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An Exelon/British Energy Company

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

Clinton Power Station, Unit 1
Facility Operating License No. NPF-62
NRC Docket No. 50-461

Subject: Power Uprate Ascension Test Report for Clinton Power Station, Unit 1

References: (1) Letter from J. M. Heffley (AmerGen Energy Company, LLC) to U. S. NRC, "Request for License Amendment for Extended Power Uprate Operation," dated June 18, 2001

(2) Letter from U. S. NRC to O. D. Kingsley (Exelon Generation Company, LLC), "Clinton Power Station, Unit 1 – Issuance of Amendment (TAC NO. MB2210)," dated April 5, 2002

In Reference 1, AmerGen Energy Company (AmerGen), LLC submitted a request for changes to the operating license and Technical Specifications for Clinton Power Station (CPS), Unit 1, to allow operation at uprated power levels. As stated in Reference 1, the power uprate at CPS will be implemented over two refueling outages. The first phase of implementation was completed as part of the Spring 2002 refueling outage and the second phase of implementation will be completed as part of the next refueling outage in 2004. The NRC approved this request for CPS in Reference 2.

In Reference 1, AmerGen committed to provide a summary of the power ascension testing conducted during implementation of the power uprate. The attachment to this letter provides this test summary for Phase 1 of the power ascension testing. A supplemental test summary will be provided following completion of the second phase of power ascension testing.

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Should you have any questions related to this letter, please contact Mr. Timothy A. Byam at (630) 657-2804.

Respectfully,

T. W. Simpkin
Manager – Licensing

Attachment: Clinton Power Station, Unit 1 Extended Power Uprate Power Ascension Test Report

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Clinton Power Station
Office of Nuclear Facility Safety – Illinois Department of Nuclear Safety

Attachment

Clinton Power Station, Unit 1
Extended Power Uprate
Power Ascension Test Report

Clinton Power Station, Unit 1
Extended Power Uprate
Power Ascension Test Report

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1.0 EXECUTIVE SUMMARY

The Clinton Power Station (CPS) Unit 1 extended power uprate (EPU) startup test report is prepared in accordance with commitments contained in Section 10.4, "Required Testing," of the Safety Analysis Report that accompanied the CPS EPU amendment request (Reference 1). This report summarizes the startup testing performed at CPS Unit 1 following implementation of EPU. EPU was implemented in accordance with Amendment No. 149 to Facility Operating License No. NPF-62, which the NRC approved in Reference 2.

CPS Unit 1 was previously licensed to operate at a rated thermal power (RTP) of 2894 megawatts-thermal (MWt). The result of the EPU is a RTP increase of approximately 20% to 3473 MWt. All testing specified in the CPS Updated Safety Analysis Report (USAR) Section 14.2.12.2, "Startup Test Procedures," was addressed and evaluated for applicability to the new RTP.

The NRC approved the EPU license amendment request on April 5, 2002. Specific instrument setpoints changes to allow operation above the original licensed RTP and other plant modifications for EPU were completed during the Spring 2002 refueling outage. The EPU test program began when CPS Unit 1 entered Mode 1 on May 6, 2002 and all EPU startup tests required for the current operating cycle were completed on May 19, 2002. Tests were performed in accordance with site procedures in combination with various surveillance test procedures described in this report.

The power ascension testing program included six test conditions starting at 60% RTP up to 92% RTP (i.e., 3195 MWt). Partial testing was completed at 94.8% RTP (i.e., 3292 MWt), but testing at this power level was not completed due to production risk. The reactor was subsequently returned to 92% RTP (i.e., 3195 MWt), where all EPU testing had been successfully completed. Based on the guidance provided in ELTR1 (Reference 3), power can be increased in 5% intervals before additional testing is performed. Therefore, no further testing is required prior to power operation above 97% RTP.

Results of the testing and data gathering demonstrated successful operation at uprated power. No unusual system or component adjustments were required for successful completion of the test program. All systems performed in a satisfactory manner during both power ascension and dynamic testing.

2.0 PURPOSE

This report is prepared in accordance with Section 10.4, "Required Testing," of the Safety Analysis Report that accompanied the CPS EPU license amendment request (Reference 1), which requires that a summary report of the EPU power ascension test program be submitted after the completion of the required testing. This report includes descriptions of the quantitative results, any corrective actions that were required and brief discussions as to why it was not necessary to repeat specific startup tests listed in USAR Section 14.2.12.2, "Startup Test Procedures", during the EPU test program.

3.0 PROGRAM DESCRIPTION

The approach to the maximum EPU power was performed using site procedures developed for the power ascension and testing. Power ascension occurred in 3% power increments each day. When increasing power above the previously recorded maximum power level, changes were made in 1½ % increments. After system stabilization, another 1½ % increase was completed until the 3% increase for the day was complete. The daily 3% power increases were implemented by reactor recirculation flow changes along a constant flow control line.

