November 19, 1996

Mr. M. L. Marchi
Manager - Nuclear Business Group
Wisconsin Public Service Corporation
Post Office Box 19002
Green Bay, WI 54307-9002

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SUBJECT: EXEMPTION FROM CERTAIN REQUIREMENTS OF 10 CFR PART 50, APPENDIX K, PARAGRAPHS I.D.3 AND I.D.5 - KEWAUNEE NUCLEAR POWER PLANT (TAC NO. M96132)

Dear Mr. Marchi:

The Commission has issued the enclosed Exemption from certain requirements of 10 CFR Part 50, Appendix K, Paragraphs I.D.3 and I.D.5, for the Kewaunee Nuclear Power Plant. This Exemption was granted in response to your request dated July 23, 1996.

The staff determined that this exemption is acceptable for Kewaunee since compliance with the literal requirements of the paragraphs cited is not necessary given that the approved evaluation model (1) is based upon appropriate experimental data, (2) satisfactorily accounts for the cooling mechanisms in the Kewaunee upper plenum injection (UPI) design for calculations of core reflood rates and heat transfer during a large-break loss-of-coolant-accident, and (3) satisfies the purpose of the exempted requirements.

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

Sincerely,

Original signed by:
Richard J. Laufer, Project Manager
Project Directorate III-3
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosure: Exemption

*See previous concurrence.

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

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Chief Engineer
Wisconsin Public Service Commission
610 N. Whitney Way
Madison, Wisconsin 53705-2829

7590-01

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
WISCONSIN PUBLIC SERVICE CORPORATION	)	Docket No. 50-305
	)	
WISCONSIN POWER AND LIGHT COMPANY	)	
	)	
MADISON GAS AND ELECTRIC COMPANY	)	
	)	
(Kewaunee Nuclear Power Plant)	)	

EXEMPTION

I.

The Wisconsin Public Service Corporation, Wisconsin Power and Light Company, and Madison Gas and Electric Company (the licensee), are the holders of Facility Operating License No. DPR-43 which authorizes operation of the Kewaunee Nuclear Power Plant (KNPP). The license provides, among other things, that it is subject to all rules, regulations, and orders of the Nuclear Regulatory Commission (the Commission) now and hereafter in effect.

The facility consists of a pressurized water reactor located at the licensee's site in Kewaunee County, Wisconsin.

II.

The Code of Federal Regulations, paragraph I.D.3, "Calculation of Reflood Rate for Pressurized Water Reactors [PWRs]," of Appendix K to Part 50 of Title 10 of the Code of Federal Regulations (10 CFR) requires that the refilling of the reactor vessel and the time and rate of reflooding of the core be calculated by an acceptable model that considers the thermal and hydraulic characteristics of the core and of the reactor system. In

particular, paragraph I.D.3 requires, in part, that, "The ratio of the total fluid flow at the core exit plane to the total flow at the core inlet plane (carryover fraction) shall be used to determine the core exit flow and shall be determined in accordance with applicable experimental data." The purpose of this requirement is to assure that the core exit flow during the post-loss-of-coolant accident (LOCA) refill/reflood phase is determined using a model that accounts for appropriate experimental data.

Paragraph I.D.5, "Refill and Reflood Heat Transfer for Pressurized Water Reactors," of Appendix K to 10 CFR Part 50 requires that (1) for reflood rates of 1 inch per second or higher, the reflood heat transfer coefficients be based on applicable experimental data for unblocked cores, and (2) for reflood rates less than 1 inch per second during refill and reflood, heat transfer calculations be based on the assumption that cooling is only by steam.

By letter dated July 23, 1996, the licensee requested an exemption from the requirements of 10 CFR Part 50, Appendix K, paragraphs I.D.3 and I.D.5, as they apply to an evaluation model (EM) for the LOCA analysis for two-loop Westinghouse plants such as Kewaunee (WCAP-10924-P, Revision 1, Volume 1, Addendum 4).

