NEXTera ENERGY DUANE ARNOLD

June 10, 2009 NG-09-0442

Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
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Duane Arnold Energy Center
Docket 50-331
License No. DPR-49

Subject: Startup Test Report for Extended Power Uprate – Phase IV (Final Report)

In accordance with the Duane Arnold Energy Center (DAEC) Updated Final Safety Analysis Report (UFSAR), Revision 18, Section 1.8.16 commitments, NextEra Energy Duane Arnold, LLC, f/k/a FPL Energy Duane Arnold, LLC, hereby submits the Extended Power Uprate (EPU) Startup Test Report – Phase IV (Final Report). This report summarizes the startup testing performed on the DAEC over the period from March 23, 2009 to March 30, 2009. The results of the final testing and data gathering demonstrated successful operation at the licensed power level of 1912 MWt, as described in the enclosed report. This completes the testing program for EPU at the DAEC.

This letter contains no new commitments and no revisions to existing commitments.

Sincerely,

Richard L. Anderson
Vice President, Duane Arnold Energy Center
NextEra Energy Duane Arnold, LLC

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, Duane Arnold Energy Center, USNRC
Resident Inspector, Duane Arnold Energy Center, USNRC

Enclosure to
NG-09-0442
June 10, 2009

DUANE ARNOLD ENERGY CENTER

EXTENDED POWER UPRATE

STARTUP TEST REPORT

PHASE – IV (Final Report)

May, 2009

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Duane Arnold Energy Center
Extended Power Uprate
Startup Test Report
Phase – IV (Final Report)

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1.0 Executive Summary

The Duane Arnold Energy Center (DAEC) Extended Power Uprate (EPU) Startup Test Report is submitted to the Nuclear Regulatory Commission (NRC) in accordance with regulatory commitments contained in the DAEC Updated Final Safety Analysis Report (UFSAR), Section 1.8.16. The report summarizes the startup testing performed as part of the implementation of EPU. EPU was approved by the NRC in Operating License Amendment No. 243 on November 6, 2001.

DAEC was previously licensed to operate at a maximum reactor power level of 1658 MWt. The result of EPU is a licensed power increase of 15.3% to a new maximum of 1912 MWt. The DAEC is implementing the EPU in planned phases that support a schedule for the necessary modifications needed to achieve the full EPU. The current phase, Phase IV, has a target power level of 1912 MWt, the licensed power level, which represents a 1.7% increase in thermal power over the Phase III power level of 1880 MWt. It should be noted that several new equipment modifications were required to achieve the Phase IV power level, including new a Main Transformer, Iso-phase bus duct cooling system, and new Feedwater pump impeller ("B" pump only).

All testing specified in the DAEC UFSAR Section 14.2 has been addressed and evaluated for applicability to EPU (Ref. 2). Special test procedures were written and implemented in combination with existing surveillance test procedures, as described in this report. All required tests were completed up to the target power of 1912 MWt. Testing was conducted over the period from March 23, 2009 to March 31, 2009. Test results were reviewed by an Expert Panel for acceptability. The final results of the testing and data gathering demonstrated successful operation at the Phase IV target power level of 1912 MWt, the licensed power level. This concludes the EPU program at the DAEC.

2.0 Purpose

In accordance with UFSAR Section 1.8.16 requirements, this report summarizes the testing performed following the implementation of the DAEC EPU, approved as Amendment #243 to Operating License DPR-49. While Amendment # 243 approved a new licensed thermal power limit of 1912 MWt, an increase of 15.3%, the implementation of the EPU is being conducted in planned phases. This report summarizes the testing performed as part of Phase IV, which resulted in a steady-state operating thermal power of 1912 MWt (the licensed power level), a 1.7% increase in thermal power over the Phase III power level of 1880 MWt. Each test performed is described in Section 6.0 of this report.

3.0 Program Description

The EPU startup testing program requirements were developed primarily from:

- Review of the original startup testing program, as described in UFSAR Section 14.2;
- Section 10.4 of the DAEC Power Uprate Safety Analysis Report (PUSAR), NEDC-32980P;
- General Electric (GE) Uprate Test Program recommendations.

The in-plant testing was begun on March 23, 2009 and was completed on March 31, 2009. The results of the testing verified the unit's ability to operate at the Phase - IV target power level of 1912 MWt.

