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United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Braidwood Station, Units 1 and 2
Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and 50-457

Subject: Supplemental Startup Report for Braidwood Station, Unit 2 - Full Power Uprate Power Ascension

Reference: Letter from James D. von Suskil (Exelon Generation Company, LLC) to U.S. NRC, "Startup Report for Braidwood Station, Units 1 and 2 – Mid-Cycle Power Uprate" dated August 15, 2001

In the referenced letter we submitted a mid-cycle startup report in accordance with the requirements of the Braidwood Station, Technical Requirements Manual, Section 5.0, "Administrative Controls," Section 5.3.a, "Startup Report." Section 5.3.a requires the submittal of a startup report within 90 days following resumption of commercial power operations after an amendment to the license involving a planned increase in power level.

The Unit 2 mid-cycle power ascension started May 24, 2001 and was completed May 28, 2001. Power was raised until Governor Valve #4 indicated Valve Wide Open (VWO). This interim mid-cycle uprated power level was approximately 3436 megawatts thermal (MWt). The remainder of the Full Power Uprate power ascension to 3586.6 MWt was recently performed following the modifications to the High Pressure (HP) Turbine in the Spring 2002 refueling outage.

The Supplemental Startup Report for Braidwood Station Unit 2 Full Power Uprate Power Ascension (i.e., Attachment 1) summarizes the startup test program and results. The Full Power Uprate Power Ascension Test Program was successfully completed with all acceptance criteria being satisfied.

Also enclosed for information are the Braidwood Unit 2 Cycle 10 Startup and Power Ascension Test Results (i.e., Attachment 2).

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If you have any questions or require additional information concerning this report, please contact Ms. Amy Ferko, Regulatory Assurance Manager, at (815) 417-2699.

Respectfully,

James D. von Suskil
Site Vice President
Braidwood Station

Attachments: 1. Braidwood Station Unit 2 Full Power Uprate Ascension Supplemental Startup Report
2. Braidwood Unit 2 Cycle 10 Startup and Power Ascension Test Results

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

ATTACHMENT 1

BRAIDWOOD STATION UNIT 2

FULL POWER UPRATE ASCENSION

SUPPLEMENTAL STARTUP REPORT

Braidwood Station Unit 2
Full Power Uprate Ascension Supplemental Startup Report

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Executive Summary

In a letter from James D. von Suskil (Exelon Generation Company, LLC) to the U.S. NRC, "Startup Report for Braidwood Station, Units 1 and 2 – Mid-Cycle Power Uprate," dated August 15, 2001, we submitted a mid-cycle startup report in accordance with the requirements of the Braidwood Station, Technical Requirements Manual, Section 5.0, "Administrative Controls," Section 5.3.a. Section 5.3.a requires the submittal of a startup report within 90 days following resumption of commercial power operations after an amendment to the license involving a planned increase in power level.

On May 4, 2001, the NRC issued License Amendment 113 for Braidwood Station, Units 1 and 2, which allowed an increase in the maximum reactor power level from 3411 megawatts thermal (MWt) to 3586.6 MWt. Power ascension on both Braidwood Station units was initiated during mid-cycle operations to an interim level, prior to performing modifications necessary to attain full power uprate.

Unit 2 Power was increased from 3431MWt to the Full Power Uprate power level of 3586.6 MWt during two separate ramps. The first ramp was completed on May 14, 2002 when the Unit reached 3548 MWt with the Feedwater Flow Calibration Multiplier set at 1.0000. The second ramp was completed on May 15, 2002 when the Unit reached 99.9% calorimetric power with the average Feedwater Flow Calibration Multiplier set at 0.98915. The Full Power Uprate Power Ascension load ramp was successfully completed with all acceptance criteria being satisfied.

Braidwood Station, Unit 2 Full Power Uprate Power Ascension Supplemental Startup Report

1.0 Purpose

This Supplemental Startup Report is submitted to the NRC to satisfy the reporting requirements of the Braidwood Station's Technical Requirements Manual, Section 5.3.a, "Startup Report," which requires this report to address the following items:

1. Address each of the tests identified in the Updated Final Safety Analysis Report.
2. Include a description of the measured values of the operating conditions or characteristics obtained during the test program and a comparison of these values with design predictions and specifications.
3. Describe corrective actions required to obtain satisfactory operation.
4. Include any additional specific details required in license conditions based on other commitments.

