October 30, 2000

Mr. Mike Reandeau
Director - Licensing
Clinton Power Station
P.O. Box 678
Mail Code #V920
Clinton, IL 61727

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KWichman

SUBJECT: CLINTON POWER STATION - EXEMPTION FROM THE REQUIREMENTS OF 10 CFR PART 50, SECTION 50.60(a) (TAC NO. MA9841)

Dear Mr. Reandeau:

The Commission has approved the enclosed exemption from specific requirements of Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Section 50.60(a) for Clinton Power Station (CPS). This action is in response to your letter of August 25, 2000, as supplemented September 21, October 14, and October 25, 2000, that submitted new pressure-temperature (P-T) limits for CPS. The new P-T limits were developed using the methodologies in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Cases N-588, "Alternative to Reference Flaw Orientation of Appendix G for Circumferential Welds in Reactor Vessels, Section XI, Division 1," and N-640, "Alternative Reference Fracture Toughness for Development of P-T Limit Curves for ASME Section XI, Division 1," in lieu of the methodologies in 10 CFR Part 50, Appendix G.

Your letters of August 25, September 21, October 14, and October 25, 2000, also included a request to amend your license to change certain Technical Specifications. That request is being handled concurrently with your exemption request, but as a separate action.

A copy of the exemption has been forwarded to the Office of the Federal Register for publication.

Sincerely,
/RA/
Jon B. Hopkins, Senior Project Manager, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-461
Enclosure: As stated

cc w/encl:
See next page

DOCUMENT NAME: G:\PDIII-2\CLINTON\exemp-9841.wpd **See previous concurrence

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OFFICE	OGC	DD:DLPM
NAME	A Hodgdon**	J Zwolinski
DATE	10/24/00	10/30/00

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*See K Wichman to A Mendiola memorandum of 9/15/00

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DATE	10/ 19 /00	10/ 18 /00	10/ /00	09/ 15 /00	10/ /00

OFFICE	OGC	DD:DLPM
NAME		J Zwolinski
DATE	10/ 24 /00	10/ /00

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*See K Wichman to A Mendiola memorandum of 9/15/00

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 30, 2000

Mr. Mike Reandeau
Director - Licensing
Clinton Power Station
P.O. Box 678
Mail Code #V920
Clinton, IL 61727

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Docket No. 50-461

Enclosure: As stated

cc w/encl: See next page

Mike Reandeau

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7590-01-P

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
AMERGEN ENERGY COMPANY, LLC	)	Docket No. 50-461
	)	
(Clinton Power Station)	)	

EXEMPTION

I.

AmerGen Energy Company, LLC (AmerGen, the licensee) is the holder of Facility Operating License No. NPF-62 which authorizes operation of the Clinton Power Station (CPS). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (the Commission) now or hereafter in effect.

The facility consists of a boiling water reactor located on the licensee's CPS site in DeWitt County, Illinois.

II.

The U.S. Nuclear Regulatory Commission (NRC) has established requirements in Appendix G of Part 50 to Title 10, *Code of Federal Regulations* (10 CFR Part 50, Appendix G), to protect the integrity of the reactor coolant pressure boundary in nuclear power plants. This Appendix to Part 50 requires the pressure-temperature (P-T) limits for an operating plant to be at least as conservative as those that would be generated if the methods of Appendix G to Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code

(Appendix G to the Code) were applied. The methodology of Appendix G to the Code postulates the existence of a sharp surface flaw in the reactor pressure vessel (RPV) that is normal to the direction of the maximum applied stress. For materials in the beltline and upper and lower head regions of the RPV, the maximum flaw size is postulated to have a depth that is equal to one-fourth of the thickness and a length equal to 1.5 times the thickness. For the case of evaluating RPV nozzles, the surface flaw is postulated to propagate parallel to the axis of the nozzle's corner radius. The basic parameter in Appendix G to the Code for calculating P-T limit curves is the stress intensity factor, K_I, which is a function of the stress state and flaw configuration. The methodology requires that licensees determine the reference stress intensity (K_{Ia}) factors, which vary as a function of temperature, from the reactor coolant system (RCS) operating temperatures, and from the adjusted reference temperatures (ARTs) for the limiting materials in the RPV. Thus, the critical locations in the RPV beltline and head regions are the 1/4-thickness (1/4T) and 3/4-thickness (3/4T) locations, which correspond to the points of the crack tips if the flaws are initiated and grown from the inside and outside surfaces of the vessel, respectively. Regulatory Guide (RG) 1.99, Revision 2, provides an acceptable method of calculating ARTs for ferritic RPV materials; the methods of RG 1.99, Revision 2, include methods for adjusting the ARTs of materials in the beltline region of the RPV, where the effects of neutron irradiation may induce an increased level of embrittlement in the materials.

