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U.S. Nuclear Regulatory Commission
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Dresden Nuclear Power Station, Units 2 and 3
Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

Quad Cities Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Additional Testing Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station

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

In the referenced letter, Commonwealth Edison (ComEd) Company, now Exelon Generation Company (EGC), LLC, submitted a request for changes to the operating licenses and Technical Specifications (TS) 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. In subsequent discussions between EGC and Mr. L. W. Rossbach and other members of the NRC, most recently on April 30, 2001, the NRC requested that EGC provide additional information regarding the planned power uprate testing. The attachment to this letter provides the requested information.

Should you have any questions related to this information, please contact Mr. Allan R. Haeger at (630) 663-6645.

Respectfully,

R. M. Krich
Director – Licensing
Mid-West Regional Operating Group

A001

Attachments:
Affidavit
Additional Testing Information Supporting the License Amendment Request to Permit Uprated Power Operation

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

STATE OF ILLINOIS	**)**	
COUNTY OF DUPAGE	**)**	
IN THE MATTER OF	**)**	
EXELON GENERATION COMPANY, LLC	**)**	**Docket Numbers**
DRESDEN NUCLEAR POWER STATION UNITS 2 AND 3	**)**	**50-237 AND 50-249**
QUAD CITIES NUCLEAR POWER STATION UNITS 1 AND 2	**)**	**50-254 AND 50-265**

SUBJECT: Additional Environmental Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station

AFFIDAVIT

I affirm that the content of this transmittal is true and correct to the best of my knowledge, information and belief.

R. M. Krich
Director – Licensing
Mid-West Regional Operating Group

Subscribed and sworn to before me, a Notary Public in and for the State above named, this 18th day of May, 2001.

Notary Public

"OFFICIAL SEAL"
Timothy A. Byam
Notary Public, State of Illinois
My Commission Expires 11/24/2001

Attachment
Dresden Nuclear Power Station, Units 2 and 3
Quad Cities Nuclear Power Station, Units 1 and 2
Additional Testing Information Supporting the License Amendment Request to Permit Uprated Power Operation

Background

In Reference 1, referred to in this attachment as the Extended-Power Licensing Topical Report (ELTR) -1, General Electric (GE) described a generic approach to Boiling Water Reactor (BWR) extended power uprates (EPUs) (i.e. uprates of greater than 5% of rated thermal power). This approach was accepted by the NRC in Reference 2. Section 5.11.9 of ELTR-1, "Power Uprate Testing," states that a Main Steam Isolation Valve (MSIV) closure test, equivalent to that conducted in the initial startup testing, will be performed if the power uprate is more than 10% above any previously recorded MSIV closure transient data. This section also states that, for uprates of more than 15% and potential operating pressure changes of < 75 psi, a Generator Load Rejection test, equivalent to that conducted in the initial startup testing, will be performed if the power uprate is more than 15% above any previously recorded Generator Load Rejection transient data.

While not specifically discussed in ELTR-1, the basis for performing these tests, referred to in this attachment as large transient tests, was to verify that plant and equipment performance is as predicted from models and as projected from previous test data.

In Reference 3, Commonwealth Edison (ComEd) Company, now Exelon Generation Company (EGC), LLC, requested changes to support uprated power operation for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. These proposed changes would allow DNPS and QCNPS to operate at approximately 117% of the current rated thermal power (RTP). Attachment E of Reference 3, "Power Uprate Safety Analysis Report (PUSAR)," provides supporting information for these proposed changes. PUSAR Section 10.4, "Required Testing," states that DNPS and QCNPS do not intend to perform the large transient tests specified in ELTR-1 for the following reasons. First, operating history has shown that previous transients are within expected performance. Second, the power uprate transient analyses show that all safety criteria are met. Third, given that these tests will not provide significant new information, performing these tests will unnecessarily challenge safety systems. The following sections of this attachment provide additional information in support of these statements.

