FPL

October 19, 2012

L-2012-382
10 CFR 50.36

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

Re: St. Lucie Plant Unit 1
Docket No. 50-335
Renewed Facility Operating License No. DPR-67
Extended Power Uprate Cycle 24 Startup Report

References:

(1) T. Orf (NRC) to M. Nazar (FPL), "St. Lucie Plant, Unit 1 – Issuance of Amendment Regarding Extended Power Uprate (TAC No. ME5091)", July 9, 2012 (Accession No. ML12156A208).

Pursuant to St. Lucie Unit 1 Technical Specification (TS) 6.9.1.1, Florida Power & Light Company (FPL) is submitting the Cycle 24 Startup Report. This report is required due to the implementation of the Extended Power Uprate (EPU) Project Amendment No. 213 that was issued via Reference 1.

Should you have any questions regarding this submittal, please contact Mr. Jack Hoffman, St. Lucie Extended Power Uprate Licensing Manager, at 772-467-7493.

Sincerely,

ES Katzman

Eric S. Katzman
Licensing Manager
St. Lucie Plant

Attachments (1)

A001
NRR

St. Lucie Unit 1 - Cycle 24
Extended Power Uprate
Power Ascension Testing Summary

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I. Introduction

The purpose of this Startup Report is to provide a summary description of the plant startup and power ascension testing performed at St. Lucie Unit 1 following Cycle 24 refueling which implemented the Extended Power Uprate (EPU) project. The EPU License Amendment Request (LAR) was submitted by Florida Power and Light Company (FPL) to NRC via Reference 1. The NRC Commission approved and issued Amendment No. 213 to FPL via Reference 2. The amendment increased the authorized maximum steady-state reactor core power from 2700 megawatts thermal (MWt) to 3020 MWt. This Cycle 24 Startup Report is being submitted in accordance with St. Lucie Unit 1 Technical Specification 6.9.1.1, items (2) and (4).

The plant startup and power escalation testing verifies that key EPU core and plant parameters are operating as predicted. The major parts of this testing program include:

1) Initial criticality following refueling,

2) Zero power physics testing, and

3) Power ascension testing.

The test data collected during EPU startup and power ascension and summarized in this report concludes that all major systems, structures, and components (SSCs) performed as predicted and there was no adverse impact to the performance of the unit. The EPU startup and power ascension test data satisfied all acceptance criteria and demonstrated conformance to predicted performance. Copies of the completed EPU startup and power ascension test procedures are available on site for review.

II. Cycle 24 Fuel Design

The St. Lucie Unit 1 Cycle 24 reload is composed of 100 fresh fuel assemblies (Region FF), 76 once burned assemblies (Region EE), and 41 twice burned assemblies (Region DD) for a total of 217 fuel assemblies manufactured by AREVA-NP, Inc (AREVA). The primary design change to the core for Cycle 24 was the replacement of 100 irradiated fuel assemblies with 100 fresh Region FF fuel assemblies.

All assemblies in the Cycle 24 reload core are of the debris-resistant design. The Region FF fuel employs the same design as that of the previous cycle Region EE fuel. This design includes the use of high thermal performance (HTP) spacer grids, high mechanical performance (HMP) lower grid and the use of the "FuelGuard" lower tie plate. The fuel assembly design for Region FF fuel utilizes radial enrichment zoning similar to that used in previous regions, to reduce peaking, and gain margin in steaming rate to improve fuel performance with respect to fuel rod corrosion, and crud deposition.

The safety analysis for Cycle 24 core was performed by AREVA-NP using NRC approved methodology, with input from FPL. The analyses for the Cycle 24 EPU core support a Departure from Nucleate Boiling Ratio (DNBR) limit at the 95/95 probability/confidence level, consistent with the applicable DNB correlation previously approved by the NRC. The analyses also support the linear heat rate limit corresponding to the fuel centerline melt. All analyses were performed with the assumption of a steam generator tube plugging level not to exceed 10% average, with a maximum asymmetry of ± 2% about the average.

The Cycle 24 core map is represented in Figure 1. The assembly serial numbers and control element assembly (CEA) serial numbers are given for each core location. The Cycle 24 reload sub-batch identifications are provided in the table below.

Cycle 24 - Reload Sub-Batch ID

Sub-Batch	Number of Assemblies
DD1	4
DD2	16
DD3	16
DD4	5
EE1	16
EE2	12
EE3	28
EE4	12
EE5	8
FF1	8
FF2	28
FF3	32
FF4	20
FF5	12
Total	217

III. Approach to Criticality

The approach to criticality involved diluting from a non-critical boron concentration of 1735 ppm to a predicted critical boron concentration of 1517 ppm. Inverse Count Rate Ratio (ICRR) plots were maintained during the dilution process using wide range channels B and D. Refer to Figures 2 and 3 for ICRR information. The table below summarizes the dilution rates and times, as well as beginning and ending boron concentrations.

Initial criticality for St. Lucie Unit 1, Cycle 24, was achieved on March 18, 2012 at 14:50 with CEA group 7 at 120 inches withdrawn and all other CEAs at the all-rods-out (ARO) position. The actual critical Boron concentration was measured to be 1512 ppm.

Approach to Criticality

Dilution Rate	Initial Boron Concentration	Final Boron Concentration	Dilution Time (minutes)
132 gpm	1735	1667	20
88 gpm	1667	1567	46
44 gpm	1567	1512	44

IV. Zero Power Physics Testing

To verify that the St. Lucie Unit 1 Cycle 24 core operating characteristics are consistent with the design predictions and to provide assurance that the core can be operated as designed, the following tests were performed:

1) Reactivity Computer Checkout,
2) All-Rods-Out Critical Boron Concentration,
3) Isothermal Temperature Coefficient Measurement, and
4) Measurement of Rod Worth.

Reactivity Computer Checkout

Proper operation of the reactivity computer is ensured by performing the "Reactivity Computer Checkout." This part of the testing determines the appropriate testing range and checks that reactivity changes are being correctly calculated by the reactivity computer's internal algorithms. The testing range is selected such that the signal to noise ratio is maximized and that testing is performed below the point of adding nuclear heat. The reactivity calculation is checked by performing a positive and negative reactor period test through introduction of a known amount of positive and negative reactivity. The results of the reactivity computer checkout were compared to predictions provided in the reload engineering change package. Satisfactory agreement was obtained.