3.1 PROGRAM DEVELOPMENT

The CPS EPU test program was developed in accordance with the generic guidelines provided in ELTR1 (Reference 3) and the license amendment request (Reference 1), including the safety analysis report. The CPS EPU Project Task Report T1005, "Startup Test Specification," along with other program task reports provided the testing or equipment monitoring recommendations. Large transient tests described in the ELTR1 (i.e., generator load rejection test and MSIV full closure test) were not included as part of the CPS EPU test program. The NRC concurred with this deviation from the ELTR1 in the Safety Evaluation for the CPS EPU license amendment (Reference 2). Consequently no large transients were included within the CPS EPU power ascension test program.

The EPU power ascension test program was developed to verify the following:

- Plant systems and equipment affected by power uprate are operating within design limits.
- Nuclear fuel thermal limits are maintained within expected margins.
- The response of the main steam pressure control system is stable.
- The response of the reactor water level control system is stable.
- Plant radiation levels are acceptable and stable.
- Reactor water and feedwater chemistry analyses are acceptable.
- Piping vibrations on main steam and feedwater piping are within acceptable limits.
- Turbine valve surveillance testing is acceptable at higher power levels.
- Main Steam Isolation Valve functional testing is acceptable at higher power levels.

- The overlaps between the intermediate range monitors (IRMs) and the average power range monitors (APRMs) are within the design limits.
- APRM calibrations meet all acceptance criteria.
- Feedwater and main steam flow element calibrations match within normal instrument tolerance.
- Reactor feedwater pump performance is satisfactory.

3.2 PREREQUISITES TO POWER ASCENSION TESTING

Prior to the commencement of power ascension testing, the test procedure required the completion of numerous activities to assure that the plant was ready for EPU operation and testing. These activities included the following.

- The applicable plant operating procedures, administrative procedures, surveillance test procedures, calibration and maintenance procedures, chemical and radiological procedures and other similar procedures were reviewed and revised as required.
- The applicable plant instrumentation setpoint changes, re-scaling and/or calibrations were completed.
- Baseline data was taken as required by the test procedure.
- Computer software programs were reviewed and revised as required to support the power uprate test program.
- The simulator was modified to reflect changes to parameters, setpoints, and EPU operation.
- Licensed operator training was completed prior to power ascension at EPU power levels. This training included an overview of the test program and changes to the plant as a result of EPU. Simulator training was conducted to demonstrate accident situations and normal power operation at EPU power levels.
- The following plant unique items were evaluated and found to be acceptable for EPU: NRC commitments, Safety Evaluations completed but not yet implemented, Emergency Operating Procedures, and impact of installed Temporary Modifications on EPU.

4.0 ACCEPTANCE CRITERIA

Plant parameters were evaluated during power ascension with two levels of acceptance criteria. The acceptance criteria associated with plant design variables are classified as Level 1. The acceptance criteria associated with expectations in regard to the performance of a system or component are classified as Level 2. The following paragraphs describe the actions required if a specific criterion is not satisfied.

Level 1 Acceptance Criteria

Level 1 acceptance criteria normally relate to the values of process variables assigned in the design of plant component or systems. If a Level 1 test criterion is not satisfied, the plant must be placed in a hold condition that is judged to be satisfactory and safe, based upon prior testing. Plant operating or test procedures or

the Technical Specifications may guide the decision on the direction to be taken. Tests consistent with this hold condition may be continued. Resolution of the problem must be immediately pursued by equipment adjustments or through engineering evaluation as appropriate. Following resolution, the applicable test portion must be repeated to verify that the Level 1 requirement is satisfied. A description of the problem must be included in the report documenting successful completion of the test.

Level 2 Acceptance Criteria

If Level 2 acceptance criteria are not satisfied, plant operating or test plans would not necessarily be altered. The limits stated in this category are usually associated with expectations of system performance whose characteristics can be improved by equipment adjustments. An investigation of the system performance, as well as the measurement and analysis methods would be initiated.

Following resolution of a Level 2 acceptance criterion failure, the applicable test portion need not be repeated to verify the Level 2 requirement is satisfied.

5.0 POWER ASCENSION AND TEST PROGRAM SUMMARY

The EPU test program began when CPS Unit 1 entered Mode 1 operation on May 6, 2002, and ended with EPU start-up tests completed on May 19, 2002. Baseline testing was initiated during the power ascension. Pressure control system testing was successfully performed at approximately 15% power. Main steam and feedwater piping vibrations were monitored at 40% power.

