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RS-02-011

January 15, 2002

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: Additional Testing Information Supporting the License Amendment Request to Permit Up-rated Power Operation at Clinton Power Station

Reference: 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

In the referenced letter, AmerGen Energy Company (AmerGen), LLC, submitted a request for changes to the Facility Operating License No. NPF-62 and Appendix A to the Facility Operating License, Technical Specifications (TS), for Clinton Power Station (CPS) to allow operation at an up-rated power level. The proposed changes in the referenced letter would allow CPS to operate at a power level of 3473 megawatts thermal (MWt). This represents an increase of approximately 20 percent rated core thermal power over the current 100 percent power level of 2894 MWt. The NRC, in a conference call, requested 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. Timothy A. Byam at (630) 657-2804.

Respectfully,

*for J.W. Simpkins*  
K. R. Jury  
Director – Licensing  
Mid-West Regional Operating Group

*A001*

January 15, 2002  
U. S. Nuclear Regulatory Commission  
Page 2

Attachments:

Affidavit

Attachment: Additional Testing Information Supporting the License Amendment  
Request to Permit Up-rated Power Operation at Clinton Power Station


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

STATE OF ILLINOIS )  
COUNTY OF DUPAGE )  
IN THE MATTER OF )  
AMERGEN ENERGY COMPANY, LLC ) Docket Number  
CLINTON POWER STATION, UNIT 1 ) 50-461

**SUBJECT: Additional Testing Information Supporting the License Amendment  
Request to Permit Up-rated Power Operation at Clinton Power Station**

**AFFIDAVIT**

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

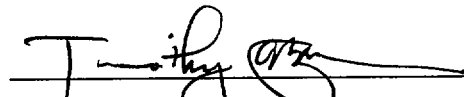


T. W. Simpkin  
Manager – Licensing

Subscribed and sworn to before me, a Notary Public in and

for the State above named, this 15<sup>th</sup> day of

January, 2002.

  
Notary Public



## ATTACHMENT

### **Additional Testing Information Supporting the License Amendment Request to Permit Up-rated Power Operation at Clinton Power Station**

#### Question 12.1

*Provide information addressing why large transient tests should not be performed at CPS. As part of this information, discuss the following:*

- a. Identify the plant systems and components challenged by the large transient tests under consideration (i.e., Load Rejection and Main Steam Isolation Valve Closure tests) and those systems/components' parameters important for the tests (e.g., valve closure time).*
- b. Identify modifications made to these systems and components as a result of uprate.*
- c. Provide an evaluation of the effect of the power uprate for both steady state and transient response (e.g., increased power, steam flow, feed flow, etc.) on these systems and components.*
- d. Describe the testing and data collection that is being performed on these systems and components including any that is part of the power ascension test plan.*
- e. Discuss and evaluate related past experience regarding these types of transients at other uprated plants.*

#### Response 12.1

##### **Background**

In Reference 1, the Extended-Power Uprate 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, for uprates of more than 15%, 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, AmerGen Energy Company (AmerGen), LLC, requested changes to support uprated power operation for Clinton Power Station (CPS). These proposed changes would allow CPS to operate at approximately 120% 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 CPS does not intend to perform the large transient tests specified in ELTR-1 for the following reasons. First, operating history has shown previous transient events from full power to be within expected peak limiting values. Second, the power uprate transient analyses show that all safety criteria are met and that this uprate does not cause any previous non-limiting events to become limiting. Third, given that these tests will not provide significant new information, performing these tests is non-conservative and will unnecessarily challenge safety systems. The following sections of this attachment provide additional information in support of these statements.

## ATTACHMENT

### **Additional Testing Information Supporting the License Amendment Request to Permit Up-rated Power Operation at Clinton Power Station**

#### **Transient Modeling**

The safety analyses performed for the CPS power uprate 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 CPS. 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. 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

## ATTACHMENT

### **Additional Testing Information Supporting the License Amendment Request to Permit Up-rated Power Operation at Clinton Power Station**

was controlled to remain the same for all of the up-rated 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 up-rated 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.

Reference 4 provides information relative to the data taken at KKL during its startup program and includes information that favorably compares the predicted ODYN runs with the actual plant response. These large transient tests at KKL demonstrated the response of the equipment and the reactor response. The close agreement observed to the predicted response provided additional bases for confidence that the uprate licensing analyses consistently reflected the behavior of the plant.

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 CPS uprate does not involve a reactor pressure change, 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 5). 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 CPS components is well documented at current power levels. No significant components related to these transients are changed for EPU.

AmerGen 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.

## ATTACHMENT

### Additional Testing Information Supporting the License Amendment Request to Permit Up-rated Power Operation at Clinton Power Station

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

<b>Component In Transient Analysis</b>	<b>Operating Pressure/ Temperature Change</b>	<b>Operating Flow Rate Change</b>	<b>Parameter of Importance In Transient Analysis</b>	<b>Transient Analysis Parameter Value Change for EPU</b>	<b>Component Testing</b>	<b>Comment</b>
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. These valves are capable of maintaining the minimum closure time under steam line break flows of at least 135% of the up-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.

**ATTACHMENT**

**Additional Testing Information Supporting the License Amendment Request  
to Permit Up-rated Power Operation at Clinton Power Station**

<b>Component In Transient Analysis</b>	<b>Operating Pressure/ Temperature Change</b>	<b>Operating Flow Rate Change</b>	<b>Parameter of Importance In Transient Analysis</b>	<b>Parameter Value Change for EPU</b>	<b>Component Testing</b>	<b>Comment</b>
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 change the full power operating position of the TCVs, thereby changing the effective closure time of the TCVs during a Generator Load Rejection transient, but this effect on closure time will be included in the transient analysis performed as part of the reload analysis. The TCV and TSV stroking <u>rate</u> 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.



