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U. S. Nuclear Regulatory Commission
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Dresden Nuclear Power Station, Unit 2
Facility Operating License No. DPR-19
NRC Docket No. 50-237

Subject: Power Uprate Ascension Test Report for Dresden Nuclear Power Station, Unit 2

References: (1) Letter from R. M. Krich (Commonwealth Edison Company) to U. S. NRC, "Request for License Amendment for Power Uprate Operation," dated December 27, 2000

(2) Letter from U. S. NRC to O. D. Kingsley (Exelon Generation Company, LLC), "Dresden Nuclear Power Station, Units 2 and 3 – Issuance of Amendments for Extended Power Uprate," dated December 21, 2001

In Reference 1, Commonwealth Edison Company, now Exelon Generation Company (Exelon), LLC, submitted a request for changes to the operating licenses and Technical Specifications for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2, to allow operation at uprated power levels. The NRC approved this request for DNPS in Reference 2.

In Reference 1, Exelon 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. A similar report will be provided for DNPS, Unit 3 following power uprate implementation in fall 2002.

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Should you have any questions related to this letter, please contact Mr. Allan R. Haeger at (630) 657-2807.

Respectfully,

for J. W. Simpkin
Keith R. Jury
Director – Licensing
Mid-West Regional Operating Group

Attachment: Dresden Nuclear Power Station, Unit 2 Extended Power Uprate Power Ascension Test Report

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Dresden Nuclear Power Station

Attachment

Dresden Nuclear Power Station, Unit 2
Extended Power Uprate
Power Ascension Test Report

Dresden Nuclear Power Station, Unit 2
Extended Power Uprate
Power Ascension Test Report

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1.0 EXECUTIVE SUMMARY

The Dresden Nuclear Power Station (DNPS) Unit 2 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 DNPS EPU amendment request (Reference 1). This report summarizes the startup testing performed at DNPS Unit 2 following implementation of EPU. EPU was implemented in accordance with Amendment No. 191 to Facility Operating License No. DPR-19, which the NRC approved in Reference 2.

DNPS Unit 2 was previously licensed to operate at a rated thermal power (RTP) of 2527 megawatts-thermal (MWt). The result of the EPU is a RTP increase of approximately 17% to 2957 MWt. All testing specified in the DNPS Updated Final Safety Analysis Report (UFSAR) Section 14.2.4.2, "Description of Startup Tests," was addressed and evaluated for applicability to the new RTP.

The EPU test program began when DNPS Unit 2 was synchronized to the grid on November 9, 2001. Baseline testing was performed prior to approval of the EPU license amendment request. The NRC approved the EPU license amendment request on December 21, 2001. Specific instrument setpoints were implemented on December 21 and 22, 2001 to allow operation above the previous RTP. Other plant modifications for EPU were completed during the previous refueling outage. EPU testing began on December 26, 2001. All required EPU startup tests were completed by December 30, 2001. Additional tests, including a 100 hour demonstration run and turbine performance tests were completed on January 11, 2002. Tests were performed in accordance with special procedures in combination with various surveillance test procedures described in this report.

The power ascension testing program included six test conditions starting at 90% of the original RTP up to 2816 MWt, which was the highest achievable power level based on the main generator limitation of 912 megawatts-electric (MWe). All tests were completed at this final test condition. Because the final test condition exceeded 95% rated thermal power (RTP) of 2957 MWt and 95% of rated core flow, this final condition adequately represents the 100% test condition of the new RTP and no additional startup testing will be performed.

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 stable manner during both power ascension and dynamic testing. DNPS Unit 2 is operating satisfactorily at 912 MWe.