All startup testing specified in UFSAR Section 14.2 has been evaluated for applicability to the EPU testing program (Ref. 2). Special Test Procedures (SpTPs) were written to coordinate and control the startup testing program. Where possible, the testing program took credit for existing Surveillance Test Procedures (STP).

The majority of the testing falls within the following categories:

- Verification that the control systems (i.e., Condensate and Feedwater and EHC-Pressure Regulation) are stable at uprated conditions.
- Collection of system performance data to verify modifications made to support EPU operation were performing as expected.
- Collection of general plant data (i.e., radiation surveys, coolant chemistry, thermal performance) for comparison to previous plant rated conditions.

Table 2 presents the Test Conditions at which startup testing was performed in Phase IV. Reactor core flow could be any flow within the safe operating region of the power/flow map (Figure 1) that will produce the required power level. Testing at a given power level was completed and thoroughly reviewed prior to proceeding to the subsequent Test Condition. Test results were reviewed by an Expert Panel, a multi-disciplinary group, chaired by the Assistant Operations Manager, who made the recommendation to the Operations Manager to continue; the On-site Review Group (ORG)[1] reviewed that recommendation, and the Plant Manager gave final approval that it was acceptable to increase power and proceed to the next Test Condition.

4.0 Acceptance Criteria

For each recommended test, individual test abstracts will define the purpose of the test, the appropriate test conditions and the associated acceptance criteria.

Test criteria for each test have up to two levels of importance. The criteria associated with plant safety are classified as Level 1. The criteria associated with design expectations are classified as Level 2.

1. Level 1 Variable or Criteria

   Data trend, singular value, or information relative to a Technical Specifications margin and/or plant design in a manner that requires strict observance to ensure the safety of the public, safe operation of the plant, continued operation at power, worker safety, and/or equipment protection.

   Failure to meet Level 1 criteria constitutes failure of the specific test. The plant must be placed in a safe condition, based upon prior testing, until the problem is resolved, and the test is satisfactorily repeated, if necessary.

2. Level 2 Variable or Criteria

   Data trend, singular value, or information relative to optimizing system or equipment performance that does not fall under the definition of Level 1 criteria.

   Level 2 criteria do not constitute a test failure or acceptance; they serve as information only. It is not required to repeat a test due to a Level 2 criterion failure.

5.0 EPU Startup Test Program Summary

Post-modification testing was performed as part of startup from RFO21 on March 5, 2009 and baseline data was collected after power ascension to the previous Phase III steady state power level of 1880 MWt (Ref. 1). It should be noted that

[1] The DAEC ORG is similar to other licensee's Plant Operating Review Committee (PORC).

several new equipment modifications were required to achieve the Phase IV power level, including a new Main Transformer, Iso-phase bus duct cooling system, and new Feedwater pump impeller ("B" pump only).

One modification was of special note. Changes were made to the Reactor Recirculation System (RRS) to allow operation above 100% rated core flow (Increase Core Flow (ICF)). Engineering evaluations had been performed to justify operation up to 105% of rated core flow (51.45 Mlb/hr) (Ref. 5), provided RRS equipment remained within their specific design ratings. Prior to beginning EPU testing, post-modification testing at > 100% rated core flow was conducted to evaluate the plant response, in particular, various RRS equipment parameters and reactor process variables, such as pump speed, motor voltage/current, vibration, bearing temperatures, etc. (Note: reactor thermal power was not allowed to exceed the Phase III reactor power level (1880 MWt).) ICF testing was conducted on March 19, 2009. The limiting parameter was found to be recirculation pump speed (design value = 1710 rpm). No equipment anomalies were noted and plant procedures were revised to allow ICF.

Operational baseline data at 1880 MWt was evaluated and sufficient margin was available to allow a power level increase up to the target Phase IV level of 1912 MWt. The EPU Phase IV test program was begun on March 23, 2009.

Because of specific plant operating conditions above 1880 MWt, the Expert Panel had placed specific additional acceptance criteria on power ascension and testing beyond that specified in the startup test program description. Specifically, two key areas were highlighted:

1. Concerns with tight operating margins on the feedwater heater drain system caused the additional criterion of *any* feedwater heater dump valve opening as cause to abort the power ascension and testing.
2. Noticeable vibrations in small bore piping in the Feedwater and Condensate Systems identified in Phase III, were a focal point in Phase IV. Specific acceptance criteria were created for the identified sections of piping. Monitored vibration levels above these criteria were also cause to abort power ascension and testing, pending further engineering evaluations.