All-Rods-Out Critical Boron Concentration

The measurement of the all-rods-out (ARO) critical boron concentration was performed. The measured value was 1517.6 ppm which compared favorably with the design value of 1517 ppm. This was well within the acceptance limits of ± 50 ppm.

Isothermal Temperature Coefficient Measurement

The measurement of the isothermal temperature coefficient (ITC) was performed and the resulting moderator temperature coefficient (MTC) was derived. The MTC was determined to be 1.48 pcm/°F which compared favorably to the predicted MTC value of 1.37 pcm/°F, well within the acceptance criteria of ± 2.0 pcm/°F. This complies with the St. Lucie Unit 1 Technical Specification 3.1.1.4 requirements that the maximum upper limit shall be ≤ +7 pcm/°F prior to exceeding 70% of RATED THERMAL POWER.

Measurement of Rod Worth

Rod worth measurements were performed using the super-group rod swap methodology. This method involves exchanging a reference group, which is measured by the boration-dilution technique, with each of the remaining test groups. A comparison of the measured and design CEA reactivity worths is provided in the table below. The following acceptance criteria apply to the measurements made:

1) The measured value of each test group, or super-group measured, is within +15% or +100 pcm of its corresponding design CEA worths, whichever is greater and,

2) The worth of the reference group and the total worth for all the CEA groups measured is within + 10% of the total design worth.

All acceptance criteria were met.

CEA Group Worth Summary

CEA Group	Measured Worth (pcm)	Design Worth (pcm)	Percent Difference
Reference Group A	971.21	891	8.26
B	477.36	445	6.78
3	506.15	461	8.92
5 & 6	626.96	574	8.45
7	649.45	586	9.77
4	689.79	625	9.39
1	741.93	676	8.89
2	822.9	736	10.57
Total	**5485.84**	**4994**	**8.97**

Percent difference = (Measured - Design)/(Measured) *100

The measured value of each test group, or super-group measured, is within ±15% or ±100 pcm of its corresponding design CEA worths, whichever is greater and, the worth of the reference group and the total worth for all the CEA groups measured is within ±10% of the total design worth.

V. Power Ascension Test Program

The EPU power ascension test program consisted of a combination of normal startup and surveillance testing, post-modification testing, and power ascension testing deemed necessary to support acceptance of the proposed EPU. During the EPU start-up, power was increased in a slow and deliberate manner, stopping at pre-determined power levels for steady-state data gathering and formal parameter evaluation. These pre-determined power levels are referred to as test plateaus. The typical post-refueling power plateaus were used until the previously licensed full power condition (2700 MWt) was attained (approximately 89% of the EPU full power level of 3020 MWt). Above 2700 MWt, smaller intervals between test plateaus were established, with a concurrent higher frequency of data acquisition. A summary of the power ascension test plan for power levels beginning at 2700 MWt is provided in table below.

EPU Power Ascension Test Plan

Test / Activity	Description	Rated Thermal Power (% of 3020 MWt)				
		89	92	95	98	100
Nuclear & ΔT power calibration	Verify thermal power and adjust instrumentation	X	X	X	X	X
Linear power range channel calibration	Align linear excore power to calorimetric power. Modify axial power shape indication from incore flux instrumentation. (Final adjustment may precede 92% power.)		X			
Core power distribution monitoring	Monitor power distribution by incore flux map	X		X		X
Shape annealing factors	Data collection from excore and incore flux instrumentation during power ascension, starting at 30% power and ending at 92% (or sooner). Update of constants at full power.	X	X			X
Hot full power (HFP) boron check	Evaluation of critical boron concentration at HFP					X
RCS flow determination	Determine RCS flow by reactor power measurement	X				X
NSSS data collection	Data collection	X	X	X	X	X
Balance of plant (BOP) data collection	Data collection	X	X	X	X	X
BOP walkdown	Equipment monitoring	X	X	X	X	X
Vibration monitoring	Monitor vibration in plant piping and rotating equipment	X	X	X	X	X
Plant radiation surveys	Perform surveys and update survey results impacted by EPU. Areas will include portions of containment, reactor auxiliary building, fuel handling building, and the steam trestle, taking accessibility and ALARA into consideration.	X				X
MTC test at HFP	Determine MTC					X
Leading edge flowmeter (LEFM) commissioning	LEFM functional check, following vendor commissioning.			X	X	

Note: The 89% plateau corresponds to the current licensed power level of 2700 MWt, or approximately 89% of the EPU licensed power level of 3020 MWt.

Prior to exceeding the previous licensed core thermal power of 2700 MWt, the data gathered at the pre-determined power plateaus, as well as observations of the slow, but dynamic power increases between the power plateaus, allowed verification of the performance of the EPU modifications. The steady-state data collected at approximately 89% power was especially significant because this test plateau corresponded to the previous full power level of 2700 MWt. Data collected at this plateau formed the basis for comparison of data collected at higher plateaus.

Once testing was completed at the 2700 MWt plateau, power was slowly and deliberately increased through four additional test plateaus, each differing by approximately 3% of the EPU rated thermal power. Both dynamic performance during the ascension and steady-state performance for each test plateau were monitored, documented and evaluated against pre-determined acceptance criteria and expected values.

Following each increase in power level, test data was evaluated against its performance acceptance criteria and expected values (i.e., design predictions or limits). If the test data satisfied the acceptance criteria and expected values, then system and component performance were considered to have complied with their design requirements.

In addition to the steady-state parameter data gathered and evaluated at each test condition, the dynamic parameter response data gathered during the ascension between test plateaus was also evaluated and demonstrated overall stability of the plant.

Hydraulic interactions between the new main feedwater pumps and the steam generator flow control valves, as well as the impact of the higher main feedwater flow, were monitored and evaluated. Individual control systems, such as steam generator level control and feedwater heater drain level control, were optimized for the new EPU conditions, as required. The power ascension testing adequately identified any unanticipated adverse system interactions and allowed them to be corrected in a timely fashion prior to full power operation at the uprated conditions.