2.0 PURPOSE

This report is prepared in accordance with Section 10.4, "Required Testing," the Safety Analysis Report that accompanied the EPU license amendment request (Reference 1), which requires that a summary report of the EPU Program be submitted after the completion of the uprate test program. The 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 the UFSAR 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 previous recorded maximum power level, changes were made in 1% increments. After system stabilization, another 1% increase was completed until the 3% increase for the day was complete. The daily 3% power increases were made by increasing reactor recirculation flow along a constant flow control line. Because of operational limitations unrelated to the power uprate program, to accomplish subsequent 3% increases it was necessary to reduce power and adjust control rods to maneuver the reactor onto a higher flow control line. In doing so, it was possible to increase power along a new constant flow control line using recirculation flow adjustments each day.

3.1 PROGRAM DEVELOPMENT

The DNPS EPU test program was developed in accordance with the generic guidelines provided in Licensing Topical Report (ELTR) NEDC-31897P-A, "Generic Guidelines for General Electric Boiling Water Reactor Power Uprates," and the license amendment request, including the safety analysis report. The DNPS 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 ELTR (i.e., generator load rejection test and MSIV full closure test) were not included as part of the DNPS EPU test program. The NRC concurred with this deviation from the ELTR in the Safety Evaluation for the EPU license amendment (Reference 2). Consequently no large transients were included within the DNPS EPU power ascension test program.

The EPU power ascension test program verified 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 analysis are acceptable.

- Piping vibrations on main steam and feedwater piping were found to be acceptable.
- Moisture carry-over from the reactor dryer/separator is less than pre-uprate condition.
- Turbine valve surveillance testing was determined to be acceptable at higher power levels.
- The overlap between the intermediate range monitors (IRMs) and the source range monitors (SRMs) and between the 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.
- The applicable plant instrumentation setpoint changes, re-scaling and/or calibrations were completed.
- Baseline data was taken as required by the test procedure.
- Commitments which were the result of the EPU Safety Analysis Report, the NRC EPU Safety Evaluation, and actions committed in response to numerous requests for additional information were verified as either completed, included in the power ascension program, or evaluated as not impacting power ascension.
- Computer software programs were reviewed and revised as required to support the power uprate test program, including the safety parameter display system.
- Licensed operator training was completed prior to power ascension at EPU power levels. Training included 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 simulator was modified to reflect changes to parameters, setpoints, and EPU operation.
- Emergency operating procedures were revised and operators were trained on the changes prior to EPU power operation.

4.0 ACCEPTANCE CRITERIA

Plant parameters during power ascension were evaluated with two levels of acceptance criteria. The criteria associated with plant design variables are classified as Level 1. The 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 a Level 2 acceptance criterion is 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 must be repeated to verify that the Level 2 requirement is satisfied.

5.0 POWER ASCENSION AND TEST PROGRAM SUMMARY

The EPU test program began when DNPS Unit 2 was synchronized to the grid on November 9, 2001, and ended with EPU start-up tests completed on January 11, 2002. Baseline testing was initiated during the power ascension. Pressure control system testing was successfully performed on November 9 at approximately 25% power and again at 75% power on November 12. Main steam and feedwater piping vibrations were monitored at 50%, 75% and 100% of original RTP. 100% original RTP data was collected on December 14.

The EPU license amendment request was approved on December 21, 2001. Following management reviews of the EPU prerequisites and license amendment requirements, instrument setpoints were revised to support the power increase. These setpoint changes were completed on December 22, 2001.

On December 26, reactor power was reduced to approximately 77% of EPU rating to allow feedwater level control testing to begin. Control system adjustments were performed to accommodate three reactor feedwater pump operation. Testing was successfully completed in preparation for increasing reactor power. All systems performed in a stable manner. Control system testing for pressure control and reactor level control were successfully completed each day.

Power ascension was limited by the maximum output of the main generator, nominally 912 MWe. Therefore, the maximum power achieved on December 30, 2001, was 2816 MWt, or 95.2% RTP. The more recent BWR plant start-ups have used 95% as a benchmark for the full power test condition (i.e., > 95% reactor power and > 95% of rated core flow is sufficient to meet the full power requirement). Since DNPS Unit 2 achieved 95.2% reactor power and 95.3% core flow, no further testing will be required to allow power operation up to the RTP of 2957 MWt.

