AmerGen[SM]

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-01-281

December 7, 2001

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

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. Attachment A to this letter provides the information requested in NRC Questions 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9, 10.10, 10.11, 10.12, 10.13, 10.14, 10.15, 10.16 and 10.17 of Reference 2. Responses to the remaining NRC questions in Reference 2 will be provided separately.

APOI

A portion of the information in Attachment A is proprietary to the General Electric Company, and AmerGen requests that it be withheld from public disclosure in accordance with 10 CFR 2.790, "Public inspections, exemptions, requests for withholding," paragraph (a)(4). The proprietary information is indicated with sidebars. Attachments B-1 through B-5 provide the affidavits supporting the request for withholding the proprietary information in Attachment A from public disclosure, as required by 10 CFR 2.790, paragraph (b)(1). Attachment C contains a non-proprietary version of Attachment A.

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

Respectfully,

Keith R. Jury

K. R. Jury
Director – Licensing
Mid-West Regional Operating Group

Attachments:

Affidavit

Attachment A:	Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Proprietary version)
Attachment B-1:	Affidavit for Withholding Portions of RAI Questions 10.3 and 10.6 of Attachment A from Public Disclosure
Attachment B-2:	Affidavit for Withholding Portions of RAI Question 10.7 of Attachment A from Public Disclosure
Attachment B-3:	Affidavit for Withholding Portions of RAI Question 10.8 of Attachment A from Public Disclosure
Attachment B-4:	Affidavit for Withholding Portions of RAI Questions 10.9 and 10.10 of Attachment A from Public Disclosure
Attachment B-5:	Affidavit for Withholding Portions of RAI Question 10.12 of Attachment A from Public Disclosure
Attachment C:	Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-proprietary version)

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.

Keith R. Jury

K. R. Jury
Director – Licensing
Mid-West Regional Operating Group

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

for the State above named, this 7th day of

December, 2001.

Anese L. Grigsby
Notary Public

OFFICIAL SEAL
ANESE L. GRIGSBY
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 3-13-2005

ENCLOSURE 1

RCPB Piping Stress Summary

ENCLOSURE 1

The following CPS RCPB piping systems are impacted by EPU.

CPS	Description
Main Steam A	Main steam piping system (Inside Containment)
Main Steam B/C	Main steam piping system (Inside Containment)
Main Steam D	Main steam piping system (Inside Containment)
Main Steam Drain Lines	MS drain piping system (Inside Containment)
SRV Piping	Safety Relief Valve Discharge Piping
RPV Head Vent Piping	RPV Head vent Piping
RCIC Piping	RCIC Piping system
Feedwater Piping	Feedwater Piping system (Inside Containment)

The maximum stress ratios for each of the piping systems impacted by EPU are provided below. All stresses are less than the applicable original code of construction allowable stresses.

System	Node Number	Condition	Current Design Basis (psi)	EPU Stress (psi)	Allowable (psi)	Ratio EPU/ Allowable
Main Steam A	029	Upset	14,698	15,506	31,860	0.49
Main Steam A	029	Emergency	14,608	14,608	39,825	0.37
Main Steam A	425	Faulted	27,040	28,527	54,600	0.52
Main Steam B/C	037	Upset	18,092	19,087	31,860	0.60
Main Steam B/C	037	Emergency	18,050	18,050	39,825	0.45
Main Steam B/C	050	Faulted	40,063	42,266	54,600	0.77
Main Steam D	029	Upset	16,749	17,670	31,860	0.55
Main Steam D	029	Emergency	16,642	16,642	39,825	0.42
Main Steam D	029	Faulted	28,278	29,833	53,100	0.56
MS Drain Lines	85B	Upset	20,694	21,832	31,860	0.69
MS Drain Lines	85B	Emergency	25,442	25,442	39,825	0.64
MS Drain Lines	245	Faulted	25,038	26,415	53,100	0.50
SRV Piping On MSL-A	441	Occasional	9730	10,265	27,000	0.38
SRV Piping On MSL-A	441	Level C	9726	9726	33,750	0.29
SRV Piping On MSL-A	416	Level D	13,594	14,342	45,000	0.32

ENCLOSURE 1

System	Node Number	Condition	Current Design Basis (psi)	EPU Stress (psi)	Allowable (psi)	Ratio EPU/ Allowable
SRV Piping On MSL-B/C	111	Occasional	6911	7291	27,000	0.27
SRV Piping On MSL-B/C	111	Level C	6912	6912	33,750	0.21
SRV Piping On MSL-B/C	111	Level D	7046	7434	45,000	0.17
SRV Piping On MSL-D	083	Occasional	9224	9731	27,000	0.36
SRV Piping On MSL-D	083	Level C	9224	9224	33,750	0.27
SRV Piping On MSL-D	102	Level D	11,224	11,841	45,000	0.26
RPV Head Vent Piping	5	Upset	15,500	16,353	31,860	0.51
RPV Head Vent Piping	5	Emergency	26,500	26,500	39,825	0.67
RPV Head Vent Piping	5	Faulted	27,000	28,485	53,100	0.54
RCIC Piping	55B	Upset	24,431	25,775	31,860	0.81
RCIC Piping	55B	Emergency	13,381	13,381	39,825	0.34
RCIC Piping	55B	Faulted	11,582	12,219	53,100	0.23
Feedwater Piping	130	9 Design*	20,162	20,162	26,550	0.76
Feedwater Piping	130	9B	20,162	21,271	31,860	0.67
Feedwater Piping	130	9C	20,065	21,169	39,825	0.53
Feedwater Piping	60	9D*	22,692	22,692	53,100	0.43
Feedwater Piping	140B	12	56,638	58,734	58,845	0.998
Feedwater Piping	43	13	53,369	54,543	58,845	0.93

* Not affected by EPU.

ENCLOSURE 1

The maximum fatigue usage factors for each of the piping subsystems impacted by extended power uprate are provided below. All fatigue usage factors satisfy the ASME Code requirements.

Subsystem	Location	Current Design Basis CUF	EPU CUF
Main Steam A	115	0.0679	0.069
Main Steam B/C	050	0.090	0.091
Main Steam D	086	0.080	0.081
MS Drain Lines	090	0.071	0.072
SRV Piping	NA	NA	NA
RPV Head Vent Piping	010	0.099	0.100
RCIC Piping	55B	0.072	0.073
Feedwater Piping	140B	0.464	0.53

ENCLOSURE 2

RCPB Pipe Supports, Anchors, Nozzles, Load Summary

ENCLOSURE 2

The following CPS RCPB piping systems are impacted by EPU.

CPS	Description
Main Steam A	Main steam piping system (Inside Containment)
Main Steam B/C	Main steam piping system (Inside Containment)
Main Steam D	Main steam piping system (Inside Containment)
Main Steam Drain Lines	MS drain piping system (Inside Containment)
RPV Head Vent Piping	RPV Head vent Piping
RCIC Piping	RCIC Piping system
Feedwater Piping	Feedwater Piping system (Inside Containment)

The maximum support/anchor/penetration/component loads for each of the piping systems impacted by EPU are provided below. All loads following EPU are within the capacity of the supports/anchors/penetrations/components and attached building structure.

RCPB One-Directional Support:

System	Pipe Support Number	Location Point	Service Level*	EPU Load (Lbs)	EPU Load within Support/ Building Capacity?
Main Steam A	S-103	016	Upset	13,053	Yes
			Faulted	29,132	Yes
Main Steam B/C	S-104	065	Upset	13,401	Yes
			Faulted	38,008	Yes
Main Steam D	S-103	016	Upset	12,272	Yes
			Faulted	28,971	Yes
MS Drain Lines	1MS05002X	20	Upset	1434	Yes
			Faulted	1532	Yes
RPV Head Vent	1NB01002S	35	Upset	674	Yes
			Faulted	1073	Yes
RCIC	1RI01005X	36	Upset	2233	Yes
			Faulted	2545	Yes
Feedwater	1FW01042S	660	Upset	20,229	Yes
			Faulted	19,779	Yes

* Level A and Level C are not affected by TSV loads.

ENCLOSURE 2

RCPB Two-Directional Supports

Pipe Guide Number	Node Point	Service Level*	Loading Direction	EPU Load (lbs and in - lbs)	EPU Load within Support./ Building Capacity?
MS Line A G101	29	Level B	FX	0	Yes
			FY	31,963	
			FZ	19,572	
			MX	490,925	
			MY	0	
			MZ	0	
		Level D	FX	0	Yes
			FY	34,063	
			FZ	21,968	
			MX	624,638	
			MY	0	
			MZ	0	
MS Lines B&C G101	29	Level B	FX	0	Yes
			FY	27,258	
			FZ	33,769	
			MX	537,823	
			MY	0	
			MZ	0	
		Level D	FX	0	Yes
			FY	32,263	
			FZ	33,209	
			MX	759,735	
			MY	0	
			MZ	0	
MS Line D G101	29	Level B	FX	0	Yes
			FY	26,144	
			FZ	25,054	
			MX	569,006	
			MY	0	
			MZ	0	
		Level D	FX	0	Yes
			FY	33,274	
			FZ	27,902	
			MX	696,784	
			MY	0	
			MZ	0	

* Level A and Level C are not affected by TSV loads.