Power ascension was limited by commercial agreements supporting the electrical grid, nominally 1062 MWe main generator output. The maximum power achieved to support this limit was reached on May 18, 2002, at 92% RTP (i.e., 3195 MWt) where all EPU tests were successfully completed. CPS original start-up test requirements specified 95% reactor power as the threshold for 'full power' testing. However, only partial testing was completed at 94.8% RTP (i.e., 3292 MWt) due to the production risk associated with the remaining power ascension testing. ELTR1 allows 5% power increases before additional testing is required. Therefore, since CPS Unit 1 successfully completed all testing at 92% reactor power, no further testing will be required prior to power operation above 97% RTP. This provides operational margin during periods of low efficiency caused by hot summer conditions.

There were no Level 1 test criteria failures. Data collected at uprated conditions showed the increase in reactor power had little effect on reactor water chemistry and radiological conditions throughout the plant.

6.0 TESTING REQUIREMENTS AND RESULTS

Each of the tests discussed in USAR Section 14.2.12.2 was evaluated for applicability to the EPU test program. Table 1 contains a listing of the original startup test program and its applicability to EPU. Throughout the following discussion, test

numbers are used to specify specific start-up tests. These numbers are used because they are relatively common throughout the industry.

Section 6.1 identifies each USAR Section 14.2.12.2 test not required to be performed for EPU. The purpose of the test and the rationale for exempting the test from the EPU program are discussed.

Section 6.2 identifies each USAR Section 14.2.12.2 test that was performed for EPU. The purpose of the test, a description of the test and the test results are included.

Table 2 lists seven test conditions and the associated percent of RTP. Table 3 lists all the tests performed for EPU and the test condition(s) for each test. Note in the discussion below that many surveillance tests similar to the original USAR Chapter 14 tests are performed periodically. The EPU test program takes credit for these existing plant procedures and did not require additional tests.

6.1 Tests Not Required for Power Uprate

6.1.1 Test No. 3 – Fuel Loading

The purpose of this test is to load fuel safely and efficiently to the full core size. This evolution is not affected by EPU operation. The CPS Technical Specification (TS) surveillance requirements and procedures satisfy this testing requirement. Therefore, no additional testing is required for EPU conditions.

6.1.2 Test No. 4 – Full Core Shutdown Margin

The purpose of the shutdown margin test is to demonstrate that throughout the fuel cycle the reactor will be subcritical with the analytically determined highest worth control rod being fully withdrawn with all other rods fully inserted. As indicated in ELTR1, shutdown margin requirements will not change with EPU operation. The CPS TS and surveillance procedures satisfy this testing requirement. Therefore, no additional testing is required for EPU conditions.

6.1.3 Test No. 5 – Control Rod Drive (CRD) System

The purpose of this test is to demonstrate that the control rod drive operation and the hydraulic system perform properly over the full range of primary coolant temperatures and pressure. As stated in the ELTR1, the performance of the CRD system is independent of power level and the operating characteristics remain unchanged for uprates with no increase in reactor pressure. Routine scheduled surveillances assure compliance with CPS TS and maintain the system performance. Therefore, no additional EPU testing is necessary.

6.1.4 Test No. 6 – Source Range Monitor (SRM) Performance and Control Rod Sequence

The purpose of this test is to demonstrate that the operational sources, SRM instrumentation, and rod withdrawal sequencer provide adequate information to

achieve criticality and increase power in a safe and efficient manner. These are initial startup test evolutions that are not affected by EPU. Therefore, this initial start-up test is not required for EPU.

6.1.5 Test No. 11 – Local Power Range Monitor (LPRM) Calibration

The purpose of this test is to calibrate the LPRMs. The ability of the LPRMs to detect neutron flux is not affected by EPU. The CPS TS and surveillance procedures maintain the calibration of these instruments. Therefore, no additional testing is required for EPU conditions.

6.1.6 Test No. 13 – Process Computer

This test verifies the performance of the process computer under plant operating conditions. EPU does not affect the functions of the process computer; however, some input variables required modification in support of EPU implementation. Those changes were made in accordance with the plant modification program. Therefore, this test is not required for EPU.

6.1.7 Test No. 14 – Reactor Core Isolation Cooling (RCIC)

This test verifies the proper operation of the RCIC system and demonstrates reliability in automatic starting from cold standby condition. Acceptable RCIC system operation is periodically demonstrated during normal surveillance testing. EPU did not change any of the RCIC pump or turbine operating characteristics due to the constant reactor pressure uprate condition. Therefore, no special testing is required for EPU.

6.1.8 Test No. 16 – Selected Process Temperatures

The purpose of this test is to assure various vessel metal temperatures and reactor water level reference leg temperatures are monitoring the appropriate condition during normal operations. These are initial startup test requirements that are unaffected by EPU operation. Existing site calibration procedures are sufficient to maintain proper performance. Therefore, no special testing is required for EPU.

6.1.9 Test No. 17 – System Expansion

The purpose of the thermal expansion test is to confirm that the pipe suspension system is working as designed and that the pipe is free of obstructions that could constrain free movement caused by thermal expansion. Since the CPS EPU does not include a reactor vessel pressure increase, nor the corresponding primary coolant temperature change, thermal expansion of the drywell piping is not affected by EPU. The feedwater piping system will experience an increase in final feedwater temperature during EPU. This temperature rise is within the design parameters of the system. Piping vibration monitoring is being performed under Test No. 33. Therefore, no additional tests are required for EPU.