Corrective Action Program (CAP) documents were to be initiated to document any identified issues and the resulting corrective actions taken.

On March 23, 2009, power ascension and testing at 1880 MWt was satisfactorily completed. The Expert Panel made the recommendation to the ORG and subsequently to the Plant Manager to raise power to Test Condition 2 (1900 MWt) and continue testing. Power ascension and testing at 1900 MWt commenced on March 24, 2009 and concluded on March 25, 2009. No significant issues were identified at 1900 MWt and authorization was given to proceed to the final target power level of 1912 MWt. On March 26, 2009, power ascension and testing at 1912 MWt was satisfactorily completed.

The Expert Panel review of the last set of data at Test Condition 3 (1912 MWt) was concluded on March 30, 2009 and the formal recommendation to the Operations Manager, ORG, and Plant Manager regarding continued steady state operation at the Phase IV target power level of 1912 MWt was made. Plant Manager concurrence was given to remain at 1912 MWt.

As discussed in Section 6.1, based upon review of test data at lower power levels, the test matrix at higher power was simplified and some test steps were not performed, as they would not have provided useful data.

The completed testing at the Phase IV target power level of 1912 MWt demonstrated stable plant operation. Changes in plant chemistry and radiological conditions were minor, vibration measurements of main steam and feedwater piping were acceptable, and no plant equipment anomalies were noted.

6.0 Testing Requirements

Each of the Startup tests discussed in UFSAR Section 14.2 has been evaluated for applicability to EPU (Ref. 2). Pre-operational tests used to confirm construction of systems were per design are excluded and not discussed further. Several tests performed in EPU Phase I were not required to be re-performed in Phase IV (Ref. 2). Throughout the following discussion, the test numbers and titles are consistent with the original Startup Test Specification.

Section 6.1: This section identifies each Section 14.2 test required to be performed for EPU. The purpose of the test, a description of the test, Acceptance Criteria, and the test results are included.

Section 6.2: This section identifies additional test/data collection that was performed to assess the performance of the unit at EPU conditions. The purpose of the test, a description of the test, and the test results are included.

Section 6.3 This section identifies additional activities conducted based upon recommendations from industry operating experience with EPU.

Table 1 identifies the tests/activities conducted as part of Phase IV. Table 2 presents the Test Conditions for Phase IV.

UFSAR Section 14.2 Tests Required for EPU- Phase IV

6.1.1 Test No. 1 – Chemical and Radiochemical Monitoring

Purpose: The purpose of this test is to maintain control of and knowledge about the quality of the reactor coolant chemistry and radiochemistry at EPU conditions.

Description: Samples were taken and measurements were made at the uprated conditions to determine 1) the chemical and radiochemical quality of reactor water and reactor feedwater and 2) gaseous release.

Test Conditions: 1, 2, and 3

Acceptance Criteria:

Level 1: a) Chemical factors defined in the Technical Specifications, Fuel Warranty, and Technical Requirements Manual are maintained within the limits specified.
b) The activity of gaseous and liquid effluents conforms to license limitations.

Level 2: Water quality is known at all times and remains within the guidelines of the water quality specifications.

Results: All Acceptance Criteria were met at all Test Conditions. No abnormalities were observed.

6.1.2 Test No. 2 – Radiation Monitoring

Purpose: The purpose of this test is to monitor radiation at the EPU conditions to assure that personnel exposures are maintained ALARA, that radiation survey maps are accurate and that radiation areas are properly posted.

Description: Gamma dose rate measurements and, where appropriate, neutron dose rate measurements were made at specific limiting locations throughout the plant to assess the impact of EPU on actual plant area dose rates. UFSAR radiation areas will be monitored for any required posting changes.

Test Conditions: 1, 2, and 3

Acceptance Criteria:

Level 1: The radiation doses of plant origin and the occupancy times of personnel in radiation areas shall be controlled consistent with the guidelines of The Standard for Protection Against Radiation outlined in 10CFR20.

Level 2: Not Applicable.

Results: Radiation surveys were conducted with hydrogen water chemistry in service. The general plant dose rates were comparable to those experienced at the previous (Phase III) power level. Radiation dose rates remain compliant with all applicable regulatory limits.