ENCLOSURE 2

Anchors

Pipe Anchor Number	Node Point	Service Level*	Loading Direction	EPU Load (lbs and in - lbs)	EPU Load within Support./ Building Capacity?
Main Steam Lines B/C ANC A101	017	Level B	FX	102,870	Yes
			FY	34,363	
			FZ	56,724	
			MX	165,474	
			MY	4,081,004	
			MZ	715,422	
		Level D	FX	102,871	Yes
			FY	34,363	
			FZ	56,724	
			MX	165,474	
			MY	4,081,004	
			MZ	715,422	
Main Steam Line D ANC046	46	Level B	FX	96,235	Yes
			FY	35,375	
			FZ	48,559	
			MX	159,370	
			MY	2,805,695	
			MZ	702,119	
		Level D	FX	96,235	Yes
			FY	35,375	
			FZ	48,559	
			MX	159,370	
			MY	2,805,695	
			MZ	702,119	

* Level A and Level C are not affected by TSV loads.

Main Steam Penetration Head Fitting Loads

Maximum Head Fitting Loads at Penetration	Service Level	Head Fitting Location	Location Point	EPU Load (lbs and in - lbs)	Allowable Load (lbs and in - lbs)	Ratio EPU/Allowable
(Inside)-MR	Level B	MS Line B/ C	015-018	2,508,475	4,500,000	0.557
	Level D	"	"	2,387,735	6,745,000	0.354
(Outside)- MR	Level B	MS Line B/ C	015-014	2,926,460	7,348,000	0.398
	Level D	"	"	2,926,460	9,381,000	0.312

ENCLOSURE 2

Feedwater Penetration Stress and CUF

Penetration No.	Loading Condition	Stress Category	EPU Stress (psi) / CUF	Allowable Stress (psi) / CUF	Ratio = EPU / Allowable (Stress & CUF)
1PC0010	Design	General Membrane (Pm)	15,411	19,450	0.79
		Membrane + Bending (Pl+Pb)	16,570	29,174	0.57
	Normal / Upset	Expansion Stress (Pe)	36,269	39,600	0.92
		Primary + Secondary (Pl+Pb+Pe+Q)	26,511	47,340	0.56
	Emergency	General Membrane (Pm)	11,261	29,575	0.38
		Membrane + Bending (Pl+Pb)	12,019	44,362	0.27
	Faulted	General Membrane (Pm)	37,293	42,000	0.89
		Membrane + Bending (Pl+Pb)	50,314	63,000	0.80
	Cumulative Usage Factor (CUF)	Not Applicable	0.072	1.0	0.07

Main Steam RPV Nozzle Loads

Maximum RPV Nozzle Loads	Service Load Case	RPV Nozzle Location	Location Point	EPU Load (lbs and in - lbs)	Allowable Load (lbs and in - lbs)	Ratio EPU/Allowable
HR	Secondary (Level B)	MS Line B & C	079	65,661	767,000	0.086
MR	Secondary (Level B)	MS Line B & C	079	5,034,521	16,580,000	0.304
HR	Primary (Level D)	MS Line D	2	48,082	455,900	0.105
MR	Primary (Level D)	MS Line D	2	2,313,615	9,040,000	0.256

ENCLOSURE 2

Feedwater RPV Nozzle Loads

Nozzle No.	Node No.	Service Level	Stress Category	EPU Resultant Shear (lbs)	Allowable Resultant Shear (lbs)	Ratio = EPU / Allowable	EPU Resultant Moment (in - lbs)	Allowable Resultant Moment (in - lbs)	Ratio = EPU / Allowable
N4	110	Weight	Primary	2,189	12,600	0.17	91,017	349,000	0.26
		Thermal	Secondary	3,135	58,200	0.05	595,418	1,455,000	0.41
		A/B	Primary	14,939	27,200	0.55	680,577	732,262	0.93
		A/B	Primary + Secondary	10,983	58,200	0.19	906,983	2,433,000	0.37
		D	Primary	10,782	27,200	0.40	483,589	1,327,000	0.36

Feedwater Valve Accelerations*

Valve No.	Direction	EPU Service Level B Acceleration (g's)	Allowable Service Level B Acceleration (g's)	Service Level B Ratio = EPU / Allowable	EPU Service Level C Acceleration (g's)	Allowable Service Level C Acceleration (g's)	Service Level C Ratio = EPU / Allowable
1B21F010B	X	1.195	3.300	0.362	1.254	4.500	0.279
	Y	0.535	2.000	0.267	0.525	3.000	0.175
	Z	1.571	3.300	0.476	1.366	4.500	0.304

* Service Level D accelerations are not affected by EPU

ENCLOSURE 3

BOP Piping Stress Summary

ENCLOSURE 3

CPS	Description
Main Steam	Main steam piping system (Outside Containment)
Feedwater	Feedwater piping system (Outside Containment)

Main Steam and Feedwater Stresses

System		ASME Code Equation	EPU Stress (psi)	Allowable Stress (psi)	Ratio = EPU/Allowable
Main Steam Piping Outside Containment	Seismically Qualified Portion	8	7,616	15,000	0.51
		9B	16,799	18,000	0.93
		9C	22,879	27,000	0.85
		10	10,292	22,500	0.46
	Non-Seismically Qualified Portion	8	8,427	15,000	0.56
		9B	17,896	18,000	0.99
		9C	Not Applicable	27,000	N/A
		10	19,640	22,500	0.87
Feedwater Piping Outside Containment	Seismically Qualified Portion	8	5,731	15,000	0.38
		9B	12,277	18,000	0.68
		9C	11,782	27,000	0.44
		10	16,559	22,500	0.74
	Non-Seismically Qualified Portion	8	14,317	15,000	0.95
		9B	15,972	18,000	0.89
		9C	Not Applicable	27,000	N/A
		10	19,959	22,500	0.89

ENCLOSURE 4

BOP Pipe Supports, Anchors, Nozzles, Load Summary

ENCLOSURE 4

Main Steam & Feedwater Supports Outside Containment

System	Pipe Support Number (Support Direction)	Location Point	Service Load Case	EPU Load (Lbs)	EPU Load within Support/Building Capacity?[6]
Seismic MS Supports	1MS07001G (Y)	45	Level B	42,564	Yes
			Level C	40,843	Yes
	1MS07001G (Z)	45	Level B	22,690	Yes
			Level C	22,014	Yes
Non-Seismic MS Supports	1MS01007S (X)	955	Level B	12,083	Yes
Seismic FW Supports	1FW03012X	296	Level B	20,209	Yes
			Level C	35,732	Yes
Non-Seismic FW Supports	1FW03035S	487	Level B	2300	No – Modification Required[1]
	1FW03052X	737	Level B	22,190	No – Modification Required[2]
	1FW03064X	899	Level B	13,397	No – Modification Required[3]
	1FW03070X	837	Level B	16,256	No – Modification Required[4]
	1FW03097S	888	Level B	1701	No – Modification Required[5]
	1FW03084R	968	Level B	21,256	Yes

1. EC No. 331323 replaces the snubber on 1FW03035S with a larger snubber.
2. EC No. 331323 stiffened the baseplate on 1FW03052X.
3. EC No. 331323 stiffened the baseplate on 1FW03064X.
4. EC No. 331323 stiffened the baseplate and added an auxiliary "kicker" on 1FW03070X.
5. EC No. 331323 replaces the snubber on 1FW03097S with a larger snubber.
6. No support modifications were required for any BOP piping supports due to EPU other than those listed.

ATTACHMENT B-1

Affidavit for Withholding Portions of RAI Questions 10.3 and 10.6 of Attachment A from Public Disclosure

General Electric Company

AFFIDAVIT

I, George B. Stramback, being duly sworn, depose and state as follows:

(1) I am Project Manager, Regulatory Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Attachment 1 to letter GE-CPS-AEP-076, *Response to NRC RAI Regarding EPU – RAIs 10.2, 10.3, 10.4, and 10.6*, dated November 15, 2001. The proprietary information in Attachment 1 (*GE-CPS-AEP-076, GE Responses to NRC RAIs for EPU – RAIs 10.2, 10.3, 10.4, and 10.6,* (GE Company Proprietary)), is identified by bars marked in the margin adjacent to the specific material.

(3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), 2.790(a)(4), and 2.790(d)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals cost or price information, production capacities, budget levels, or commercial strategies of General Electric, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, of potential commercial value to General Electric;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in both paragraphs (4)a. and (4)b., above.

(5) The information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains further details regarding the GE proprietary report NEDC-32989P, *Safety Analysis Report for Clinton Power Station Extended Power Uprate,* Class III (GE Proprietary Information), dated June 2001, which contains detailed results of analytical models, methods and processes, including computer codes,

which GE has developed, obtained NRC approval of, and applied to perform evaluations of transient and accident events in the GE Boiling Water Reactor ("BWR").

The development and approval of these system, component, and thermal hydraulic models and computer codes was achieved at a significant cost to GE, on the order of several million dollars.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GE.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GE would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GE of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

STATE OF CALIFORNIA)
) ss:
COUNTY OF SANTA CLARA)

George B. Stramback, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at San Jose, California, this 15th day of November 2001.

George B. Stramback
General Electric Company

Subscribed and sworn before me this 15th day of November 2001.