6.1.10 Test No. 20 – Steam Production

The purpose of performing this test is to demonstrate that the nuclear steam supply system is providing steam sufficient to satisfy all appropriate warranties as specified contractually. This is an initial startup test requirement that is not applicable to EPU. Therefore, this test is not required for EPU.

6.1.11 Test No. 22 – Pressure Regulator

The purpose of this test is to demonstrate acceptable performance of the back-up pressure regulator during simulated failure of the in-service pressure regulator.

The fail over test to the back up pressure regulator was not performed. Evaluation by Site Engineering and General Electric Company (GE) determined that a large pressure deviation would be required to simulate a regulator failure and observe the standby regulator swap over. Because such a large error signal was required it was determined to be an unnecessary production risk to perform that portion of the test. Both pressure regulators were tested via step changes to confirm successful control system dampening. Furthermore, the ± 10 psi step change was sufficient to test the control system and verify proper response in lieu of the fail over test.

6.1.12 Test No. 23 – Feedwater System

The following feedwater system tests were not performed as part of the EPU test program: 1) Loss of feedwater heating and 2) Feedwater pump trip.

The purpose of the loss of feedwater heating test is to demonstrate adequate response to a feedwater temperature loss. The feedwater pump trip test is intended to demonstrate the capability of the automatic core flow runback feature to prevent a low water level scram following the trip of one feedwater pump. As specified in the ELTR1, transient analyses were performed to confirm that the existing set of reload analysis transients remains valid. Loss of feedwater heating and a feedwater pump trip for scram avoidance are two such events, which were found acceptable. Therefore, these tests are not required for EPU.

6.1.13 Test No. 25 – Main Steam Isolation Valve (MSIV) Full Closure Test

The purpose of this test is to determine the reactor transient behavior that results from the simultaneous full closure of all MSIVs. Transient tests performed at high power levels during the initial startup demonstrated the adequacy of protection for these severe transients. Actual MSIV full closure events have shown that the plant responds as the transient analysis has predicted. These analyses show that, should an MSIV full closure event occur at uprate conditions, the change in unit parameters will be small since the reactor dome pressure does not change for the EPU condition. Therefore, testing the unit's response to an MSIV full closure transient at EPU conditions is not required. The NRC concurred with this determination in Reference 2.

6.1.14 Test No. 26 – Relief Valves

This test is designed to verify proper operation of the relief valves and verify their leak tightness following operation. The EPU affects neither of these tests because the reactor dome pressure does not change with the power increase. Normal plant surveillance procedures ensure that the system is operating satisfactory and that the TS are met. Therefore, relief valve testing is not required for EPU.

6.1.15 Test No. 27 – Turbine Trip and Generator Load Rejection

These tests demonstrate the response of the reactor and its control systems to protective trips initiated by the turbine and generator. Transient tests performed at high power levels during the initial startup demonstrated the adequacy of protection for these severe transients. Analysis shows that should these transients occur at uprate conditions, the change in unit performance will be small since the reactor dome pressure remains the same for EPU conditions. Therefore, testing the unit's response to turbine and generator trips at EPU conditions is not required. The NRC concurred with this determination in Reference 2.

6.1.16 Test No. 28 – Shutdown from Outside the Control Room

This test demonstrates that the reactor can be brought from an initial steady-state power level to the point where normal low pressure shutdown cooling is initiated and under control with reactor vessel pressure and water level controlled from outside the control room. The actions performed by the operating crew are unchanged by EPU. There is a small incremental increase in decay heat load, but the time to achieve emergency shutdown remains acceptable. Therefore, existing site procedures are sufficient and no additional testing is required.

6.1.17 Test No. 29 – Recirculation Flow Control System

The purpose of this test is to demonstrate the recirculation flow control system's capability over the entire flow control range and verify that controllers are functioning properly for system performance and stability.

The Clinton EPU does not involve an increase in maximum core flow. ELTR1 indicates in Section 5.6.2 that the Recirculation System will have to overcome a slight increase in the two-phase flow resistance due to an increase in the core average void fraction. It also indicates that the system will accommodate the expected insignificant increase at EPU conditions when operating at maximum core flow. Therefore, the Recirculation System is unaffected by the EPU, and this testing is not required.

6.1.18 Test No. 30 – Recirculation System

The purposes of these tests are the following:

a) Determine transient responses following a single reactor recirculation pump trip and verify that the feedwater level control system maintains proper level.
b) Verify acceptable performance of the Recircirculation Pump Trip (RPT) circuitry.
c) Obtain Recirculation System performance data during the start-up test program.
d) Verify no Recirculation System cavitation occurs on the operable region of the power/flow map.