2.0 Full Power Uprate Power Ascension Program Scope

2.1 Program Development

The development of the power uprate test recommendations and acceptance criteria was based on the review of similar power uprate test programs performed at other nuclear plants, and the generic guidelines provided in WCAP-10263, "A Review Plan for Uprating the License Power of a PWR Power Plant," dated 1983.

The full power uprate Power Ascension Test Program verified the following items:

- Automatic control systems and equipment affected by the Full Power Uprate Power Ascension are maintained within selected operating limits.
- Chemistry parameters are below the "Action" levels.
- Steam Generator feedwater flow and water level are satisfactorily maintained in automatic control.
- The feedwater heater level control system is stable.
- Selected Area Radiation Surveys have been updated and found acceptable.
- Condensate / Condensate Booster and Heater Drain pump swaps do not cause any divergent oscillations.

2.2 Prerequisites for Full Power Uprate Power Ascension Testing

Prior to the commencement of full power uprate power ascension testing, a special test procedure required the completion of numerous activities. These activities included the following items.

- The applicable plant instrumentation setpoint changes or recalibrations were completed as determined by the Power Uprate Master Design Change Package (DCP).
- Plant modifications required to support operation at the full uprate power level were closed out.
- The Clearance Order Log and the Operation Configuration Change log were reviewed to assure there was no effect on uprate testing.
- Baseline data was taken at 3431 MWt.

2.3 Full Power Uprate Power Ascension Testing

Full power uprate power ascension was performed in accordance with a Braidwood Station Special Procedure (SPP). A Heightened Level of Awareness (HLA) briefing was completed with operations and other appropriate plant personnel prior to power ascension.

Power was increased from 3431MWt to the Full Power Uprate power level of 3586.6 MWt during two separate ramps. The first ramp was completed on May 14, 2002 when the Unit reached 3548 MW_t with the Feedwater Flow Calibration Multiplier set at 1.0000. The second ramp was completed on May 15, 2002 when the Unit reached 99.9% calorimetric power with the average Feedwater Flow Calibration Multiplier set at 0.98915. Following the power increase, control system and equipment performance data was collected and evaluated in accordance established acceptance criteria. At the 99.9% full power plateau, the following activities were performed:

- Reactor fuels parameters were evaluated.
- Automatic control systems were evaluated.
- Chemistry evaluations were conducted.
- Feedwater and main steam parameters for turbine driven main feedwater pump speed, feedwater control valve position, feedwater pump, condensate pump and condensate booster pump suction pressure net positive suction head (NPSH) requirements, and steam generator water level control were evaluated.
- Feedwater heater level control performance data were evaluated.

- Main generator stator internal temperature data were collected and evaluated.
- Radiation surveys were performed and evaluated at key points in the power ascension sequence.
- Secondary plant and turbine/generator system performance were evaluated.
- Condensate / Condensate Booster system performance was evaluated.
- A selected set of equipment performance data (e.g., plant process computer points, control room readings, and local readings) was collected and evaluated.

2.4 Test Acceptance Criteria

General Discussion

The development of the power uprate test recommendations and acceptance criteria was based on the review of similar power uprate test programs performed at other plants and the power uprate master DCP.

Following the load increase in power level to 99.9% calorimetric power, test data recorded during the power ascension were evaluated and compared to performance acceptance criteria (i.e., design predictions or limits). If the test data satisfied the acceptance criteria, then system and component performance were determined to comply with their design requirements.

Plant parameters during full power uprate power ascension were evaluated using two levels of acceptance criteria. The criteria associated with plant safety were classified as Level 1. The criteria associated with design expectations were classified as Level 2. The following paragraphs describe the actions required to be taken if an individual criterion was not satisfied.

Level 1 Acceptance Criteria

Level 1 acceptance criteria normally relate to the values of process variables for components and systems determined during the design of the plant. If a level 1 test criterion is not satisfied, the plant must be placed in a safe "hold" condition. Plant operating or test procedures or the Technical Specifications may guide the decision on the appropriate actions to be taken. Resolution of the problem must be immediately pursued by equipment adjustments or through engineering evaluation, as appropriate. Following resolution, the applicable test steps must be repeated to verify that the Level 1 acceptance criterion is satisfied. A description of the problem must be included in the test report documenting successful completion of the test.

