measurement

The control rod reactivity worth measurements were performed in accordance with BVT 1.5-2.2.2, Appendix D, Reference Bank (CB B) Worth by Dilution and Appendix E, Rod Bank Worths by Interchange Methods. The following results were noted:

Rod Bank	Test Conditions	Predicted Worth (pcm)	Measured Worth (pcm)
Control Bank B	Dilution	1363 ± 136	1334.8
Control Bank D	Interchange	1004 ± 151	920.5
Control Bank C	Interchange	992 ± 149	996.6
Control Bank A	Interchange	604 ± 91	589.5
Shutdown Bank B	Interchange	939 ± 141	905.7
Shutdown Bank A	Interchange	1089 ± 163	1029.3
Total Banks	-----------	5991 ± 599	5776.4

Test results were within acceptance criteria.

5.5 Zero Power Flux Map

A zero power flux map was performed in accordance with procedure BVT 1.3-8.3.1, Incore Movable Detector Flux Mapping. A special battery power supply was used to amplify the signals from the movable incore detector system. This D.C. power supply eliminated the problem of detector noise associated with low power flux map. The data taken by the Movable Incore Detector System was digitized and stored by the plant computer. This information was then fed into a large scale DLC Corporate computer which performed the core power distribution calculation using the Westinghouse "Incore" code. The measured values of assembly power were in good agreement with predicted values with one exception at detector location (N-12) which showed a slightly higher power density. The following results were noted:

	Measured Value	Acceptance Criteria
$F^N_{\Delta H}$	[illegible].545	< 2.02
F^T_Q	2.381	< 4.51
Quadrant Power Tilt	1.021	< 1.02

The provisions of TS 3.2.4 (Quadrant Power Tilt) are not applicable below 50% RTP. According to test procedure, an additional flux map to verify power distribution was performed at about 50% RTP. The results are discussed in the Section 5.6.

5.6 Core Power Distribution

The procedure and method used by the licensee to verify that the plant is operating within the power distribution limits defined in TS were reviewed and discussed with cognizant licensee personnel. The data taken by the Movable Incore Detector System is obtained on the plant P-250 process computer. This information was then fed into the DLC Corporate computer as input to the "INCORE" analysis code and a short form summary result transmitted back to BVPS. The computer results were analyzed both by the station reactor engineer and corporate nuclear engineers for compliance with operating parameters and technical specifications.

The inspector observed flux mapping activities in the control room on January 7, 1985 and noted that these tests were being performed in accordance with an approved written procedure and by qualified personnel. The inspector reviewed the subsequent Full Core Flux Map (#502) which was performed at 53% RPT. All measured values of assembly power were within predicted limits. This flux map did not show the high relative power density at location N-12 noted in the Zero Power Flux Map. The inspector also verified that engineering and nuclear uncertainties were applied in the evaluation. The following results were noted:

	Measured Value	TS Limit
$F^N_{\Delta H}$	1.446	1.77
F^T_Q	1.920	4.33
Quadrant Power Tilt	1.013	1.02
F_{XY} (Unrodded Upper Axial Zone)	1.515	1.85
F_{XY} (Unrodded Middle Axial Zone)	1.512	1.89
F_{XY} (Unrodded Lower Axial Zone)	1.532	1.84

No unacceptable conditions were identified.

5.7 Core Thermal Power Evaluation

The licensee performs a daily check of reactor thermal power by calculating daily heat balance using the C1-3 log sheet. The inspector reviewed the log sheets for tests performed since the operation of Cycle 5 and verified that the frequency of evaluation and excore power range channel calibrations were performed within the requirements as prescribed by the TS.

The inspector reviewed the technical content of the licensee's calculation method. The fixed heat losses through containment environment were included in the Reactor Coolant Pump (RCP) heat input term. However, a continuous steam generator (SG) blowdown heat loss was not included in the current C1-3 log sheet. Since the current method used in the licensee's thermal power determination contains a conservative approach, such as assuming steam flow equal to feedwater flow, the neglecting of SG blowdown term is considered to have minor impact on core thermal power determination. The licensee is planning to evaluate this situation.

The inspector had no further questions.

5.8 Shutdown Margin Determination

The inspector reviewed the licensee's shutdown margin determination procedure OST 1.49.1 and surveillance results performed during Mode 1 operation (at 49% RTP) on January 8, 1985. The control rod worth and assumed maximum stuck rod worth used in the calculation were consistent with the nuclear design and core management report (WCAP-10660). The result based on insertion of control rods alone showed shutdown margin of 5.936% $\Delta K/K$ which met TS requirement of $\geq$ 1.77% $\Delta K/K$. However, the inspector noticed that the Cycle 4 rod worth and power defect curves were still contained in the current procedure although the Cycle 5 data was provided through a temporary procedure change. To prevent the possibility of operator inadvertently using these curves, the licensee agreed to remove the Cycle 4 curves from the current procedure. This is an Inspector Follow-up Item (334/85-01-01).

6. Quality Assurance (QA) and Quality Control (QC) Interface During Startup Physics Testing

The inspector discussed the subject of QA/QC's role in Cycle 5 startup physics testing with cognizant representatives. The inspector reviewed Refueling Procedure FP-DLW-R4, and noted that QC inspectors verified refueling activities. QA has a plan to audit TS surveillance requirements for Cycle 5 operation. However, the inspector did not find evidence that QA had an active surveillance program which covered startup physics testing. To further strengthen QA coverage in this area, at the exit meeting, the licensee's QA manager agreed to audit or assign auditors to witness performance of future cycle startup physics testing. This will be reviewed during future inspections.

7. Exit Interview

Licensee management was informed of the purpose and scope of the inspection at the entrance interview. The findings of the inspection were periodically discussed and were summarized at the conclusion of the inspection on January 11, 1985. Attendees at the exit interview are denoted in paragraph 1.

No written material was provided to the licensee by the inspector at any time during this inspection.