ELTR1 indicates that the recirculation system will accommodate an expected insignificant increase at EPU conditions when operating at maximum core flow. In addition, the performance of the RPT test is not required according to ELTR1. RPT circuitry is tested per existing site surveillance procedures, which adequately maintains this function. Therefore, this test is not required for EPU.

The feedwater level control system will be demonstrated to respond appropriately during steady state and dynamic testing, and is therefore expected to successfully respond to this event. Therefore, this test is not required for EPU.

As EPU involves no change in total core flow, the performance of the recirculation system is unaffected. Therefore, data collection during startup is not required for EPU.

The Recirculation System cavitation check is an initial startup test requirement that is not affected by EPU. Site procedures requiring the operation within the approved power-flow map is sufficient to preclude this condition. Therefore, this test is not required for EPU.

6.1.19 Test No. 31 – Loss of Turbine-Generator and Offsite Power

This test demonstrates proper performance of the AC power supply systems and reactor system transient performance during the simultaneous loss of turbine-generator and off-site power. EPU does not change the ability of the electrical systems to function properly during a loss of the main turbine-generator and a loss of offsite power. The ability of the reactor systems (e.g., HPCS and RCIC) to function properly at uprate conditions was demonstrated during execution of normal system surveillance procedures. Existing site procedures also assure proper operation of the electrical sequencing of the diesel generator loads.

Transient analyses have been performed for limiting transients, which bound this event. The results indicate conformance with core thermal operating limits. Therefore, this test is not required for EPU.

6.1.20 Test No. 35 – Recirculation System Flow Calibration

The purpose of this test is to perform complete calibration of the installed Recirculation System flow instrumentation. The recirculation flow characteristics do not change for EPU. The maximum core flow remains the same following the extended uprate. Also, none of the installed flow instrumentation has been changed for EPU. Existing site procedures are sufficient to maintain calibration on this system. Therefore, this test is not required for EPU.

6.1.21 Test No. 70 – Reactor Water Cleanup (RWCU) System

The purpose of this test is to demonstrate specific aspects of the mechanical operability of the RWCU system. For EPU conditions, the RWCU system flows, temperatures and pressures will not change. This is supported by the ELTR1 conclusion that RWCU is independent of reactor power. Since none of the process fluid characteristics are changed, none of the mechanical characteristics will change either. Therefore, this test is not required for EPU.

6.1.22 Test No. 71 – Residual Heat Removal System (RHR)

The purpose of this test is to demonstrate the ability of the RHR system to remove residual and decay heat from the reactor during refueling and shutdown conditions. The ELTR1 indicates that the RHR Low Pressure Coolant Injection (LPCI) licensing and design flow rates and the RHR shutdown cooling mode flow rate and operating pressures will not be increased. Therefore, this test is not required for EPU.

6.1.23 Test No. NA – Drywell Atmosphere Cooling

The purpose of this test is to verify the ability of the drywell cooling system to maintain design conditions in the drywell during operation and post scram conditions. Because the extended uprate is being implemented by maintaining reactor dome pressure constant, process fluid temperatures and likewise the drywell temperatures will also remain relatively constant during the higher power conditions. Therefore, this test is not required for EPU.

6.1.24 Test No. NA – MSIV Leakage Control

The purpose of this test is to demonstrate the ability of the MSIV Leakage Control System to depressurize the piping between the MSIVs and the outboard motor-operated isolation valve and maintain this piping at a slight negative pressure with respect to the atmosphere. EPU has no affect on the MSIV Leakage Control System. Therefore, this test is not required for EPU.

6.1.25 Test No. 74 – Offgas System (OG)

The purpose of this test is to verify the proper operation of the OG over its expected operating parameters. The ELTR1 indicates that the OG performance is not significantly dependent upon the reactor power level. The GE Offgas Task Report shows the system parameters remain within the design limits at EPU conditions. Therefore, this test is not required for EPU.

6.1.26 Test No. NA – Penetration Cooling

The purpose of this test is to demonstrate the ability of the penetration coolers to cool the concrete surrounding selected high temperature penetrations in the containment wall. Containment penetration temperatures will not change with increasing power for EPU. This is a result of the constant reactor dome temperature for EPU. Since the process fluid pressure and temperature do not change, neither will the containment wall penetration. Existing site procedures are sufficient to maintain this system. Therefore, this test is not required for EPU.

6.1.27 Test No. 99 - Neutron Flux Noise Surveillance

The purpose of this test is to monitor the neutron flux noise levels in the reactor and to verify that the behavior is within expected limits. This is an initial startup test that is not affected by the CPS EPU. Therefore, this test is not required for EPU.

6.2 Tests Required for Power Uprate

6.2.1 Test No. 1 – Chemical and Radiochemical

Purpose: To maintain control of and knowledge about the quality of reactor coolant chemistry and radiochemistry at EPU conditions.