For the Braidwood Station full power uprate power ascension, the following specific Level 1 acceptance criteria were established:

- The chemical and volume control system can maintain RCS volume and a steady RCS boron concentration during steady state power level and routine power changes without excessive operator intervention.
- Steam generator feedwater flow and steam generator water level are satisfactorily maintained in automatic control.
- The turbine driven main feedwater pump speed during steady state conditions does not exceed 5500 RPM.

All the above Level 1 criteria were met for Unit 2 following the full power uprate power ascension.

Level 2 Acceptance Criteria

If a Level 2 acceptance criteria limit is not satisfied, then startup testing may proceed after an investigation by testing, engineering, and operations personnel. The limits stated in this category are usually associated with expectations of system performance whose characteristics can be improved by equipment adjustments.

For the Braidwood full power uprate power ascension, the following specific Level 2 acceptance criteria were established.

System and Equipment Performance

- System and Equipment Level 2 acceptance limits are identified in various attachments of the appropriate SPP. Any limits that were exceeded required a documented evaluation in the SPP Test Report.

Turbine Generator Temperature Monitoring System (TGTMS)

- TGTMS Data are within Acceptance Limits.
- Turbine Supervisory Vibration Data are within Acceptance Limits.
- Turbine End Turn Vibration Limits are within guidelines.

Plant Instrumentation

- RCS delta temperature power and calorimetric power are within plus or minus 2% of the plant process computer (PPC) indication.
- Nuclear Instrumentation and calorimetric power are within plus or minus 2%.
- RCS pressure remains stable with no unexpected operation of backup heaters during steady state power levels.
- RCS flow between pre-uprate PPC points and post- uprate PPC points are within plus or minus 2%.

- Steam Flow / Feed Flow Mismatch are less than 2% between pre-uprate PPC points and post-uprate PPC points.

- Pre-heater flow is less than or equal to 3.672×10^6 lbm/hr for steam generators 2A, 2B, 2C, and 2D.

3.0 Unit 2 - Summary of Testing and Equipment Performance Results

3.1 Unit 2 Power Ascension Chronological Sequence of Events

No.	Event Description	Date @ Time
1	Completed Heighten Level of Awareness (HLA) Brief	5/13/02 @ 1100
2	Obtained Baseline Data at the 3431 MWt Plateau	5/14/02 @ 0630
3	Commenced first ramp to 3548 MWt	5/14/02 @ 0847
4	Secured ramp at 3548 MWt	5/14/02 @ 1300
5	Completed data collection in accordance with SPP at 3548 MWt	5/14/02 @ 1530
6	Completed Pre Job Brief for ramp to 100% power with average Feedwater Flow Calibration Multiplier set at 0.98915	5/15/02 @ 0830
7	Commenced ramp to 3586.6 Mwt	5/15/02 @ 0916
8	Secured ramp at 3586.6 MWt	5/15/02 @ 1056
9	Completed review and signoff of testing for the full power uprate power ascension plateau	6/10/02 @ 1100

3.2 Unit 2 - Control Systems Performance Results

Control Systems most affected by the full power uprate power ascension were monitored to assure acceptable performance and compliance with their specific Level 1 and 2 acceptance criteria. The following table summarizes these control systems.

No.	Control System Description	Level 1 Acceptance Criteria	Level 2 Acceptance Criteria	Tuning Adjustments Required
1	RCS (Pressurizer) Pressure	Satisfied	Satisfied	None
2	Pressurizer Level Control	Satisfied	Satisfied	None
3	Rod Control	Satisfied	Satisfied	None
4	Steam Generator Level Control System	Satisfied	Satisfied	None
5	Feedwater Pump Speed Control	Satisfied	Satisfied	None
6	Steam Flow / Feed Flow Mismatch	Satisfied	Satisfied	None
7	Feedwater Heater Level Control System	Satisfied	Satisfied	None
8	DEHC Control System	Satisfied	Satisfied	None

3.3 Unit 2 – System and Equipment Performance Results

The following systems and selected equipment within the plant most affected by full power uprate power ascension were closely monitored to assure that equipment performed as predicted and that they operated within their design requirements.