TERRY J. MORGAN
Commission # 1304914
Notary Public - California
Santa Clara County
My Comm. Expires May 18, 2005

Notary Public, State of California

ATTACHMENT B-2

Affidavit for Withholding Portions of RAI Question 10.7 of Attachment A from Public Disclosure

General Electric Company

AFFIDAVIT

I, George B. Stramback, being duly sworn, depose and state as follows:

(1) I am Project Manager, Regulatory Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Attachment 2 to letter GE-CPS-AEP-081, *Response to NRC RAI Regarding EPU – RAIs 9.1, 9.2, 9.4, and 10.7,* dated November 21, 2001. The proprietary information in Attachment 2 (*GE-CPS-AEP-081, GE Responses to NRC RAIs for EPU – RAIs 9.2, 9.4, and 10.7,* (GE Company Proprietary)), is identified by bars marked in the margin adjacent to the specific material.

(3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), 2.790(a)(4), and 2.790(d)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals cost or price information, production capacities, budget levels, or commercial strategies of General Electric, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, of potential commercial value to General Electric;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in both paragraphs (4)a. and (4)b., above.

(5) The information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains further details regarding the GE proprietary report NEDC-32989P, *Safety Analysis Report for Clinton Power Station Extended Power Uprate,* Class III (GE Proprietary Information), dated June 2001, which contains detailed results of analytical models, methods and processes, including computer codes,

which GE has developed, obtained NRC approval of, and applied to perform evaluations of transient and accident events in the GE Boiling Water Reactor ("BWR").

The development and approval of these system, component, and thermal hydraulic models and computer codes was achieved at a significant cost to GE, on the order of several million dollars.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GE.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GE would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GE of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

STATE OF CALIFORNIA)

) ss:

COUNTY OF SANTA CLARA)

George B. Stramback, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at San Jose, California, this 21st day of November 2001.

George B. Stramback
General Electric Company

Subscribed and sworn before me this 21st day of NOVEMBER 2001.

Notary Public, State of California

ANNA HANLIN
Commission # 1184507
Notary Public - California
Santa Clara County
My Comm. Expires Jun 19, 2002

ATTACHMENT B-3

Affidavit for Withholding Portions of RAI Question 10.8 of Attachment A from Public Disclosure

General Electric Company

AFFIDAVIT

I, **George B. Stramback,** being duly sworn, depose and state as follows:

(1) I am Project Manager, Regulatory Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Attachment 1 to letter GE-CPS-AEP-079, *Response to NRC RAI Regarding EPU – RAIs 9.5, 9.6, and 10.8,* dated November 19, 2001. The proprietary information in Attachment 1 (*GE-CPS-AEP-079, GE Responses to NRC RAIs for EPU – RAIs 9.5, 9.6, and 10.8,* (GE Company Proprietary)), is identified by bars marked in the margin adjacent to the specific material.

(3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), 2.790(a)(4), and 2.790(d)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

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c. Information which reveals cost or price information, production capacities, budget levels, or commercial strategies of General Electric, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, of potential commercial value to General Electric;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in both paragraphs (4)a. and (4)b., above.

(5) The information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains further details regarding the GE proprietary report NEDC-32989P, *Safety Analysis Report for Clinton Power Station Extended Power Uprate,* Class III (GE Proprietary Information), dated June 2001, which contains detailed results of analytical models, methods and processes, including computer codes,

which GE has developed, obtained NRC approval of, and applied to perform evaluations of transient and accident events in the GE Boiling Water Reactor ("BWR").

The development and approval of these system, component, and thermal hydraulic models and computer codes was achieved at a significant cost to GE, on the order of several million dollars.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

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STATE OF CALIFORNIA)
) ss:
COUNTY OF SANTA CLARA)

George B. Stramback, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at San Jose, California, this 19th day of November 2001.

George B. Stramback
General Electric Company

Subscribed and sworn before me this 19th day of November 2001.

Notary Public, State of California

ANNA HANLIN
Commission # 1184507
Notary Public - California
Santa Clara County
My Comm. Expires Jun 19, 2002

ATTACHMENT B-4

Affidavit for Withholding Portions of RAI Questions 10.9 and 10.10 of Attachment A from Public Disclosure

General Electric Company

AFFIDAVIT

I, George B. Stramback, being duly sworn, depose and state as follows:

(1) I am Project Manager, Regulatory Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Attachment 1 to letter GE-CPS-AEP-077, *Response to NRC RAI Regarding EPU – RAIs 10.9, 10.10, and 10.11*, dated November 16, 2001. The proprietary information in Attachment 1 (*GE-CPS-AEP-077, GE Responses to NRC RAIs for EPU – RAIs 10.9, 10.10, and 10.11,* (GE Company Proprietary)), is identified by bars marked in the margin adjacent to the specific material.

(3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), 2.790(a)(4), and 2.790(d)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

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c. Information which reveals cost or price information, production capacities, budget levels, or commercial strategies of General Electric, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, of potential commercial value to General Electric;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in both paragraphs (4)a. and (4)b., above.

(5) The information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains further details regarding the GE proprietary report NEDC-32989P, *Safety Analysis Report for Clinton Power Station Extended Power Uprate,* Class III (GE Proprietary Information), dated June 2001, which contains detailed results of analytical models, methods and processes, including computer codes,

which GE has developed, obtained NRC approval of, and applied to perform evaluations of transient and accident events in the GE Boiling Water Reactor ("BWR").

The development and approval of these system, component, and thermal hydraulic models and computer codes was achieved at a significant cost to GE, on the order of several million dollars.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

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STATE OF CALIFORNIA)
) ss:
COUNTY OF SANTA CLARA)

George B. Stramback, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at San Jose, California, this 16th day of November 2001.

George B. Stramback
George B. Stramback
General Electric Company

Subscribed and sworn before me this 16th day of November 2001.

TERRY J. MORGAN
Commission # 1304914
Notary Public - California
Santa Clara County
My Comm. Expires May 18, 2005

Terry J. Morgan
Notary Public, State of California

ATTACHMENT B-5

Affidavit for Withholding Portions of RAI Question 10.12 Of Attachment A from Public Disclosure

General Electric Company

AFFIDAVIT

I, George B. Stramback, being duly sworn, depose and state as follows:

(1) I am Project Manager, Regulatory Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Attachment 1 to letter GE-CPS-AEP-075, R1, *Response to NRC RAI Regarding EPU – RAIs 10.12, 10.13, and 10.17*, dated December 6, 2001. The proprietary information in Attachment 1 (*GE-CPS-AEP-075, R1, Consolidated GE Response to RAI 10.12,* (GE Company Proprietary)), is identified by bars marked in the margin adjacent to the specific material.

(3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), 2.790(a)(4), and 2.790(d)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

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e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in both paragraphs (4)a. and (4)b., above.

(5) The information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

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(8) The information identified in paragraph (2), above, is classified as proprietary because it contains further details regarding the GE proprietary report NEDC-32989P, *Safety Analysis Report for Clinton Power Station Extended Power Uprate,* Class III (GE Proprietary Information), dated June 2001, which contains detailed results of analytical models, methods and processes, including computer codes,

which GE has developed, obtained NRC approval of, and applied to perform evaluations of transient and accident events in the GE Boiling Water Reactor ("BWR").

The development and approval of these system, component, and thermal hydraulic models and computer codes was achieved at a significant cost to GE, on the order of several million dollars.

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STATE OF CALIFORNIA)
) ss:
COUNTY OF SANTA CLARA)

George B. Stramback, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at San Jose, California, this 6th day of December 2001.

George B. Stramback
General Electric Company

Subscribed and sworn before me this 6th day of December 2001.

TERRY J. MORGAN
Commission # 1304914
Notary Public - California
Santa Clara County
My Comm. Expires May 18, 2005

Notary Public, State of California

ATTACHMENT C

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

Question 10.1

In Section 3.1.1 of Attachment E, you state that EPU evaluations are performed using the existing safety relief valve (SRV) setpoint tolerance analytical limits as a basis. The in-service surveillance testing of the plant's SRVs has not shown a significant propensity for high setpoint drift greater than 3 percent. During the extended refueling outage RF-6, all 16 SRVs were tested. The "as found" setpoint lift verification tests found that three of the SRVs exceeded their setpoint by greater than +/- 3 percent. Confirm whether the Clinton EPU SRV analyses are performed using + 3 percent setpoint tolerance.

Response 10.1

The Clinton Power Station (CPS) extended power uprate (EPU) safety/relief valve (SRV) analysis was performed using a tolerance of +3%.

Question 10.2

In Section 3.3.2 of Attachment E, you indicate that the effect of EPU was evaluated to ensure that the reactor vessel components continue to comply with the existing structural requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. For the components under consideration, the 1971 Edition of the Code with addenda to and including Summer 1973, which is the construction code of record, was used as the governing Code. You also indicate that if a component underwent a design modification, the governing code for that component was the code used in the stress analysis of the modified component. Provide a summary of the components that were modified and the code editions/code cases (if applicable) other than the code of record that were used for the EPU evaluation.

Response 10.2

The following components were previously modified using the applicable code editions listed below.

- Safe end and thermal sleeve, recirculation inlet nozzle, DC22A6627 – American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Division 1, Nuclear Power Plant Components, 1974 Code Edition with addenda to and including Summer 1976.