Description: Feedwater and condensate samples were taken in accordance with plant procedures at each new power level and analyzed for conductivity, sulfates, chlorides and dissolved oxygen. Additionally, gaseous samples were taken and tested for activity levels.

Results: All Level 1 and Level 2 acceptance criteria were satisfied, and the results show that for the highest power achieved, sufficient margin exists to 100% of the new RTP.

6.2.2 Test No. 2 – Radiation Measurements

Purpose: To measure radiation levels at selected locations and power conditions during plant operation to ensure the protection of plant personnel and continued compliance with 10 CFR 20.

Description: Radiation levels were measured at selected areas around the plant for both gamma radiation and neutron radiation.

Results: All Level 1 acceptance criteria were satisfied. The dose rates were comparable to those experienced at the original licensed RTP. The results did not require any change to plant radiation postings. Radiation dose rates comply with the 10 CFR 20 limit. There were no Level 2 criteria requirements.

6.2.3 Test No. 10 – IRM Performance

Purpose: To adjust the IRM system to obtain an optimum overlap with the SRM and APRM systems.

Description: Existing plant procedures were used to verify the overlap on each IRM channel met the requirements of the Technical Specifications.

Results: All Level 1 and Level 2 acceptance criteria were satisfied. The overlap was performed following the refueling outage in accordance with existing site procedures.

6.2.4 Test No. 12 – APRM Calibration

Purpose: To calibrate the APRMs to actual core thermal power, as determined by a heat balance.

Description: Each APRM channel reading was adjusted to be consistent with the new core thermal power limit, as determined by the heat balance. Existing plant surveillance procedures were used which were previously revised to account for the increase in RTP.

Results: All Level 1 and Level 2 acceptance criteria were satisfied. APRM gain adjustments were performed at different power levels during the EPU power ascension test, in accordance with TS and site surveillance procedures.

6.2.5 Test No. 19 – Core Performance

Purpose: To evaluate core performance parameters to ensure plant thermal limits are maintained during the ascension to rated conditions.

Description: In accordance with site procedures, core thermal limits and thermal power measurements were taken at each 1 ½ % power increase. Existing methodologies and procedures were used to ensure the current operational practice was maintained.

Results: All Level 1 acceptance criteria were satisfied. Results show that for the highest power achieved, sufficient margin exists to 100% of the new RTP. There were no Level 2 criteria requirements.

	Core Flow (% Rated)	MFLCPR*	MAPRAT*	MFLPD*
Level 1 Limit	< 100%	1.0	1.0	1.0
Result at 3292 MWt / 94.8 % RTP	97.9	0.908	0.940	0.946

* MFLCPR – maximum fraction of limiting critical power ratio
MAPRAT – maximum average planar linear heat generation rate ratio
MFLPD – maximum fraction of limiting power density

6.2.6 Test No. 22 – Pressure Regulator

Purpose: To determine the response of the reactor and the turbine pressure regulator system during induced step changes to the pressure regulators.

Description: The pressure regulator testing was performed in accordance with an approved site procedure. The pressure control system settings were verified to be within the acceptable limits per the guidance of GE Service Information Letter (SIL) 589, "Pressure Regulator Tuning," during the previous refueling outage.

During power ascension, ± 3, ± 6 and ± 10 psi step changes in reactor pressure were induced, and the resulting transients were recorded. The data for each step change was reviewed for acceptable performance and scram margins prior to performing the next larger pressure step change. Step changes were first performed for pressure regulator "A" in control and then with pressure regulator "B" in control. This test was performed at each power level.

Starting at approximately 150 MWe, steam flow, MWe, first-stage pressure, and pressure regulator output were recorded at approximately every 3% power increase up to the last tested power plateau of 92% power. The data were plotted to confirm pressure regulator linearity.

Results: All Level 1 acceptance criteria were satisfied. The system response to step changes at each power level was satisfactory. No signs of divergence or oscillations occurred. Pressure response time and margins to scram setpoints were adequate in all cases. No limit cycles were observed.

The decay ratio was found to be above the Level 2 criterion of 0.25. At 92% RTP testing the 'A' Pressure regulator decay ratio was found to be 0.385 and the 'B' Pressure Regulator was determined to be 0.648. This was evaluated by Site Engineering and GE to be acceptable based on the fact that no oscillations were occurring, peak values for reactor power and reactor pressure were as expected and sensed steam line pressure did not diverge.

Regulator output linearity remained within the acceptance limits.

6.2.7 Test No. 23A – Feedwater System

Purpose: To adjust the feedwater level control system for acceptable reactor level control and to demonstrate stable reactor response to induced level and flow changes.

Description: The feedwater level control system testing was performed using an approved site procedure.