No.	System Description	Level 1 Operating Limits	Level 2 Operating Limits	Equipment Performance
1	Condensate System	Satisfied	Satisfied (4)	Acceptable
2	Condenser	Satisfied	Satisfied	Acceptable
3	Condensate Booster System	Satisfied	Satisfied	Acceptable
4	Feedwater System	Satisfied	Satisfied (1)(2)(3)	Acceptable
5	Heater Drain System	Satisfied	Satisfied (5)	Acceptable
6	Reactor	Satisfied	Satisfied	Acceptable
7	Reactor Coolant System	Satisfied	Satisfied	Acceptable
8	Main Steam System	Satisfied	Satisfied	Acceptable
9	Main Turbine	Satisfied	Satisfied	Acceptable
10	Main Transformer	Satisfied	Satisfied	Acceptable
11	Auxiliary Transformers	Satisfied	Satisfied	Acceptable
12	Generator Cooling System	Satisfied	Satisfied	Acceptable
13	Generator Condition Monitoring	Satisfied	Satisfied	Acceptable
14	Main Generator and Exciter Field	Satisfied	Satisfied	Acceptable
15	Isophase Bus Cooling	Satisfied	Satisfied	Acceptable
16	Reheater Systems	Satisfied	Satisfied	Acceptable

(1) Feedwater Regulating Valves 2FW530 and 2FW540 were adjusted within limits following a troubleshooting activity after testing at the 100% power plateau was completed. The Test Director along with Engineering and Operations personnel reviewed the final positions of the Feedwater Regulating Valve position and concluded that all valves were within the optimum range of 60% to 85% open at full feedwater flow conditions.

(2) The 2B steam generator Feedwater Nozzle Flow High Alarm toggled in / out during the final ramp to 100% power and was addressed by Power Uprate Project Contingency Plan # 6. Data was taken for Feedwater Pressure, Temperature, Flow Delta Pressure, and Pre-heater bypass flow for the 2FW-520 Feedwater Loop. Surveillance 2BwVP 800-3, "Unit 2 Steam Generator Main Feedwater Nozzle Flow Surveillance," verified that the pre-heater flow was under the alarm setpoint of 3.672 KBH/hr. This surveillance determined the pre-heater flow by calculating the loop feedwater flow using the current Feedwater Flow Calibration Multiplier and making adjustments for loop uncertainties.

(3) The 2A steam generator Feedwater Isolation Valve (FWIV) outlet temperature reading was greater than the level 2 operating limit of 455°F. The Plant Process Computer Point, T2385, used to obtain the 2A steam generator FWIV outlet temperature status had a high high alarm indicating a bad input condition. Plant Process Computer Point T0408 for "STM GEN 2A Feedwater Inlet Temperature" upstream of T2385 was indicating 440.18°F with a good status and was consistent with the other steam generator FWIV outlet temperatures. Work Request 51157 was written to correct the bad input condition for Plant Process Computer Point T2385.

(4) Local Pressure Indicator 2PI-CD011 for Condensate Pump 2A Discharge Pressure was indicating ~ 30 psig above the other Condensate Pump Discharge Pressure indicators which read ~ 132 psig. This implied that Local Pressure Indicator 2PI-CD011 was out of tolerance. Work Request WR 448413 was active and the Pressure Indicator has been corrected.

(5) The 2C Flash Tank Emergency Drain Valves was positioned at 50% open by operations to maintain level in the flash tank while maintenance activities were performed to return the flash tank back to normal level control. This abnormal lineup had a minimal impact on thermal megawatts as both return flow paths return to the Condenser Hotwell. The normal lineup was restored prior to the Unit 2 Post Megawatt Electrical Verification Test.

3.4 Unit 2 – Review and Approval of Testing at the Full Power Uprate Plateau

1. Reactor Fuel Parameters: Fuel thermal margins were found acceptable for continued operation at the full power uprate power ascension plateau as demonstrated by power ascension testing performed in accordance with surveillance procedure BwVS TRM 3.1.h.1 following reload.

2. Automatic Control Systems: All automatic control systems were acceptable for continued operation at the full power uprate power ascension plateau.

3. Chemistry Approval: RCS, Condensate and Feedwater chemistry did not reach Chemistry Action Levels.

4. Feedwater and Main Steam Parameters: The turbine driven main feedwater pump speed, feedwater control valve position, and steam generator water level met Level 2 acceptance criteria. Feedwater pump, condensate pump and condensate booster pump suction pressures exceeded NPSH requirements. Feedwater Heater Level Control performance data was taken and evaluated to be acceptable.