- Safe end and thermal sleeve, recirculation inlet nozzle, DC22A6643AC – ASME Boiler and Pressure Vessel Code, Section III, Division 1, Nuclear Power Plant Components, 1974 Code Edition with addenda to and including Summer 1976.

- Safe end, feedwater nozzle, DC22A5536AJ – Article NA-3250 of ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant Components, 1974 Edition with addenda to and including Summer 1976.

- Safe end, feedwater nozzle, DC22A5552AG – Paragraph NA-3350 of ASME Boiler and Pressure Vessel Code, Section III, Division 1, Nuclear Power Plant Components, 1974 Code Edition, with addenda to and including Summer 1976.

- Control rod drive hydraulic system return nozzle cap, DC22A4940AZ – Article NA-3250, ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant components, 1974 Edition, with addenda to and including Winter 1975.

Question 10.3
In Section 3.3.2, you indicate that new stresses are determined by scaling the "original" stresses based on the EPU conditions (temperature and flow). The analyses were performed for the design, normal and upset, and emergency and faulted conditions. Provide a summary discussion of how you arrived to the scaling factors for the EPU at various service conditions. Also, provide an example to illustrate how scale factors were calculated and used in calculating the EPU stress and cumulative usage factor (CUF) at the feedwater nozzle blend radius.

Response 10.3

ATTACHMENT C

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

ATTACHMENT C

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

Normal and Upset Conditions

The pressure and mechanical loads including seismic and new loads for EPU are bounded by the loads used in the qualification of reactor pressure vessel (RPV) components for pre-EPU conditions. Hence, the primary stresses for pre-EPU bound those for EPU.

According to the ASME Code, structural adequacy is demonstrated if the maximum primary plus secondary stress intensity range (S_n) at a location on the component is less than 3 * S_m of the material at the location examined. If this limit is exceeded, a simplified plastic-elastic analysis may be used to demonstrate structural adequacy.

For components whose operating conditions do not meet the ASME Code requirements listed for "Vessels Not Requiring Analysis for Cyclic Operation," a fatigue analysis must be performed to ensure that the component does not experience fatigue failure during the expected service life of the plant. The ASME Code lists a maximum allowable cumulative fatigue usage factor (CUF) of 1.0.

Emergency and Faulted Conditions

The stresses resulting from emergency and faulted conditions remain unchanged; therefore, the ASME Code requirements are fulfilled. No further analysis of the reactor vessel and its components is necessary for these conditions.

EPU Primary Plus Secondary (P + Q) Stress Intensity Range

The following general procedure is used to calculate the EPU P+Q stress intensity range ($S_{n,new}$) for the critical conditions at the limiting location of the RPV component. The EPU stress intensity is then compared to the ASME Code allowable value.

Primary plus secondary stress scaling procedure includes the following.

- Determine the scaling factors for all transients considered in the original stress report using the appropriate EPU operating parameters listed in the Certified Design Specification, 26A5701.

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

- Multiply the limiting stress intensity reported in the governing (most recent) stress report by the largest SCF, corresponding to the transients producing the stress intensity.

- Determine the ASME Code allowable P+Q stress intensity range. The $3S_m$ ASME Code limit is evaluated at the maximum temperature of the two transients considered. However, if it can be shown that the secondary stress is a result of thermal loads rather than mechanical loads, $3S_m$ may be determined from the average of the highest and lowest metal temperatures experienced during the limiting transient. The ASME Code allowable, $3S_m$, may be taken from the governing stress report, if listed.

- Compare the scaled limiting stress intensity with the ASME Code allowable stress limit. If S_n is less than $3S_m$, the ASME Code requirements are met; however, if the limit is exceeded, the ASME Code describes other applicable analysis methods.

EPU Fatigue Evaluation

The following general procedure describes the standard method used to perform the ASME Code fatigue (F) evaluation for EPU conditions.

- Determine the applicable SCF for each stress component composing the P + Q + F stress cycle considered. This includes pressure, temperature, and flow SCFs.

- Apply the appropriate SCF to the corresponding stress component of the P + Q + F stress cycle.

- Determine the new alternating stress intensity ($S_{alt,new}$), then calculate and apply the correct fatigue strength reduction factor, $K_{e,new}$ and elastic modulus correction factor, E_c/E_a. Both of these factors are described in the ASME Code. Because the value for n and m vary by material and are included in the ASME Code, they are not listed here. The uprated $S_{alt,new}$ takes the following form:

$$S_{alt,new} = 1/2 * K_{e,new} * (E_c/E_a) * S_{P+Q+F,new}$$

Where:

$K_{e,new}$ = Simplified elastic-plastic factor

E = 1.0, for $S_{n,new} \leq 3\ S_m$
= $1.0 + [(1-n)/n(m-1)] * [(S_{n,new}/3S_m) - 1]$,

for $3S_m < S_{n,new} < 3mS_m$
= $1/n$,

for $S_{n,new} \geq 3mS_m$

- Using $S_{alt,new}$, determine the ASME Code allowable number of cycles from the fatigue curve appropriate to the material of the component under consideration.

- Repeat Steps 2-4 for each peak stress intensity corresponding to a group of cycles considered in the fatigue analysis.

- The cumulative fatigue usage factor (U) may now be determined from the following formula:

  $U = u_1 + u_2 + u_x$

  Where:

  u_x = n_x/N_x, is the incremental fatigue usage factor
  n_x = expected number of lifetime cycles experienced by the component
  N_x = Code allowable number of cycles determined in Step 4.

- Compare the cumulative usage factor to the ASME Code allowable upper limit (i.e., $U < 1.0$).

It should be noted that the required cycles used in the calculation of CUF represent the full number of design cycles for the 40-year plant life. The use of full number of design cycles is conservative. No attempt has been made in these evaluations to separate partial usage for pre-EPU and post-EPU conditions.

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

Question 10.4

In Section 3.3.2, you also indicate that if there is an increase in annulus pressurization, jet reaction, pipe restraint or fuel lift loads, the charges are considered in the analysis of the components affected for upset, emergency and faulted conditions. Provide a summary discussion of how these loads are affected by the proposed power uprate. Confirm whether and how these loads are incorporated in the EPU evaluation of the reactor vessel and internal components.

Response 10.4

There is no change in reactor pressure and temperature due to EPU. There is a slight change in reactor temperature for some regions in the thermal cycle diagram. As a result of these factors, the annulus pressurization, jet reaction, pipe restraint or fuel lift loads for EPU are bounded by the pre-EPU values. Hence, these loads are considered in the EPU structural evaluation of reactor vessel and its components.

Question 10.5

CPS will apply ASME Section XI Appendix L for fatigue assessment of the feedwater nozzle safe end. What is the CPS plan for demonstrating that the nozzle is acceptable? CPS has a fatigue-monitoring program that tracks the plant-specific fatigue. Provide a summary description of the program and how it is used to arrive at an accurate representation of the fatigue usage. Also, provide a comparison of the CPS design-basis cycles and calculated CUFs for the feedwater nozzle safe end and the actual plant operating data from the fatigue-monitoring program.

Response 10.5

Previous analysis of the feedwater nozzle safe end for uprated conditions resulted in a CUF of greater than 1.0. Based on the previous assessment, a plan to apply the allowances of ASME Code Section XI, Appendix L was developed and presented as part of the license amendment request (Appendix E to Reference 1). Currently, a more detailed analysis is in progress for the feedwater nozzle safe end for uprated conditions to confirm a CUF of less than 1.0 rather than the previous CUF of greater than 1.0. The current analysis will use more realistic evaluations in the areas of heat transfer coefficients applied to the flow scaling factor and separating the mechanical and pressure stresses from the thermal stresses for the uprated conditions. The improvement in the analysis will result in a CUF for the feedwater nozzle safe end of less than 1.0. The confirmation of this value is currently in progress and will be finalized prior to the end of the next refueling outage. As the results of the analysis are expected to confirm a CUF of less than 1.0, the allowances of ASME Code Section XI, Appendix L will not apply and the actions presented in Section 3.3.2.2 of Appendix E to Reference 1, will not be necessary.

The Fatigue Monitoring Program at CPS is established by Nuclear Station Engineering Department procedure I-25 "Class 1 Component Fatigue Monitoring Program." This procedure provides the requirements for monitoring of 32 fatigue critical locations within the plant and their exposure to 36 specified plant transients. The Fatigue Monitoring Program determines the current fatigue usage for those specific fatigue limiting locations using either cycle counting or stress-based analysis. Actual plant operating data is collected periodically and entered into an industry generic software program called "Fatigue Pro." Fatigue Pro reports are generated on a regular schedule and are reviewed, analyzed and evaluated by station experts. Actions are taken as necessary based on the results of these evaluations.

Question 10.6

In Section 3.3.2.2, Table 3-1, you indicate that the reactor vessel main flanges and bolts do not experience a change in temperature or pressure due to EPU. Hence, EPU stresses and usage factors are the same as the current values. Provide a summary of loads and design transients considered in the evaluation of closure flanges and bolts. Confirm whether and how pressure and temperature used in the evaluation of the reactor vessel main flanges and bolts are not affected by the EPU.