Transient Modeling

The safety analyses performed for the DNPS and QCNPS power uprates used the NRC-approved ODYN transient modeling code. As noted in Reference 3, this code is accepted by the NRC for GE BWRs with a range of power levels and power densities that bound the requested power uprate for DNPS and QCNPS. The ODYN code has been benchmarked against BWR test data and has incorporated industry experience gained from previous transient modeling codes. ODYN uses plant specific inputs and models all the essential physical phenomena for predicting integrated plant response to the analyzed transients. Specifically, for DNPS and QCNPS, a set of input parameters representing a conservative combination of DNPS and QCNPS parameters was used directly in the ODYN code to predict plant response to these transients. This "Unit 5" concept is discussed further in Reference 3.

Thus, the ODYN code will accurately predict the integrated plant response to these transients at EPU power levels and no new information about transient modeling is expected to be gained from performing these large transient tests.

Power Uprate Experience

ELTR-1 was written in 1996, prior to industry experience with EPUs. ELTR-1 discussed the potential for performing an EPU without increasing reactor pressure. Maintaining a constant pressure simplifies the analyses and plant changes required to achieve uprated conditions. Five units have since implemented EPUs at constant pressure as noted below with the percentage increases in RTP as noted.

- Hatch Units 1 and 2 (113% of RTP)
- Monticello (106% of RTP)
- Muehleberg (i.e., KKM) (116% of RTP)
- Liebstadt (i.e., KKL) (117% of RTP)

Data collected from testing and responses to unplanned transients for these plants has shown that plant response has consistently been within expected parameters as noted below.

The Hatch units did not perform the large transient tests discussed in ELTR-1. However, Hatch Unit 2 experienced a generator load rejection from 98% of uprated power in the summer of 1999. Hatch staff reviewed the data collected during this transient and compared it to that predicted by the ODYN code for this type of event at Hatch. The parameters compared included reactor pressure, neutron flux, heat flux, and change in reactor water level. For each of these parameters the recorded values were less than or equal to the values predicted.

The KKL power uprate implementation program was performed during the period from 1995 to 2000. Power was raised in steps from its previous operating power level of 3138 MWt (i.e., 104.2% of Original Licensed Thermal Power (OLTP)) to 3515 MWt (i.e., 116.7% OLTP). Uprate testing was performed at 3327 MWt (i.e., 110.5% OLTP) in 1998, 3420 MWt (i.e., 113.5% OLTP) in 1999, and 3515 MWt in 2000.

KKL testing for major transients involved turbine trips at 110.5% OLTP and 113.5% OLTP and a generator load rejection at 104.2% OLTP. Significant changes to the turbine-generator, and to the turbine control and bypass valves were made during the refueling outages preceding these uprated cycles. To a large extent, these equipment changes prompted the plan to perform these tests. The reactor vessel dome pressure was controlled to remain the same for all of the uprated power conditions. The testing plan monitored the following parameters.

- Reactor power
- Reactor vessel and turbine steam flow
- Reactor vessel and turbine pressure
- Effectiveness of the reactor recirculation runback
- Effectiveness of the Select Rod Insertion pattern

- Response characteristics of the modified turbine control valves (TCVs) and bypass valves

The KKL turbine and generator trip testing demonstrated the performance of equipment that was modified in preparation for the higher power levels. Equipment that was not modified performed as before. The reactor vessel pressure was controlled at the same operating point for all of the uprated power conditions. No unexpected performance was observed except in the fine-tuning of the turbine bypass opening that was done as the series of tests progressed.

These large transient tests at KKL demonstrated the response of the equipment and the reactor response. The close matches observed to predicted response provided additional bases for confidence that the uprate licensing analyses consistently reflected the behavior of the plant.

Conclusions from the KKM testing were received too late to include in this response, but are expected to be similar to the KKL results.