5. Main Generator Parameters: Generator stator temperatures and bus bar temperatures satisfied their Level 2 acceptance limits. Generator conditions were also satisfactory for continued operation at the full power uprate plateau.

6. Radiation Protection Approval: Surveys were performed and all radiological conditions were found acceptable for operation at the full power uprate plateau.

7. Secondary Plant And Turbine/Generator Systems Approval: System and Equipment data obtained by System Engineering were reviewed and performance found acceptable at the full power uprate plateau.

8. Condensate (CD) / Condensate Booster (CB) System Approval: CD Pump and CB Pump pressures, flows, temperatures, and motor amps were found acceptable. Current computer alarm setpoints and scaling changes made as part of the power uprate were found acceptable.

9. Main Control Room Instrumentation: Zone banding was reviewed and the necessary changes were provided to the Procedure Group.

4.0 Application of the UFSAR Initial Startup Test Program to the Braidwood Full Power Ascension Test Program

4.1 General Discussion

The development of the power uprate test recommendations and acceptance criteria is based on the review of similar test programs performed at other nuclear plants; Westinghouse Topical Report, WCAP-10263, "A Review Plan for Uprating the License Power of a PWR Power Plant," dated 1983; and Section 7, "Output Determination," of the Westinghouse "Revised Proposal for Power Uprate," dated August 23, 1999. WCAP-10263 recommends that a test program be developed on a plant specific basis addressing the significance of hardware modifications and the magnitude of the power uprate. The Braidwood Station hardware upgrades were limited to the replacement of the HP turbine, instrument setpoint scaling changes, and minor equipment modifications that were completed as part of the plant modification process.

The Updated Final Safety Analysis Report (UFSAR) Chapter 14, "Initial Test Program," addresses the Braidwood initial test program. The initial test program included both preoperational and initial startup testing. Each of these programs is discussed in the following paragraphs:

4.1.1 Preoperational Tests

Preoperational testing consisted of system performance tests performed prior to core load on completed systems prior to final acceptance. These tests demonstrated the capability of structures, systems and components to meet safety related performance requirements.

This category of tests is now conducted as part of the post modification testing process. The full power uprate modification tests (setpoint and scaling changes) were successfully completed as part of the modification process and work control process.

4.1.2 Initial Startup Tests

Initial startup testing consisted of those single and multi-system tests that occurred during or after fuel loading and which demonstrated overall plant performance. This included such activities as precritical tests, low-power tests (i.e., including criticality tests), and power ascension tests. This testing confirmed the design bases and demonstrated, where possible, that the plant is capable of withstanding the anticipated transients and postulated accidents.

This category of tests was reviewed for applicability in developing the Braidwood Station Full Power Uprate Test Program.

4.1.3 Comparison of UFSAR Startup Tests to Power Ascension Tests

The following table addresses each of the initial power ascension tests and their applicability to the Braidwood Station Full Power Uprate Power Ascension Test Program. Tests identified with a 'Yes' were incorporated into the Braidwood Station Full Power Uprate Power Ascension Test Program.

Test No. (1)	**Startup Test Title**	Required in Full Power Uprate Test Procedure	Acceptance Criteria Same as UFSAR
14.2-62	Initial Core Load	No	NA
14.2-63	Control Rod Drives	No	NA
14.2-64	Rod Position Indicators	No	NA
14.2-65	Reactor Trip Circuit	No	NA
14.2-66	Rod Drop Measurements	No	NA
14.2-67	Incore Flux Monitor System	No	NA
14.2-68	Nuclear Instrumentation	No	NA
14.2-69	Reactor Coolant System Pressure	No	NA
14.2-70	Reactor Coolant System Flow	No	NA
14.2-71	Pressurizer Effectiveness	No	NA
14.2-72	Water Chemistry	Yes (2)	Yes
14.2-73	Radiation Surveys	Yes (3)	Yes
14.2-74	Effluent Radiation Monitors	No	NA
14.2-75	Initial Criticality	No	NA
14.2-76	Power Ascension	Yes (4)	Yes
14.2-77	Moderator Temperature Reactivity Coefficient Measurement	No	NA
14.2-78	Control Rod Reactivity Worth Measurement	No	NA
14.2-79	Boron Reactivity Worth Measurement	No	NA
14.2-80	Flux Distribution Measurement	No	NA
14.2-81	Pseudo Rod Ejection	No	NA
14.2-82	Power Reactivity Coefficient Measurement	No	NA
14.2-83	Core Performance Evaluation	No	NA
14.2-84	Flux Asymmetry Evaluation	No	NA
14.2-85	Full-Power Plant Trip	No	NA
14.2-86	Shutdown from Outside the Control Room	No	NA
14.2-87	Loss of Offsite Power	No	NA
14.2-88	10% Load Swing	No	NA
14.2-89	50% Load Reduction	No	NA
14.2-90	RTD Cross-Calibration	No	NA
14.2-91	Turbine Trip from 25% Power	No	NA