The acceptance criteria for the power ascension test plan were established as discussed in Regulatory Guide (RG) 1.68, Initial Test Programs for Water-Cooled Nuclear Power Plants. Criteria were provided against which the success or failure of the test was judged. In some cases, the criteria were qualitative. Where applicable, quantitative criteria had appropriate tolerances.

Specific acceptance criteria and expected values were established and incorporated into the power ascension test procedures.

Vibration Monitoring

A piping and equipment vibration monitoring program, including plant walkdowns and monitoring of plant equipment, was established to ensure that any steady-state flow induced piping vibrations following EPU implementation were not detrimental to the plant, piping, pipe supports, or connected equipment.

The predominant way of assessing piping and equipment vibrations was to monitor the piping during the plant heat-up and power ascension. The methodology used for monitoring and evaluating vibration was in accordance with ASME OM-S/G-2007, Standards and

Guides for Operation and Maintenance of Nuclear Power Plants, Part 3, Requirements for Preoperational and Initial Startup Vibration Testing of Nuclear Power Plant Piping Systems.

The scope of the piping and equipment vibration monitoring program included accessible piping that experienced an increase in process flow rates. Branch lines attached to this piping (experiencing increased process flows) were also monitored as operating experience has shown that branch lines are susceptible to vibration-induced damage. The scope of the program included the following systems:

- Main steam (outside of containment),
- Feedwater (outside of containment),
- Condensate,
- Heater drains and vents, and
- Extraction steam.

VI. Results

During power ascension, the fixed incore detector system is utilized to verify the core is loaded properly and there are no abnormalities occurring in various core parameters (core peaking factors, linear heat rate, and tilt) for the various power plateaus. The incore detectors were replaced during Cycle 24 as a part of their regularly scheduled replacement program. Incore operability was demonstrated throughout each power ascension plateau (pre-EPU and post-EPU), and incore alarm set-points were programmed into the plant computer at the following intervals:

Pre-EPU (2700 MWt): 30%, 45%, 70% and 92%
Post-EPU (3020 MWt): 30%, 64%, 89% and 100%

No incore alarms were received during either power ascension and no linear heat rate monitoring issues were encountered.

Nuclear & ΔT Power Calibration

Nuclear power and delta-T power calibrations were performed at the 89%, 92%, 95%, 98% and 100% EPU power plateaus. The appropriate calibrations were performed prior to advancing reactor power to the next higher power level as specified by procedure. These calibrations were performed by the control room operating crews. All calibrations were determined to be satisfactory for each of the reactor protection system (RPS) channels.

Linear Power Range Channel Calibration

Linear range excore nuclear instruments were calibrated at varying intervals across the two power ascension campaigns. In the case of the first start-up under pre-EPU conditions (2700 MWt), the reactor protective system (RPS) linear range detectors and the two control channels, were calibrated at 30% power and then again once power was in excess of 95%. This was to ensure compliance with the shape annealing factor procedure for determining the linear relationship between the incore detectors and the excore detectors.

Following transition to EPU operation (3020 MWt), nuclear instrument calibrations were performed at 30%, 92% and 100% power. No instrument performance issues were identified in either of the two power ascension programs.

Core Power Distribution Monitoring

Following the St. Lucie Unit 1 EPU plant startup, power distribution flux maps were produced at EPU power levels of 89%, 95% and 100% (Figures 4, 5 and 6) to monitor core performance at the new power levels. These flux maps were used to compare the measured power distribution with the predicted power distribution. For the purposes of power ascension, the acceptance criteria require the root mean square (RMS) value of the power deviation to be less than or equal to 5%. The individual assembly powers should be within 10% of the predicted power for assembly relative powers greater than or equal to 0.9. The acceptance criteria were satisfied for all cases.

Shape Annealing Factors

A shape annealing factor (SAF) test was performed during the pre-EPU power ascension. This test was a part of the pre-EPU testing program in advance of the expected middle-of-cycle shutdown to implement EPU. The SAF measurement data for all excore detectors showed a good statistical correlation coefficient and agreement with the trend of each of the other RPS channels indicating that the calculated SAFs are valid and acceptable for use during the EPU power ascension program. The measured SAFs for all the excore detectors and the control channels met all acceptance criteria limits with correlation coefficients greater than 0.999 for each channel. A separate SAF test was not required during the EPU power ascension.

Hot Full Power (HFP) Boron Check

The hot full power boron check is performed once the new core power level has been raised to 100% and has been at that power level for a time sufficient to establish equilibrium poison conditions. The reactor coolant system is sampled and the value of the equilibrium boron concentration is adjusted by other sources of reactivity to determine a final value of the full power boron concentration. This is then compared to the design boron concentration value, with the acceptance criterion being less than 50 ppm difference. The hot full power boron was measured after the EPU full power equilibrium conditions were established. Because sufficient cycle operation had taken before the 100% EPU power level was reached, the effects of boron-10 (B-10) depletion were required to be taken into consideration. When a correction factor for the B-10 depletion was applied, the measured to predicted boron difference was calculated to be 7.8 ppm, the measurement shows very good agreement with the predicted value.

RCS Flow Determination

A determination of RCS flow by calorimetric parameters was performed at the 89% and 100% EPU power plateaus. At the 89% power plateau, the measured RCS flow was 413,238 gpm and at the 100% power plateau, the measured RCS flow was 413,232 gpm. In both cases, the measured RCS flow met the minimum Technical Specification acceptance criteria, including uncertainties.

NSSS Data Collection

The St. Lucie Unit 1 nuclear steam supply system (NSSS) significant parameters were observed at the 89%, 92%, 95%, 98% and 100% EPU power plateaus. These significant parameters included RCS temperatures, pressurizer pressure, pressurizer level, containment pressure, containment temperature, steam generator pressure, and steam generator level. Based on analyses performed as part of the EPU project, RCS temperatures were the only significant parameter expected to vary during the power ascension. Plots for RCS cold leg temperature, hot leg temperature, and average temperature at the various power plateaus are shown on Figure 7. During power ascension, the NSSS significant parameter values compared well with the predicted values. The following is a summary of the NSSS significant parameters at the various power plateaus:

- RCS temperatures – RCS hot leg, cold leg, and average temperatures for the EPU power plateaus are shown on Figure 7. As can be seen, the maximum measured cold leg temperature at 100% EPU power of 550.4°F remained below the EPU limit of 551°F. The maximum measured hot leg temperature of 600.5°F corresponds well to the predicted hot leg temperature of 600.4°F, when corrected to actual measured RCS flow.
- Pressurizer pressure – remained constant at 2250 psia throughout the power ascension.
- Pressurizer level - remained constant at 66% throughout the power ascension.
- Containment pressure – average pressure ranged from 0.07 psig to 0.25 psig throughout the power ascension.
- Containment temperature – temperature ranged from 96.7°F to 98°F throughout the power ascension.
- Steam generator pressure – ranged between 863 psia at 89% EPU power and 865 psia at 100% EPU power.
- Steam generator level – remained constant at 65% narrow range scale throughout the power ascension.

