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

SUBJECT: KEWAUNEE NUCLEAR POWER PLANT - ISSUANCE OF LICENSE AMENDMENT REGARDING STEAM GENERATOR SLEEVED TUBES AT KEWAUNEE (TAC NO. MA3949)

Dear Mr. Marchi:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No.148 to Facility Operating License No. DPR-43 for the Kewaunee Nuclear Power Plant. This amendment revises the Technical Specifications (TSs) in response to your application dated October 27, 1998, as supplemented on February 23, 2000.

The amendment revises the plugging limits specified in TS 4.2.b, "Steam Generator Tubes," for the Westinghouse hybrid-expansion-joint sleeve and the Westinghouse laser-welded sleeve. The proposed amendment also revises the list of applicable references specified in TS 4.2.b.

A copy of the Safety Evaluation is also enclosed. Notice of Issuance will be included in the Commission's next regular biweekly Federal Register notice.

Sincerely,

/RA/

Tae Kim, Senior Project Manager, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosures: 1. Amendment No.148 to License No. DPR-43
2. Safety Evaluation

cc w/encls: See next page

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OFFICE	PM:PD3-1	E	LA:PD3-1	E	SC:EMCB		OGC NLO with comments		SC:PD3-1
NAME	TJKim TJK		THarris JLH		ESullivan*		BWeisman by phone		CCraig DSH for
DATE	6/16/00		6/16/00		4/26/00		June 13 /00		6/22/00

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

June 27, 2000

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

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Tae Kim, Senior Project Manager, Section 1
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Enclosures: 1. Amendment No. 148 to License No. DPR-43
2. Safety Evaluation

cc w/encls: See next page

Kewaunee Nuclear Power Plant

cc:

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Chairman
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Harold Reckelberg, Chairman
Kewaunee County Board
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Madison, WI 53702

U.S. Nuclear Regulatory Commission
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Regional Administrator - Region III
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James D. Loock, Chief Engineer
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610 N. Whitney Way
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

WISCONSIN PUBLIC SERVICE CORPORATION

WISCONSIN POWER AND LIGHT COMPANY

MADISON GAS AND ELECTRIC COMPANY

DOCKET NO. 50-305

KEWAUNEE NUCLEAR POWER PLANT

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 148
License No. DPR-43

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Wisconsin Public Service Corporation, Wisconsin Power and Light Company, and Madison Gas and Electric Company (the licensees) dated October 27, 1998, as supplemented on February 23, 2000, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. DPR-43 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No.148, are hereby incorporated in the license. The licensees shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance, and shall be implemented within 30 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Darl S. Hood for

Claudia M. Craig, Chief, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: June 27, 2000

ATTACHMENT TO LICENSE AMENDMENT NO. 148

FACILITY OPERATING LICENSE NO. DPR-43

DOCKET NO. 50-305

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the area of change.

REMOVE	INSERT
TS 4.2-6	TS 4.2-6
TS 4.2-7	TS 4.2-7
TS 4.2-8	TS 4.2-8

Category	Inspection Results
C-1	Less than 5% of the total tubes inspected are degraded tubes, and none of the inspected tubes are defective.
C-2	One or more tubes, but not more than 1% of the total tubes inspected are defective, or between 5% and 10% of the total tubes inspected are degraded tubes.
C-3	More than 10% of the total tubes inspected are degraded tubes or more than 1% of the inspected tubes are defective.

NOTE: In all inspections, previously degraded tubes must exhibit significant (>10%) further wall penetrations to be included in the above percentage calculations.

3. Inspection Frequencies

The above required in-service inspections of steam generator tubes shall be performed at the following frequencies:

a. In-service inspections shall be performed at refueling intervals not more than 24 calendar months after the previous inspection. If two consecutive inspections following service under AVT conditions, not including the pre-service inspection, result in all inspection results falling into the C-1 category; or if two consecutive inspections demonstrate that previously observed degradation has not continued and no additional degradation has occurred, the inspection interval may be extended to a maximum of once per 40 months.

b. If the results of the in-service inspection of a steam generator conducted in accordance with Table TS 4.2-2 fall in Category C-3, the inspection frequency shall be increased to at least once per 20 months. The increase in inspection frequency shall apply until a subsequent inspection meets the conditions specified in TS 4.2.b.3.a and the interval can be extended to a 40-month period.