Notes: (1) UFSAR Chapter 14 table numbers.
(2) Water Chemistry at uprate power in accordance with Chemistry Action Levels.
(3) Radiation Surveys done in certain specified areas.
(4) Special Test Procedure at full uprate power was implemented.

5.0 ELECTRICAL OUTPUT TESTS

The objective of the Braidwood Station Power Uprate initiative was to optimize electrical power production by implementing an approximate 5% increase in reactor power. In conjunction with the reactor power uprate, turbine hardware changes were made to increase each unit's turbine-generator output. Four electrical output tests were performed to collect plant data to calculate the electrical output of each unit. A "Pre-Uprate Electrical Output Test" and a "Post-Uprate Electrical Output Test" were conducted on each unit in order to determine the change in electrical output of each unit's turbine generator. Testing was performed in accordance with BwVP 850-22, "Braidwood Power Uprate Project Pre and Post Installation Electrical Output Test.

Seasonal variations and plant operating conditions affect electrical power output. As a result, electrical output may be higher or lower than the value indicated on heat balance drawings. To account for variations in conditions, calculations were performed to normalize electrical output consistent with the conditions noted on the baseline heat rate drawings. These calculations were performed by the turbine vendor and reviewed by Exelon Nuclear.

Test Objective

Collect data for determining the corrected electrical output at the baseline heat-rate conditions at pre-uprate and at post-uprate power levels.

Plant Conditions or Prerequisites

The reactor and turbine power levels were stable. Operation was near full power with the RCS temperature within 1°F of the programmed reference temperature. Steam generator blowdown and main condenser hotwell makeup systems were isolated. The main generator reactive load was adjusted between 300 and 350 Mega-Volt-Amps Reactive (MVARS). Test equipment was installed for data collection.

Test Summary

The test method was based on the American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME), "Steam Turbines, Performance Test Code, PTC-6, Alternate Method." The plant configuration was controlled by the test procedure. Each test collected two data sets with the plant at steady state conditions.

ASME Test Criterion

The corrected heat rate for the two data sets was within 0.25% satisfying the ASME Test criteria. If the heat rate difference were greater than 0.25%, an additional data collection would have been required.

5.1 Unit 1 Electrical Output Test Results

Using test data, the electrical output was corrected to pre-uprate and post-uprate heat rate conditions. Results are presented in the table below.

Pre-Uprate		Post-Uprate		
Data Set	Corrected Electrical Output (MWe)	Data Set	Corrected Electrical Output (MWe)	Gain in Electrical Output (MWe)
1	1157.770	1	1241.836	
2	1158.381	2	1241.312	
Avg.	1161.076 –	Avg.	1241.574	80.498

Average includes adjustment for Main Turbine Driven Feedwater Pumps being supplied by Main Steam as opposed to Extraction Steam.

5.2 Unit 2 Electrical Output Test Results

Using test data, the electrical output was corrected to pre-uprate and post-uprate heat rate conditions. Results are presented in the table below.

Pre-Uprate		Post-Uprate		
Data Set	Corrected Electrical Output (MWe)	Data Set	Corrected Electrical Output (MWe)	Gain in Electrical Output (MWe)
1	1175.705	1	1213.389	
2	1175.563	2	1212.896	
Avg.	1178.634 –	Avg.	1213.142	34.508

Average includes adjustment for Main Turbine Driven Feedwater Pumps being supplied by Main Steam as opposed to Extraction Steam.

6.0 Additional Testing

Additional testing including a Moisture Carryover Test for both Unit 1 and Unit 2 will be performed later in the Fall of 2002. The review of results for these tests will be performed and approved in accordance with a special procedure and can be reviewed by the NRC using the normal special test review process.