6.1.3 Test No. 19 – Core Performance

Purpose: The purpose of this test is to measure and evaluate the core thermal power and fuel thermal margin to ensure a careful, monitored approach to the EPU level.

Description: Core thermal power was measured using the current plant methods of monitoring reactor power. Demonstration of the fuel thermal margin was performed and was projected to the next test condition to show expected acceptance margin and was satisfactorily confirmed by the measurements taken at each test condition before advancing further.

Test Conditions: 1, 2, and 3

Acceptance Criteria:

Level 1: a) Average Planar Linear Heat Generation Rates (APLHGR) shall be less than or equal to the limits specified in the Core Operating Limits Report (COLR).
b) Minimum Critical Power Ratios (MCPR) shall be greater than or equal to limits specified in the COLR.
c) Maximum Linear Heat Generation Rate (LHGR) shall be less than or equal to the limits specified in the COLR.
c) Steady-state reactor power shall be limited to values on or below the Maximum Extended Load-Line Limit Analysis (MELLLA) upper boundary.
d) Core flow shall not exceed its rated value.
Note: as a result of ICF evaluations and testing, this criterion was revised to "Core flow shall not exceed 105% of rated (51.45 Mlb/hr)."

Level 2: Not Applicable.

Results: Per normal operating practices, thermal limits are continuously monitored during power ascensions. Specific core monitoring cases were performed at the specified Test Conditions. Projections at the next Test Condition were made to determine if adjustments in control rod position would be necessary to maintain thermal limits within Acceptance Criteria. By adjusting the control rod patterns in the core, the Acceptance Criteria were met at all power levels.

6.1.4 Test No. 22 – Pressure Regulator

Purpose: The purposes of this test are to:

a) confirm the adequacy of the setting for the pressure control loop used in the analysis of the transients induced in the reactor pressure control system using the pressure regulators,
b) demonstrate the takeover capability of the backup pressure regulator upon failure of the controlling pressure regulator and to set spacing between the setpoints at an appropriate value,
c) demonstrate smooth pressure control transition between the control valves and bypass valves when reactor steam generation exceeds steam used by the turbine, and
d) demonstrate that other affected parameters are within acceptable limits during pressure regulator induced transient maneuvers in preparation for operation at uprated conditions.

Description: The pressure regulator system tuning was verified to be within the guidance of Service Information Letter (SIL) 589, "Pressure Regulator Tuning."

The backup regulator test was not required to be performed in Phase IV, as the maximum power level for this test (1540 MWt) was reached in Phase I.

During testing, step changes in reactor pressure, of increasing magnitude (±1 to 2 psi, ±3 to 4 psi, ±5 to 6 psi, ± 7 to 8 psi, and ±9 to 10 psi), were simulated, and the resulting transients were recorded. The data for each step change were analyzed for acceptable performance and scram margins prior to performing the next increased pressure step change. Step changes were first performed with pressure regulator "A" in control and second with pressure regulator "B" in control.

Test Conditions: 1 and 3

Acceptance Criteria:

Level 1: The transient response of the turbine inlet (throttle) pressure to any test input must not diverge.

Level 2: a) The decay ratio of the turbine inlet (throttle) pressure must be less than or equal to 0.25. (This criterion does not apply to tests involving simulated failure of one regulator with the backup regulator taking over.)
b) The pressure response time from initiation of pressure setpoint change to the turbine inlet (throttle) pressure peak shall be less than 10 seconds.
c) Pressure control system deadband, delay, etc., shall be small enough that steady state limit cycles (if any) shall produce steam flow variations no larger than ± 0.5 percent of rated steam flow.
d) The peak neutron flux and peak vessel pressure shall remain below the scram settings by 7.5 percent and 10 psi, respectively, for all pressure regulator transients.
e) The variation in incremental regulation, over the range from approximately 10% to 100% of rated core thermal power, shall meet the following:

Percent Steam Flow	Variation
0% to 85%	< 4 : 1
85% to 97%	< 2 : 1
97% to 99%	< 5 : 1

Results: All test steps were completed at Test Conditions 1 and 3 using the "A" regulator. At Test Conditions 1 and 3, test steps of ±1 to 2 psi, ±5 to 6 psi, and ±9 to 10 psi, using the "B" regulator, were performed. Reduced testing of the "B" regulator was done, given its confirmatory nature, i.e., the "B" regulator is the back-up regulator. In addition, previous testing demonstrated fidelity of response between the "A" an "B" regulators.

