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U.S. Nuclear Regulatory Commission
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BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 1
DOCKET NO. 50-325/LICENSE NO. DPR-71
CYCLE 14 STARTUP REPORT

Ladies and Gentlemen:

In accordance with Section 13.4.2.1 of the Updated Final Safety Analysis Report (UFSAR) for the Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2, Carolina Power & Light (CP&L) Company is submitting the enclosed Cycle 14 startup report for BSEP, Unit 1.

UFSAR Section 13.4.2.1 states that a summary report of plant startup and power escalation testing will be submitted following installation of fuel that has a different design or has been manufactured by a different fuel supplier. During BSEP, Unit 1 Refueling Outage 13 (i.e., B114R1), CP&L loaded GE14 fuel assemblies manufactured by Global Nuclear Fuel – Americas. The enclosed startup report has been prepared to satisfy UFSAR Section 13.4.2.1, and addresses the tests identified in Section 14.4.1 of the UFSAR.

Please refer any questions regarding this submittal to Mr. Leonard R. Beller, Supervisor - Licensing/Regulatory Programs, at (910) 457-2073.

Sincerely,

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Enclosure: Brunswick Unit 1, Cycle 14 Startup Report

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Brunswick Unit 1, Cycle 14 Startup Report

BRUNSWICK UNIT 1, CYCLE 14
STARTUP REPORT

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1.0 Introduction

This report summarizes observed data from the initial Brunswick Unit 1, Cycle 14 (B1C14) startup tests. The Cycle 14 core represents the first loading of the GE14 fuel type in Unit 1. 248 GE14 fuel assemblies have been loaded.

Pursuant to the requirements of Section 13.4.2.1 of the BSEP 1 & 2 Updated FSAR, 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) 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 BNP UFSAR
2.2 BNP Technical Specifications
2.3 NGGS-NFP-0002, "Guidelines for BWR Cycle Management Calculations"
2.4 0ENP-24.13, "Core Verification"
2.5 0FH-11, "Refueling"
2.6 0PT-14.2.1, "Single Rod Scram Insertion Times Test"
2.7 0PT-14.3.1, "Insequence Critical Shutdown Margin Calculation"
2.8 0PT-14.5.2, "Reactivity Anomaly Check"
2.9 0PT-50.0, "Reactor Engineering Refueling Outage Testing"
2.10 0PT-50.3, "Tip Reproducibility And Uncertainty Determination"
2.11 0PT-90.2, "Friction Testing of Control Rods"

3.0 UFSAR Section 14.4.1, Item 1: Core Loading Verification

A Core Loading Pattern Verification was performed per BNP Engineering Procedure 0ENP-24.13, "Core Verification." The core was verified to be loaded in accordance with the B1C14 Full Core Loading Pattern.

4.0 UFSAR Section 14.4.1, Item 4: TIP Operability and Core Power Symmetry

a. TIP Uncertainty

A TIP uncertainty determination was completed according to BNP Periodic Test Procedure 0PT-50.3, "Tip Reproducibility and Uncertainty Determination." The acceptance criterion for this test requires the TIP Total Noise Uncertainty to be ≤ 7.1%. The measured uncertainty was 2.4418%, thus meeting the criteria.

b. Core Power Symmetry

Core power symmetry is indirectly verified via the standard traversing in-core probe (TIP) uncertainty measurement performed per 0PT-50.3, described in Section 4.0.a.

Direct power symmetry measurement utilizing computed bundle powers is no longer performed at Brunswick with the improved POWERPLEX core monitoring system. POWERPLEX methodology does not require core symmetry. Therefore, the Core Power Symmetry Test was replaced by a more appropriate Bundle Power Analysis. The test results and acceptance criteria are provided in item (c) below.

c. Bundle Power Analysis

BNP Periodic Test procedure 0PT-50.0, "Reactor Engineering Refueling Outage Testing," was revised to replace the Core Power Symmetry Test with a Bundle Power Analysis. This analysis compares the MICROBURN-B predictions of bundle powers to the plant process computer's measured bundle powers. The comparison must verify that the absolute difference between measured and predicted bundle powers meets the acceptance criterion of ≤ 8.64%. Bundles located in peripheral control cells or uncontrolled peripheral locations are excluded.

The acceptance criterion was met with the maximum radial difference calculated as 8.12% per procedure NGGS-NFP-0002, "Guidelines for BWR Cycle Management Calculations."