7.0 Full Power Capability

Braidwood Station, Units 1 and 2 were able to achieve the uprated full license power level of 3586.6 MWt. The results of the startup test program have indicated that the plant can safely operate at the current uprated power levels. No additional supplemental startup test reports are required for either of the Braidwood Station Units.

ATTACHMENT 2

BRAIDWOOD STATION

UNIT 2 CYCLE 10

STARTUP AND POWER ASCENSION TEST RESULTS

Braidwood Station
Unit 2 Cycle 10
Startup and Power Ascension Test Results

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Braidwood Station Unit 2 Cycle 10 Startup and Power Ascension Test Results

1.0 Introduction

Braidwood Station conducted a comprehensive test program following reload. The test program outlined in this report summarizes events and testing performed during the first heatup and power ascension to 100%.

The Braidwood Unit 2 Cycle 10 (U2C10) core includes a feed batch of 85 fuel assemblies manufactured by Westinghouse. The new fuel region incorporates Integral Fuel Burnable Absorber (IFBA) rods with a B-10 loading of 1.6X and a 100 psig backfill pressure. Thirty-two twice burned Unit 2 assemblies were reinserted with refurbished top nozzles. Table 1.1 contains characteristics of the Braidwood Unit 2 Cycle 10 core design.

The Cycle 10 reactor core achieved initial criticality on May 10, 2002 at 1623 hours. The Unit 2 Main Generator was synchronized to the grid on May 12, 2002 at 0602 hours. Power escalation testing, including testing at full power, was completed on May 16, 2002.

Table 1.1
Braidwood Unit 2 Cycle 10 Core Design Data

- Unit 2 Cycle 9 Burnup: 505 EFPD
- Unit 2 Cycle 10 design length: 522 EFPD

Region	Fuel Type	Number of Assemblies	Enrichment w/o U-235	Cycles Burned
8A	VANTAGE +	4	4.605	2
9A	VANTAGE +	8	4.600	2
9B	VANTAGE +	4	4.406	2
10B	VANTAGE +	16	3.797	2
11A	VANTAGE +	64	4.950	1
11B	VANTAGE +	12	4.750	1
12A	VANTAGE +	60	4.950	0
12B	VANTAGE +	25	4.600	0

2.0 Core Testing

2.1 Low Power Physics Testing

Low Power Physics Testing (LPPT) is performed at the beginning of each cycle and a summary of the Startup Physics Test results from U2C10 is contained in Table 2.1. All test results were determined to be acceptable.

2.2 Power Escalation Testing

Power Escalation Testing is performed during the initial power ascension to full power for each cycle and is controlled by surveillance procedure BwVS TRM 3.1.h.1. Tests are performed from 0% through 100% with major testing plateaus at approximately 30%, and 100% power. Significant tests included:

- Core Power Distribution measurements.
- Reactor Coolant System Delta-T Measurements.
- Hot Full Power Critical Boron Concentration Measurement.
- Reactor Coolant System Flow Measurements.

2.3 Core Power Distribution

Core power distribution measurements were performed during power escalation at intermediate power (i.e., less than 30%) and full power. Measurements are made to verify flux symmetry and to verify core peaking factors are within limits. Data obtained during these tests are used to check calibration of Power Range Nuclear Instrumentation System (NIS) channels and to calibrate them if required. Measurements are made using the Moveable Incore Detector System and analyzed using the BEACON computer code.

Results of the core power distribution measurements at <30%, and full power are shown in Tables 2.2 and 2.3, respectively.

2.4 Full Power Loop Delta-T Determination

The purpose of this test is to determine the full power Delta-T for each Reactor Coolant loop in order to recalibrate any loop with significant change. This procedure is applicable in MODE 1 and is performed above 95% Rated Thermal Power (RTP) after each refueling outage. Results are contained in Table 2.4.

2.5 Reactor Coolant System Flow Measurement

The purpose of this test is to verify by precision heat balance that RCS total flow rate is ≥ 380,900 gpm and within the limits specified in the COLR (≥ 380,900). Results are contained in Table 2.5.