Response 10.6

Question 10.7

In Section 3.3.3, you state that the original acoustic loads on the reactor internal components, following a postulated recirculation line break, were also updated in accordance with current methodology. Provide a summary of the methodology and assumptions used in calculating the acoustic loads and provide an example to illustrate how the acoustic loads and flow induced loads were calculated, at the critical locations (i.e., shroud), due to recirculation line break for the EPU condition.

Response 10.7

The updated methodology for calculating the loads on reactor internal components for a postulated recirculation line break is based on the studies performed in support of reactor shroud cracking concerns.

Acoustic Load Methodology Summary

The acoustic loads, which occur just after an instantaneous pipe break, are due to a decompression wave in the vessel, with reflections from and attenuations by jet pumps, and the subsequent reflection of the wave against itself on the far side of the reactor vessel from the pipe break.

Flow Induced Load Methodology Summary

Table 10.7-1

Calculation Example of Scale Factors

Table 10.7-2

Flow-Induced Loads on Shroud Example

Question 10.8

In Section 3.3.4, you indicate that for components experiencing increased loads due to EPU, the existing stresses are scaled-up in proportion to the loads, and the combined stresses and fatigue usage factors were compared to the code allowables for the various service conditions. Provide a summary describing how you arrived to the scaling factors for the EPU at various service conditions. Also, provide an example to illustrate how scale factors were calculated and the calculation of the EPU stress and CUF at the feedwater sparger pipe/tee and at the jet pump riser brace.

Response 10.8

ATTACHMENT C

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

Question 10.9
In Section 3.3.5, you evaluate the effects of the EPU on the potential for flow-induced vibration of the reactor internal components due to the increase in steam product (>20 percent) in the core, the increase in the core pressure drop, and the increase in the recirculation pump speed. You indicated that the evaluation was based on the vibration data for the reactor internal components recorded during the startup testing of the NRC designated prototype plant and on operating experience from similar plants. The expected vibration levels under EPU conditions were estimated by extrapolating the vibration data recorded during startup testing at Kuo Sheng 1, the prototype plant, and on GE Nuclear Energy BWR operating experience. Discuss whether and how the recorded vibration data at Kuo Sheng 1 can be applicable for CPS and provide the basis for using the operating experience of similar plants. Also, provide a sample evaluation for the most critical components (i.e., jet pump).

Response 10.9
The evaluation was performed based on measured vibration data from Kuo Sheng 1 plant and on operating experience of similar plants. CPS is a Boiling Water Reactor (BWR)/6 reactor with a 218-inch diameter vessel. Kuo Sheng 1 is the Nuclear Regulatory Commission (NRC) designated prototype for BWR/6 218 plants. The reactor internals of CPS and the prototype plant are identical. The recirculation pump speeds and the rated core flows are also identical. Hence, the recorded vibration data at the prototype plant is applicable to CPS. The operating experience of similar plants was used for two components (jet pump sensing line and steam dryer) that were not instrumented at Kuo Sheng 1.

Furthermore, since CPS has a fixed recirculation pump speed, the VPF during EPU is not changed from that during current licensed thermal power (CLTP) conditions. Therefore, there are no JPSL issues due to EPU. The operational history of dryers in similar plants was also studied to see if there were any flow induced vibration related problems in the dryer. Details of this are provided in the response to RAI Question 10.10.

The reactor internals at the prototype plant were extensively instrumented during the startup testing of the plant for purposes of vibration monitoring to confirm the structural integrity of major components in the reactor with respect to flow induced vibration. Extensive vibration measurements were made over a period of two years covering a wide range of operational conditions from pre-operational (without fuel), pre-critical (with fuel but not critical) and power operational tests. The power operational tests were conducted at two rod line conditions at various core flows. The sensors consisted of strain gages, accelerometers and displacement measuring devices. The sensors consisted of strain gages, accelerometers and displacement measuring devices. The sensor signals were recorded on-line during the test program on magnetic media and on brush chart paper. The vibration signals of the components were analyzed at balanced flow test conditions and at the two rod lines to determine the expected vibration response in the power uprate region. The extrapolated vibration peak amplitude response in the power uprate region was compared with the allowable design criteria of 10,000 psi peak stress intensity to determine the acceptability of the vibration level. At this stress level, sustained operation is allowed without incurring any fatigue usage.

A sample evaluation is shown for the jet pump in Table 10.9-1 below. The evaluation process is as follows. The signals of the components were analyzed at balanced flow test conditions at 60% and 100% rod lines to determine the expected vibration response in the power uprate region. The extrapolated vibration peak amplitude response in the power uprate region was compared with the allowable design criteria of 10,000 psi peak stress intensity. In order to apply the vibration criteria, a dynamic structural analysis is performed to relate peak stresses to measured strains or displacements at sensor locations. Mathematical models for each component are developed using finite element methods. Natural frequencies and modes of vibration are calculated. The location of the peak stress intensity is identified, including the effects of stress concentration factors. The modal strains and displacements at sensor locations are determined relative to peak stress intensity on a normalized basis, such that the highest peak stress intensity is 10,000 psi. The contribution of the various modes is absolute summed for conservatism.

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

Table 10.9-1
Extrapolation for Jet Pump Vibration Data, Sensor S43

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

Question 10.10

In Section 3.3.5, you provide a list of components (including steam dryer) that were evaluated for the flow-induced vibration. You also indicate that during EPU operation, the components in the upper zone of the reactor, such as the steam separators and dryers, are mostly affected by the increased steam flow. Provide recorded or testing data and a summary of the evaluation with regard to the flow-induced vibration affecting steam dryers. Discuss the potential for flow-induced vibration of the steam dryers due to various mechanisms, including, in particular, the fluid-elastic instability in the steam separators and dryers at the proposed power level. If the details of the analysis and the results are documented in a report, submit the report for staff review. In light of the discussion in GE SIL No. 474 and BWRVIP-06 report, discuss how you can ensure that the steam dryer will maintain its structural integrity during the EPU operation.

Response 10.10

The steam dryer has no safety function. The sole function of the steam dryer is to remove moisture from the steam in order to minimize erosion of the piping and turbine and to improve the turbine efficiency. BWRVIP-06, which was endorsed by the NRC, also states that the dryer is non-safety related and failure of a dryer component may cause an operability concern but has no safety impact. Hence, the dryer was not instrumented during startup testing and no measured vibration data is available for the prototype plant.

The design criteria for the steam dryer is that the structural integrity of the dryer is maintained when subjected to a steam line break occurring beyond the main steam isolation valves. Since the reactor steam dome pressure is not changed under EPU conditions, steam dryer structural integrity evaluations performed for a main steam line break for the current rated thermal power are applicable to EPU conditions.

During EPU, the normal operation pressure drop through the dryer is less than 10% of the faulted condition value for main steam line break. The dynamic pressure loads causing vibration are also of the same order of magnitude as the normal operation pressure drop. The steam dryer meets the design basis criteria for faulted conditions, which is more severe than normal operational loads.

The operational history of dryers in similar plants was also studied to see if there were any flow induced vibration related problems in the dryer. Only drain channel cracks at steady state conditions were found due to vibration effects. Drain channel cracks and recommended actions are discussed in detail in GE Safety Information Letter (SIL) Number 474, "Steam Dryer Drain Channel Cracking." In 1996 the CPS steam dryer was found to have a crack in the right side vertical weld of drain channel 8. Thus drain channel cracking has occurred even during normal operation and usually they are repaired at a convenient time after detection. While instances of drain channel cracking have occurred at operating plants, it is an operational issue only, relating to proper drying of the steam before it leaves the dryer. No structural integrity problems have been observed with these cracks. Drain channel cracking does not preclude safe operation of the reactor.

Outer bank hood damage due to turbine stop valve (TSV) closure was found in a BWR/5 plant. The outer bank hood (adjacent to the steam outlet nozzles) at BWR/6 plants are four times thicker than at the plant where the damage occurred and there have been no such damage in BWR/6 plants. Hence, it is expected that the outer bank hood can withstand the transient. This also is an operational issue only and not a safety issue. The dryers are visually inspected during removal in each refueling outage and any significant cracking can be repaired.

Question 10.11
Provide a discussion on the potential for excessive vibrations, high noise levels, and the instrument lines leakage that might be caused by the increased recirculation pump speed or flow for the proposed power uprate, as described in the NRC Information Notice 95-16. Confirm whether the jet pump riser brace will be susceptible to vibration from the recirculation pump vane passing frequency due to the EPU at CPS.

Response 10.11
Since CPS has a flow control valve for recirculation flow control, the recirculation pump speed does not change. There is no change in core flow rates associated with this EPU. Due to the increase in back pressure during EPU, the recirculation flow is increased slightly by less than 2.3%.

In any event, the vibration issue associated with increased containment noise and vibration levels due to increased recirculation pump speed and/or flow rate was investigated and reported in GE SIL Number 600, "Increased Containment Noise and Vibration at Increased Recirculation Pump Speed." The conclusion of this investigation was that the increased noise and vibration levels associated with higher recirculation pump speeds or flow rates were a direct result of a residual heat removal (RHR) testable check valve not being properly seated. Testing demonstrated that the containment noise and RHR vibration levels were greatly attenuated when the RHR testable check valve was properly seated.