The methodology of Appendix G requires that P-T curves must satisfy a safety factor of 2.0 on primary membrane and bending stresses during normal plant operations (including heatups, cooldowns, and transient operating conditions), and a safety factor of 1.5 on primary membrane and bending stresses when leak rate or hydrostatic pressure tests are performed on the RCS. Table 1 to 10 CFR Part 50, Appendix G, provides the staff's criteria for meeting the P-T limit requirements of Appendix G to the Code and 10 CFR Part 50, Appendix G.

By letter dated August 25, 2000, as supplemented September 21, October 14, and October 25, 2000, AmerGen submitted a license amendment request to update the P-T limit curves for CPS. In the submittals, AmerGen also requested NRC approval for exemptions to use Code Cases N-588 and N-640 as methods that would allow AmerGen to deviate from complying with the requirements in 10 CFR Part 50, Appendix G, for generating the P-T limit curves.

Code Case N-588

AmerGen has requested, pursuant to 10 CFR 50.60(b), an exemption to use Code Case N-588 as the basis for evaluating the axial and circumferential welds in the CPS RPV. The current methods of Appendix G to the Code mandate consideration of an axial flaw in full penetration RPV welds, and thus, for circumferential welds, dictate that the flaw be oriented transverse to the axis of the weld. Postulation of an axial flaw in a circumferential weld is unrealistic because the length of the flaw would extend well beyond the girth of the circumferential weld and into the adjoining base metal material. Industry experience with the repair of weld indications found during preservice inspection, and data taken from destructive examination of actual vessel welds, confirms that any remaining flaws are small, laminar in nature, and do not transverse the weld bead orientation. Therefore, any potential defects introduced during the fabrication process, and not detected during subsequent nondestructive examinations, would only be expected to be oriented in the direction of weld fabrication. For circumferential RPV welds, the methods of the Code Case therefore postulate the presence of a flaw that is oriented in a direction parallel to the axis of the weld (i.e., in a circumferential orientation).

An analysis provided to the American Society of Mechanical Engineers (ASME) Code's Working Group on Operating Plant Criteria (WGOPC) (in which Code Case N-588 was

developed) indicated that if an axial flaw is postulated on a circumferential weld, then based on the correction factors for membrane stress (M_m) given in the Code Case for the inside diameter circumferential (0.443) and axial (0.926) flaw orientations, it is equivalent to applying a safety factor of 4.18 on the pressure loading under normal operating conditions.[1] Appendix G to the Code only requires that a safety factor of 2 be placed on the contribution of the pressure load in the case of an axially-oriented flaw in an axial weld, shell plate, or forging. By postulating a circumferentially-oriented flaw on a circumferential weld and using the appropriate correction factor, the margin of 2 is maintained for the stress integrity calculation for the circumferential weld. Consequently, the staff determined that the postulation of an axially-oriented flaw on a circumferential RPV weld adds a level of conservatism in the P-T limits that goes beyond the margins of safety required by 10 CFR Part 50, Appendix G, and by Appendix of the Code. For this reason, the methods of the Code Case reduce the applied stress intensities for primary membrane and bending stresses in circumferential flaws by a factor of approximately 2 ($\approx$0.926/0.443).[2] This is realistic since the postulated circumferential flaw in the vessel will propagate if a stress is applied in a direction normal to the axis of the flaw (i.e., by application of an axially oriented stress that results in Mode I crack propagation of the circumferential flaw). Such tensile stresses in the RPVs are typically about half the magnitudes of the corresponding membrane stresses.