From the power uprate experience discussed above, it can be concluded that large transients, either planned or unplanned, have not provided any significant new information about transient modeling or actual plant response. Since the DNPS and QCNPS uprates do not involve reactor pressure changes, this experience is applicable. Based on this experience, GE has submitted a licensing topical report for NRC review that applies to extended power uprates accomplished without reactor pressure increases (Reference 4). This topical report does not include large transient testing as a requirement.

Component Analysis and Testing

Another aspect of ensuring that plant response to large transients will be as predicted is related to individual component performance. With many years of operational experience, the performance of DNPS and QCNPS components is well documented at current power levels. No significant components related to these transients are changed for EPU.

EGC and GE have analyzed the performance of the major components that affect the MSIV closure and generator load rejection transients. This analysis used basic engineering principles and current licensing basis to demonstrate that transient testing is not needed to show that these components will respond as designed. The results of this analysis are listed in Table 1. The table also shows the surveillance testing that will confirm that the components maintain their expected performance capability.

Table 1
Analysis of Component Response to Transients at Extended Power Uprate (EPU) Conditions

Component In Transient Analysis	Operating Pressure/ Temperature Change	Operating Flow Rate Change	Parameter of Importance In Transient Analysis	Transient Analysis Parameter Value Change for EPU	Component Testing	Comment
Main Steam Isolation Valves (MSIVs)	None	20% increase	Minimum closure time	None	Confirmed by Technical Specifications (TS) Surveillance	Closure time is not affected by EPU flow rate. Current licensing basis is that these valves are capable of maintaining the minimum closure time under steam line break flows of at least 175% of current rated steam flow, which is the maximum flow that can be passed by the steam flow restrictors. Also, additional steam flow assists in closing the MSIVs due to their angled globe valve design.
Main Steam Line Geometry	None	20% increase	Length and volume of lines	None	N/A	Acoustic phenomena are included in transient and dynamic loads analyses using approved codes
Control rod insertion for scram	None	N/A	Maximum delay and rod insertion time	None	Confirmed by TS Surveillance	Reactor pressure is unchanged. This results in no change in Control Rod insertion time.
Relief and Safety/Relief valves	None	None	Opening delay and time to establish full flow	None	Setpoints unchanged and confirmed by surveillance	Not affected by EPU conditions.

Component In Transient Analysis	Operating Pressure/ Temperature Change	Operating Flow Rate Change	Parameter of Importance In Transient Analysis	Parameter Value Change for EPU	Component Testing	Comment
Turbine Stop Valves (TSVs) and Turbine Control Valves (TCVs)	< 2% decrease at turbine inlet	20% increase	Minimum closure time	None	Exercised in surveillance	Main turbine modifications will only slightly change the full power operating position of the TCVs, thereby slightly changing the effective closure time of the TCVs during a Generator Load Rejection transient, but this effect on closure time is included in the transient analysis. The TCV and TSV stroking rate will not be affected, because these valves are controlled by a servo-controlled hydraulic system designed for valves-wide-open flow. Therefore, the ability of the TCVs and TSVs to close is not affected by the EPU steam flow rate.
Scram signals on MSIV closure and Turbine-Generator (T-G) trip	None	N/A	Maximum time signal is passed to Reactor Protection and Control Rod Drive Systems	None	Confirmed by TS Surveillance	Electronic system response is unaffected by EPU.
Turbine bypass valves	< 2% decrease at turbine inlet	None (bypass flow not changed for EPU)	Opening delay and stroke time	None	Confirmed by TS surveillance	Turbine bypass opening response is not affected by EPU because there is no change to the system or the operating conditions. The bounding T-G trip cases used to establish fuel operating limits neglect opening of the bypass valves.