Balance of Plant (BOP) Data Collection

The St. Lucie Unit 1 balance of plant (BOP) significant parameters were observed at the 89%, 92%, 95%, 98% and 100% EPU power plateaus. As the majority of the EPU hardware changes were made to BOP equipment, extensive monitoring of the secondary side was performed during the EPU power ascension. Major systems and components monitored included:

- High pressure turbine, low pressure turbine, main generator and exciter vibration,
- High pressure turbine, low pressure turbine, main generator and exciter bearing temperatures,
- High and low pressure turbine steam pressure and temperature,
- Moisture separator reheater (MSR) pressure and temperature,
- Turbine digital controls,
- Main generator gas temperatures,
- Turbine cooling water system performance,
- Condensate, main feedwater, and heater drain system pressure and temperature,
- Condensate, main feedwater, and heater drain pump performance,

- Feedwater heater performance,
- Heater drain valve performance,
- Main condenser performance,
- Main transformer performance,
- Isolated phase bus cooling performance, and
- Main generator electric output.

The BOP data collected during the EPU power ascension testing is too extensive to include in this summary report. The completed test procedure and all BOP data collected at the 89%, 92%, 95%, 98% and 100% EPU power plateaus are available for review on-site, if required. As indicated in the summary section below, there were very few deficiencies observed at the power plateaus and very few BOP parameters required evaluation.

BOP Walkdown

Balance of plant (BOP) walkdowns were performed during the 89%, 92%, 95%, 98% and 100% EPU power plateaus. The purpose of the walkdowns was to visually observe operation of accessible components during the power ascension. Multiple test personnel were used to accomplish the walkdowns and the test personnel discussed all observations and findings prior to power escalation. The corrective action program was utilized to document any walkdown findings or deficiencies. The following is a summary of the test deficiencies identified during the BOP walkdowns at the various power plateaus (note that piping and equipment vibration observations are discussed in the next subsection):

- 89% power – two deficiencies were noted. The first involved a higher than expected reading on the C phase of the isophase bus duct. However, alternate measurement concluded the issue to be an instrumentation issue. The second issue involved a lower than expected low pressure turbine inlet pressure. This condition was determined not to be a threat to power ascension and continued monitoring would be performed.
- 92% power – no additional test deficiencies were noted at this power level.
- 95% power – no additional test deficiencies were noted at this power level.
- 98% power – only one new test deficiency was noted at this power level. A turbine speed nuisance alarm was received from the new turbine control system. The equipment vendor evaluated the condition and determined that a setpoint change would resolve the nuisance alarms.
- 100% power – six minor issues were identified at the 100% EPU power plateau. The most significant was a lower than expected main feedwater pump suction pressure (10 psi low). However, sufficient margin (140 psi) was determined to exist between the measured value and the main feedwater pump low suction pressure trip. The remaining five items were not significant and were entered into the corrective action program for subsequent disposition.

Vibration Monitoring

The St. Lucie Unit 1 piping and equipment within the scope of the EPU vibration monitoring program were observed at several different plant operating conditions, namely the 89%, 92%, 95%, 98% and 100% EPU power plateaus. The first observations were conducted prior to the shutdown in which the EPU modifications were implemented. Data from these observations was used to develop the list of priorities and baseline data for observation during the EPU power escalation. By comparing the observed pipe vibrations / displacements at various power levels with previously established acceptance criteria, potentially adverse pipe vibrations were identified, evaluated and resolved. The following is a summary of the vibration observations at the various power plateaus:

- 89% power – the walkdowns identified two vibration issues that required further review. The first issue involved a previously identified vibration issue that was satisfactorily isolated. The second involved a degraded spring hanger that was evaluated for acceptability in the current mode of operation.
- 92% power – the walkdowns identified three new vibration issues of interest. The first involved a spring hanger bottomed-out on an auxiliary steam line, the second issue involved a piping segment that had a slight interference with a floor penetration, and the third issue involved a valve handwheel interfering with a handrail. Al three issues were subsequently evaluated as acceptable.
- 95% power – one new vibration point of interest was identified for further monitoring. This item was evaluated and did not impact power ascension to the 98% plateau.
- 98% power - one new vibration point of interest was identified for further monitoring. This item was evaluated and did not impact power ascension to the 100% plateau. A total of seven (7) low margin vibration items were captured at this point and were being tracked as part of the power ascension program.
- 100% power – all piping and equipment vibration points of interest and all thermal expansion/support issues were evaluated and deemed acceptable. A total of eight (8) low margin vibration items were captured at this point and would be inspected in the near future for any potential changes.
- Post-EPU inspection – a final piping and equipment vibration walkdown was conducted approximately ten (10) days after the 100% EPU power plateau was reached. All previously identified piping and equipment vibration points of interest and all thermal expansion/support issues remained acceptable. The eight (8) low margin vibration items were unchanged and deemed acceptable for continued operation.

Plant Radiation Surveys

Plant radiation surveys were taken at the 89% and 100% EPU power level. The plant radiation survey areas included portions of containment, the reactor auxiliary building, the fuel handling building, and the steam trestle, taking both accessibility and ALARA into consideration. Once the radiation survey information was obtained at the 89% and 100% EPU power level, a review of the data was performed by the plant Radiological Protection department and the following conclusions were reached:

- The radiation survey results were acceptable for 100% EPU power operation, and
- The radiological postings were adequate for 100% EPU power operation.