After power ascension to 2816 MWt was completed, a 100 hour demonstration run was performed followed by two turbine performance tests. The demonstration run began January 2, 2002 and lasted until January 6. The two turbine performance tests were conducted on January 10 and 11. The results will be used to determine the total electrical output.

There were no Level 1 or Level 2 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 UFSAR Section 14.2.4, "Description of Startup Tests," was evaluated for applicability to EPU test program. Table 1 contains a listing of the original startup tests and their 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. However, the numbers do not conform to the DNPS UFSAR nomenclature, since DNPS Unit 2 was one of the earliest BWR start-ups.

Section 6.1 identifies each Section 14.2.4 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 Section 14.2.4 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 six 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 UFSAR 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

This test demonstrates the ability to safely and efficiently load fuel to the full core size. Fuel loading is performed during every refueling outage in accordance with site procedures. EPU has no impact on this evolution. Therefore, no additional testing was required for EPU.

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 ELTR-1, shutdown margin requirements will not change with EPU operation. The Technical Specifications and surveillance procedures evaluate this evolution. Therefore no testing is required for EPU conditions.

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

The purpose of this test is to monitor the hydraulic system and drive operation, including measuring basic operating characteristics. As mentioned in the ELTR-1, 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 Technical Specifications and maintain the system performance. Therefore, no EPU testing is necessary.

6.1.4 Test No. 6 - Control Rod Sequence

Control rod sequence testing demonstrates the acceptability of a specified control rod withdrawal sequence. The rod patterns for intermediate power levels up to the applicable power level are evaluated using existing site procedures. Therefore this initial start-up test is not required for EPU.

6.1.5 Test No. 7 - Calibration of Rods

The purpose of this test is to determine the relationship between reactor power and control rod motion in standard sequences. These conditions are not significantly affected by EPU operation and therefore were not performed during power ascension testing.

6.1.6 Test No. 9 - Source Range Monitor (SRM) Response

The SRM portion of this test demonstrates that the operational sources, SRM instrumentation, and rod withdrawal sequences provide adequate information to the operator during startup. The Technical Specifications and plant procedures ensure proper SRM response during startup. Therefore this initial start-up test is not required for EPU.

6.1.7 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 plant Technical Specifications and surveillance procedures maintain the calibration of these instruments.

6.1.8 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. Those changes were made in accordance with plant modification program. Therefore, this test is not required for EPU.

6.1.9 Test No. 14 – Isolation Condenser (IC)

This test verifies the proper operation of the IC system and provides baseline data for future surveillance testing. Acceptable IC system operation is periodically demonstrated during normal surveillance testing. Plant specific transient analysis performed for EPU conditions demonstrated that the system has the capability to maintain adequate reactor water level following a loss of feedwater event. EPU increases the decay heat rate generation during a reactor isolation event. Initial start-up tests and subsequent testing indicate the IC system has adequate heat removal capability to meet these higher decay heat values. Therefore, no special testing is required for EPU.

6.1.10 Test No. 15 – High Pressure Coolant Injection (HPCI) System

This test verifies the proper operation of the HPCI System at the operating pressure. Acceptable HPCI System operation is periodically demonstrated during normal surveillance testing that includes adjustments for reactor dome pressure. Since EPU is accomplished without changing reactor pressure, special testing is not required for EPU.

6.1.11 Test No. 16 – Reactor Vessel Temperatures

The purpose of this test is to ensure that the thermal stresses in the reactor pressure vessel (RPV), as indicated by measured temperatures, do not exceed expected temperature differences during reactor heatup and cooldown. Since the uprate was performed at a constant reactor pressure, there are no changes in reactor temperatures and this test is not required for EPU.

6.1.12 Test No. 17 – System Expansion

This test verifies reactor drywell piping and major equipment are unrestrained with regard to thermal expansion. Since the EPU does not change the reactor dome pressure or the corresponding primary coolant temperature, thermal expansion of the drywell piping and equipment is unaffected. Therefore, no special testing is required for EPU.