Power Uprate Testing Program
The EPU test program follows the approach outlined in ELTR-1, Appendix L, Section L.2 "Guidelines for Uprate Testing." Incremental power increases will be made in steps of 3% power and the increase will be along a constant rod pattern line beginning at 90% of the current licensed power level. Present methods used to calculate core thermal power and fuel thermal limits will be utilized during the power ascension. Indicated core power will be re-scaled to the EPU power level prior to exceeding the current rating. Routine measurements of operating performance parameters will be evaluated at each power level and new projected values will be provided prior to exceeding the previous power level. The test program will be continued up to the maximum power level allowed by the main generator capability, which is expected to be approximately 115% of current rated thermal power, depending on environmental conditions at the time of the test. Since this power level is expected to be within 5% of the requested uprated power level (i.e., 117% of current rated thermal power), the test program will be considered complete after completion of tests at this power level. This is in accordance with previous GE startup test specifications which specified that testing performed within 5% of full power and within 5% of rated core flow is considered representative of 100% rated thermal power.

The following is a list of the tests and monitoring and a short description of their purpose. Table 2 indicates the approximate power levels at which each test will be performed.

Chemical and Radiochemical Monitoring – Test #1
The objective of this test is to maintain control of and knowledge about the quality of the reactor coolant chemistry and radiochemistry at extended uprate conditions. Routine reactor water samples are collected and analyzed for conductivity, sulfates, chlorides and dissolved iodine-131. Condensate and feedwater samples will be analyzed for conductivity, iron and dissolved oxygen content. Acceptance criteria are based on Technical Specifications (TS) limits and EGC program requirements.

Radiation Monitoring – Test # 2
The purpose of this test is to monitor area radiation levels at the extended power uprate conditions to assure that personnel exposures are maintained As Low As Reasonably Achievable (ALARA), that radiation survey maps are accurate, and that radiation zones are properly posted.

Intermediate Range Monitor (IRM) Performance – Test # 10
The purpose of this test is to adjust the Intermediate Range Monitor System to obtain an optimum overlap with the Source Range Monitor (SRM) and Average Power Range Monitor (APRM) systems. The existing plant surveillance program, which assures compliance with the TS limits, will be utilized to satisfy this requirement. An evaluation of the most recent surveillance will be performed following APRM re-scaling.

APRM Calibration – Test # 12
The purpose of this test is to calibrate the APRMs to the power uprate level. The existing plant surveillance program, which assures compliance with the TS limits, will be utilized to satisfy this requirement. Additionally, calibration checks and adjustments will be made periodically during the approach to full uprated power.

Core Performance – Test # 19
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 power uprate level. Existing calculation methods will be utilized to ensure TS compliance. Fuel thermal margin values will be predicted for the next power level to show the expected acceptable margin prior to the next power increase.

Pressure Control Incremental Regulation – Test # 22
The purpose of this test is to determine the response of the reactor and the turbine governor system to the operating pressure regulator and the backup pressure regulator. The pressure control system will be tested to verify proper dampened response to induced perturbations in the system.

Feedwater Level Control Incremental Regulation – Test # 23A
The purpose of this test is to adjust the feedwater control system for acceptable reactor water level control and to demonstrate stable control system response to changes in reactor water level and feedwater flow changes.

Feedwater Runout – Test # 23B
The purpose of this test is to verify that the maximum feedwater runout value is consistent with feedwater pump limitations. The feedwater pump runout trip setting is being revised to accommodate three-pump operation. The pump flow characteristics will be monitored during power ascension and compared to pump performance curves.

Reactor Feedwater Pump Trip / Recirculation Pump Auto-Runback – Test # 23C
The purpose of this test is to demonstrate the capability of the automatic reactor recirculation pump flow runback feature. As a result of running three feedwater pumps, a design change will be installed to provide an automatic runback following an inadvertent feedwater pump trip with a corresponding low level signal or a condensate pump trip when feedwater flow is above 90% of rated. This feature is being added in order to prevent a low water level scram. Testing will include assurance that the circuitry will perform its intended function.

Feedwater Flow Element Calibration Check – Test # 23D
The purpose of this test is to confirm acceptable calibration of the feedwater flow elements at uprated power conditions. Feedwater flow data from the flow elements will be compared to known flow data information, such as the most recent calibration data.

