November 25, 1998

Mr. M. L. Marchi
Site Vice President - Kewaunee Plant
Wisconsin Public Service Corporation
P.O. Box 19002
Green Bay, WI 54307-9002

SUBJECT: ISSUANCE OF EXEMPTION FROM 10 CFR 50.60 BY APPLYING ASME CODE CASE N-588 FOR KEWAUNEE NUCLEAR POWER PLANT (TAC NO. MA2471)

Dear Mr. Marchi:

In response to your exemption request dated August 6, 1998, the Commission has issued the enclosed exemption from the requirements of 10 CFR 50.60 and Appendix G to modify the methodology incorporated in the Kewaunee licensing basis. The exemption allows WPSC to apply American Society of Mechanical Engineers (ASME) Code Case N-588 to permit the postulation of a circumferentially-oriented flaw (in lieu of an axially-oriented flaw) for the evaluation of the KNPP reactor pressure vessel (RPV) pressure-temperature (P-T) limit curves. A copy of the staff's safety evaluation is also enclosed.

Your application also requested an exemption to allow use of Code Case N-514. However, following discussions with NRC staff, your personnel determined that relief from N-514 is unnecessary. Thus, whereas the safety evaluation addresses both requests, the exemption encompasses only the N-588 request.

A copy of the enclosed exemption has been forwarded to the Office of the Federal Register for publication. If you have any questions regarding this exemption, please contact me at 301-415-3026.

Sincerely,

Original signed by:

William O. Long, Senior Project Manager
Project Directorate III-3
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosures: Exemption
Safety Evaluation

cc w/encl: See next page

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NAME	BBoger		JZwolinski	
DATE	11/19 /98		11/20 /98	

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

November 25, 1998

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Site Vice President - Kewaunee Plant
Wisconsin Public Service Corporation
P.O. Box 19002
Green Bay, WI 54307-9002

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Project Directorate III-3
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosures: Exemption
Safety Evaluation

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Public Service Commission
of Wisconsin
P. O. Box 7854
Madison, WI 53707-7854

7590-01-P

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
WISCONSIN PUBLIC SERVICE COMPANY	)	Docket No. 50-305
	)	
(Kewaunee Nuclear Power Plant)	)	
	)	
	)	
	)	

EXEMPTION

I.

The Wisconsin Public Service Company (WPSC, the licensee) is the holder of Facility Operating License No. DPR-43, which authorizes operation of the Kewaunee Nuclear Power Plant. The operating license states, among other things, that the licensee is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (the Commission) now or hereafter in effect.

The Kewaunee Nuclear Power Plant is a pressurized-water reactor facility located at the licensee's site in Kewaunee County, Wisconsin.

II.

By letter dated August 6, 1998, WPSC submitted an exemption request to certain requirements in Title 10 of the Code of Federal Regulations, Part 50, Appendix G, "Fracture Toughness Requirements," which invokes ASME, Section XI, Appendix G pressure-temperature limits for reactor pressure vessels (RPVs).

III.

The NRC has established requirements in 10 CFR Part 50 to protect the integrity of the reactor coolant system pressure boundary. 10 CFR 50.60(a) and 10 CFR Part 50, Appendix G.IV.2. require (via reference to 10 CFR 50.55a) that pressure-temperature (P-T) limits be established for RPVs during normal operation and vessel hydrostatic testing based on the methodology provided in the 1989 Edition of ASME Section XI, Appendix G. Pursuant to 10 CFR 50.60(b), alternatives to the requirements of 10 CFR Part 50, Appendix G.IV.2 may be used when an exemption is granted by the Commission. The underlying purpose of 10 CFR 50.60(a) and 10 CFR Part 50, Appendix G, is to establish fracture toughness requirements for the reactor coolant system pressure boundary to provide adequate margins of safety during normal operation, including anticipated operational occurrences and system hydrostatic tests, to which the pressure boundary may be subjected over its service lifetime.

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. Special circumstances are present whenever, according to 10 CFR 50.12(a)(2)(ii), "Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule." The NRC staff examined WPSC's rationale to support the exemption request and concluded that the use of Code Case N-588 would also meet the underlying intent of the regulations. The licensee's request for the exemption under the special circumstances of 10 CFR 50.12(a)(2)(ii) was found to be appropriate. Application of the regulation is not necessary to achieve the underlying purpose of the rule because, as stated in the staff Safety Evaluation, dated November 25, 1998, adequate margins of safety on the structural integrity of the reactor

coolant pressure boundary are maintained with the application of Code Case N-588. Therefore, the NRC staff has concluded that an exemption to the requirements of 10 CFR 50.60 and 10 CFR Part 50, Appendix G.IV.2 should be granted to allow WPSC to apply the methodology in ASME Code Case N-588 for the purpose of developing P-T limits for the KNPP RPV.