c. Additional, unscheduled in-service inspections shall be performed on each steam generator in accordance with the first sample inspection specified in Table TS 4.2-2 during the shutdown subsequent to any of the following conditions:

   1. Primary-to-secondary tube leaks (not including leaks originating from tube-to-tubesheet welds) in excess of the limits of TS 3.1.d and TS 3.4.d or

2. A seismic occurrence greater than the Operating Basis Earthquake, or

3. A loss-of-coolant accident requiring actuation of the engineering safeguards, where the cooldown rate of the Reactor Coolant System exceeded 100°F/hr, or

4. A main steam line or feedwater line break, where the cooldown rate of the Reactor Coolant System exceeded 100°F/hr.

d. If the type of steam generator chemistry treatment is changed significantly, the steam generators shall be inspected at the next outage of sufficient duration following 3 months of power operation since the change.

4. Plugging Limit Criteria

The following criteria apply independently to tube and sleeve wall degradation except as specified in TS 4.2.b.5 for the tube support plate intersections for which voltage-based plugging criteria are applied or for degradation except as specified in TS 4.2.b.6 for tubesheet crevice region in which the F* and EF* criteria is applied.

a. Any tube which, upon inspection, exhibits tube wall degradation of 50% or more shall be plugged or repaired prior to returning the steam generator to service. If significant general tube thinning occurs, this criterion will be reduced to 40% wall degradation. Tube repair shall be in accordance with the methods described in the following:

WCAP-14685, Revision 4, "Laser Welded Repair of Hybrid Expansion Joint Sleeves for Kewaunee Nuclear Power Plant "

WCAP-14685, Revision 2, Addendum 1, "Laser Welded Repair of Hybrid Expansion Joint Sleeves for Kewaunee Nuclear Power Plant Addendum 1: Evaluation of Weld Repaired HEJ Sleeved Tubes "

WCAP-11643, "Kewaunee Steam Generator Sleeving Report (Mechanical Sleeves) "

CEN-629-P Revision 2, "Repair of Westinghouse Series 44 and 51 Steam Generator Tubes Using Leak Tight Sleeves "

CEN-632-P Revision 0, "Repair of Kewaunee Steam Generator Tubes Using a Resleeving Technique " or

WCAP-13088, Revision 3, "Westinghouse Series 44 and 51 Steam Generator Generic Sleeving Report" including Addendum 1 to Revision 4.

b. Any Westinghouse mechanical hybrid expansion joint (HEJ) sleeve which, upon inspection, exhibits wall degradation of 23% or more shall be plugged or repaired prior to returning the steam generator to service. Figure TS 4.2-1 depicts a Westinghouse HEJ sleeve.

c. For disposition of parent tube indications in the upper joint of Westinghouse HEJ sleeved tubes,* as depicted in Figure TS 4.2-1, the following requirements will apply:

   1. HEJ sleeved tubes shall be inspected with a non-destructive examination technique capable of locating the bottom of the hardroll upper transition. HEJ sleeved tubes with circumferential parent tube indications located $\geq$ 0.92 inch (plus an allowance for NDE uncertainty) below the bottom of the hardroll upper transition, as measured on the inside of the sleeve, may remain in service.

   2. HEJ sleeved tubes with circumferential parent tube indications located < 0.92 inch (plus an allowance for NDE uncertainty) from the bottom of the hardroll upper transition, as measured on the inside of the sleeve, shall be plugged or repaired prior to returning the steam generator to service.

   3. HEJ sleeved tubes with axial parent tube indications located in the parent tube pressure boundary, as depicted in Figure TS 4.2-1, shall be plugged or repaired prior to returning the steam generator to service.

d. Any Combustion Engineering leak tight sleeve which, upon inspection, exhibits wall degradation shall be plugged prior to returning the steam generator to service. This plugging limit applies to the sleeve up to and including the weld region.

e. Any Westinghouse laser welded sleeve which, upon inspection, exhibits wall degradation of 23% or more, shall be plugged prior to returning the steam generator to service. This plugging limit applies to the sleeve up to and including the weld.