The specific provision of paragraph I.D.3 from which the licensee requested an exemption, is the calculation of core exit flow based on carryover fraction. The licensee stated that the prescriptions for this calculation given in paragraph I.D.3 were based on data for a bottom-flooding configuration design. The Kewaunee design relies on upper plenum injection (UPI) for the ECCS injection during the reflood phase of a large-break LOCA. UPI is not a "lower flooding design;" its ECCS flow patterns, flow magnitudes,

core cooling mechanisms, and, in fact, the meanings and impacts of the terms "inlet" and "exit" are different than those of bottom flooding plants. The EM is described in WCAP 10924-P, Revision 1, "Westinghouse Large-Break LOCA Best-Estimate Methodology, Volume 1: Model Description and Validation, Addendum 4: Model Revisions," dated August 1990, which was generically approved in a staff SER dated February 8, 1991. The EM determines core flow, including flow "exiting" the core, flow "entering" the core, and flow within the core and elsewhere within the reactor coolant system (RCS) in accordance with applicable experimental data. The data are different than that referenced in paragraph I.D.3, however, they were found acceptable because they are specifically applicable to UPI designs. Because of the differences between UPI design considerations and those for bottom flooding designs mentioned above, the "carryover fraction" as defined in paragraph I.D.3 is not calculated in the approved EM and would not have the same technical significance if it were. The licensee, therefore, concludes that, in using the approved UPI model for Kewaunee, it will not comply with paragraph I.D.3. The staff SER of February 8, 1991, finds that the WCAP-10924-P EM contains an empirically verified model, more directly applicable to top flooding situations, to calculate core exit flow, which satisfies the technical purpose of the Appendix K, paragraph I.D.3 requirement to determine the core exit flow, but does not comply with the letter of the requirement.

In more detail, the intent of the Appendix K, paragraph I.D.3, requirement is to assure that the calculation of core exit flow is performed using an EM which has been verified against appropriate experimental data for LOCA accident analyses. The Westinghouse COBRA/TRAC code (WCOBRA/TRAC)

consists of (1) Westinghouse Large-Break LOCA Best Estimate Methodology, Volume 1: Model Description and Validation, WCAP-10924-P-A, Rev. 1, and Addenda 1, 2, and 3, December 1988, and (2) a Westinghouse Large-Break LOCA Best-Estimate Methodology, Volume 2: Application to Two-Loop PWRs Equipped with Upper Plenum Injection, WCAP-10924-P-A, Rev. 2, December 1988.

To assess WCOBRA/TRAC's capability for predicting the correct thermal-hydraulic behavior for upper plenum injection situations, WCOBRA/TRAC has been compared to the Japanese Cylindrical Core Test Facility data which models the interaction effects of upper plenum injection in a large scale test facility. WCOBRA/TRAC predicts the thermal-hydraulic effects of the upper plenum injection such that the carryover of steam and water into the hot legs is more realistically calculated.

The staff finds that the exemption from the paragraph I.D.3 requirement is acceptable because the licensee has provided an acceptable method to satisfy the underlying purpose of the requirement that appropriately models heat transfer mechanisms in UPI designs, and application of the regulation is not necessary to achieve the underlying purpose of the rule.

Paragraph I.D.5, dealing with refill and reflood heat transfer for PWRs, provides heat transfer prescriptions for refill, reflood with a flooding rate of less than 1 inch per second, and reflood with a flooding rate of more than 1 inch per second for bottom-flooding PWRs. The purpose of the paragraph is to assure that heat transfer in the core is appropriately calculated in the refill and reflood phases of post-LOCA recovery.

Paragraph I.D.5.a requires that "New correlations or modifications to the FLECHT [full length emergency cooling heat transfer] heat transfer

correlations are acceptable only after they are demonstrated to be conservative, by comparison with FLECHT data, for a range of parameters consistent with the transient to which they are applied." The licensee requested an exemption from the prescriptions of this paragraph because the FLECHT data do not portray UPI core heat transfer mechanisms as realistically as the more recent data upon which the models in WCAP-10924 were based. The licensee also indicates that the Kewaunee design is not lower flooding, and that technical considerations are different between bottom flooding designs and UPI design similar to those discussed above for paragraph I.D.3. The licensee identified that the WCAP-10924-P EM contains an empirically verified model which accounts for refill and reflood heat transfer, which satisfies the purpose of the paragraph I.D.5.a requirement. The heat transfer models in the approved UPI EM are based on comparisons to data other than the FLECHT data cited in paragraph I.D.5.a, and comparisons to the applicable data demonstrate acceptable conservatism (as identified in the staff SER of February 8, 1991). Because of the differences in bases, it is not clear that the licensee can demonstrate monotonic conservatism with respect to FLECHT data.

Further, to meet the intent of Appendix K, paragraph I.D.5, which is to use the most applicable data for LOCA accident analyses to appropriately calculate heat transfer during the refill and reflood phases; the WCOBRA/TRAC code has been verified against two independent sets of experimental data which model the upper plenum injection flow and heat transfer situation.

The first series of tests which have been modeled by WCOBRA/TRAC are the Westinghouse G-2 refill downflow and counterflow rod bundle film boiling experiments (Westinghouse G-2, 17x17 Refill Heat Transfer Tests and Analysis,

WCAP-8793, August 1976).