MTC Test at HFP

The magnitude of the moderator temperature coefficient (MTC) was measured in accordance with Technical Specification 4.1.1.4.2 with St. Lucie Unit 1 operating at the pre-EPU 100% power level (2700 MWt). This Technical Specification requires a measurement be performed within 7 effective full power days (EFPD) of achieving equilibrium full power conditions. The measured MTC magnitude of -4.83 pcm/°F was in very good agreement with a predicted value of -4.48 pcm/°F when corrected for boron concentration differences due to the difference in the time in life between the predicted exposure and the actual time of the performance of the test. The measured value of the MTC met all acceptance criteria limits. The measurement of the MTC was not required to be performed at the EPU 100% power level (3020 MWt).

Leading Edge Flowmeter (LEFM) Commissioning

As described in References 1 and 2, the St. Lucie Unit 1 EPU project included a 1.7% Measurement Uncertainty Recapture (MUR) thermal power increase. To achieve the MUR power increase of 1.7%, the Cameron Leading Edge Flow Meter (LEFM) CheckPlus™ ultrasonic flow measurement instrumentation was installed to improve feedwater flow measurement accuracy. An individual LEFM CheckPlus™ system flow element (spool piece) was installed in each of the two main feedwater lines and was calibrated in a site-specific model test at Alden Research Laboratories with traceability to National Standards. The LEFM CheckPlus™ system was installed and commissioned in accordance with FPL procedures and Cameron installation and test requirements. LEFM CheckPlus™ commissioning included verification of ultrasonic signal quality and evaluated the actual plant hydraulic velocity profiles as compared to those documented during the Alden Research Laboratories testing. Final verification of the site-specific uncertainty analyses occurred as part of the LEFM CheckPlus™ system commissioning process. The commissioning process provides final positive confirmation that actual performance in the field meets the uncertainty bounds established for the instrumentation.

Significant results were as follows:

- Confirmation was obtained from Cameron certifying that the LEFM CheckPlus™ was functioning in accordance with the performance requirements.
- The measured feedwater flow difference between the LEFM CheckPlus™ and the original plant venturi instrumentation was well within the acceptance criteria.
- The feedwater temperature difference between the LEFM CheckPlus™ and the plant temperature instrumentation was well within the acceptance criteria.
- The reactor power difference between the LEFM CheckPlus™ and the original plant venturi instrumentation was well within the acceptance criteria.

VIII. <u>Summary</u>

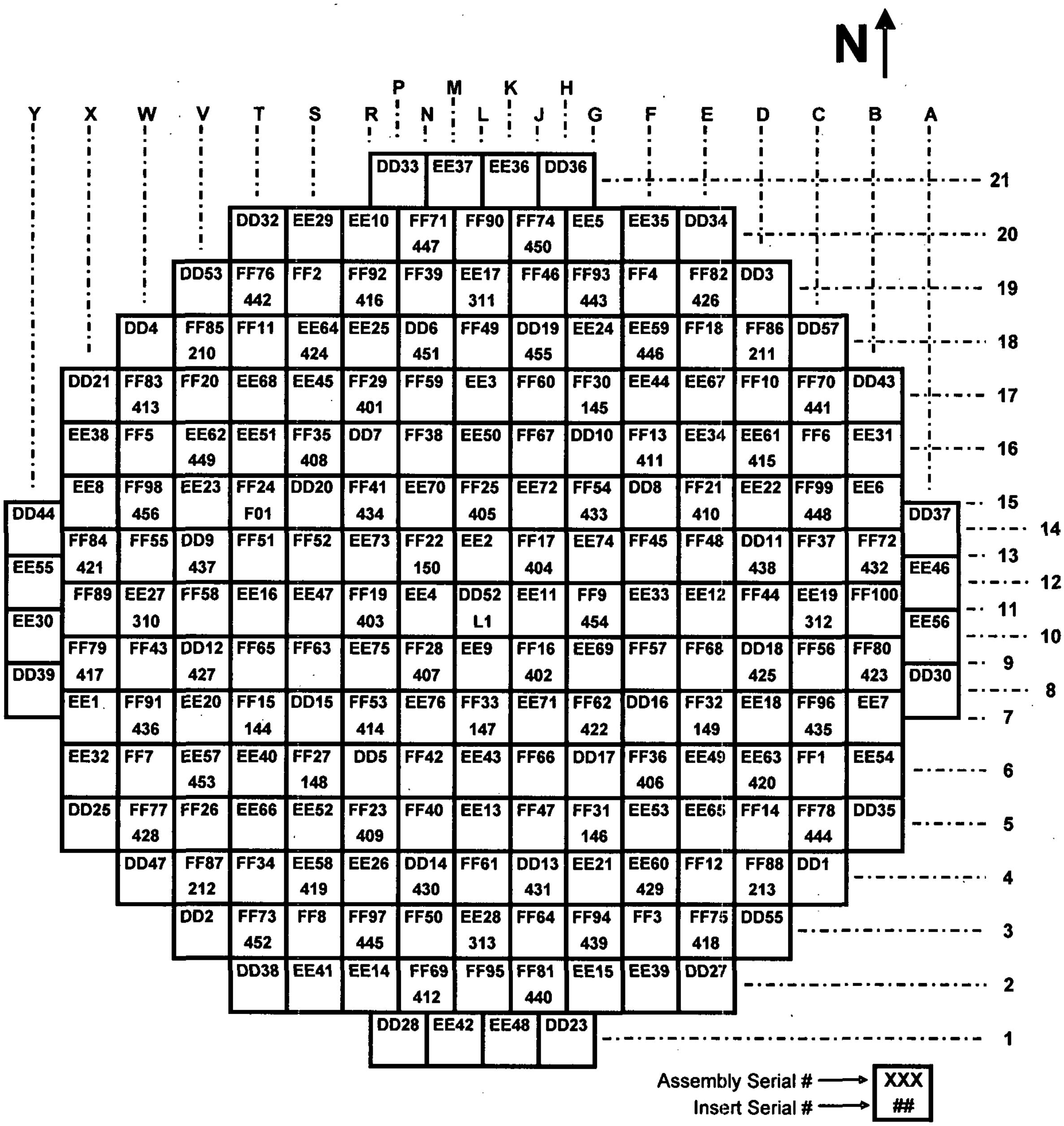
The test data collected during EPU startup and power ascension and summarized in this report concludes that all major systems, structures, and components (SSCs) performed as predicted and there was no adverse impact to the performance of the unit. The EPU startup and power ascension test data satisfied all acceptance criteria and demonstrated conformance to predicted performance. Copies of the completed EPU startup and power ascension test procedures are available on site for review.