IV.

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), an 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 an exemption from the requirements of 10 CFR 50.60(a) and 10 CFR Part 50, Appendix G.IV.2 to allow WPSC to apply the methods in ASME Code Case N-588 for the evaluation of KNPP pressure-temperature limits.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of this exemption will not have a significant effect on the quality of the human environment (63 FR 65265).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 25th day of November 1998.

FOR THE NUCLEAR REGULATORY COMMISSION

Frank J. Miraglia

Frank J. Miraglia, Acting Director
Office of Nuclear Reactor Regulation

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IV.

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), an 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 an exemption from the requirements of 10 CFR 50.60(a) and 10 CFR Part 50, Appendix G.IV.2 to allow WPSC to apply the methods in ASME Code Case N-588 for the evaluation of KNPP pressure-temperature limits.

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FOR THE NUCLEAR REGULATORY COMMISSION
Original signed by:
Frank J. Miraglia, Acting Director
Office of Nuclear Reactor Regulation

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NAME	BBoger*		FMiraglia	
DATE	11/19 /98		11 / 24 /98	

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST TO APPLY ASME CODE CASE N-514 AND CODE CASE N-588

KEWAUNEE NUCLEAR POWER PLANT

WISCONSIN PUBLIC SERVICE CORPORATION

DOCKET NO. 50-305

1.0 INTRODUCTION

By letter dated August 6, 1998, the Wisconsin Public Service Corporation (WPSC), licensee for the Kewaunee Nuclear Power Plant (KNPP), requested that the NRC exempt the unit from the application of specific requirements of Title 10 of the Code of Federal Regulations Part 50 (10 CFR Part 50) Section 60 and Appendix G. WPSC requested an exemption to permit use of American Society for Mechanical Engineers (ASME) Code Case N-514 to permit the use of an alternative method (to the method established in Nuclear Regulatory Commission Standard Review Plan (SRP) Section 5.2.2, Reactor Systems Branch Technical Position 5-2 (RSB 5-2)) for establishing the KNPP low temperature over pressurization protection (LTOP) system enable temperature. WPSC also requested an exemption for the use of Code Case N-588 to permit the postulation of a circumferentially-oriented flaw (in lieu of an axially-oriented flaw) for the evaluation of the KNPP reactor pressure vessel (RPV) pressure-temperature (P-T) limit curves.

2.0 REGULATORY REQUIREMENTS

The NRC has established requirements in 10 CFR Part 50 to protect the integrity of the reactor coolant system pressure boundary. 10 CFR 50.60(a) and 10 CFR Part 50, Appendix G.IV.2. requires (via reference to 10 CFR 50.55a) that pressure-temperature (P-T) limits be established for RPVs during normal operation and vessel hydrostatic testing based on the methodology provided in the 1989 Edition of ASME Section XI, Appendix G. In order to protect these P-T limit curves and provide pressure relief during low temperature over pressurization events, pressurized water reactor licensees have installed protection systems (LTOP systems) as part of the reactor coolant system pressure boundary. WPSC is required as part of the KNPP Technical Specifications (TS) to develop, update, and submit reactor vessel P-T limits and LTOP setpoints for NRC review and approval.

3.0 LICENSEE'S DETERMINATION

3.1 ASME Code Case N-514

In their August 6, 1998 letter, KNPP determined that the exemption request under 10 CFR 50.12(a)(2)(ii) or 10 CFR 50.12(a)(2)(iii) from the provisions of 10 CFR 50.60 and 10 CFR Part 50 Appendix G was necessary for the application of Code Case N-514 since the methodology for determining the enable temperature cited in Code Case N-514 (the greater of 200 °F or the limiting RPV adjusted nil-ductility reference temperature at the 1/4T through-wall location plus 50 °F) may be less conservative than the methodology specified in SRP Section 5.2.2, RSB 5-2 (the limiting RPV adjusted nil-ductility reference temperature at the 1/4T or 3/4T through-wall location plus 90 °F). The licensee's technical justification for this request cited that "[t]hese guidelines will relieve some operational restrictions, yet provide adequate margins to prevent failure of the reactor vessel. Further, by relieving the operational restrictions, these guidelines result in a reduced potential for activation of pressure relieving devices, thereby improving nuclear plant safety."

WPSC concluded that these guidelines would provide, "...the same range of margin against vessel failure for conditions where experience indicates that these events occur, as ASME Section III and Section XI, Appendix G provide for the normal heatup and cooldown conditions."

