AmerGen
An Exelon/British Energy Company

AmerGen Energy Company, LLC
Clinton Power Station
R.R. 3 Box 228
Clinton, IL 61727-9351
Phone: 217-935-8881

RS-02-014

January 16, 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 Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station

References:

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

(2) Letter from J. B. Hopkins (U.S. NRC) to O. D. Kingsley (Exelon Generation Company, LLC), "Clinton Power Station, Unit 1 – Request For Additional Information (TAC No. MB2210)," dated November 14, 2001

(3) Letter from K. R. Jury (Exelon Generation Company) to U.S. NRC, "Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station," dated December 7, 2001

In Reference 1, 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 uprated power level. The proposed changes in Reference 1 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 Reference 2 requested additional information regarding the proposed changes in Reference 1. Reference 3 provided the requested information. The NRC, in a conference call, requested additional follow-up information regarding the information provided in Reference 3. The attachment to this letter provides the additional follow-up information.

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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

Attachments:

Affidavit
Attachment: Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated 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 Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated 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 16th day of

January, 2002.

"OFFICIAL SEAL"
TIMOTHY A. BYAM
NOTARY PUBLIC STATE OF ILLINOIS
COMMISSION EXPIRES 12/04/05

Notary Public

ATTACHMENT

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station

Question 1

In reference to your response to Question 10.5, provide a summary describing the methodology, transients and assumptions of the more detailed analysis for the feedwater nozzle fatigue usage. Confirm that the detailed analysis will result in a CUF less than 1.0 for the feedwater nozzle safe end for 40 years life and that the analysis will be finalized prior to the implementation of the EPU. You also indicated that the fatigue monitoring program implemented at CPS provides requirements for monitoring fatigue usage for 32 critical locations within the plant. Provide a comparison of the fatigue usage factors for the feedwater nozzle as calculated by (1) the design basis analysis, (2) using cycle counting stress based analysis, and (3) using computer software "Fatigue Pro" with the collected actual plant operation data. Also, provide the calculated maximum EPU stress at the feedwater nozzle safe end with and without the thermal bending stress.

Response 1

The feedwater (FW) nozzle safe end usage factor originally calculated for Clinton Power Station (CPS) extended power uprate (EPU), discussed in Section 3.3.2.2 of Attachment E to Reference 1, was based on a number of conservative assumptions. This resulted in a cumulative usage factor (CUF) greater than 1.0 and a plan to apply the allowances of the American Society of Mechanical Engineers (ASME) Code Section XI, Appendix L to ensure continued safe operation. Subsequently, General Electric (GE), at the direction of CPS, was tasked with providing a detailed analysis of the FW nozzle safe end to determine if other options were available to address the issue. This analysis is nearing completion and preliminary results indicate a CUF of less than 1.0 primarily by using more realistic methods of analysis and more accurate estimates of plant operational cycles.

Four different methods of reducing the conservatism in the original EPU calculations for the FW nozzle safe end were applied and are described below.

- Reduce the flow scaling factor and apply the flow scaling factor only to rapid cycling stresses.
- Separate thermal stresses from mechanical and pressure stresses and apply thermal scaling factors to the thermal stresses only.
- Separate pre-EPU usage and post-EPU usage.
- Reduce the design basis number of hot standby cycles.

The details of each of these items are briefly discussed in the following discussions.

Reduced Flow Scaling Factor / Rapid Cycling

The EPU flow scaling factor, in the analysis performed for Reference 1, was conservatively based on the ratio (EPU flow / pre-EPU flow) $^{0.8}$ which yielded a scaling factor of 1.189. A more accurate relationship for the scaling factor is based on $(\Delta T_M / \Delta T_f)_{EPU} / (\Delta T_M / \Delta T_f)_{pre\text{-}EPU}$, where ΔT_M is the metal temperature differential and ΔT_f is the fluid temperature differential. Considering pre-EPU and EPU conditions, the revised scaling factor is established to be 1.094. During system

cycling, the time duration of the transient events is relatively long and results in essentially no change in temperature distribution as a result of EPU. Rapid cycling events are of short duration with flow changes affecting heat transfer at the fluid / nozzle interface. Therefore, the flow scaling factor is applied to these events.

Thermal / Mechanical and Pressure Stress
The initial EPU evaluation performed for Reference 1 conservatively applied the thermal scaling factors to the total stress, S_n. This resulted in an increased K_e factor and an increased CUF. Revised analyses are based on subtracting the mechanical and pressure stress terms from the total stress, applying the thermal scaling factor to the thermal stress terms, the pressure scaling factor to the primary (i.e., mechanical and pressure) terms as applicable, and recombining the increased thermal and primary mechanical and pressure stress terms to establish a revised K_e and S_{alt} stress for calculating the CUF.

Separate Pre-EPU usage and Post-EPU Usage
The original design basis and EPU evaluations were based on either set of conditions over the full 40-year design life. Calculated usage factor for each set of conditions can be scaled to represent the years of operation at pre-EPU conditions (14 years/40 years) and post EPU conditions (26 years/40 years).