VII. References

1) R. L. Anderson (FPL) to U.S. Nuclear Regulatory Commission (L-2010-259), "License Amendment Request for Extended Power Uprate," November 22, 2010 (Accession No. ML103560419).

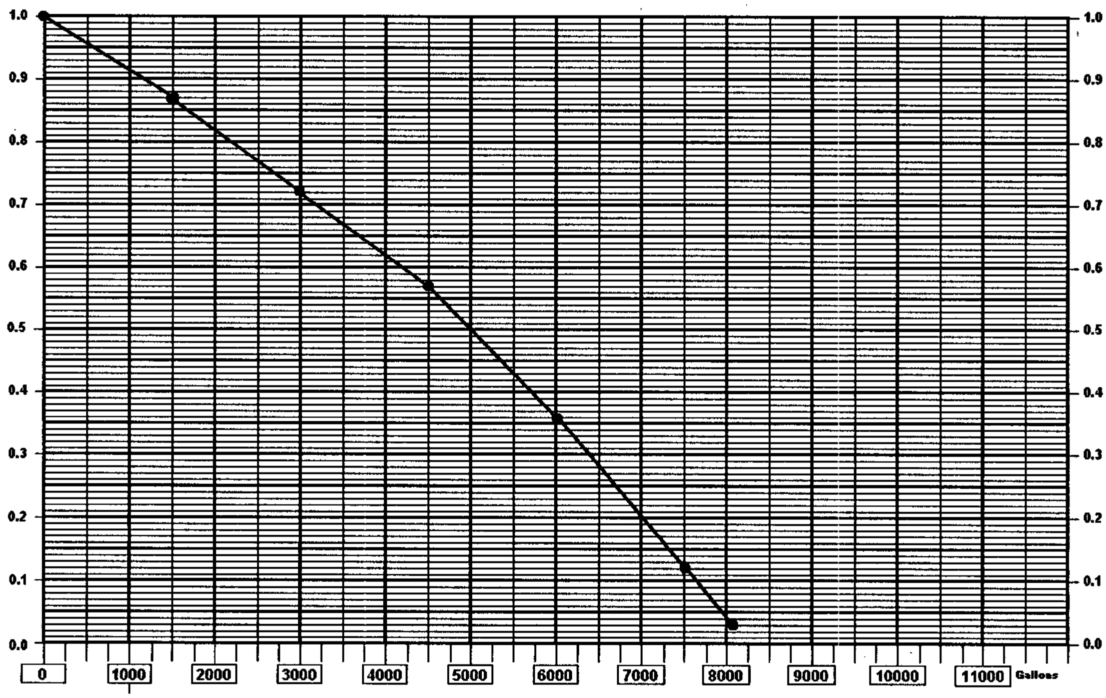
2) T. Orf (NRC) to M. Nazar (FPL), "St. Lucie Plant, Unit 1 – Issuance of Amendment Regarding Extended Power Uprate (TAC No. ME5091)", July 9, 2012 (Accession No. ML12156A208).