All Level 1 and Level 2 Acceptance Criteria were satisfied. The system response to step changes at each power level was satisfactory. No signs of divergence occurred. Pressure response time and margins to scram setpoints were adequate in all test cases. System linearity was confirmed.

6.1.5 Test No. 23 – Feedwater System

6.1.5.1 Test No. 23C – Feedwater Control System (Step Changes in Level)

Purpose: The purposes of this test are to adjust the feedwater control system for acceptable reactor water level control and to demonstrate stable reactor response to subcooling changes.

Description: Small step changes in reactor water level (±1, ±2, ±3, and ±5 inches) were inserted to evaluate level control stability and any oscillatory response. These step changes were performed in both "A" and "B" Level Control and each set in both single-element and three-element control. A total of 32 level setpoint change tests were planned at each Test Condition. System responses (steamflow, feedflow and vessel water level) were monitored for overall stability.

Small step changes in system flow were introduced by making level adjustments (±1 and ±2 inches) with the Master Feedwater Regulating Valve (FRV) in Automatic, and one individual FRV controller in Automatic and the other FRV controller in Manual. The tests were repeated with the individual FRV controller settings reversed. A total of 8 system flow tests were planned at each Test Condition. System responses (steamflow, feedflow and vessel water level) were monitored for overall stability.

Test Conditions: 1 and 3

Acceptance Criteria:

Level 1: The transient response of any feedwater level control system related variable to any test input must not diverge.

Level 2: a) Level control system-related variables may contain oscillatory modes of response. In these cases, the decay ratio for each controlled mode of response shall be less than or equal to 0.25.

b) Following a ± 3 inch level setpoint adjustment in three element control, the time from the setpoint change until the level peak occurs shall be less than 60 seconds without excessive feedwater swings (changes in feedwater flow greater than 25% of rated flow).

Results: Based upon previous test results, the test matrix was simplified at Test Conditions 1 and 3 by omitting all the ± 5 inch level setpoint change tests. Also, the "B" three element and single element level control tests for the ±1, and ±2 inch level setpoint change tests were omitted, i.e., only the ±3 inch test was performed, as it has the explicit Level 2 acceptance criterion. Similarly, for the "A" controller, single element tests, only the ±3 inch tests were performed.

All tests performed met the Acceptance Criteria. At no time was unstable control system behavior observed and response time was within the 60-second criterion.

6.1.5.2 Test No. 23D – Feedwater Flow Element Calibration

Purpose: The purpose of this test is to confirm acceptable calibration of the feedwater flow elements at uprated power conditions.

Description: In order to verify accurate feedwater flow input to the process computer, feedwater flow data from the flow elements will be compared against known flow source information (i.e., the ultrasonic flow meter).

Test Conditions: 1 and 3

Acceptance Criteria:

Level 1: Not Applicable.

Level 2: The accuracy of the feedwater flow venturi indication relative to the calibrated flow information shall be within acceptable tolerance for flow rates between 20 and 125 percent rated. The process signal noise shall be within acceptable tolerance of rated flow.

Results: The venturies were within the required tolerances at each Test Condition. No anomalies were observed.

6.1.6 Test No. 25E – Main Steam Flow Element Calibration

Purpose: The purpose of this test is to confirm acceptable calibration of the main steam flow elements at uprated power conditions.

Description: In order to verify accurate steam flow input to the process computer, steam flow data from the flow elements will be compared against known flow source information.

Test Conditions: 1 and 3

Acceptance Criteria:

Level 1: Not Applicable.

Level 2: The accuracy of the main steamline flow venturi relative to the calibrated feedwater flow shall be within ± 5 percent of rated steam flow at flow rates between 20 and 125 percent rated. The process signal noise shall be within ± 5 percent of rated steam flow.

Results: The main steamline flow venturies were within the required tolerances at each Test Condition. No anomalies were observed.

6.2 Additional Tests

6.2.1 Steady-State Data Collection

Purpose: To obtain steady-state data of important plant parameters during EPU operation.

Description: Plant parameters, both Nuclear Steam Supply System (NSSS) and Balance of Plant (BOP) were recorded at various Test Conditions and evaluated for anomalous behavior prior to increasing power to the next Test Condition.