Turbine Valve Surveillance – Test # 24
The purpose of this test is to determine the maximum reactor power levels for periodic surveillance testing of the main turbine control, stop and combined intermediate valves. By monitoring reactor power, pressure and steam flows a new higher power level limit will be established at which turbine valve testing can be performed safely.

Main Steam Flow Element Calibration Check – Test # 25D
The purpose of this test is to confirm acceptable calibration of the main steam flow elements at uprated power conditions. Steam flow data collected during power ascension will be compared to known flow data information, such as the re-scaled calibration data.

Steam Separator-Dryer Performance – Test # 31
The purpose of this test is to evaluate steam separator-dryer moisture carryover performance and to demonstrate that the MSL moisture level is within appropriate limits. Post start-up data will be compared to data gathered during the previous operating cycle to evaluate acceptable performance of the modification to the dryer.

Primary Containment Piping Vibration – Test # 33
The purpose of this test is to ascertain the vibration measurements on the Main Steam and Feedwater system piping in the Primary Containment to evaluate the vibration stress effect due to EPU conditions. Increased steam flows and feedwater flows have the potential to increase vibration levels. Data will be collected at lower power levels to provide baseline information for comparison to the uprated values. The data collected at higher power levels will be analyzed to ensure no deleterious effects are encountered.

Power Conversion Piping Vibration – Test # 98
The purpose of this test is to gather vibration measurements on the Main Steam and Feedwater system piping outside of the containment to evaluate the vibration stress effect due to the EPU. Data will be collected at lower power levels to provide baseline information for comparison to the uprated values. The data collected at higher power levels will be analyzed to ensure no deleterious effects are encountered.

GE14 Fuel Delta-P Test – Test # 99
The purpose of this test is to gather data on the GE14 fuel to evaluate the lower tie plate pressure drop and to determine the effect, if any, on the lower tie plate pressure drop on the maximum core flow capability.

System and Equipment Performance Data
Steady-state data will be taken and evaluated at each power incremental step on select equipment and systems that are determined to be power dependent. Data collection will begin at 90% of the current licensed power level and continue at each incremental power step to the maximum power level achieved. The data will be reviewed and projected values determined prior to exceeding the previous power level. This data includes routine measurements of reactor and system pressures, flows, levels, temperatures and vibrations as determined by engineering judgement and experience.

Attachment
Dresden Nuclear Power Station, Units 2 and 3
Quad Cities Nuclear Power Station, Units 1 and 2
Additional Testing Information Supporting the License Amendment Request to Permit Uprated Power Operation
Table 2
Extended Power Uprate (EPU) Test Schedule

Original Licensed Power Level, %		50%	75%	90%	100%	103%	106%	109%	112%	115%	117%
Reactor Thermal Power, MWth (Quad Cities)		**1256**	**1883**	**2260**	**2511**	**2586**	**2662**	**2737**	**2812**	**2898**	**2957**
Licensed Power Uprate, %		42.5%	63.7%	76.4%	84.9%	87.4%	90.0%	92.6%	95.1%	98.0%	100%
Reactor Thermal Power, MWth (Dresden)		**1263**	**1895**	**2274**	**2527**	**2603**	**2679**	**2754**	**2830**	**2898**	**2957**
Licensed Power Uprate, %		42.7%	64.1%	76.9%	85.5%	88.0%	90.6%	93.1%	95.7%	98.0%	100%
Data Collection	**Test #**										
Chemical/Radiochemical Samples	1				X	X	X	X	X	X	
Radiation Monitoring	2				X	X	X	X	X	X	
Intermediate Range Performance (Overlap Check)	10										
Average Power Range Monitor Calibrations	12			X	X		X		X	X	
Core Performance	19			X	X	X	X	X	X	X	
Feedwater Flow Element Calibration Check	23D			X	X	X	X	X	X	X	
Main Steam Flow Element Calibration Check	25D			X	X	X	X	X	X	X	
Primary Containment Piping Vibration Data	33	X	X	X	X	X	X	X	X	X	
Power Conversion Piping Vibration	98	X	X	X	X	X	X	X	X	X	
System/Equip Performance Data (Note 1)				X	X	X	X	X	X	X	
Warranty Test										X	
Tests and Surveillances											
Pressure Control Incremental Regulation	22		X	X	X	X	X	X	X	X	
Feedwater Level Control Incremental Regulation	23A		X	X	X	X	X	X	X	X	
Feedwater Pump Runout (Data Collection)	23B				X	X	X	X	X	X	
Turbine Valve Surveillance (Optional)	24			X	X	X					
Steam Dryer Performance	31				X	X	X	X	X	X	
GE14 Fuel Delta-P Test	99				X	X	X	X	X	X	

