Progress Energy

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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Brunswick Steam Electric Plant, Unit No. 1
Renewed Facility Operating License No. DPR-71
Docket No. 50-325
Cycle 19 Startup Report

Ladies and Gentlemen:

In accordance with the Brunswick Steam Electric Plant (BSEP) Updated Final Safety Analysis Report (UFSAR), Section 13.4.2.1, "Startup Report," Carolina Power & Light Company (CP&L) is submitting the enclosed Brunswick Unit 1 Cycle 19 Startup Report. The report is required as a result of the first loading of AREVA ATRIUM 10XM fuel during the Spring 2012 refueling outage.

No regulatory commitments are contained in this letter. Please refer any questions regarding this submittal to Mr. Lee Grzeck, Acting Supervisor – Licensing/Regulatory Affairs, at (910) 457-2487.

Sincerely,

Annette H. Pope
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WRM/wrm

Enclosure: Brunswick Unit 1 Cycle 19 Startup Report

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Brunswick Unit 1 Cycle 19
Startup Report

BRUNSWICK UNIT 1, CYCLE 19
STARTUP REPORT

July 2012

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1.0 Introduction

This report summarizes observed data from the Brunswick Steam Electric Plant (BSEP) Unit 1, Cycle 19 (B1C19) startup tests. The Cycle 19 core represents the first loading of the AREVA ATRIUM 10XM fuel type in Unit 1. A fresh fuel batch size of 234 ATRIUM 10XM fuel assemblies has been loaded (Reference 2.11).

Pursuant to Section 13.4.2.1 of the BSEP 1 & 2 Updated Final Safety Analysis Report (UFSAR) (Reference 2.1), a summary report of plant startup and power escalation testing shall be submitted to the NRC should any one of four conditions occur. Condition (3) of the referenced requirements applies:

> (3): "installation of fuel that has a different design or has been manufactured by a different fuel supplier."

This report shall include results of neutronics related startup tests following core reloading as described in the UFSAR.

2.0 References

2.1 BSEP UFSAR
2.2 BSEP Technical Specifications
2.3 0ENP-24.13, "Core Verification" (PGN RMS 4897970)
2.4 0FH-11, "Refueling" (PGN RMS 4912721)
2.5 0PT-14.2.1, "Single Rod Scram Insertion Times Test" (PGN RMS 4963855)
2.6 0PT-14.3.1, "Insequence Critical Shutdown Margin Calculation" (PGN RMS 4963860)
2.7 0PT-14.5.2, "Reactivity Anomaly Check" (PGN RMS 4975909)
2.8 0PT-50.0, "Reactor Engineering Refueling Outage Testing" (PGN RMS 4973658)
2.9 0PT-50.3, "TIP Uncertainty Determination"(PGN RMS 4975910)
2.10 0PT-90.2, "Friction Testing of Control Rods" (PGN RMS 4945102)
2.11 CMR U1 CYCLE 19, "UNIT 1, CYCLE 19, CYCLE MANAGEMENT REPORT", Revision 0.

3.0 UFSAR Section 14.4.1, Item 1: Core Loading Verification

A Core Loading Pattern Verification was performed per BSEP Engineering Procedure 0ENP-24.13, "Core Verification" (Reference 2.3). The core was verified to be loaded in accordance with the analyzed B1C19 core design.

4.0 UFSAR Section 14.4.1, Item 4A: TIP Operability and Bundle Power Evaluation

a. TIP Measurement Uncertainty

Radial (bundle or 2D) and nodal (3D) gamma TIP measurement uncertainties were determined in accordance with BSEP Periodic Test Procedure 0PT-50.3, "TIP Uncertainty Determination"(Reference 2.9). Total radial TIP measurement uncertainty at high core thermal power (CTP) (>80% CTP) was 0.688% and total nodal TIP measurement uncertainty was 1.361%. These radial and nodal uncertainties were also determined at medium core thermal power (40% to 80% CTP) and were 0.842% and 1.775%, respectively. The results met the test acceptance criteria.