To confirm acceptable performance of the feedwater level control system, step changes in feedwater flow were inserted. Flow changes of 5% and 10% were performed with one turbine driven reactor feedwater pump (TDRFP) in manual and observing the proper response of the other pump in automatic. Additionally, reactor level step changes of ± 1", ± 2", ± 3", and ± 6" were inserted and the resulting dynamic changes were recorded. The step changes were performed for varying combinations of single element and three-element control with one pump in automatic and the other in manual. The magnitude of the flow and level changes was decreased as reactor power was increased to ensure the margin to reactor trips was maintained.

Results: All Level 1 acceptance criteria were satisfied. The feedwater control system response to level and flow changes was stable and satisfactory. There were no signs of divergence during the induced transients and no adjustments to the control system were required.

The Level 2 acceptance criteria requirements were found acceptable.

6.2.8 Test No. 23D – Maximum Feedwater Runout Capability

Purpose: To demonstrate that the maximum feedwater runout capability is compatible with the licensing assumptions in the USAR for the EPU conditions.

Description: During the EPU power ascension, pressures, flows and feedwater pump-turbine speed data is recorded. This measured data is compared to original pump performance data to calculate the expected runout feedwater flow at design transient conditions, i.e. 1080 psia reactor pressure and maximum turbine speed of 5512 rpm. This measured value is then compared to the USAR maximum flow.

Results: All Level 1 and Level 2 acceptance criteria were satisfied for conditions above the original licensed rated power level of 2894 MWt. Also, the reactor feedwater pump performance data indicates that for the highest power achieved, sufficient margin exists to 100% of the new RTP.

Measured pump performance indicated a flow rate of approximately 112% of rated flow when corrected to the licensing conditions with a Level 2 acceptance limit of < 115%. At lower power levels (< 75%), the calculated flow rates were above the Level 2 criteria. This is due to the pumps operating below their pump curves, the very low pump speeds at that power level and two TDRFPs in operation.

6.2.9 Test No. 24 – Turbine Valve Surveillance

Purpose: To determine the maximum reactor power levels for periodic surveillance testing of the main turbine control, stop and combined intermediate valves.

Description: Turbine valves were fully stroked at each power level in accordance with existing site procedures during power ascension. Conservative criteria were set to predict reactor and system response at each higher power level.

Results: All Level 2 acceptance criteria were met. New maximum power levels were determined based on the data collected and provided for site procedure revisions. The main turbine stop valves and combined intermediate valves were stroked at 92% RTP, 3195 MWt with no abnormalities noted. The new maximum power level for routine control valve stroke tests was determined to be 83% RTP, 2894 MWt. There were no Level 1 criteria requirements.

6.2.10 Test No. 25A – Main Steam Isolation Valves (MSIV)

Purpose: To determine the maximum reactor power levels for periodic surveillance testing of the MSIVs.

Description: MSIVs were functionally tested at each power level in accordance with existing site procedures during power ascension. Conservative criteria were set to assure adequate reactor parameter margins and system response at each higher power level.

Results: All Level 2 acceptance criteria were met. A maximum power level was determined based on the data collected and provided for site procedure revisions. An MSIV was partially stroked at 92% RTP, 3195 MWt with no abnormalities noted. This power level was determined to be acceptable to perform future MSIV Functional surveillance testing. There were no Level 1 criteria requirements.

6.2.11 Test Nos. 33 and 100 – Drywell Piping Vibration

Purpose: To ascertain the vibration measurements on the main steam and feedwater system piping and to evaluate the vibration stress effect due to EPU.

Description: Linear Variable Differential Transducers (LVDT) were installed on representative main steam and feedwater piping supports both inside and outside the containment to measure the flow induced vibration effect during extended power operation.

Results: All Level 2 acceptance criteria were satisfied and the results show that for the highest power achieved, sufficient margin exists to 100% of the new RTP. The highest vibration readings inside containment were found on the main steam lines. Peak-to-peak displacement readings reached 75% of the established acceptable limit. These values were steady and relatively constant through the power ascension.

All 31 LVDTs outside containment were well within the established acceptance criteria. Only three LVDTs indicated vibrations at about 50% of the limit, the highest being on the 'B' Feedwater line at 16 mils actual with a limit of 29 mils. Most of the vibration readings were about 25 to 30 mils which, corresponds to approximately 20% to 35% of the limit. There were no Level 1 criteria requirements.

6.3 Additional Tests Performed

6.3.1 System and Equipment Performance Data

Purpose: To monitor key plant systems and equipment parameters during the power ascension and assure that equipment is operating as expected.

Description: The selected parameter data was collected at steady-state power levels and used to predict the performance at the next higher power level. Predictions provided a careful approach to the power increases by monitoring each small incremental change in performance.

Results: Over 300 plant parameters were monitored at each test condition. The performance of the systems and equipment demonstrated good agreement with expectations. Key systems monitored were main turbine, main generator and auxiliaries, main condenser, condensate and condensate booster, feedwater and feedwater heaters, offgas, main steam and the nuclear boiler. There were no Level 1 or Level 2 acceptance criteria associated with this monitoring.