## ATTACHMENT

### **Additional Testing Information Supporting the License Amendment Request to Permit Up-rated Power Operation at Clinton Power Station**

#### **Power Uprate Testing Program**

The EPU test program follows the approach outlined in ELTR-1, Appendix L, Section L.2 "Guidelines for Uprate Testing." Beginning at 90% of the current licensed power level, power will be increased along a constant rod pattern line up to 100% of the current licensed power level. Incremental power increases above 100% of the current licensed power level will then be made in steps of 2% power and the increase will continue to be along a constant rod pattern line. 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 due to 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., 120% 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 during power ascension following the spring 2002 refueling outage (i.e., C1R08). The remaining power ascension testing will be performed following the next refueling outage (i.e., C1R09).

#### *Chemical and Radiochemical – 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 AmerGen program requirements.

#### *Radiation Measurements – 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 Average Power Range Monitor (APRM) system. 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.

## **ATTACHMENT**

### **Additional Testing Information Supporting the License Amendment Request to Permit Upgraded Power Operation at Clinton Power Station**

#### **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 Regulator – 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 dampening of induced perturbations in the system.

#### **Water Level Setpoint, Manual Feedwater Flow Changes – 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.

#### **Maximum Feedwater Runout Capability – Test # 23D**

The purpose of this test is to verify that the maximum feedwater runout capability is compatible with licensing assumptions for EPU conditions. The pump flow characteristics will be monitored during power ascension and compared to pump performance curves.

#### **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.

#### **Drywell 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 drywell 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.

#### **Outside Drywell Piping Vibration – Test # 100**

The purpose of this test is to gather vibration measurements on the Main Steam and Feedwater system piping outside of the drywell to evaluate the vibration stress effect due to the EPU. Data will be collected at lower power levels to provide baseline

## ATTACHMENT

### **Additional Testing Information Supporting the License Amendment Request to Permit Up-rated Power Operation at Clinton Power Station**

information for comparison to the up-rated values. The data collected at higher power levels will be analyzed to ensure no deleterious effects are encountered.

#### 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

### Additional Testing Information Supporting the License Amendment Request to Permit Up-rated Power Operation at Clinton Power Station

**Table 2  
Extended Power Uprate (EPU) Test Schedule**

Original Licensed Power Level, %				48.0%	72.0%	90.0%	100%	102.0%	104.4%	106.8%
Reactor Thermal Power, MWth	Startup	Sync	868	1389	2084	2605	2894	2952	3022	3091
Licensed Power Uprate, %			25%	40%	60%	75%	83.3%	85%	87%	89%
<b>EPU Start-up Tests (C1R08)</b>										
Reactor Water Samples							X		X	X
Radiation Surveys & Posting							X		X	X
Core Performance						X	X	X	X	X
APRM Cal's /Gain Adjust. - per TS		X	X				X		X	X
IRM Performance (Overlap Check)	X									
Piping Vibration Data				X	X		X	X	X	X
FW Flow Calibration					X	X	X	X	X	X
Max FW Runout Capability					X	X	X	X	X	X
Water Level Setpoint, Manual FW Flow Changes					X	X	X	X	X	X
Turbine Valve Surveillance					X	X	X	X	X	X
Pressure Regulator		X			X	X	X	X	X	X
System/Equip Performance Data						X	X	X	X	X
FW Htr performance/valve positions						X	X	X	X	X
MSR Optimization							X			

## ATTACHMENT

### Additional Testing Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station

#### 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 CPS probabilistic risk assessment (PRA) models, are listed in Table 3.

**Table 3**  
**Conditional Core Damage Probabilities for Transient Tests**

Event	CPS Conditional Core Damage Probability
Steam line isolation from full power	1.8E-6
Generator load rejection from full power	1.2E-6

In comparison, the following internal events core damage frequency (CDF) after power uprate was previously reported (Reference 6).

CPS CDF = 1.42E-5 per year

The sum of the CCDPs for the transients of concern is 3.0 E-6. This is approximately equivalent to the core damage probability incurred by 2.5 months of normal operation of CPS.

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

#### 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 CPS EPU testing program will test the control systems and monitor important plant parameters during ascension to EPU power level.

Given this information, AmerGen has determined that, for the CPS constant pressure uprate, 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 CPS, AmerGen will compare the actual plant response to the response predicted for a transient with similar initial conditions and equipment availability in accordance with AmerGen's event response procedures.

## ATTACHMENT

### Additional Testing Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station

#### Question 12.2

*Identify any new systems or features being installed and address why an integrated plant test for purposes of demonstrating plant response with the new system/feature should not be performed at CPS.*

#### Response 12.2

As part of the CPS extended power uprate, there are no new systems, features or significant additional components being installed to support the increased power level. The modifications listed in Reference 3 consist of improvements or enhancements to existing systems and components.

#### **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 General Electric, "Staff Position Concerning General Electric Boiling-Water Reactor Extended Power Uprate Program," dated February 8, 1996
3. AmerGen letter to U.S. NRC, "Request for License Amendment for Extended Power Uprate Operation," dated June 18, 2001
4. Exelon letter to U.S. NRC, "Additional Testing Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station," dated September 27, 2001
5. GE letter to U.S. NRC, "Submittal of GE Proprietary Licensing Topical Report NEDC-33004P, 'Constant Pressure Power Uprate,'" dated March 19, 2001
6. AmerGen letter to U.S. NRC, "Supplemental Information Supporting the License Amendment Request to Permit Extended Power Uprate Operation at Clinton Power Station," dated September 28, 2001