b. Measured and Calculated TIP Comparison

Radial and nodal deviations between measured and calculated TIP data were determined in accordance with BSEP Periodic Test Procedure 0PT-50.3, "TIP Uncertainty Determination" (Reference 2.9). The radial deviation at high core thermal power (>80% CTP) was 1.877% and the nodal deviation was 3.051%. These radial and nodal deviations were also determined at medium core thermal power (40% to 80% CTP) and were 2.094% and 4.105%, respectively. The results met the test acceptance criteria.

c. Monitored Power Uncertainty

Radial and nodal monitored power uncertainties were determined in accordance with BSEP Periodic Test Procedure 0PT-50.3, "TIP Uncertainty Determination" (Reference 2.9). The radial monitored power uncertainty at high core thermal power (>80% CTP) was 2.620% and the nodal monitored power uncertainty was 3.111%. These radial and nodal uncertainties were also determined at medium core thermal power (40% to 80% CTP) and were 2.858% and 3.769%, respectively. The results met the test acceptance criteria.

d. Bundle Powers

This analysis compares the MICROBURN-B2 predictions of bundle powers to the plant process computer's measured bundle powers in accordance with BSEP Periodic Test procedure 0PT-50.0, "Reactor Engineering Refueling Outage Testing" (Reference 2.8). Bundles located in peripheral control cells or uncontrolled peripheral locations are excluded. The maximum radial difference was calculated to be 2.30% at medium power (40% to 80% CTP). The results met the test acceptance criteria.

5.0 UFSAR Section 14.4.1, Item 2: Control Rod Mobility

Control rod mobility is verified by two tests: friction testing and scram timing. The results of these tests and their acceptance criteria are described below.

a. Friction Testing

Friction Testing was performed prior to startup per BSEP Periodic Test Procedure 0PT-90.2, "Friction Testing of Control Rods" (Reference 2.10). Control rods were verified to complete full travel without excessive binding or friction. In a prerequisite to 0PT-90.2, the reactor was observed to remain subcritical during the withdrawal of the most reactive rod per the BSEP Fuel Handling Procedure 0FH-11, "Refueling" (Reference 2.4).

b. Scram Time Testing

Scram Time Testing was performed for each control rod prior to exceeding 40% power per BSEP Periodic Test Procedure 0PT-14.2.1, "Single Rod Scram Insertion Times Test" (Reference 2.5). The acceptance criteria for these tests are found in Technical Specification 3.1.4 (Reference 2.2). The control rods had a scram time of ≤ 7.0 seconds and thus were considered operable in accordance with Technical Specification 3.1.3. The maximum measured 5%, 20%, 50%, and 90% insertion times are given in Attachment 1 of this report.

The core average 20% insertion time measured was 0.829 seconds which is equal to the analyzed nominal speed limit of ≤ 0.829 seconds.

6.0 UFSAR Section 14.4.1, Item 3: Reactivity Testing

Reactivity Testing consists of a shutdown margin (SDM) measurement, reactivity anomaly check, and measured critical k_{eff} comparison to predicted values. The results of these tests are provided below with the acceptance criteria.

a. Shutdown Margin

SDM measurements were performed per BSEP Periodic Test Procedure 0PT-14.3.1, "Insequence Critical Shutdown Margin Calculation" (Reference 2.6). The cycle minimum SDM was determined to be 1.848% Δk/k compared to a predicted cycle minimum SDM value of 1.48% Δk/k (Reference 2.11), resulting in an absolute difference of 0.368% Δk/k. The cycle minimum SDM is determined by subtracting the maximum decrease in SDM which occurs at 0.0 GWD/MTU cycle exposure (R = 0.0% Δk/k) from the SDM at beginning-of-cycle (BOC). The acceptance criterion for minimum SDM is defined in Technical Specification 3.1.1, which requires the SDM be ≥ 0.38% Δk/k during the entire cycle. Since the cycle minimum SDM was determined to be 1.848% Δk/k for B1C19, the acceptance criterion is met.