6.1.13 Test No. 18 – Axial Power Distribution

This test determines core power distribution using the traversing in-core probe (TIP) system, confirms reproducibility of TIP system readings, and determines core power symmetry. Existing site procedures verify proper TIP operation and core power symmetry. EPU does not impact these parameters. Therefore, no special testing is required for EPU.

6.1.14 Test No. 21 – Flux Response to Rods

This startup test demonstrates stability in the power reactivity loop with increasing reactor power and determines the effect of control rod movement on reactor stability. EPU had only a minor impact on core stability. The interim corrective actions stability regions and the Option III oscillation power range monitor trip enabled region on the power/flow map were revised for uprated power such that there is only minimal impact on the stability margin. Therefore, additional testing is not required for EPU.

6.1.15 Test No. 24 – Bypass Valve Measurements

The purpose of the bypass valve measurement test was to determine the reactor and turbine governor system response when opening a turbine bypass valve. Regulator settings would be optimized using the data from this test. The pressure control system regulator settings were tested and optimized as part of the pressure control system test. The bypass valves were full stroked during EPU testing to determine the new maximum safe power level to perform the surveillance in the future. Therefore, no additional bypass valve testing is required.

6.1.16 Test No. 25 – Main Steam Isolation Valves (MSIVs)

The objectives of this test are to:

- Determine the operational characteristics of the MSIVs at selected power levels.
- Determine reactor transient effects during simultaneous full closure of all MSIVs.

The MSIVs are no longer full stroked as part of surveillances at power. The surveillance requirements are listed in the TS and follow the American Society of Mechanical Engineers (ASME) Code for cold shutdown tests. Therefore, the plant procedures and TS are sufficient and no additional testing is needed.

Full MSIV closure testing performed at high power during the initial startup demonstrates the adequacy of protection for this large transient test. A detailed evaluation was completed which concluded this transient test would not provide any new information regarding the way the reactor responds to a full MSIV closure test. Analysis shows that should these transients occur at EPU conditions, the change in unit performance will be small based on the constant reactor dome pressure for EPU conditions. Also the operating history of the plant has shown that previous transients are within the expected performance. Additionally, the EPU transient analysis shows that all safety criteria are met. Therefore, testing the plant's response to full closure of the MSIVs at the uprated power level is not required. The NRC concurred with this determination in Reference 2.

6.1.17 Test Nos. 27 & 28 – Turbine Trip and Generator Load Rejection Demonstration

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 uprated conditions, the change in unit performance will be small since the reactor dome pressure remains the same for EPU condition. 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.

6.1.18 Test No. 30 – Recirculation System

The two objectives of this test are to evaluate the recirculation flow to the reactor for power transient responses resulting from a recirculation pump trip and to calibrate jet pump flow instrumentation.

EPU does not involve a change in total core flow at full power operation. Additionally, the ELTR-1 indicates that the recirculation system will accommodate an expected insignificant increase at EPU conditions when operating at maximum core flow. Also, in accordance with the ELTR-1 the single recirculation pump trip test is not required for EPUs. Since the recirculation system is unaffected by the EPU no start-up testing is required.

EPU modified the recirculation system speed control circuitry to improve the plant's response to a single reactor feedwater pump trip event. A recirculation pump runback feature was installed during the recent refueling outage as a plant reliability feature. The runback occurs on a loss of the fourth running condensate pump or the third running reactor feedwater pump. These features were functionally tested during startup testing as part of the design modification implementation procedures. Acceptable performance was demonstrated via the functional tests.

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

This test demonstrates proper performance of the reactor, and plant electrical equipment and systems during the loss of auxiliary power transient. 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., HPCI and Isolation Condenser) to function properly at uprated conditions was demonstrated during execution of normal system surveillance procedures. Therefore, this test is not required for EPU.