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 BNP Periodic Test Procedure 0PT-90.2, "Friction Testing of Control Rods." Control rods were verified to complete full travel without excessive binding or friction. In a pre-requisite to 0PT-90.2, the reactor was observed to remain subcritical during the withdrawal of the most reactive rod in BNP Fuel Handling Procedure 0FH-11, "Refueling."

b. Scram Time Testing

Scram Time Testing was performed for each control rod prior to exceeding 40% power per BNP Periodic Test Procedure 0PT-14.2.1, "Single Rod Scram Insertion Times Test." The acceptance criteria for this test are found in Technical Specification 3.1.4. All 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 average 20% insertion time measured from the low power testing was 0.812 seconds, thus meeting the ODYN Option B time requirement of ≤ 0.861 seconds.

6.0 UFSAR Section 14.4.1, Item 3: Reactivity Testing

Reactivity Testing consists of a shutdown margin 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

Shutdown margin measurements were performed per BNP Periodic Test Procedure 0PT-14.3.1, "Insequence Critical Shutdown Margin Calculation." The initial BOC shutdown margin was measured as 1.53% Δk compared to a predicted value of 1.582% Δk, an absolute difference of 0.052% Δk. The acceptance criterion for minimum shutdown margin is defined in Technical Specification 3.1.1.1, which requires the shutdown margin be ≥ 0.38% Δk during the entire cycle. Since for B1C14 the minimum shutdown margin is predicted to occur at BOC (R= 0 %Δk), the acceptance criterion is met.

b. Reactivity Anomaly

A reactivity anomaly test was performed at near rated conditions (2555.5 MWt or 99.9%) per BNP Periodic Test Procedure 0PT-14.5.2, "Reactivity Anomaly Check." 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. The measured and predicted values for k_{eff} were 1.00410 and 1.00100, respectively, a difference of 0.31% Δk. This is within the ±1% Δk requirement.

c. Cold Critical Eigenvalue (k_{eff})

The measured BOC cold critical k_{eff} was inferred as 1.00076 by nodal simulator code calculations with actual critical conditions as input. The predicted BOC cold critical k_{eff} was 1.00100 resulting in a measured to predicted difference of -0.024% Δk. Therefore, per Technical Specification 3.1.2, the acceptance criterion requiring agreement within ±1% Δk 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-B predictions at medium and high power levels. The results of these comparisons and the POWERPLEX statepoints are provided as Attachment 2. The acceptance criteria specified in 0PT-50.0 require the two codes' thermal limits agree within 0.15 for medium power testing and 0.10 for high power testing. The acceptance criteria were met.

b. Hot Full Power Eigenvalue

After establishing a sustained period of full power (2556.3 MWt) equilibrium operation, the predicted and core follow Hot Full Power Eigenvalues (k_{eff}) are compared. At 270 MWD/MT the core follow k_{eff} was calculated as 1.00111 and the predicted k_{eff} was 1.00067. The difference between the predicted and core follow values is -0.044% Δk which is within the $\pm 1\%$ Δk reactivity anomaly requirements.

8.0 Summary

Evaluation of the Brunswick Unit 1, Cycle 14 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 shutdown margin demonstration indicates adequate shutdown margin will exist throughout B1C14. All UFSAR prescribed and additional tests met their acceptance criteria.

Attachment 1 to the B1C14 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	0.440	0.328
20%	36	1.080	0.895
50%	26	1.830	1.492
90%	06	3.350	2.669

Attachment 2 to the B1C14 Startup Report

Core Monitoring Software Comparisons to Predictions

Medium Power Testing Plateau 61.6% CMWT, 02APR02, 04.53				
Thermal Limit	POWERPLEX On-Line Monitoring	MICROBURN-B Predicted	Absolute Difference	Acceptance Criteria
MFLCPR	0.791	0.786	0.005	< 0.15
MAPRAT	0.772	0.753	0.019	< 0.15
MFLPD	0.644	0.628	0.016	< 0.15

High Power Testing Plateau 91.8% CMWT, 02APR05, 17.53				
Thermal Limit	POWERPLEX On-Line Monitoring	MICROBURN-B Predicted	Absolute Difference	Acceptance Criteria
MFLCPR	0.877	0.888	0.011	< 0.10
MAPRAT	0.882	0.906	0.024	< 0.10
MFLPD	0.829	0.819	0.010	< 0.10