Application of Code Case N-588 will only matter if the Code Case is applied for the case where a circumferential weld is the most limiting material in the beltline region of the boiling water reactor (BWR) designed RPV. Since application of the Code Case methods allow

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(1) The margin of safety of 4.18 is arrived at by dividing 0.926 by 0.443 and then multiplying by the required safety factor of 2.

(2) The Code Case accomplishes this by reducing the M_m factors for circumferential welds that are used for calculations of the stress intensities attributed to primary membrane stresses (K_{Im}) and primary bending stresses (K_{Ib}). As stated previously, for RPVs with wall thicknesses in the range of 4.0-12.0 inches, the M_m factor for circumferential welds is 0.443. This is the normal wall thickness range for GE designed boiling water reactors.

licensees to reduce the stress intensities attributed to the circumferential weld, the net effect of the Code Case would allow AmerGen to use the next most limiting base metal or axial weld material in the RPV as the basis for evaluating the vessel and generating the P-T limit curves, if the circumferential weld (girth weld) is the most limiting material in the beltline region of the vessel. In this case, the Code Case is relevant to the evaluation of the CPS RPV, because the CPS RPV is limited by Circumferential Weld AE (Material Heat 76492).[3]

WGOPC has concluded that application of Code Case N-588 to plant P-T limits are still sufficient to ensure the structural integrity of RPVs during plant operations. The staff has concurred with WGOPC's determination and has previously granted exemptions to use Code Case N-588 for the Quad Cities Nuclear Power Station (NRC letter to Commonwealth Edison dated February 4, 2000). In the staff's letter of February 4, 2000, the staff concluded that the procedure in Appendix G to the Code was developed for axially oriented flaws and that such a procedure was physically unrealistic and overly conservative for postulating flaws of this orientation in a circumferential weld. The staff also concluded that relaxation of the requirements of Appendix G to the Code by application of Code Case N-588 is acceptable and would maintain, pursuant to 10 CFR 50.12(a)(2)(ii), the underlying purpose of the ASME Code and the NRC regulations to ensure an acceptable margin of safety for the Quad Cities RPVs and reactor coolant pressure. AmerGen's proposal to use Code N-588 for generation of the CPS P-T limit curves is predicated on the same technical basis as was used for generation of the Quad Cities P-T limits. The staff therefore concludes that Code Case N-588 is acceptable for application to the CPS P-T limits. Hence, the staff concurs that relaxation of the ASME

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(3) The most limiting 1/4T material for the generation of the CPS P-T limits is Circumferential Weld AE (Material Heat 76492). According to the AmerGen submittal of August 25, 2000, this weld has a 1/4T RT_{NDT} value at 32 EFPY of 55°F. Application of Code Case N-588 will change the basis for evaluating the vessel to the next most limiting plate or vertical weld material, which according to AmerGen is material heat 3P4955 (used to fabricate vertical welds BE, BF, and BG, which according to AmerGen have a 1/4T RT_{NDT} value at 32 EFPY of 51°F).

Section XI, Appendix G, requirements by application of ASME Code Case N-588 is acceptable for CPS and would maintain, pursuant to 10 CFR 50.12(a)(2)(ii), the underlying purpose of the ASME Code and the NRC regulations to ensure an acceptable margin of safety.

Code Case N-640

AmerGen has requested, pursuant to 10 CFR 50.60(b), an exemption to use ASME Code Case N-640 (previously designated as Code Case N-626) as the basis for establishing the P-T limit curves. Code Case N-640 permits application of the lower bound static initiation fracture toughness value equation (K_{Ic} equation) as the basis for establishing the curves in lieu of using the lower bound crack arrest fracture toughness value equation (i.e., the K_{Ia} equation, which is based on conditions needed to arrest a dynamically propagating crack, and which is the method invoked by Appendix G to Section XI of the ASME Code). Use of the K_{Ic} equation in determining the lower bound fracture toughness in the development of the P-T operating limits curve is more technically correct than the use of the K_{Ia} equation since the rate of loading during a heatup or cooldown is slow and is more representative of a static condition than a dynamic condition. The K_{Ic} equation appropriately implements the use of the static initiation fracture toughness behavior to evaluate the controlled heatup and cooldown process of a reactor vessel. The staff has required use of the initial conservatism of the K_{Ia} equation since 1974 when the equation was codified. This initial conservatism was necessary due to the limited knowledge of RPV materials. Since 1974, additional knowledge has been gained about RPV materials. Therefore, the lower bound static fracture toughness K_{Ic} equation provides an acceptable method for calculating P-T limits. In addition, P-T curves based on the K_{Ic} equation will enhance overall plant safety by opening the P-T operating window with the greatest safety benefit in the region of low temperature operations.