6.1.20 Test No. 34 - RPV Internals Vibration

The purpose of this test is to obtain vibration measurements on various reactor internal components to demonstrate the mechanical integrity of the system to flow induced vibration and to verify the accuracy of the analytical model. An analysis was performed for the reactor internals, which determined the design continues to comply with the existing structural requirements.

6.1.21 Test No. 30 – Rod Pattern Exchange

The purpose of this test is to perform a representative change in basic rod pattern at a high reactor power level. This is an initial start-up test requirement that is not applicable because the conditions have not changed due to EPU.

6.1.22 Test No. 34 – LPRM Response

The purpose of this test is to determine the response characteristics of LPRM chambers at the typical flux levels encountered in current boiling water reactors. The operating conditions of EPU will not affect the LPRM response. Normal plant procedures for calibration are sufficient and no additional testing is required.

6.2 Tests Required for Power Uprate

6.2.1 Test No. 1 – Chemical/Radiochemical Samples

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

Description: 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 results indicate an expected acceptable performance at 100% of the new RTP.

6.2.2 Test No. 2 – Radiation Monitoring

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 and Level 2 acceptance criteria were satisfied. The dose rates were comparable to those experienced at the previous RTP. The results did not require any change to plant radiation postings. Normal plant shielding was adjusted at one containment penetration to account for neutron streaming. Radiation dose rates remain compliant with the 10 CFR 20 limit.

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 surveillance 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 prior to the adjustment of the APRMs to the uprated level. Additional overlap was required by the procedure to account for the uprated power difference.

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 limit measurements and thermal power were taken at each 1% power increase. Existing methodologies and procedures were used to ensure the current operational practice was maintained.

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

	Core Flow (% Rated)	MFLCPR*	MAPRAT*	MFLPD*
Level 1 Limit	< 100%	1.0	1.0	1.0
Result at 2816 MWt / 95.2 % RTP	95.3	0.817	0.794	0.854

* 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 and acceptable performance of the back-up pressure regulator during simulated failure of the in-service pressure regulator.

Description: The pressure regulator testing was performed in accordance with a site special procedure. The pressure control system settings were verified to be within the acceptable limits per the guidance of Service Information Letter (SIL) 589, "Pressure Regulator Tuning," during the previous refuel 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 analyzed 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. A fail-over test from one pressure regulator to the stand-by regulator was performed to verify proper control system response.

Starting at ~ 150 MWe, steam flow, MWe, first-stage pressure, and pressure regulator output were recorded at approximately every 3% power increase up to 100% of the new RTP. The data were plotted to confirm pressure regulation linearity.

Results: 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. All Level 1 and Level 2 acceptance criteria were satisfied.

A minor adjustment was made to the steam line resonance compensator (SLRC) card. A second SLRC card was installed during the refueling outage. As part of that modification testing, the second harmonic frequency was found at a slightly lower frequency than expected. These adjustments were completed before power was increased above the previous RTP.

Regulator output linearity remained within the acceptance limits.

6.2.7 Test No. 23A – Feedwater Level Control 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 a site special procedure.

During power ascension, ±1", ±3" and ±5" step changes in reactor level were induced, and the resulting transients were recorded. The data for each step change were analyzed for acceptable performance and tuning of the control system would be performed as needed. Also, 5%, 10% and

20% flow changes were performed on one feedwater regulating valve placed in manual to verify acceptable system response of the other valve while in automatic system control. This data was also used to make small tuning adjustments to the control system.

Results: All Level 1 and Level 2 acceptance criteria were satisfied. The feedwater control system response to level and flow changes was stable and satisfactory with only minor tuning adjustments. There were no signs of divergence during the induced transients.

6.2.8 Test No. 23B – Maximum Feedwater Runout Capability

Purpose: To determine if the maximum feedwater runout flow is consistent with the EPU transient analysis and licensing assumptions.