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*TS 4.2.b.4.c is applicable for operating cycle 23 only.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO AMENDMENT NO. 148 TO FACILITY OPERATING LICENSE NO. DPR-43

WISCONSIN PUBLIC SERVICE CORPORATION

WISCONSIN POWER AND LIGHT COMPANY

MADISON GAS AND ELECTRIC COMPANY

KEWAUNEE NUCLEAR POWER PLANT

DOCKET NO. 50-305

1.0 INTRODUCTION

By a letter dated October 27, 1998, as supplemented on February 23, 2000, Wisconsin Public Service Corporation (WPSC, or the licensee) submitted a proposed amendment to the Kewaunee technical specification (TS). The proposed amendment would revise the plugging limits specified in TS 4.2.b, "Steam Generator Tubes," for the Westinghouse hybrid expansion joint (HEJ) sleeve and the Westinghouse laser-welded sleeve. The proposed amendment would also revise the list of applicable references specified in TS 4.2.b. The February 23, 2000, supplement is within the scope of the original notice and does not change the proposed no significant hazards consideration finding.

The current licensing bases for the laser-welded repair of HEJ sleeves are documented in Westinghouse Topical Report, WCAP-14685, Revision 3, "Laser Welded Repair of Hybrid Expansion Joint Sleeves for Kewaunee Nuclear Power Plant," which was incorporated into TS 4.2.b by reference via Amendment No. 135 dated June 7, 1997. The proposed amendment would replace WCAP-14685, Revision 3, with Revision 4 which includes the updated wall degradation and plugging limit calculations for HEJ sleeves as well as the revised design basis information for the minimum weld width associated with laser-welded repair of HEJ sleeves.

The current licensing basis for the laser-welded sleeves is documented in Westinghouse Topical Report, WCAP-13088, Revision 3, "Westinghouse Series 44 and 51 Steam Generators Generic Sleeving Report - Laser Welded Sleeves," which was incorporated into TS 4.2.b by reference via Amendment No. 127 dated September 24, 1996. The proposed amendment, in addition to revising the plugging limit for the Westinghouse laser-welded sleeves, would add Addendum 1 to WCAP-13088, Revision 4 into TS 4.2.b, by reference. This addendum provides the revised design basis information for the minimum weld width associated with laser-welded sleeve.

Both WCAP-14685, Revision 3, and WCAP-13088, Revision 3, have been developed and qualified in accordance with Section III of the American Society of Mechanical Engineers Boiler

and Pressure Vessel Code (ASME Code). The associated plugging limits for these sleeves have been developed in accordance with Regulatory Guide (RG) 1.121.

2.0 BACKGROUND

General Design Criterion (GDC) 14 of Appendix A of 10 CFR Part 50, requires that the reactor coolant pressure boundary be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. RG 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes," issued in August 1976, provides guidance on acceptable minimum structural safety margins. RG 1.121 recommends that the margin of safety against tube rupture (or pullout from the tubesheet) under normal operating conditions should be at least three at any tube location where defects have been detected. Kewaunee TS 4.2.b, "Steam Generator Tubes," identifies criteria used to assure the integrity of the SG tubes that are part of the primary coolant pressure boundary. If a tube is found to be defective, the TS requires the tube to either be plugged, which eliminates it from the pressure boundary, or be repaired (by sleeving), which restores its integrity.

Class 1 components, such as SG tubes, must satisfy appropriate sections of the ASME Code. When a repair is made to the degraded SG tubes using laser welded sleeves or HEJ sleeves, the repair method must be qualified in accordance with IWA 4000 of Section XI of the ASME Code.

Kewaunee has two Westinghouse model 51 SGs, A and B. The SG tubes were fabricated with mill annealed alloy 600 and the HEJ sleeves with Alloy 690. There are a total of about 2200 HEJ sleeved tubes in SGs A and B. Of the 2200 HEJ sleeved tubes, about 670 sleeves were subsequently repaired with laser-welding. There are a total of about 500 ABB laser-welded sleeved tubes in SGs A and B, but no Westinghouse laser-welded sleeves have been installed to date.

The HEJ sleeve is installed in a degraded tube in the tubesheet by hydraulic expansion at both ends to create an upper and a lower hydraulic expansion joint to secure and position the sleeve over the flaw in the parent tube. Then, a mechanical rolling tool is inserted into the sleeve and it expands the hydraulic expansion further outward to create an interference fit, (i.e., a hardroll), at the upper and lower ends of the sleeve. The sleeve, including upper and lower hardrolls, forms a new pressure boundary as a replacement for the degraded portion of the tube. The upper hardroll joint has an upper transition (HRUT) and a lower transition (HRLT) region.