Figure 1
Cycle 24 - Core Loading Pattern



Cycle 24 - Boron Dilution Curve

Figure 2
Inverse Count Ratio Plot - Channel B



Cycle 24 - Boron Dilution Curve

Figure 3
Inverse Count Ratio Plot - Channel D

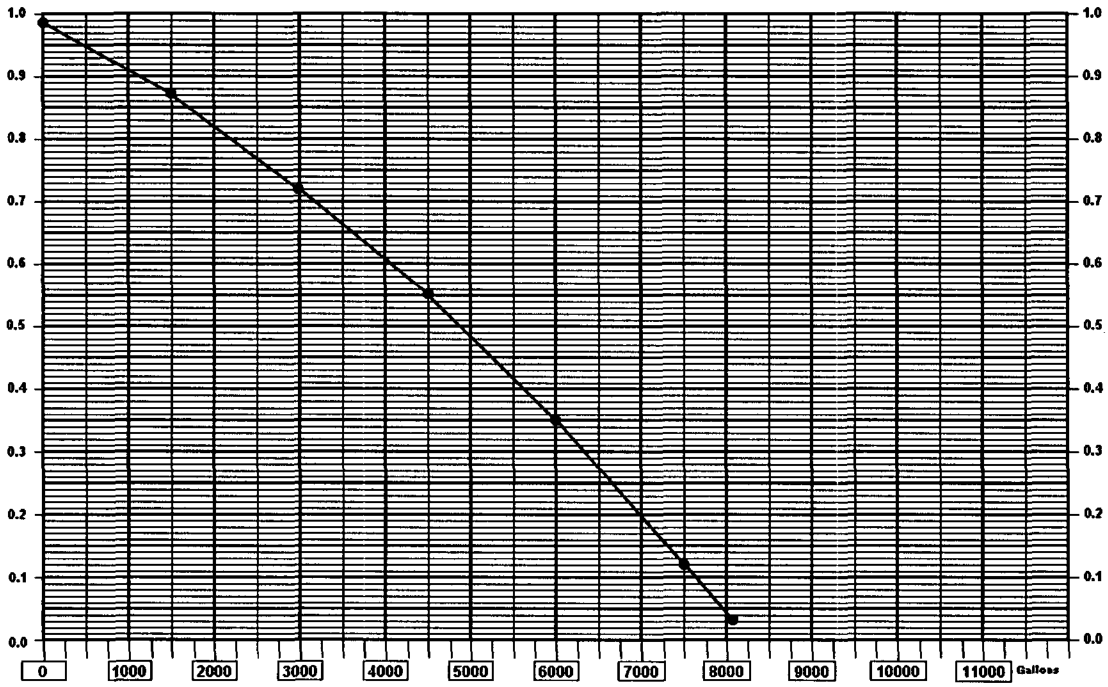
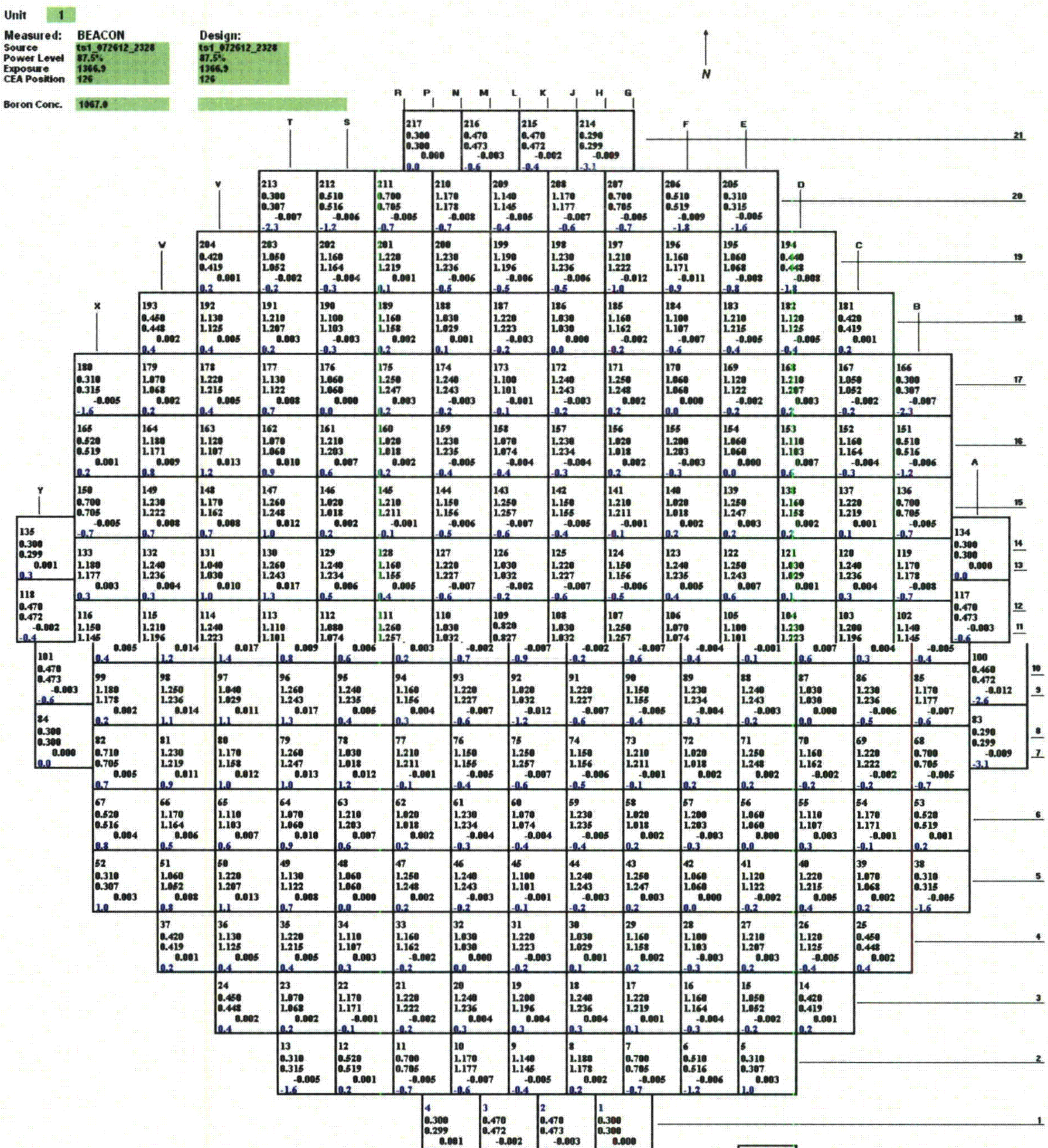