6.3.2 Test No. 23 – Feedwater Flow Element Calibration Check

Purpose: To confirm acceptable calibration of the feedwater flow elements at uprated power conditions.

Description: Data was collected at each power level plateau during power ascension. The data was compared to the expected feedwater flow element output. Additionally, the feedwater flow measurements were compared to the steam flow measurements.

Results: The Level 2 acceptance criteria were met for the Test Conditions at 89%, 92% and 95% RTP. The feedwater flow element measurements were within 1.8 % of the expected feedwater flow versus an acceptance value of 2.0%. The Level 2 criterion was not met at 83% and 86% power. This is because the measured flow rate becomes more accurate at the higher flow rates where the calibration of the flow elements is most accurate. There were no Level 1 criteria requirements.

7.0 REFERENCES

1. Letter from J. M. Heffley (AmerGen Energy Company, LLC) to U. S. NRC, "Request for License Amendment for Extended Power Uprate Operation," dated June 18, 2001

2. Letter from U. S. NRC to O. D. Kingsley (Exelon Generation Company, LLC), "Clinton Power Station, Unit 1 – Issuance of Amendment for Extended Power Uprate," dated April 5, 2002.

3. General Electric Company Licensing Topical Report, "Generic Guidelines for General Electric Boiling Water Reactor Extended Power Uprate," NEDC-32424P-A, Class III, February 1999.

Table 1
USAR Section 14.2.12.2 Tests

USAR Section	Test No.	Power Ascension Test	Required for EPU
14.2.12.2		**From Mode 1 to Maximum Achievable Power**	
1	1	Chemical/Radiochemical Samples	Yes
2	2	Radiation Measurements	Yes
3	3	Fuel Loading	No
4	4	Full Core Shutdown Margin	No
5	5	Control Rod Drive System	No
6	6	SRM Performance And Control Rod Sequence	No
9	10	IRM Performance	Yes
10	11	LPRM Calibration	No
11	12	APRM Calibration	Yes
12	13	Process Computer	No
13	14	RCIC System	No
14	16	Selected Process Temperatures	No
15	17	System Expansion	No
17	19	Core Performance	Yes
19	22	Pressure Regulator	Yes [1]
20	23	Feedwater System	Yes [2]
21	24	Turbine Valve Surveillance	Yes
22	25	Main Steam Isolation Valves	Yes
23	26	Relief Valves	No
24	27	Turbine Trip and Generator Load Rejection	No
25	28	Shutdown from Outside Control Room	No
26	29	Recirculation Flow Control System	No
27	30	Recirculation System	No
28	31	Loss of Turbine-Generator and Offsite Power	No
29	33 & 100	Drywell Piping Vibration	Yes
30	35	Recirc System Flow Calibration	No
31	70	Reactor Water Clean-up System	No
32	71	Residual Heat Removal System	No
33	-	Drywell Atmosphere Cooling	No
34	-	MSIV Leakage Control	No
35	74	Offgas System	No
36	-	Penetration Cooling	No
37	20	Steam Production	No
38	99	Neutron Flux Noise Surveillance	No

[1] Base line performance testing performed at 15% power

[2] Feedwater level control and pump capability tests performed, loss of feedwater heating and pump trip test not required.

Table 2
EPU Test Conditions

Test Condition (1)	Power Level (%)	MWt
1	60	2084
2	75	2605
3	83	2894
4	86	2987
5	89	3091
6	92	3195
7	95	3299

(1) Additional testing was performed below 75% power to establish baseline data and confirm acceptable control settings.

Table 3

Tests Performed At EPU Test Conditions

Test Description	Test Condition						
	1	2	3	4	5	6	7
Chemical and Radiochemical			X	X	X	X	X
Radiation Measurements			X	X	X	X	X
IRM Performance	X (1)						
APRM Calibration	X (2)	X	X	X	X	X	X
Core Performance		X	X	X	X	X	X
Pressure Control System (4)	X		X	X	X	X	
FWLC System	X	X	X	X	X	X	
Maximum Feedwater Runout Capability	X	X	X	X	X	X	X
FW Flow Element Calibration Check	X	X	X	X	X	X	X
Turbine Valve Stroking	X	X	X	X	X	X	X
MSIV Functional Test	X	X	X	X	X	X	X
Piping Vibration Monitoring (3)	X		X	X	X	X	X
System/Equipment Performance		X	X	X	X	X	X

Notes:

(1) IRM Performance demonstrated by overlap checks with the APRMs at approximately 10% power.
(2) APRM gain adjustments checked at each power level and adjusted as necessary.
(3) Baseline vibration data also collected at 40% EPU power.
(4) Baseline performance and control system settings tested at 15% power.