Generating the RCS P-T limit curves developed in accordance with Appendix G to the Code, without the relief provided by ASME Code Case N-640, would unnecessarily require the RPV to be maintained at a temperature exceeding 212 °F during the pressure test. Consequently, steam vapor hazards would continue to be one of the safety concerns for personnel conducting inspections in primary containment. Implementation of the proposed curves, as allowed by ASME Code Case N-640, provides an adequate margin of safety and would eliminate steam vapor hazards by allowing inspections in primary containment to be conducted at a lower coolant temperature. Thus, pursuant to 10 CFR 50.12(a)(2)(ii), the underlying purpose of the regulation will continue to be served.

WGOPC has concluded that application of Code Case N-640 to plant P-T limits are still sufficient to ensure the structural integrity of RPVs during plant operations. The staff has concurred with ASME's determination and has previously granted exemptions to use Code Case N-640 for the Quad Cities Nuclear Power Station (NRC letter to Commonwealth Edison dated February 4, 2000). In the letter of February 4, 2000, the staff concluded that application of Code Case N-640 would not significantly reduce the safety margins required by 10 CFR Part 50, Appendix G, and would eliminate steam vapor hazards by allowing inspections in the primary containment to be conducted at a lower coolant temperature. The staff also concluded that relaxation of the requirements of Appendix G to the Code by application of Code Case N-640 is acceptable and would maintain, pursuant to 10 CFR 50.12(a)(2)(ii), the underlying purpose of the ASME Code and the NRC regulations to ensure an acceptable margin of safety for the Quad Cities RPVs and reactor coolant pressure boundary. AmerGen's proposal to use Code N-640 for generation of the CPS P-T limit curves is predicated on the same technical basis as was used for generation of the Quad Cities P-T limits. The staff therefore concludes that Code Case N-640 is acceptable for application to the CPS P-T limits. Hence, the staff

concurs that relaxation of the ASME Section XI, Appendix G, requirements by application of ASME Code Case N-640 is acceptable for CPS and would maintain, pursuant to 10 CFR 50.12(a)(2)(ii), the underlying purpose of the ASME Code and the NRC regulations to ensure an acceptable margin of safety.

III.

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR Part 50, when (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present. The staff accepts the licensee's determination that the exemption would be required to approve the use of Code Cases N-588 and N-640. The staff examined the licensee's rationale to support the exemption requests and concurred that the use of the code cases would meet the underlying intent of these regulations. Based upon a consideration of the conservatism that is explicitly incorporated into the methodologies of 10 CFR Part 50, Appendix G; Appendix G of the Code; and Regulatory Guide 1.99, Revision 2, the staff concludes that application of the code cases as described would provide an adequate margin of safety against brittle failure of the RPV. This is also consistent with the determination that the staff has reached for other licensees under similar conditions based on the same considerations. Therefore, the staff concludes that requesting exemption under the special circumstances of 10 CFR 50.12(a)(2)(ii) is appropriate and that the methodology of Code Cases N-588 and N-640 may be used to revise the P-T limits for Clinton Power Station.

IV.

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), the exemption is authorized by law, will not endanger life or property or common defense and

security, and is, otherwise, in the public interest. Therefore, the Commission hereby grants AmerGen Energy Company, LLC, exemption from the requirements of 10 CFR Part 50, Section 50.60(a) and 10 CFR Part 50, Appendix G, for Clinton Power Station.

Pursuant to 10 CFR 51.32, an environmental assessment and finding of no significant impact has been prepared and published in the *Federal Register* (65 FR 61204). Accordingly, based upon the environmental assessment, the Commission has determined that the granting of this exemption will not result in any significant effect on the quality of the human environment.

This exemption is effective upon issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

John A. Zwolinski, Director
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Dated at Rockville, Maryland,
this 30th day of October 2000