The laser-welded sleeve is installed in a degraded tube in the tubesheet by laser-welding the sleeve at both ends to secure and position the sleeve over the flaw in the parent tube. The laser weld is autogenous, that is, no filler material is used in the weld. The weld joint is made by applying a power source to a laser weld head, thereby liquidizing sleeve and tube material. The joint is formed by fusion of the molten sleeve metal with molten tube metal. Chemical analysis of the solidified weld metal has confirmed that it conforms to the requirements for nickel-chromium-iron Alloy 690.

3.0 EVALUATION

Proposed Changes to TS 4.2.b, "Steam Generator Tubes":

1. TS 4.2.b.4.b will be revised to specify the corrected value for the plugging limit of the Westinghouse mechanical HEJ sleeves. The plugging limit will be changed from 24 percent to 23 percent of sleeve wall thickness.

2. TS 4.2.b.4.e will be revised to specify the corrected value for the plugging limit of Westinghouse laser-welded sleeves. The plugging limit will be changed from 25 percent to 23 percent of sleeve wall thickness.

3. TS 4.2.b.4.a will be revised to replace Revision 3 with Revision 4 of WCAP-14685 and to include Revision 4, Addendum 1, of WCAP-13088.

4. TS 4.2.b.3.c.1 will be revised to correct an administrative error.

Subsequent to the issuance of Amendments 127 and 135, which approved WCAP-13088, Revision 3, and WCAP-14685, Revision 3, respectively, the licensee identified an error involving the plugging limit calculations described in both WCAP-13088, Revision 3, and WCAP-14685 Revision 3. The licensee determined that the value of 1567 psi assumed for primary-to-secondary differential pressure in the plugging limit calculations was inconsistent with the design-basis value of 1600 psi. Westinghouse, on behalf of the licensee, recalculated the appropriate sleeve plugging limits using 1600 psi. Accordingly, the licensee proposes that the plugging limit for laser welded sleeves, as specified in TS 4.2.b.4.e, be revised from 25 percent to 23 percent of the sleeve wall thickness. Similarly, the licensee proposed that the plugging limit for HEJ sleeves, as specified in TS 4.2.b.4.b, be revised from 24 percent to 23 percent of the sleeve wall thickness. The staff finds the revised plugging limits for both laser welded sleeves and HEJ sleeves acceptable since these values are more conservative than the current plugging limits and are based on calculations that are consistent with RG 1.121.

In addition to the revised plugging limits, the licensee proposed to revise TS 4.2.b.4.a to replace Revision 3 with Revision 4 of WCAP-14685 and to include Revision 4, Addendum 1, of WCAP-13088. The purpose of this change is to provide the revised design basis information regarding the minimum weld width for both laser-welded sleeves and laser-welded repair of HEJ sleeves. Westinghouse determined that the finite element analysis to qualify the minimum weld-width of 0.015 inch had under-predicted the shear stress in the laser weld. The laser welded sleeve methodology described in WCAP-13088, Revision 3, and the laser-welded repair methodology described in WCAP-14685, Revision 3, were qualified with the minimum weld-width of 0.015 inch, such that the calculated stresses on the welds exceeded the ASME Code design allowable stresses.

In light of the discovered discrepancy in the final element analysis, Westinghouse initiated a verification program to demonstrate the acceptability of the laser weld having a minimum specified weld width of 0.015 inch. This verification program included review of field weld data to show that the average width of field welds would be greater than 0.015 inch.

Class 1 components, such as steam generator tubes, must satisfy appropriate sections of the ASME Code. When a repair is made to the degraded steam generator tubes using laser welded sleeves or HEJ sleeves, the repair method must be qualified in accordance with IWA 4000 of Section XI of the ASME Code. Section XI, in turn, references the original construction code of the plant, that is, ASME Code Section III. If a Class 1 component cannot satisfy stress limits by analysis, Section III NB-3649 permits establishing design adequacy by the use of experimental stress analysis in accordance with Section III, Appendix II, or by performance of burst tests in accordance with American National Standards Institute (ANSI) B16.9. This methodology is referred to as design-by-test. If the burst test approach is used, ASME Code NB-3649 specifies that the burst pressure of the component should be demonstrated as equal to or greater than the burst pressure of the weakest pipe attached to the piping product. In other words, a design-by-test should demonstrate that the component in question (the weld) is not the weakest link in the system. Therefore, the burst pressure of the weakest pipe in this case is calculated based, in part, on the minimum specified wall thickness of the sleeve.