3.2 ASME Code Case N-588

ASME Code Case N-588 amends the provisions of the 1989 Edition of ASME Section XI, Appendix G by permitting the postulation of a circumferentially-oriented reference flaw (i.e. a flaw postulated to extend to a depth of one-quarter of the thickness of the ferritic RPV weld material, from either the outside diameter or the clad-to-base material interface on the inside diameter with an aspect ratio of 6:1) as the limiting flaw in a RPV circumferential weld for the purpose of establishing RPV P-T limits. The 1989 Edition of ASME Section XI, Appendix G would require that such a reference flaw be postulated as an axially-oriented flaw in the circumferential weld. Since the pressure stresses on a circumferentially-oriented flaw are lower than the pressure stresses on an axially-oriented flaw by a factor of 2 (thereby reducing the applied stress intensity by approximately a factor of 2), WPSC concluded that use of Code Case N-588 as the basis for establishing the KNPP RPV P-T limits would be less conservative than the methodology currently endorsed by 10 CFR Part 50, Appendix G and, therefore, an exemption to apply the Code Case would be required by 10 CFR 50.60.

WPSC addressed the technical justification for this exemption by citing (1) industry experience and aspects of RPV fabrication which support the postulation of circumferentially-oriented flaws for these welds and (2) an assessment of the margins for circumferentially-oriented flaws. Regarding item (1), WPSC noted that:

> [w]hen considering a reference flaw with respect to a weld, the reference flaw would represent any prior existing defect that may have been introduced during fabrication....Postulating the Appendix G [axially-oriented flaw] reference flaw in a circumferential weld is physically unrealistic and overly conservative, because the length of the flaw is 1.5 times the vessel thickness, which is much longer than the

> width of the reactor vessel girth weld....Industry experience with the repair of weld indications found during pre-service 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 non-destructive examinations, would only be expected to be oriented in the direction of weld fabrication. For circumferential welds this indicates a postulated defect with a circumferential orientation.

Regarding the issue of margins with respect to the postulation of a circumferentially-oriented flaw, WPSC referred to an analysis provided to the ASME Code's Working Group on Operating Plant Criteria (WGOPC) (in which Code Case N-588 was developed) by Ron Gamble of Sartrex Corp. Based on the stress magnification factors (M_m) given in the Code Case for the inside diameter circumferential (0.443) and inside diameter axial (0.926) flaw orientations, if an axial flaw is postulated on a circumferential weld, it is equivalent to applying a safety factor of 4.18 on the pressure loading under normal operating conditions. Appendix G requires a safety factor of 2 on the contribution of the pressure load in the case of an axially-oriented flaw in a axial weld, shell plate, or forging. By postulating a circumferentially-oriented flaw on a circumferential weld and using the appropriate stress magnification factor, the margin of 2 is maintained for the contribution of the pressure load to the integrity calculation of the circumferential weld.

4.0 STAFF EVALUATION

4.1 ASME Code Case N-514

The staff reviewed the licensee's application regarding the use of ASME Code Case N-514 to redefine the methodology for establishing the KNPP LTOP system enable temperature. The staff finds that the use of the criteria cited in the code case (the greater of 200 °F or the limiting RPV adjusted nil-ductility reference temperature at the 1/4T through-wall location plus 50 °F) is an acceptable alternative to the criteria cited in RSB 5-2 (the limiting RPV adjusted nil-ductility reference temperature at the 1/4T or 3/4T through-wall location plus 90 °F) because use of the N-514 criteria continues to ensure that the KNPP LTOP system will be enabled to protect the RPV at temperatures where brittle fracture of the RPV might occur. However, the staff has concluded that the application of this alternative methodology does not require an exemption since the principal methodology is only defined by an NRC branch technical position and is not specified by 10 CFR 50, Appendix G. WPSC may apply this alternative methodology in its forthcoming submittal on the KNPP P-T limits and LTOP system setpoints and the staff will formally review its application at that time.

4.2 ASME Code Case N-588

The staff reviewed the licensee's application regarding the use of ASME Code Case N-588 to redefine the reference flaw orientation to be considered with respect to the KNPP circumferential RPV weld for the purposes of P-T limits development. The staff finds that the postulation of an axially-oriented flaw on a circumferential RPV weld is a level of conservatism that is not required to establish P-T limits to protect the reactor coolant system pressure boundary from failure during hydrostatic testing, heatup, and cooldown. Based on the

manufacturing processes used to fabricate RPVs for U.S. facilities, it is reasonable to conclude that, if a significant defect were to exist in a circumferential weld, it would lie in the plane of the welding direction. The use of stress magnification factors which account for this difference in flaw orientation (i.e. account for the approximately a factor of 2 difference in the applied pressure stress between the axial and circumferential directions) is acceptable. The staff reviewed the stress magnification factors proposed in Code Case N-588 by comparing them with an independent formulation for K_{IM} based on reference 1 and the staff results agreed with the code case results to within 6 percent.