The containment noise and vibration associated with the RHR system testable check valve, at increased pump speeds and flow rates, was determined by testing to have no detrimental effect on plant equipment, including the reactor recirculation system piping, RHR piping, the recirculation pumps and motors, and the containment structure.

The recirculation pump speed (and hence the VPF) is fixed at CPS and does not change with EPU. Hence, there is no increased possibility of resonance with the VPF due to EPU. The riser brace natural frequencies are well above the VPF and there have been no reported failures of riser braces in BWR/6 plants.

Question 10.12
In reference to Section 3.5, provide a discussion of the methodology and assumptions used for evaluating the reactor coolant pressure boundary piping (RCPB) systems for the proposed power uprate. Also, provide the calculated maximum stresses and fatigue usage factors for both the current design-basis and the EPU conditions, critical locations on the evaluated RCPB piping systems, allowable stress limits, and the code and code edition used in the evaluation of the power uprate. If different from the code of record, justify and reconcile the differences. Were the analytical computer codes used in the evaluation different from those used in the original design-basis analysis? If so, identify the new codes used and provide your justification for their use by specifying how these codes were benchmarked for such applications.

Response 10.12
Evaluation methodologies for the piping and associated structures such as nozzles, penetrations, supports, etc., are described in Section 5.5.2 and Appendix K of Reference 2 (ELTR1), and Section 4.8 of Reference 3 (ELTR2). The power uprate parameters of piping systems (pressure, temperature and flow) were compared with the corresponding pre-EPU values to determine the increases in temperature, pressure, and flow due to power uprate conditions. The multiplying factors were then used to determine the percentage increases in applicable ASME Code stresses, displacements, CUF, and pipe interface component loads (including supports) as a function of percentage increase in pressure, temperature, and flow. The percentage increases were applied to the highest calculated stresses, displacements, and the CUF at applicable piping system node points to conservatively determine the maximum extended power uprate calculated stresses, displacements and usage factors. This approach is conservative because power uprate does not affect weight and dynamic loads (e.g., seismic loads are unaffected by power uprate).

The factors were also applied to nozzle loads, support loads, penetration loads, valves, pumps and heat exchangers nozzles and anchors so that these components could be evaluated for acceptability, where required. For some main steam, main steam branch piping, and feedwater pipe supports, more detailed evaluations were performed. In these cases the individual load components affected by EPU (thermal and hydraulic transient) were updated for EPU and recombined with the loads unaffected by EPU to determine acceptability of the pipe supports.

The summary of reactor coolant pressure boundary (RCPB) piping evaluation results is provided in Enclosure 1. In addition, no new pipe break locations were identified as a result of EPU.

The Code allowables from the Code of Record used for the EPU evaluations are the same as those used in the original and existing design basis piping stress calculations. A listing of these Codes is provided in Table 10.12-1.

Table 10.12-1

Piping	Code
Class 1 main steam and recirculation piping	ASME B&PV Code, Section III, Subsection NB, 1983 Edition through Winter 1984 Addendum
Other Class 1 piping (feedwater and main steam branch piping excluding main steam relief valves (MSRV))	ASME B&PV Code, Section III, Subsection NB, 1977 Edition through Winter 1979 Addendum
Class 2 and 3 piping (MSRV branches to first anchor)	ASME B&PV Code, Section III, Subsection NC/ND, 1983 Edition through Winter 1984 Addendum

The analytical techniques used in the CPS EPU evaluations are in accordance with the CPS licensing and design basis requirements.

No new computer codes were used or new assumptions were introduced for this evaluation.

Question 10.13

Provide a summary of your evaluation of pipe supports, nozzles, penetrations, guides, valves, pumps, heat exchangers and anchors at the power uprate condition. The evaluation should include the methodology, assumptions, and results of the evaluation for the critical piping systems affected by the proposed power uprate. Were the analytical computer codes used in the evaluation different from those used in the original design-basis analysis. If so, identify the new codes and provide your justification for their use by specifying how were these codes benchmarked for such applications.

Response 10.13

The evaluation methodology for pipe supports, nozzles, penetrations, guides, valves, pumps, heat exchangers and anchors at the EPU condition is provided in response to Question 10.12.

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

The Code allowables from the Code of Record are the same as those used in the original and existing design basis piping stress calculations. The analytical techniques used in the CPS EPU evaluations are in accordance with the CPS licensing and design basis requirements.

No new computer codes were used or new assumptions were introduced for this evaluation.

Enclosure 2 provides critical evaluation results for the pipe supports, nozzles, etc. No pipe support or equipment modifications were required as a result of EPU.

Question 10.14
In Section 3.5.5, you indicate that the main steam (MS) and feedwater (FW) piping will experience increased vibration levels, approximately proportional to the square of the flow velocities. For the proposed power uprate, the flow rates and flow velocities will increase by more than 20 percent of the flow rate at the original rated thermal power for the MS and FW piping systems. Provide an evaluation of the cumulative fatigue usage factor (in addition to the startup and shutdown cycles), and the potential for flow-induced vibration in the MS and FW piping (during the normal and upset operations), and in heat exchangers following the power uprate. In Section 10.4.3, you indicated that the vibration level may even be higher if other flow induced vibration mechanisms occur. Provide a discussion on the potential for flow-induced vibration of the main steam and feedwater piping due to various mechanisms, including, in particular, the fluid-elastic instability at the proposed power level.

Response 10.14
The steady state FIV maximum stress levels of the main steam (MS) and feedwater (FW) piping must remain below the endurance limit of the piping material. This is because many cycles of vibration will be encountered over the remaining design life of the plant. For austenitic (stainless) steel piping material, the mean value of endurance limit stress, at which high cycle fatigue failures can occur, is in the vicinity of 30,000 psi. The actual design fatigue endurance limit is set well below this value. The design fatigue endurance limit for steady state alternating stresses from vibration is 13,600 psi (zero to peak) for austenitic (stainless) steel piping materials. The design fatigue endurance limit for steady state alternating stresses from vibration is 7,690 psi (zero to peak) for carbon steel piping materials. These fatigue design endurance limits were taken from ASME Code Section III, Division 1 - Appendix I, Figure I - 9.2.2 (1989), and the ASME Operating and Maintenance Standard (OM) S/G 1997, "Requirements for Preoperational and Initial Startup Vibration Testing of Nuclear Power Plant Piping Systems."

The potential for FIV of the main steam and feedwater piping due to various FIV mechanisms, such as a fluid-elastic instability, is possible. However, it is not possible to analytically predict which FIV mechanism, if any, may occur within the MS or FW piping at the new and higher MS and FW flow rates associated with the new EPU flow conditions. For this reason, CPS will perform a startup piping vibration test program for the MS and FW piping systems during power ascension to the new EPU conditions, as discussed in Section 10.4.3 of Attachment to Reference 1. These startup tests are intended to show that the steady state MS and FW piping FIV levels at the new and higher EPU flow conditions are well below the fatigue endurance limit of the piping material.

Startup, shutdown, normal and upset conditions or transient vibration cycles associated with the MS and FW piping are assessed in the piping evaluation report prepared for the planned EPU at the uprated flow conditions. MS and FW piping systems are analyzed to the following codes.

- ANSI B31.1 Power Piping Code, 1967 edition
- ANSI B31.1 Power Piping Code, 1967 edition and 1973 through 1976 Summer Addenda
- ASME Code Section III, Sub-section NC (Class 2), 1977 through 1978 Winter Addenda
- ASME Code Section III, Sub-section ND (Class 3), 1974 through 1976 Summer Addenda

If the vibration levels measured in the startup piping vibration test program planned for the MS and FW piping during initial plant operation at the new, higher EPU flow conditions are below the acceptance criteria, then the FIV levels are acceptable and well below the fatigue endurance limit of the piping material, independent of the FIV mechanism occurring.

Question 10.15

In Section 4.1.2.3 concerning subcompartment pressurization, you state that the increase in actual asymmetrical loads on the vessel, attached piping and biological shield wall, due to the postulated main steam and feedwater pipe breaks in the annulus between the reactor vessel and biological shield wall is bounded by the original analysis. The biological shield wall and component designs remain adequate, because there is sufficient pressure margin available. Discuss how the feedwater line break mass and energy releases at EPU power level of 3473 MWth are bounded by the licensing basis mass and energy releases at the current power level of 2894 MWth and confirm whether the biological shield wall and the reactor vessel and internals will be affected by the proposed power uprate as a result of the EPU.

Response 10.15

The mass and energy releases from a postulated FW line break in the annulus in the CLTP and EPU analyses were calculated using the methods of APED-4827, "Maximum Two-Phase Vessel Blowdown From Pipes," dated April 1965.

The mass and energy releases from the FW side of the postulated break are based on the initial FW enthalpy and pressure. The FW pressure and enthalpy increase for EPU conditions. The critical mass flux (lbm/ft^2-sec) is determined using the Moody slip flow model for both CLTP and EPU conditions. The critical mass flux decreases with increasing enthalpy and increases with increasing pressure. The effect of the increase in enthalpy more than offsets the increase in initial pressure and the resulting EPU critical mass flux is bounded by the CLTP value. The methods of APED-4827 are then used to determine the FW flow from the FW header side of the break.