Description: A new reactor feedwater pump runout value was determined for three pump operation for the EPU program. This value was implemented as part of a setpoint change. Reactor feedwater pump performance data was collected per existing site procedures. Calculations based on the manufacturer's pump curves were performed to verify proper operation.

Results: All Level 1 and Level 2 acceptance criteria were satisfied. Reactor feedwater pump performance data indicates an expected acceptable performance at 100% of the new RTP. Pump performance factors were determined to be 97% of the expected pump curve for each pump at the highest power level tested, 95.2% RTP.

6.2.12 Test No. 31 – Steam Separator-Dryer Performance

Purpose: To evaluate reactor steam separator-dryer moisture carryover performance.

Description: Samples were taken in accordance with plant procedures at each new power level and analyzed to determine the amount of moisture carryover from the reactor to the turbine.

Results: All Level 1 and Level 2 acceptance criteria were satisfied. The results indicate a moisture carryover of 0.016 %. This is in contrast to the 0.2% moisture carryover which existed prior to the EPU modifications to the steam dryer.

6.2.13 Test No. 33 – Drywell Piping Vibration

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

Description: Accelerometers were installed on representative main steam and feedwater piping in the drywell to measure the flow induced vibration effect during extended power operation.

Results: All Level 1 and Level 2 acceptance criteria were satisfied. Results indicate an expected acceptable performance at 100% of the new RTP. Readings at the highest achieved power level indicated a ten~~wo~~-fold to four-fold margin to the acceptance criteria. For example, the "A" main steam piping vibration amplitude in the north-south direction at one location inside the drywell at the highest power level achieved was measured at 13.42 mils against an acceptance criterion for infinite life of 124 mils.

6.2.14 Test No. 98 – Power Conversion Piping Vibration

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

Description: Accelerometers were installed on representative main steam and feedwater piping outside the drywell to measure the flow induced vibration effect during extended power operation.

Results: All Level 1 and Level 2 acceptance criteria were satisfied. Results indicate an expected acceptable performance at 100% RTP. Readings at the highest achieved power level indicated a ten~~wo~~-fold to four-fold margin to the acceptance criteria. For example, a main steam drain line vibration amplitude in the vertical direction at one location inside the drywell at the highest achieved power level was measured at 22 mils against an acceptance criterion for infinite life of 116 mils.

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 100 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, transformers and auxiliaries, off-gas, reactor recirculation and the reactor.

6.3.2 Test No. 24 – Turbine Valve Surveillances

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

Description: Turbine valves were full 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 1 and Level 2 acceptance criteria were met. New maximum power levels were determined based on the data collected and provided for site procedure revisions. The bypass valves, stop valves and combined intermediate valves were stroked at the maximum power achieved, 2816 MWt. The new maximum power level for routine control valve stroke tests was determined to be < 2700 MWt. This was based on measured values during testing and is similar to the percentage of rated power prior to the Uprate.

6.3.3 Test No. 25D – Main Steam Flow Element Calibration Check

Purpose: To confirm acceptable calibration of the main steam flow elements at EPU conditions.

Description: Data was collected at each power level during power ascension. The steam flow data was compared relative to the calibrated feedwater flow measurements.

Results: All Level 1 and Level 2 acceptance criteria were met. Steam flow measurements were within 5% of the feedwater flow measurements at each power level. The results also showed an expected acceptable performance at 100% RTP.

6.3.4 Test No. 23D – 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 flow element output. Additionally, at selected power levels including maximum tested power, the flow element data was compared to an ultrasonic flow measurement device.

Results: All Level 1 and Level 2 acceptance criteria were met. The feedwater flow element measurements were within 0.4 % of the ultrasonic flow measurements. Results indicate an expected acceptable performance at 100% of the new RTP.