b. Reactivity Anomaly

A reactivity anomaly test was performed at near rated conditions (2901.5 MWt or 99.3% of rated power) per BSEP Periodic Test Procedure 0PT-14.5.2, "Reactivity Anomaly Check" (Reference 2.7). The acceptance criterion is defined by Technical Specification 3.1.2, which requires that the reactivity difference between monitored and predicted core k_{eff} be within ±1% Δk/k. The measured and predicted values for k_{eff} were 1.0023 and 0.9995 (Reference 2.11), respectively, an absolute difference of 0.28% Δk/k. This is within the ±1% Δk/k requirement.

c. Cold Critical Eigenvalue (k_{eff})

The measured BOC cold critical k_{eff} per BSEP Periodic Test Procedure 0PT-14.3.1, "Insequence Critical Shutdown Margin Calculation" (Reference 2.6), was inferred as 0.99769 by applying the period correction of -0.00023 to the nodal simulator code calculated k_{eff} value of 0.99792 using actual critical conditions as input. The predicted BOC cold critical k_{eff} was 0.9940 (Reference 2.11) resulting in a measured to predicted difference of 0.369% Δk/k. Therefore, per Technical Specification 3.1.2, the acceptance criterion requiring agreement within ±1% Δk/k is met.

7.0 Additional Testing Results

As a matter of course, key testing and checks beyond those specified in the UFSAR are performed during initial startup and power ascension. These "standard" tests are described in items (a) and (b) below.

a. Core Monitoring Software Comparisons to Predictions

Thermal limits calculated by the online POWERPLEX Core Monitoring Software System were compared to those calculated by MICROBURN-B2 predictions at medium and high power levels (Reference 2.8). The results of these comparisons and the POWERPLEX statepoints are provided as Attachment 2. The results met the test acceptance criteria.

b. Hot Full Power Eigenvalue

After establishing a sustained period of full power equilibrium operation at 128.9 MWD/MTU on May 07, 2012, the predicted and core follow Hot Full Power

Eigenvalues (k_{eff}) were compared. (Reference 2.8). The core follow k_{eff} was calculated as 1.0023 and the predicted k_{eff} was 1.0021. The difference between the predicted and core follow values is 0.02% Δk/k which is within the ±1% Δk/k reactivity anomaly requirements.

8.0 Summary

Evaluation of the BSEP Unit 1, Cycle 19 startup data concludes the core has been loaded properly and is operating as expected. The startup and initial operating conditions and parameters compare well to predictions. Core thermal peaking design predictions and measured peaking comparisons met the startup acceptance criteria. The BOC SDM demonstration indicates adequate SDM will exist throughout B1C19. The UFSAR prescribed and additional tests met their acceptance criteria.

Attachment 1 to the B1C19 Startup Report

Results of Control Rod Scram Time Testing

Maximum Measured Scram Insertion Time Technical Specification 3.1.4			
Insertion	**Position/Notch**	**Tech Spec "Slow" Limit (seconds)**	**Maximum Measured Insertion Time (seconds)**
5%	46	0.44	0.323
20%	36	1.08	0.986
50%	26	1.83	1.734
90%	06	3.35	3.099

Attachment 2 to the B1C19 Startup Report

Core Monitoring Software Comparisons to Predictions

Medium Power 65.2% CMWT, May 03, 2012				
Thermal Limit	**POWERPLEX On-Line Monitoring**	**MICROBURN-B2 Predicted**	**Absolute Difference**	**Acceptance Criteria**
CMFLCPR	0.767	0.771	0.004	≤ 0.061
CMAPRAT	0.563	0.538	0.025	≤ 0.164
CMFDLRX	0.714	0.682	0.032	≤ 0.164

High Power 99.0% CMWT, May 07, 2012				
Thermal Limit	**POWERPLEX On-Line Monitoring**	**MICROBURN-B2 Predicted**	**Absolute Difference**	**Acceptance Criteria**
CMFLCPR	0.849	0.845	0.004	≤ 0.041
CMAPRAT	0.760	0.742	0.018	≤ 0.109
CMFDLRX	0.867	0.853	0.014	≤ 0.109