The reactor steam dome pressure at EPU conditions does not change from the licensing basis analysis during the time period of interest for the evaluation of the annulus pressurization loads. Although the pressure in the feedwater header is slightly higher due to the higher feedwater flow rate at EPU conditions, the mass and energy releases from the vessel side of the break for EPU are essentially the same as the CLTP values.

The result of the evaluation is that the EPU integrated mass release at the time of peak differential pressure (0.1 seconds) is 22% less than the licensing basis mass release and the EPU integrated energy release is 33% less than the licensing basis energy release. Therefore, it is concluded that the FW line break licensing basis annulus pressurization analysis remains bounding.

Question 10.16

Discuss the functionality of safety related mechanical components (i.e., safety-related valves and pumps, including air-operated valves (AOV) and safety and relief valves) affected by the proposed power uprate to ensure that the performance specifications and technical specification requirements (e.g., flow rate, close and open times) will be met for the proposed power uprate. Confirm that safety-related AOV and motor-operated valves will be capable of performing their intended function(s) following the proposed power uprate including such affected parameters as fluid flow, temperature, pressure and differential pressure, and ambient temperature conditions. Identify the mechanical components that were not evaluated at the uprated power level. Also, discuss the effects of the proposed power uprate on the pressure locking and thermal binding of safety-related power-operated gate valves for Generic Letter (GL) 95-07. Confirm whether and how the EPU peak drywell temperature in exceedance of 330 °F does not affect the current CPS GL-96-06 evaluation.

Response 10.16

Plant mechanical systems, including safety-related mechanical components, were evaluated to assess operating condition changes at EPU. As described in Reference 1, some plant systems were determined to be not impacted or only slightly impacted by EPU. For the remaining plant systems, further evaluations were performed to ensure the adequacy of the system components to operate as required at EPU conditions. This review included all safety-related mechanical components (e.g., pumps and valves) within the system. Safety-related pumps, safety relief valves and other components were determined to be adequately designed for operation at EPU conditions.

The EPU project was developed around the performance of individual task reports covering all plant systems and uprate specific analysis and programs. These task reports document a comprehensive evaluation in each of the subject areas, of the effects of power uprate. These evaluations included verification of design requirements, performance specifications, and technical specification compliance under uprated conditions. As the scope of the power uprate does not include a reactor pressure increase, there is little or no impact to safety related equipment including emergency core cooling systems and no modifications are necessary. The impact of power uprate to the plant is primarily due to the increase in flow in the steam and feedwater systems, and the increase in electrical output of the generator. Affected systems and their supporting equipment were evaluated based on the projected increases in flow, flow velocity, temperature, and electrical power. Modifications to hardware, changes to setpoints, and desired improvements in operating margin were identified in several balance-of-plant systems and are being implemented to support increased power operation. The list of planned modifications to CPS is contained in Attachment G to Reference 1.

Air-operated valves and associated safety and relief valves were evaluated as part of their respective systems. No changes were identified that require modification to air-operated valves or safety relief valves. It is expected that tuning of valves to optimize system operation will be necessary and this will be identified and performed as required during the startup, testing, and operation at uprated power levels.

Motor-operated valves contained within the scope of the station Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," program were evaluated for operation under uprated power conditions. The following impacts were specifically evaluated for each valve within the scope of the program.

- Evaluate differential pressure impact
- Evaluate degraded voltage impact
- Evaluate elevated temperature impact
- Evaluate stroke time impact
- Evaluate velocity head impact
- Evaluate margin impact
- Evaluate impact for thermal binding and pressure locking
- Evaluate seismic/weak link impacts

The conclusion of the evaluations is that the operation at uprated power levels does not affect the ability of the GL 89-10 MOV's to perform their design function. Specific valves within the scope of the program have had their operating margins reduced due to various evaluated parameters, however, the margins remain within the capability of the MOVs. This scope of review included the provisions of GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," for MOVs.

Original calculations performed in support of the GL 96-06, "Assurance of Equipment Operability and Containment Integrity During Design Basis Accident Conditions," evaluations and responses were reviewed to ensure the containment design temperatures were used as the basis of the evaluations. As the containment design temperature is unchanged as a result of EPU, the results remain valid. In addition, the GL 96-06 evaluations for potential water hammer were reviewed considering an increased drywell (DW) peak temperature (340°F). Conclusions of the water hammer evaluations were based on ensuring the closed loop cooling systems do not exceed saturation temperatures at system pressures, and thereby are not susceptible to vapor formation and subsequent collapse. Based on the EPU increased DW peak temperature (340°F), saturation conditions were re-evaluated and found that original qualitative evaluations and judgements remain valid.

Question 10.17

In reference to Section 3.11, provide a summary addressing your evaluation of the effects of the proposed power uprate on the balance of plant (BOP) piping, components, and pipe supports, nozzles, penetrations, guides, valves, pumps, heat exchangers and anchorages. Also, provide the calculated maximum stresses and fatigue usage factors for the most critical BOP piping systems, the allowable limits, the code of record and code edition used for the power uprate conditions. If different from the code of record, justify and reconcile the differences.

Response 10.17

The evaluation methodology for pipe supports, nozzles, penetrations, guides, valves, pumps, heat exchangers and anchors at EPU condition is provided in response to Question 10.12, above. For the main steam and feedwater system piping outside containment, stop valve closure and pump trip transient (respectively) were re-analyzed for EPU operating conditions to more accurately determine the Clinton plant specific loads for supports and equipment only. Pipe stresses remain in accordance with the response to Question 10.12.

The Code allowables from the Code of Record and analytical techniques used in the extended power uprate evaluations are the same as those used in the original and existing design basis piping stress and support calculations. A listing of these Codes are provided in Table 10.17-1.

Table 10.17-1

Piping	Code
Class 2 and 3 piping	ASME B&PV Code, Section III, Subsection NC/ND, 1977 Edition through Winter 1978 Addendum
Class other piping	ANSI B31.1, Power Piping, 1973 Edition

The evaluation results are summarized in Enclosures 3 and 4. Five (5) feedwater system pipe supports on the non-safety, non-seismic portion required modifications as a result of the EPU loads. Two (2) of the pipe supports required the replacement of snubbers, two (2) pipe supports required stiffening of the support base plates, and one (1) support required modification of the auxiliary steel.

No new pipe break locations were identified as a result of EPU.

ATTACHMENT C

Additional Mechanical Systems Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station (Non-Proprietary)

No new computer codes were used or new assumptions were introduced for this evaluation.

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

3. General Electric Company Licensing Topical Report, "Generic Evaluations of General Electric Boiling Water Reactor Extended Power Uprate," NEDC-32523P-A, Class III, February 2000, and Supplement 1, Volumes I and II

4. General Electric Report, GENE-523-A096-0995, "Perry, Clinton and River Bend Shroud Safety Assessment", dated March 6, 1996

5. Letter from K.N. Jabbour (NRC) to J.T. Beckham, Jr. (GPC), "Safety Evaluation Report for Core Shroud Stabilizer Design Edwin I. Hatch Nuclear Plant, Unit 1 (TAC No. M90270)," September 30, 1994

6. Letter from K. R. Jury (Exelon Generation Company, LLC) to U.S. NRC, "Additional Materials Engineering Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station," dated December 6, 2001

ENCLOSURE 1

RCPB Piping Stress Summary

ENCLOSURE 1

The following CPS RCPB piping systems are impacted by EPU.

CPS	Description
Main Steam A	Main steam piping system (Inside Containment)
Main Steam B/C	Main steam piping system (Inside Containment)
Main Steam D	Main steam piping system (Inside Containment)
Main Steam Drain Lines	MS drain piping system (Inside Containment)
SRV Piping	Safety Relief Valve Discharge Piping
RPV Head Vent Piping	RPV Head vent Piping
RCIC Piping	RCIC Piping system
Feedwater Piping	Feedwater Piping system (Inside Containment)

The maximum stress ratios for each of the piping systems impacted by EPU are provided below. All stresses are less than the applicable original code of construction allowable stresses.

ENCLOSURE 1

ENCLOSURE 1

The maximum fatigue usage factors for each of the piping subsystems impacted by extended power uprate are provided below. All fatigue usage factors satisfy the ASME Code requirements.

ENCLOSURE 2

RCPB Pipe Supports, Anchors, Nozzles, Load Summary

ENCLOSURE 2

The following CPS RCPB piping systems are impacted by EPU.

CPS	Description
Main Steam A	Main steam piping system (Inside Containment)
Main Steam B/C	Main steam piping system (Inside Containment)
Main Steam D	Main steam piping system (Inside Containment)
Main Steam Drain Lines	MS drain piping system (Inside Containment)
RPV Head Vent Piping	RPV Head vent Piping
RCIC Piping	RCIC Piping system
Feedwater Piping	Feedwater Piping system (Inside Containment)

The maximum support/anchor/penetration/component loads for each of the piping systems impacted by EPU are provided below. All loads following EPU are within the capacity of the supports/anchors/penetrations/components and attached building structure.