Test Conditions: 1, 2, and 3

Results: This data was gathered during early Spring conditions which can cycle between low ambient temperature and warmer temperatures and various humidity on a daily basis, which can make trending of data difficult. Specifically, the environmental conditions can overshadow the plant response to the increases in power level.

Review of the steady-state plant data did not identify any anomalous behavior, when the ambient conditions were considered.

6.2.2 Power Conversion System Piping Vibration Monitoring

Purpose: The purpose of this test is to gather vibration and displacement measurements on the Main Steam and Feedwater (FW) system piping to evaluate the vibration stress effect due to the EPU.

Description: During the EPU power ascension, locations on Main Steam and Feedwater piping, coincidental with those in the initial startup vibration measurements report or evaluated as representative of the piping system, were monitored for vibration. Vibration measurements taken above that of the previous Test Condition will permit a thorough assessment of the impact of EPU.

Subsequent to Phase I, additional vibration monitoring points and associated acceptance criteria were generated for the Feedwater system piping. Specifically, nine additional monitoring points were added on the FW pump discharge piping and FW Regulating Valve areas.

Screening criteria (frequency and magnitude) are established for evaluating the vibration data. If the "Negligible" values in the screening criteria are exceeded, engineering evaluation of the data is required.

Test Conditions: 1, 2, and 3

Results: After startup from RFO21, one of the original 38 sensors on the Main Steam and FW piping systems (XVE44105) began to exhibit excessive noise and its data was discounted. At Test Condition 3, a second sensor (XVE44127) began to exhibit poor data quality as well. The loss of data from these 2 sensors was evaluated and determined to not impact the overall ability to monitor for excessive piping vibration.

It should be noted that during Phase IV of EPU, modifications were made to the "B" Feedwater pump and motor to allow for a higher feedwater flow capability necessary to achieve the target power level of 1912 MWt, with the required flow margin. The change in pump characteristics, in particular pump vane passing frequency, was known to impact the vibration characteristics of the piping systems. Thus, this piping was targeted for monitoring as part of post-modification testing of this modification. Results of this monitoring follow:

During vibration monitoring during previous test conditions (1880 MWt), the 3-inch condensate reject line (GBD-013) was observed as having high vibration. Engineering evaluation determined that the measured vibration value on this piping was 71% of the allowable. Thus, this line was targeted for Phase IV monitoring. At the Phase IV Test Conditions 1, 2 and 3, the measured vibrations were 54%, 63% and 84% of allowable, respectively. No further action is warranted, as adequate margin remains at 1912 MWt.

All the remaining Main Steam and Feedwater piping vibration monitoring points were within the "negligible" criterion and no further evaluation was required.

6.2.3 General Service Water (GSW) Heat Exchanger Performance Monitoring

Purpose: To gather data on GSW system performance to optimize cooling capacity to individual components.

Description: Obtain GSW flow (ultrasonic), GSW inlet temperature (contact pyrometer), GSW outlet temperature, and throttle valve positions for various component heat exchangers. The GSW system piping was replaced for EPU with piping of a larger size to increase the cooling to critical components, such as generator stator hydrogen cooling. This testing was to confirm adequate cooling and to provide data for further system balancing (i.e., optimize cooling to critical components.)

Test Conditions: 1 and 3

Results: As noted earlier, this testing was performed during early Spring conditions, with daily fluctuations in both ambient temperature and humidity. These ambient effects overwhelm the changes due to the power level increases and making trending from one test condition to the next meaningless. The Expert Panel did review the individual data sets at each test condition and did not identify any areas of concern.

6.3 Industry Operating Experience with EPU

6.3.1 Steam Dryer Inspections and On-line Monitoring (SIL 644, Rev. 1)

While not part of the formal EPU Startup Test Program, the results of the steam dryer inspections and subsequent on-line monitoring of moisture carryover is a key attribute of demonstrating safe and reliable steam dryer operation at uprated power levels. Service Information Letter (SIL) 644, Rev. 1 provides the latest recommendations for performing these inspections and on-line monitoring.

Steam dryer inspections were conducted, per the SIL, during RFO21. These inspections did not find any major problems, only minor indications were found as described below.

The inspection documented one area of local deformation (rolled material), likely from handling of the dryer. The plastically deformed (rolled) material is located at the lower right corner of the 0° upper guide. The damage is structurally insignificant, and will have no effect on the upper guide function.