These experiments were performed as a full length 17x17 Westinghouse rod bundle array which had a total of 336 heated rods. The injection flow was from the top of the bundle and is scalable to the UPI injection flows. The pressures varied between 20-100 psia which is the typical range for UPI top flooding situations. Both concurrent downflow film boiling and countercurrent film boiling experiments were modeled using WCOBRA/TRAC. Both of these flow situations are found in the calculated core response for a PWR with UPI.

In addition to modeling these separate effects tests, WCOBRA/TRAC has been used to model the Japanese Cylindrical Core Test Facility experiments with upper plenum injection. The tests which have been modeled included (1) a symmetrical UPI injection with maximum injection flow, (2) minimum injection flows with a nearly symmetrical injection pattern, (3) a minimum UPI injection flow with a skewed UPI injection, and (4) a cold leg injection reference test for the UPI tests.

The results of these comparisons are documented and show that WCOBRA/TRAC does predict heat transfer behavior for these complex film boiling situations as well as the system response for upper plenum injection situations.

The effect of flow blockage due to cladding burst is explicitly accounted for in WCOBRA/TRAC with models which calculate cladding swelling, burst, and area reduction due to blockage. These models are based on previously approved models used in current evaluation models and on flow blockage models determined to be acceptable by the staff. The effect of flow blockage is accounted for from the time burst is calculated to occur. The fluid models in WCOBRA/TRAC calculate flow diversion as a result of the blockage and take into

account the blockage from the time the cladding burst is calculated to occur. Thus, the heat transfer behavior is predicted for these complex film boiling situations and, thus, the intent of Appendix K, paragraph I.D.5, which requires flow blockage effects be taken into account, is met.

The staff finds that the exemption from the paragraph I.D.5.a requirement is acceptable based on the provision of an acceptable method to satisfy the purpose of the paragraph that requires appropriate calculation of core reflood rates and heat transfer during a large break LOCA.

Paragraph I.D.5.b requires that "During refill and during reflood when reflood rates are less than one inch per second, heat transfer calculations shall be based on the assumption that cooling is only by steam, and shall take into account any flow blockage calculated to occur as a result of cladding swelling or rupture as such blockage might affect both local steam flow and heat transfer." The EM approved for UPI plants which the licensee proposes to reference does base heat transfer on cooling other than steam if other regimes are calculated to occur. The bases of acceptability, including data comparisons, for this are discussed in the generic SER for the EM. By using this methodology, the licensee does not comply with this requirement, since the methodology recognizes that for a top flooding design, the preponderance of cooling water falls down into the core from above and may or may not be vaporized. Because the licensee's model does not meet the "steam cooling only" requirement of I.D.5.b, but provides an approved alternate methodology (which does consider the thermal and hydraulic effects of cladding swelling and rupture, as also required in paragraph I.D.5.b) for calculating heat transfer, the staff finds the exemption from the requirement of I.D.5.b

acceptable, as compliance is demonstrated not to be necessary to achieve the underlying purpose of the rule.

III.

Section 50.12 of 10 CFR permits the granting of an exemption from the regulations under special circumstances. According to 10 CFR 50.12(a)(2)(ii), special circumstances are present whenever application of the regulation in question is not necessary to achieve the underlying purpose of the rule.

The staff finds that the requested exemptions for Kewaunee are acceptable, since compliance with the literal requirements of the paragraphs cited is not necessary given that the approved EM is based upon appropriate experimental data, the approved EM satisfactorily accounts for the cooling mechanisms in the Kewaunee UPI design for calculations of core reflood rates and heat transfer during a large break LOCA, and that the approved EM satisfies the purpose of the exempted requirements.

Thus, using the best-estimate thermal-hydraulic approved large break LOCA EM, the underlying purpose of the Appendix K, paragraphs I.D.3 and I.D.5 requirements can be achieved.

IV.

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12, this exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security.

Therefore, the Commission hereby grants an exemption from 10 CFR Part 50, Appendix K, paragraphs I.D.3 and I.D.5. The staff also finds that the large break LOCA EM described in any approved version of WCAP-10924-P incorporated

by Kewaunee may be used in licensing analyses, and that further exemptions will not be necessary unless the updated approved versions of the EM do not meet other requirements of 10 CFR 50.46 and/or Appendix K.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of the exemption will have no significant impact on the quality of the human environment (61 FR 42447).

This exemption is effective upon issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

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

Dated at Rockville, Maryland
this 19th day of November 1996

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