Reduce the Design Basis Number of Hot Standby Cycles
Reactor vessel components were originally designed for a conservative number of hot standby event cycles, versus the design number specified for the attached piping. A reduction in the number of cycles to be used for the nozzle qualification is justified since they are 1) compatible with the number of cycles specified for the attached piping, and 2) CPS has a fatigue monitoring program that monitors usage at the FW nozzle during the life of the plant to ensure that the actual number of fatigue cycles is accurately represented by the analysis.

The results of this calculation, which is based on these reductions in conservatism, demonstrate that the CUF for 40 years of plant operation will be less than 1.0. Preliminary results of this analysis demonstrate the CUF for the FW nozzle safe end for 40 years of plant operation will be approximately 0.88. This result includes 14 years of operations at pre-EPU conditions and 26 years of operations at EPU conditions. This report will be completed prior to EPU implementation.

A comparison of the calculated fatigue usage factors for the FW nozzle safe end for the conditions requested, is provided below.

Design Basis Analysis
The CUF from the original design basis analysis is 0.9503. It is based on 40 years of original design basis operation (pre-EPU) and event cycles.

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Cycle Counting Stress Based Analysis
CPS maintains a CUF design basis analysis for the full 40-year design life as required by the ASME Code. CPS does not maintain a stress-based analysis for any specific number or combination of event cycles less than the full design basis number of events. Unless specific conditions justified otherwise, these types of calculations would be redundant to the insights provided by the Fatigue Monitoring Program and the "Fatigue Pro" software, which utilizes design basis stresses and actual event cycles to track cumulative usage on an ongoing basis.

Using Computer Software "Fatigue Pro"
Prior to EPU operation, utilization of the "Fatigue Pro" software indicates a cumulative usage factor of approximately 0.6 for the feedwater nozzle safe end using actual fatigue cycle events to date. For EPU operation, the software is being modified to reflect inputs provided by the detailed analyses currently being performed as discussed above.

Based on the generic GE BWR/6 Feedwater Nozzle Stress and Fatigue Analysis, the primary stress is determined for a number of cases and includes both primary and secondary stress values. The maximum primary plus secondary EPU stress (Sn) calculated in this analysis is equal to 70.4 ksi. The associated primary stress (Pm + Pb) for this case with the thermal stress component removed is 16.6 ksi.

Question 2
In your response 10.17, you indicated that five feedwater system pipe supports require modifications as a result of the EPU loads. Discuss the EPU conditions (increased pressure, temperature, flow rate, etc.) that resulted in the increase of loads in each of the feedwater support modifications. Confirm that these feedwater support modifications will be implemented prior to the EPU.

Response 2
The implementation of EPU at CPS results in increases to pressures, temperatures, and flow rates for the FW piping. While the internal piping pressure increases due to EPU, pressure is not a parameter in the determination of loads on piping supports. Temperature and flow are used for load calculations of FW piping supports. The increases in temperature and flow rate for the FW system are:

Parameter	Current Design[1]	EPU[2]	Percentage Change
Temperature	425°F	427.5°F	+0.7%
Flow Rate	12,421,300 lb/hr	15,100,410 lb/hr	+21.6%

(1) Current design temperature and pressure are from the existing design basis (pre-EPU) calculations.
(2) EPU temperatures and pressures are from the EPU PEPSE 120% heat balance.

The supports that require modifications due to increases in FW temperature and flow rate are located outside containment on the non-seismically qualified portion of the FW system. The increase in flow rate affects FW pump trip transient loads, which are treated as an upset load for the pipe supports. Since this portion of piping is non-seismic, the significance of pipe support load increases due to FW pump trip is greater when compared to the significance of pump trip load increases on the seismically qualified portions of the FW system.

The impact of the increases to FW system temperature and flow rate due to EPU was evaluated by reanalyzing the FW piping for the increased piping temperatures and flow rates. The results of the evaluation showed that sufficient margins existed in the support qualifications for all FW piping supports except 1FW03035S, 1FW03052X, 1FW03064X, 1FW03070X, and 1FW03097S. The modifications to 1FW03035S and 1FW03097S replace the existing snubbers with larger snubbers. The modifications to 1FW03052X and 1FW03064X stiffen the support base plates. The modification to 1FW03070X adds an auxiliary steel member to stiffen an existing member. As stated above, these supports are located outside the containment on the non-seismically qualified portion of the FW system. These modifications will be complete prior to implementation of EPU at CPS.

Question 3

In regard to Section 10.4.3, start up testing, you indicate that the vibration levels at the uprated power levels (i.e., 105%, 110%, ...) are extrapolated to compare to the acceptance criteria. Confirm whether you will also need to collect the vibration data at 50 % and 75% (in addition to the 100%) of the current rated power in the start up testing to extrapolate the vibration stress at the 105% power level.

Response 3

The response to Question 3 has been provided in Reference 2.

References

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

2. Letter from K. R. Jury (Exelon Generation Company) to U.S. NRC, "Additional Testing Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station," dated January 15, 2002