Note 1: Systems include main generator, turbine, feedwater, feedwater heaters, condensate, main transformer, reactor recirculation, nuclear boiler

Negative Aspects of Conducting Large Transient Tests
The risk posed by intentionally initiating these transients, although small, should not be incurred unnecessarily. The risk of a single event is given by its conditional core damage probability (CCDP). The CCDP values for these transients, as derived from the current DNPS and QCNPS probabilistic risk assessment (PRA) models, are listed in Table 3.

Table 3
Conditional Core Damage Probabilities for Transient Tests

Event	DNPS Conditional Core Damage Probability	QCNPS Conditional Core Damage Probability
Steam line isolation from full power	7 E –7	1.6 E –6
Generator load rejection from full power	3 E –7	5 E –7

In comparison, the following internal events core damage frequencies (CDFs) after power uprate were previously reported.

DNPS 2.82 E –6 per year

QCNPS 4.85 E –6 per year

For DNPS, the sum of the CCDPs for the transients of concern is 1.0 E –6. This is approximately equivalent to the CDP incurred by 4 months of normal operation of one of the DNPS units.

For QCNPS, the sum of the CCDPs for the transients of concern is 2.1E –6. This is approximately equivalent to the CDP incurred by 5 months of normal operation of one of the QCNPS units.

In addition, conducting these tests would cause additional thermal cycles on the units.

Summary
The information presented in this attachment has demonstrated that conducting large transient tests will not provide significant new information regarding transient modeling or the performance of plant components. The transient model has been shown to be accurate at EPU power levels and power densities. Experience with plants that have implemented EPU without changing reactor pressure has shown that transient performance following uprate has matched expectations. The DNPS and QCNPS EPU testing programs will test the control systems and monitor important plant parameters during ascension to EPU power level.

Given this information, EGC has determined that, for the DNPS and QCNPS constant pressure uprates, the large transient tests proposed in ELTR-1 present an unnecessary challenge to safety systems without any commensurate benefit.

Should either of these large transients (i.e., MSIV closure or generator load rejection) occur following implementation of the EPU at DNPS or QCNPS, EGC will compare the actual plant response to the response predicted for a transient with similar initial conditions and equipment availability, using the ODYN code. This comparison will be performed for at least the following parameters.

- Neutron flux (i.e., reactor power) peak and time response
- Reactor pressure peak and time response
- Reactor vessel level and time response

This comparison will be performed for the first transient of the types mentioned above that occurs within the first two years of EPU implementation at any one of the four units (i.e., DNPS Units 2 and 3, and QCNPS Units 1 and 2). Following the first transient that occurs on any unit, subsequent events will be analyzed in accordance with EGC's event response procedures.

References

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

2. Letter from U.S. NRC to G.L. Sozzi (General Electric), "Staff Position Concerning General Electric Boiling-Water Reactor Extended Power Uprate Program," dated February 8, 1996

3. Letter from R. M. Krich to U.S. NRC, "Request for License Amendment for Power Uprate Operation," dated December 27, 2000

4. Letter from J. Klapproth (GE) to U.S. NRC, "Submittal of GE Proprietary Licensing Topical Report NEDC-33004P, 'Constant Pressure Power Uprate,'" dated March 19, 2001