Westinghouse performed both structural analysis and "burst tests" to determine the average weld width that would be necessary to show compliance with the applicable code requirements. The structural analysis showed that an average weld width of 0.021 inch meets all of the design-by-analysis requirements of the ASME Code. The results of the burst tests on the other hand, showed that an average weld-width of 0.019 inch meets the ASME Code design-by-test requirements.

For the purpose of the verification program, Westinghouse fabricated welded specimens in accordance with the established installation procedures which were qualified in accordance with ASME Code, Section IX.

Westinghouse determined that the mean width of the test welds is 0.028 inch with a standard deviation of 0.00179 inch. Westinghouse reported that, at a confidence level of 95 percent, the probability of finding a weld-width less than 0.019 inch is 0.0005. There are a total of about 670 HEJ sleeved-tubes containing laser-welded repairs in Kewaunee steam generators A and B, but there are no tubes with laser-welded sleeves, to date. Applying the above probability value to the 670 tubes with laser-welded repairs, one would expect with 95 percent confidence that no more than 0.34 tube has a weld with the average width less than 0.019 inch. The probability of 0.34 in 670 is not insignificant. However, there are conservatisms in the Westinghouse calculations which, if adjusted for, would yield a lower probability than 0.0005 for finding an undersized laser weld repair.

One such conservatism comes from the technique for measuring widths of test welds. Westinghouse stated that an optical technique was used to measure the weld widths instead of metallurgical examination which would give precise weld width. Based on comparison with metallurgical examination, the optical measurement technique underestimates the actual weld width by about 0.004 inch. If 0.004 inch is added to the mean width of the test welds, the probability of making a weld with an average width less than 0.019 inch would be insignificantly low. Considering such a low probability, one would expect that it is highly unlikely that any tube with laser-welded repair has an average weld width less than 0.019 inch.

Another conservatism is related to the field installation of the weld as compared to the fabrication of test welds. The field welding process was qualified to a weld process specification using a power range of 328 to 351 watts for the laser equipment. The nominal

power setting for field welding (which was used at Kewaunee) was 340 watts. The test welds were deliberately made with lower power settings to obtain smaller welds to verify their structural integrity. Samples made with power setting set at the low end of the bounds (below the nominal power setting) had measured widths between 0.026 inch and 0.031 inch. There were also samples included in the burst test process that were made with power setting below the allowable power settings. The widths of these sample welds were not included in the calculation of the sample average weld width and standard deviation.

From other data presented on fabrication of welds, it is clear that the weld width is proportional to the power setting of the laser welding equipment (i.e., the lower the power setting the smaller the weld width). The field installation uses a higher power setting than that of the test welds; therefore, the field welds would have larger weld widths than the test welds. The measured mean width of the test welds would have been larger than 0.028 inch had the nominal power setting been used in fabricating test welds. These data also indicate that it is highly unlikely that any laser-weld repaired tube in the Kewaunee population has an average weld width less than 0.019 inch.

For future laser weld repairs of the HEJ sleeved tubes, as well as laser-welded sleeve installations, Westinghouse's inspection procedures include an acceptance criterion for the average width of each weld. Westinghouse stated that any welds having an average weld width less than 0.019 inch will be rejected. Any welds determined to have an average weld width of less than 0.021 inch will be subject to further disposition.

Based on the information provided and the staff evaluation described above, the staff concludes that there is reasonable assurance for the laser-weld repaired tubes to maintain overall integrity. Therefore, the staff finds the proposed changes to TS 4.2.b.4.a to replace Revision 3 with Revision 4 of WCAP-14685 and to include Revision 4, Addendum 1, of WCAP-13088 acceptable.

In addition, the staff finds the proposed changes to TS 4.2.b.3.c.1 to reflect the correct reference acceptable. The current TS refers to TS 3.4.a.1.C, which is no longer valid. TS 3.4.a.1.C became TS 3.4.d as a result of Amendment 123, which was issued on January 3, 1996. This change corrects an oversight from a previous amendment and is strictly administrative in nature.

The staff notes that the associated Bases pages for TS 4.2 will be revised by the licensee to reflect the above changes.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Wisconsin State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

This amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluent that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The

Commission has previously issued a proposed finding that this amendment involves no significant hazards consideration and there has been no public comment on such finding (63 FR 64126). Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

6.0 CONCLUSION

The staff has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: J. Tsao

Date: June 27, 2000