RCPB One-Directional Support:

System	Pipe Support Number	Location Point	Service Level*	EPU Load (Lbs)	EPU Load within Support/ Building Capacity?
Main Steam A	S-103	016	Upset	13,053	Yes
			Faulted	29,132	Yes
Main Steam B/C	S-104	065	Upset	13,401	Yes
			Faulted	38,008	Yes
Main Steam D	S-103	016	Upset	12,272	Yes
			Faulted	28,971	Yes
MS Drain Lines	1MS05002X	20	Upset	1434	Yes
			Faulted	1532	Yes
RPV Head Vent	1NB01002S	35	Upset	674	Yes
			Faulted	1073	Yes
RCIC	1RI01005X	36	Upset	2233	Yes
			Faulted	2545	Yes
Feedwater	1FW01042S	660	Upset	20,229	Yes
			Faulted	19,779	Yes

* Level A and Level C are not affected by TSV loads.

ENCLOSURE 2

RCPB Two-Directional Supports

Pipe Guide Number	Node Point	Service Level*	Loading Direction	EPU Load (lbs and in - lbs)	EPU Load within Support./ Building Capacity?
MS Line A G101	29	Level B	FX	0	Yes
			FY	31,963	
			FZ	19,572	
			MX	490,925	
			MY	0	
			MZ	0	
		Level D	FX	0	Yes
			FY	34,063	
			FZ	21,968	
			MX	624,638	
			MY	0	
			MZ	0	
MS Lines B&C G101	29	Level B	FX	0	Yes
			FY	27,258	
			FZ	33,769	
			MX	537,823	
			MY	0	
			MZ	0	
		Level D	FX	0	Yes
			FY	32,263	
			FZ	33,209	
			MX	759,735	
			MY	0	
			MZ	0	
MS Line D G101	29	Level B	FX	0	Yes
			FY	26,144	
			FZ	25,054	
			MX	569,006	
			MY	0	
			MZ	0	
		Level D	FX	0	Yes
			FY	33,274	
			FZ	27,902	
			MX	696,784	
			MY	0	
			MZ	0	

* Level A and Level C are not affected by TSV loads.

ENCLOSURE 2

Anchors

Pipe Anchor Number	Node Point	Service Level*	Loading Direction	EPU Load (lbs and in - lbs)	EPU Load within Support./ Building Capacity?
Main Steam Lines B/C ANC A101	017	Level B	FX	102,870	Yes
			FY	34,363	
			FZ	56,724	
			MX	165,474	
			MY	4,081,004	
			MZ	715,422	
		Level D	FX	102,871	Yes
			FY	34,363	
			FZ	56,724	
			MX	165,474	
			MY	4,081,004	
			MZ	715,422	
Main Steam Line D ANC046	46	Level B	FX	96,235	Yes
			FY	35,375	
			FZ	48,559	
			MX	159,370	
			MY	2,805,695	
			MZ	702,119	
		Level D	FX	96,235	Yes
			FY	35,375	
			FZ	48,559	
			MX	159,370	
			MY	2,805,695	
			MZ	702,119	

* Level A and Level C are not affected by TSV loads.

Main Steam Penetration Head Fitting Loads

Maximum Head Fitting Loads at Penetration	Service Level	Head Fitting Location	Location Point	EPU Load (lbs and in - lbs)	Allowable Load (lbs and in - lbs)	Ratio EPU/Allowable
(Inside)-MR	Level B	MS Line B/ C	015-018	2,508,475	4,500,000	0.557
	Level D	"	"	2,387,735	6,745,000	0.354
(Outside)- MR	Level B	MS Line B/ C	015-014	2,926,460	7,348,000	0.398
	Level D	"	"	2,926,460	9,381,000	0.312

ENCLOSURE 2

Feedwater Penetration Stress and CUF

Penetration No.	Loading Condition	Stress Category	EPU Stress (psi) / CUF	Allowable Stress (psi) / CUF	Ratio = EPU / Allowable (Stress & CUF)
1PC0010	Design	General Membrane (Pm)	15,411	19,450	0.79
		Membrane + Bending (Pl+Pb)	16,570	29,174	0.57
	Normal / Upset	Expansion Stress (Pe)	36,269	39,600	0.92
		Primary + Secondary (Pl+Pb+Pe+Q)	26,511	47,340	0.56
	Emergency	General Membrane (Pm)	11,261	29,575	0.38
		Membrane + Bending (Pl+Pb)	12,019	44,362	0.27
	Faulted	General Membrane (Pm)	37,293	42,000	0.89
		Membrane + Bending (Pl+Pb)	50,314	63,000	0.80
	Cumulative Usage Factor (CUF)	Not Applicable	0.072	1.0	0.07

Main Steam RPV Nozzle Loads

Maximum RPV Nozzle Loads	**Service Load Case**	**RPV Nozzle Location**	**Location Point**	**EPU Load (lbs and in - lbs)**	**Allowable Load (lbs and in - lbs)**	**Ratio EPU/Allowable**
HR	Secondary (Level B)	MS Line B & C	079	65,661	767,000	0.086
MR	Secondary (Level B)	MS Line B & C	079	5,034,521	16,580,000	0.304
HR	Primary (Level D)	MS Line D	2	48,082	455,900	0.105
MR	Primary (Level D)	MS Line D	2	2,313,615	9,040,000	0.256

ENCLOSURE 2

Feedwater RPV Nozzle Loads

Nozzle No.	Node No.	Service Level	Stress Category	EPU Resultant Shear (lbs)	Allowable Resultant Shear (lbs)	Ratio = EPU / Allowable	EPU Resultant Moment (in - lbs)	Allowable Resultant Moment (in - lbs)	Ratio = EPU / Allowable
N4	110	Weight	Primary	2,189	12,600	0.17	91,017	349,000	0.26
		Thermal	Secondary	3,135	58,200	0.05	595,418	1,455,000	0.41
		A/B	Primary	14,939	27,200	0.55	680,577	732,262	0.93
		A/B	Primary + Secondary	10,983	58,200	0.19	906,983	2,433,000	0.37
		D	Primary	10,782	27,200	0.40	483,589	1,327,000	0.36

Feedwater Valve Accelerations*

Valve No.	Direction	EPU Service Level B Acceleration (g's)	Allowable Service Level B Acceleration (g's)	Service Level B Ratio = EPU / Allowable	EPU Service Level C Acceleration (g's)	Allowable Service Level C Acceleration (g's)	Service Level C Ratio = EPU / Allowable
1B21F010B	X	1.195	3.300	0.362	1.254	4.500	0.279
	Y	0.535	2.000	0.267	0.525	3.000	0.175
	Z	1.571	3.300	0.476	1.366	4.500	0.304

* Service Level D accelerations are not affected by EPU

ENCLOSURE 3

BOP Piping Stress Summary

ENCLOSURE 3

CPS	Description
Main Steam	Main steam piping system (Outside Containment)
Feedwater	Feedwater piping system (Outside Containment)

Main Steam and Feedwater Stresses

System		ASME Code Equation	EPU Stress (psi)	Allowable Stress (psi)	Ratio = EPU/Allowable
Main Steam Piping Outside Containment	Seismically Qualified Portion	8	7,616	15,000	0.51
		9B	16,799	18,000	0.93
		9C	22,879	27,000	0.85
		10	10,292	22,500	0.46
	Non-Seismically Qualified Portion	8	8,427	15,000	0.56
		9B	17,896	18,000	0.99
		9C	Not Applicable	27,000	N/A
		10	19,640	22,500	0.87
Feedwater Piping Outside Containment	Seismically Qualified Portion	8	5,731	15,000	0.38
		9B	12,277	18,000	0.68
		9C	11,782	27,000	0.44
		10	16,559	22,500	0.74
	Non-Seismically Qualified Portion	8	14,317	15,000	0.95
		9B	15,972	18,000	0.89
		9C	Not Applicable	27,000	N/A
		10	19,959	22,500	0.89

ENCLOSURE 4

BOP Pipe Supports, Anchors, Nozzles, Load Summary

ENCLOSURE 4

Main Steam & Feedwater Supports Outside Containment

System	Pipe Support Number (Support Direction)	Location Point	Service Load Case	EPU Load (Lbs)	EPU Load within Support/Building Capacity?[6]
Seismic MS Supports	1MS07001G (Y)	45	Level B	42,564	Yes
			Level C	40,843	Yes
	1MS07001G (Z)	45	Level B	22,690	Yes
			Level C	22,014	Yes
Non-Seismic MS Supports	1MS01007S (X)	955	Level B	12,083	Yes
Seismic FW Supports	1FW03012X	296	Level B	20,209	Yes
			Level C	35,732	Yes
Non-Seismic FW Supports	1FW03035S	487	Level B	2300	No – Modification Required[1]
	1FW03052X	737	Level B	22,190	No – Modification Required[2]
	1FW03064X	899	Level B	13,397	No – Modification Required[3]
	1FW03070X	837	Level B	16,256	No – Modification Required[4]
	1FW03097S	888	Level B	1701	No – Modification Required[5]
	1FW03084R	968	Level B	21,256	Yes

1. EC No. 331323 replaces the snubber on 1FW03035S with a larger snubber.
2. EC No. 331323 stiffened the baseplate on 1FW03052X.
3. EC No. 331323 stiffened the baseplate on 1FW03064X.
4. EC No. 331323 stiffened the baseplate and added an auxiliary "kicker" on 1FW03070X.
5. EC No. 331323 replaces the snubber on 1FW03097S with a larger snubber.
6. No support modifications were required for any BOP piping supports due to EPU other than those listed.