Table 2.1
A2R09 Startup Physics Test Results

Parameter	Predicted	Measured	Difference		Review Criteria	Acceptance Criteria
ARO Critical Boron	1440 ppm	1418 ppm	22 ppm		± 50 ppm	± 1000 pcm
ARO ITC	-3.978 pcm/°F	-5.01 pcm/°F	1.032 pcm/°F		± 2 pcm/°F of design value	N/A
ARO MTC	-2.571 pcm/°F	-2.86 pcm/°F	0.289 pcm/°F		N/A	Within Tech Spec 3.1.1.3
Control Bank A Worth	379.7 pcm	387.8 pcm	2.1%	8.1 pcm	≤15% or ≤100 pcm of design	N/A
Control Bank B Worth	497.7 pcm	488.1 pcm	1.9%	9.6 pcm	≤15% or ≤100 pcm of design	N/A
Control Bank C Worth	938.3 pcm	955.4 pcm	1.8%	17.1 pcm	≤15% or ≤100 pcm of design	N/A
Control Bank D Worth	562.8 pcm	587.1 pcm	4.3%	24.3 pcm	≤15% or ≤100 pcm of design	N/A
Shutdown Bank A Worth	185.7 pcm	180.9 pcm	2.6%	4.8 pcm	≤15% or ≤100 pcm of design	N/A
Shutdown Bank B Worth	892.7 pcm	898.0 pcm	0.6%	5.3 pcm	≤15% or ≤100 pcm of design	N/A
Shutdown Bank C Worth	339.2 pcm	339.5 pcm	0.1%	0.3 pcm	≤15% or ≤100 pcm of design	N/A
Shutdown Bank D Worth	343.1 pcm	340.0 pcm	0.9%	3.1 pcm	≤15% or ≤100 pcm of design	N/A
Shutdown Bank E Worth	484.7 pcm	482.6 pcm	0.4%	2.1 pcm	≤15% or ≤100 pcm of design	N/A
Total Rod Worth	4623.9 pcm	4659.4 pcm	0.8%	35.5 pcm	≤ 5.6% between measured & predicted	≥ 93% of the sum of the predicted worths

Table 2.2
Core Power Distribution Results - <30% Power

Plant Data

Map ID:	BW21001
Date of Map:	5/12/2002
Cycle Burnup:	0.1 EFPD
Power Level:	26.6%
Control Bank D Position:	177 steps

Fluxmap Results

Core Average Axial Offset	-0.27%
Quadrant Power Tilt Ratios:	
Quadrant (N41):	0.980
Quadrant (N42):	1.008
Quadrant (N43):	0.996
Quadrant (N44):	1.017
Max. Nuclear Enthalpy Rise Hot Channel Factor	1.6434
Nuclear Enthalpy Rise Hot Channel Factor Limit	2.0743
Max. Steady State Heat Flux Channel Factor	2.0211
Steady State Heat Flux Channel Factor Limit	5.2000
Max. Transient Heat Flux Channel Factor	2.0332
Transient Heat Flux Channel Factor Limit	4.5274

Table 2.3
Core Power Distribution Results - Full Power

Plant Data

Map ID:	BW21002
Date of Map:	5/16/2002
Cycle Burnup:	3.3 EFPD
Power Level:	99.9%
Control Rod Position:	220 steps

Fluxmap Results

Core Average Axial Offset	-9.810%
Quadrant Power Tilt Ratios: Quadrant (N41):	0.989
Quadrant (N42):	0.999
Quadrant (N43):	1.004
Quadrant (N44):	1.007
Max. Nuclear Enthalpy Rise Hot Channel Factor	1.575
Nuclear Enthalpy Rise Hot Channel Factor Limit	1.7005
Max. Steady State Heat Flux Channel Factor	2.0761
Steady State Heat Flux Channel Factor Limit	2.6026
Max. Transient Heat Flux Channel Factor	2.0062
Transient Heat Flux Channel Factor Limit	2.1904

Table 2.4
Full Power Loop Delta-T

Loop	Tave (°F)	Full Power Delta-T (°F)
A	579.9	60.9
B	581.3	61.6
C	581.7	62.7
D	580.6	60.5

Table 2.5

RCS Flow vs. Acceptance Criteria

RCS loop	Measured Flow (gpm)	Minimum Flow Requirement (gpm)
2A	98,705	
2B	100,850	
2C	97,697	
2D	101,359	
Total	398,611	$\geq$ 380,900

Above data taken from Appendix B-M of 2BwVSR 3.4.1.4 RCS Flow Measurement