The inspection documents a crack-like indication around the entire perimeter of the Tie Bar 4 to baffle plate weld. The indication follows the toe of the weld (on the baffle plate side), which is characteristic of a fatigue mechanism. The weld is still maintaining alignment across the indication, and providing structural support to this location of the upper edge of the plate. This location will be targeted for inspection and potential repair during the next refuel outage.

The visual inspection of the lower guide at 0° and at 180° was performed. The torn weld and bent gusset plate on the 0° lower guide are unchanged from the condition reported in RFO18. This condition was evaluated and accepted for continued operation. The reported damage will have no impact on the lower guide function and will not result in any loose parts. A deformed (bent) lower gusset on the left side of the 180° lower guide was also previously reported. The cold work associated with this deformation may result in future IGSCC, but based on previous BWR experience this is unlikely to result in any loose parts or loss of function.

In addition, the indications identified by the inspections performed during RFO20 were specifically re-inspected and evaluated during RFO21. None of the previous indications were found to have propagated further.

A Justification for Continued Operation (JCO) was prepared that concluded plant startup and operation with the existing dryer cracking was acceptable for the upcoming (i.e., current) operating cycle. The DAEC dryer will be re-inspected during the next refuel outage, currently scheduled for Fall, 2010.

On-line moisture carryover measurements were conducted at Test Conditions 1, 2, and 3 as part of Phase IV testing activities. There is no significant increasing trend (statistically or qualitatively) in this moisture carryover data, thus there is no indication of steam dryer damage (per the guidelines of SIL 644, Rev. 1, Appendix D). Periodic monitoring will continue during the remainder of this operating cycle.

7.0 References

1. FPL Energy Duane Arnold letter, "Startup Test Report for Extended Power Uprate – Phase III," NG-05-0516, September 29, 2005.

2. NMC letter, "Response to Request for Additional Information Regarding License Amendment Request (TSCR – 056): "Elimination of License Condition 2.C(2)(b) for Performance of Large Transient Tests for Extended Power Uprate," NG-04-0478, August 9, 2004.

3. NRC letter, "Duane Arnold Energy Center – Issuance of Amendment Re: License Amendment Request TSCR-056, Modify License Condition 2.C.(2)(b) to Eliminate Main Steam Isolation Valve Closure Test for Extended Power Uprate (TAC No. MC2320)," March 17, 2005.

4. NRC letter, "Duane Arnold Energy Center - Issuance of Amendment Regarding License Amendment Request TSCR-056 to Modify License Condition 2.C.(2)(b) to Eliminate the Requirement to Perform Generator Load Rejection Large Transient Testing (TAC NO. MD2835)," September 20, 2007.

5. GEH Report, "Safety Analysis Report for Duane Arnold Energy Center Increased Core Flow," NEDC-33439P, Revision 2, January 2009.

Table 1

Test Matrix – Phase IV

Test No.	Test Title	Test Conditions (% of OLTP – 1593 MWt)		
		118.0	119.3	120.0
		1880 MWt	1900 MWt	**1912 MWt**
1	Chemical and Radiochemical Monitoring	X	X	X
2	Radiation Monitoring	X	X	X
19	Core Performance	X	X	X
22	Pressure Regulator			
	c) Step Changes in Pressure	X		X
23	Feedwater System			
	c) Step Changes in Level	X		X
	d) FW Flow Element Calibration	X		X
25	Main Steam Isolation Valves			
	e) Flow Element Calibration	X		X
27	Turbine Stop and Control Valve Trips			(a)
	General Plant Data Collection	X	X	X
	Steam and Feedwater Piping Vibration Monitoring	X	X	X
	General Service Water (GSW) Heat Exchanger Performance Monitoring	X		X
	Steam Dryer Inspections and On-line Monitoring (SIL 644, Rev. 1)	X(b)	X	X

(a) Per License Amendment # 266, this test is no longer required to be performed. (Reference 4)
(b) Steam Dryer Inspections were conducted during RFO21. On-line monitoring only was conducted as part of Phase IV testing.

Table 2

Test Conditions – Phase IV

Test Condition	Thermal Power (MWt)	% of Current Licensed Power Level (1912 MWt)	% of Original Rated Thermal Power (1593 MWt)
1	1880	98.3	118.0
2	1900	99.4	119.3
3	1912	100.0	120.0

Figure 1
DAEC Power/Flow Operating Map for EPU