FIGURE 4

Cycle 24 - Power Distribution Comparison – 89% Power

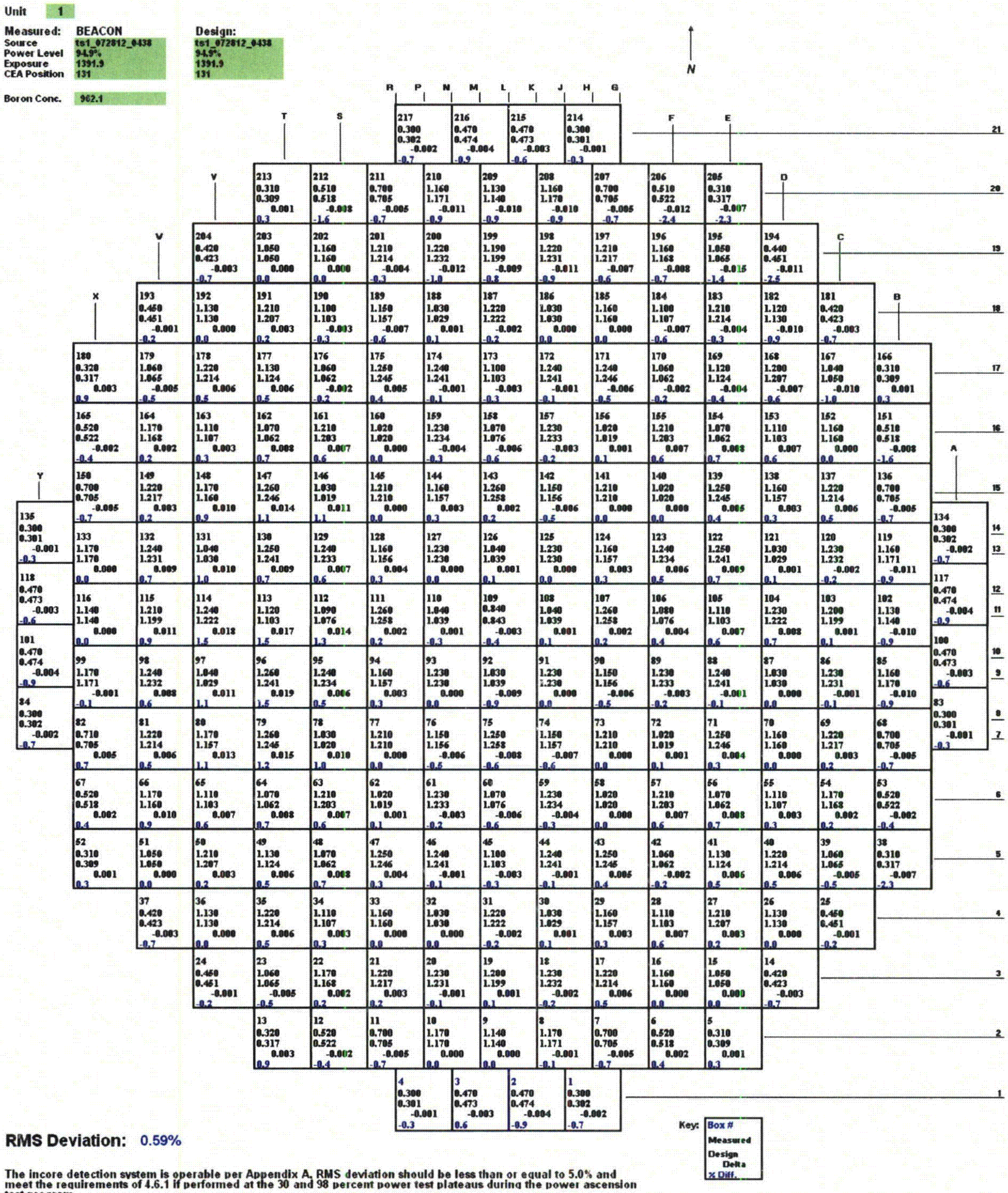


RMS Deviation: 0.58%

The incore detection system is operable per Appendix A. RMS deviation should be less than or equal to 5.0% and meet the requirements of 4.6.1 if performed at the 30 and 98 percent power test plateaus during the power ascension test program.

Figure 5

Cycle 24 - Power Distribution Comparison – 95% Power

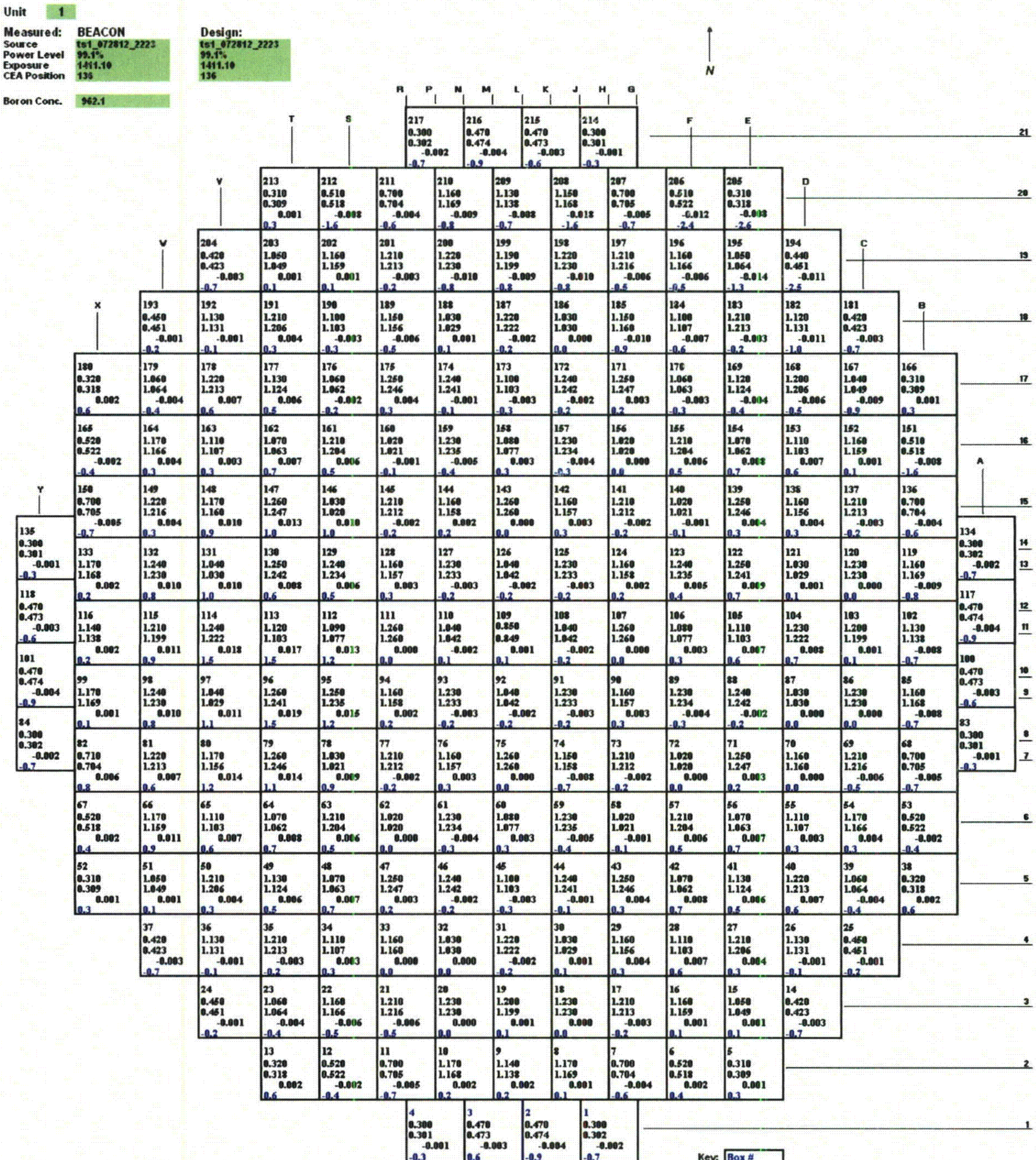


RMS Deviation: 0.59%

The incore detection system is operable per Appendix A. RMS deviation should be less than or equal to 5.0% and meet the requirements of 4.6.1 if performed at the 30 and 98 percent power test plateaus during the power ascension test program.

Figure 6

Cycle 24 - Power Distribution Comparison – 100% Power



RMS Deviation: 0.58%

The incore detection system is operable per Appendix A. RMS deviation should be less than or equal to 5.0% and meet the requirements of 4.6.1 if performed at the 30 and 98 percent power test plateaus during the power ascension test program.

Figure 7

Cycle 24 - RCS Temperature vs. Power