7.0 REFERENCES

1. Letter from R. M. Krich (Commonwealth Edison Company) to U. S. NRC, "Request for License Amendment for Power Uprate Operation," dated December 27, 2000

2. Letter from U. S. NRC to O. D. Kingsley (Exelon Generation Company, LLC), "Dresden Nuclear Power Station, Units 2 and 3 – Issuance of Amendments for Extended Power Uprate," dated December 21, 2001

Table 1
UFSAR Section 14.2.4.2 Tests

UFSAR Section	Test No.	Power Ascension Test	Required for EPU
14.2.4.2.1		**Fuel Loading and Tests at Atmospheric Pressure**	
A	1	Chemical/Radiochemical Samples	Yes (1)
B	5	Control Rod Drive System	No
C	2	Radiation Measurements	Yes (1)
D	34	Core Internal Vibration	No
E	3	Fuel Loading	No
F	4	Full Core Shutdown Margin	No
G	6	Control Rod Sequence	No
H	9	SRM Performance	No
I	10	IRM Performance	Yes (1)
J	13	Process Computer	No
14.2.4.2.2		**Heat-up from Ambient to Rated Temperature and Pressure**	
A	10	IRM Calibration	Yes (1)
B	9	SRM Performance	No (2)
C	16	Reactor Vessel Temperatures	No
D	17	System Expansion	No
E	5	Control Rod Drive System	No
F	6	Control Rod Sequence	No
G	2	Radiation Measurements	Yes (1)
H	1	Chemical/Radiochemical Samples	Yes (1)
I	25	MSIV Functional Test	No
J	19	Core Performance	Yes (1)
K	31	Steam Separator-Dryer	Yes
14.2.4.2.3		**From Rated Temperature to 100% Power**	
A	1	Chemical/Radiochemical Samples	Yes
B	2	Radiation Measurements	Yes
C	34	Core Internal Vibration	No
D	17	System Expansion	No
E	25	MSIV Functional Test	No
F	14	Isolation Condenser	No
G	15	HPCI System	No
H	30	Recirculation Pump Trips	No
I	23	Feedwater and Recirculation Flow	Yes (3)
J	27	Turbine Trip Tests	No
K	28	Generator Trip	No
L	22	Pressure Regulator Test	Yes
M	24	Bypass Valve Measurements	No
N	23	Feedwater Pumps	Yes (3)
O	21	Flux Response to Rods	No
P	11	LPRM Calibrations & Response (34)	No
Q	12	APRM Calibrations	No
R	19	Core Performance	Yes
S	7	Calibration of Rods	No
T	18	Axial Power Distribution	No
U	30	Rod Pattern Exchanges	No
V	31	Steam Separator/Dryer Measurements	Yes
W	13	Process Computer	No

(1) Testing performed during power ascension.
(2) Tested as part of the IRM overlap tests performed at power.
(3) Feedwater level control tests were performed during power ascension. No recirculation flow control tests were performed.

Table 2
EPU Test Conditions

Test Condition	Power Level (%)	MWt
1	76.9	2273
2	85	2527
3	88	2610
4	91	2700
5	94	2800
6	95	2816

Table 3

Tests Performed At EPU Test Conditions

Test Description	Test No.	Test Condition					
		1	2	3	4	5	6
Chemical/Radiochemical Samples	1		X	X	X	X	X
Radiation Surveys	2		X	X	X	X	X
IRM Performance	10	X (1)					
APRM Calibration	12	X (2)	X	X	X	X	X
Core Performance	19	X	X	X	X	X	X
Pressure Control System	22	X		X	X	X	X
FWLC System	23A		X	X	X	X	X
FW Pump Performance	23B	X	X	X	X	X	X
FW Flow Element Calibration Check	23D	X	X	X	X	X	X
Turbine Valve Stroking	24	X	X	X	X	X	X
Main Steam Flow Element Cal Check	25D	X	X	X	X	X	X
Piping Vibration Monitoring (3)	33 & 97	X	X	X	X	X	X
Steam Dryer Performance	31						
System/Equipment Performance	NA	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.
(3) Baseline vibration data also collected at 46% and 64% EPU power.