The staff would also note that, although it was not expressly addressed in the WPSC exemption request, ASME Code Case N-588 also includes changes to the methodology (see Code Case N-588, section -2214.3) for determining the thermal stress intensity, K_{IT}, which was incorporated into Section XI of the ASME Code after the 1989 Edition. The staff reviewed the basis for these changes in the K_{IT} methodology in detail as the subject of reference 2 when an exemption to utilize the ASME Appendix G methodology from the 1996 Addenda to the 1995 Edition of the Code was requested by Commonwealth Edison Company. The following paraphrases the staff's conclusions in reference 2 as they are applicable to KNPP.

The staff accepts that the modifications made to the K_{IT} methodology in paragraph -2214.3(a) of Code Case N-588 result in a determination of K_{IT} which is consistent with the methodology found in the 1989 Edition of ASME Code Section XI, Appendix G and that the use of equivalent K_{IT} values for axial and circumferential flaws is acceptable. Furthermore, the staff also accepts that the alternative methodology making use of the detailed thermal stress distribution given in -2214.3(b) is supported by the work of J.A. Kenney and T.L. Dickson for the NRC [3], A. Zahoor [4], and I.S. Raju and J.C. Newman [5]. The staff has therefore concluded that the methodology given in Code Case N-588 is acceptable for determining K_{IT}. In summary, WPSC may use the methodology in the 1989 Edition of ASME Section XI or the methodology contained in -2214.3(a) of Code Case N-588 for determining K_{IT} inasmuch as they are equivalent. However should the methodology of -2214.3(b) be used, details regarding its application (for example, the method chosen for determining thermal stresses as an input to the -2214.3(b) procedure) must be submitted for staff review when WPSC submits updated KNPP P-T limits.

Therefore, the staff has found that the use of the methodology in ASME Code Case N-588 is an acceptable alternative to the requirements of 10 CFR 50.60(a), 10 CFR Part 50, Appendix G.IV.2, and Appendix G to the 1989 Edition of Section XI of the ASME Code and that an exemption is warranted under 10 CFR 50.12(a)(2)(ii) (i.e., "[a]pplication of the regulation in the particular circumstances ...is not necessary to achieve the underlying purpose of the rule..."). The application of Code Case N-588 is justified because the RPV will be adequately protected against the possibility of brittle fracture when P-T limits curves based on the methodology in Code Case N-588 are developed.

5.0 CONCLUSION

The staff has concluded that an exemption to the requirements of 10 CFR 50.60(a) and 10 CFR Part 50, Appendix G.IV.2 should be granted to allow WPSC to apply the methodology in ASME Code Case N-588 for the purpose of developing P-T limits for the KNPP RPV. An exemption

to apply ASME Code Case N-514 for establishing an alternative methodology to set the KNPP LTOP system enable temperature is not necessary because 10 CFR, Part 50, Appendix G does not specify a methodology for establishing the LTOP system enable temperature and an exemption is not required to propose an alternative to the methodology found in a NRC branch technical position (RSB 5-2). WPSC should submit the proposed LTOP system enable temperature methodology change in their forthcoming submittal to revise the KNPP P-T limits and LTOP system setpoints.

Principal Contributor: M. Mitchell

Date: November 25, 1998

6.0 REFERENCES

[1] T. L. Anderson, "Fracture Mechanics, Fundamentals and Applications," CRC Press, 1991.

[2] G. F. Dick (USNRC) to O. D. Kingsley (ComEd), "Exemption from Requirements of 10 CFR 50.60 - Byron Units 1 and 2, and Braidwood, Units 1 and 2," dated January 16, 1998.

[3] J. A. Kenney and T. L. Dickson, "Stress-Intensity-Factor Influence Coefficients for Axially Oriented Semielliptical Inner-Surface Flaws in Clad Pressure Vessels (R_i / t = 10)", ORNL/NRC/LTR-93/33, Revision 1, September 30, 1995.

[4] A. Zahoor, Ductile Fracture Handbook, Volume 3, published jointly EPRI, NP-6301-D and Novatech, N14-3, January 1991.

[5] I. S. Raju and J. C. Newman, Jr., "Stress Intensity Factors for Internal and External Surface Cracks in Cylindrical Vessels," Journal of Pressure Vessel Technology, Vol. 104, pp. 283-288, November 1982.

11/25/92

MEMORANDUM TO: Rules and Directives Branch
Division of Administrative Services
Office of Administration

FROM: Office of Nuclear Reactor Regulation

SUBJECT: K Wiens

One signed original of the *Federal Register* Notice identified below is attached for your transmittal to the Office of the Federal Register for publication. Additional conformed copies ( ) of the Notice are enclosed for your use.

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- ☐ Notice of Availability of NRC Draft/Final Environmental Statement.
- ☐ Notice of Limited Work Authorization.
- ☐ Notice of Availability of Safety Evaluation Report.
- ☐ Notice of Issuance of Construction Permit(s).
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- ☒ Exemption.
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DOCKET NO. 50-305

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