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

SUBJECT: AMENDMENT NO. 129 TO FACILITY OPERATING LICENSE NO. DPR-43 - KEWAUNEE NUCLEAR POWER PLANT (TAC NO. M95901)

Dear Mr. Marchi:

The Commission has issued the enclosed Amendment No. 129 to Facility Operating License No. DPR-43 for the Kewaunee Nuclear Power Plant. This amendment revises the Technical Specifications (TS) in response to your application dated July 3, 1996 as supplemented on July 23, August 28, and September 16, 1996.

The amendment revises TS 4.2.b, "Steam Generator Tubes," and its associated basis, by revising the acceptance criteria for indications of tube degradation occurring in the tubesheet crevice region.

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,

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

Enclosures: 1. Amendment No. 129 to License No. DPR-43
2. Safety Evaluation

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

October 2, 1996

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Manager - Nuclear Business Group
Wisconsin Public Service Corporation
Post Office Box 19002
Green Bay, WI 54307-9002

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cc w/encls: See next page

cc:

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Chairman
Town of Carlton
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Mr. Harold Reckelberg, Chairman
Kewaunee County Board
Kewaunee County Courthouse
Kewaunee, Wisconsin 54216

Chairman
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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. 129
License No. DPR-43

1. The 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 July 3, 1996, as supplemented on July 23, August 28, and September 16, 1996, 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. 129 , 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 is to be implemented within 30 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

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

Attachment: Changes to the Technical Specifications

Date of issuance: October 2, 1996

ATTACHMENT TO LICENSE AMENDMENT NO. 129

FACILITY OPERATING LICENSE NO. DPR-43

DOCKET NO. 50-305

Revise Appendix A Technical Specifications by removing the pages identified below and inserting the enclosed pages. The revised pages are identified by amendment number and contain vertical lines indicating the area of change.

REMOVE	INSERT
TS ii	TS ii
TS 4.2-2	TS 4.2-2
TS 4.2-3	TS 4.2-3
TS 4.2-4	TS 4.2-4
TS 4.2-5	TS 4.2-5
TS 4.2-6	TS 4.2-6
TS 4.2-7	TS 4.2-7
TS 4.2-8	TS 4.2-8
TS 4.2-9	TS 4.2-9
--------	TS 4.2-10
TS B4.2-5	TS B4.2-5
TS B4.2-6	TS B4.2-6
--------	TS B4.2-7

Amendment No. ~~64,91,95,100,103,106,110,118,119,126~~,129

b. Whenever integrity of a pressure isolation valve listed in Table TS 3.1-2 cannot be demonstrated, the integrity of the remaining pressure isolation valve in each high pressure line having a leaking valve shall be determined and recorded daily. In addition, the position of the other closed valve located in the high pressure piping shall be recorded daily.

b. Steam Generator Tubes

Examinations of the steam generator tubes shall be in accordance with the in-service inspection program described herein. The following terms are defined to clarify the requirements of the inspection program.

Imperfection is an exception to the dimension, finish, or contour required by drawing or specification.

Degradation means a service-induced cracking, wastage, wear or general corrosion occurring on either inside or outside of a tube.

% Degradation is an estimated % of the tube wall thickness affected or removed by degradation.

Degraded Tube means a tube contains an imperfection $\geq$ 20% of the nominal wall thickness caused by degradation.

Defect means an imperfection of such severity that it exceeds the plugging limit. A tube containing a defect is defective.

Tube Inspection means an inspection of the steam generator tube from the point of entry (e.g., hot leg side) completely around the U-bend to the top support of the opposite leg (cold leg).

Tube is the Reactor Coolant System pressure boundary past the hot leg side of the tubesheet and before the cold leg side of the tubesheet.

Plugged Tube is a tube intentionally removed from service by plugging in the hot and cold legs because it is defective, or because its continued integrity could not be assured.

Repaired Tube is a tube that has been modified to allow continued service consistent with plant Technical Specifications regarding allowable tube wall degradation, or to prevent further tube wall degradation. A tube without repairs is a nonrepaired tube. This definition does not apply to the portion of the tube below the F* or EF* distance provided the tube is not degraded (i.e., no detectable degradation permitted) within the F* distance for F* tubes and within the EF* distance for EF* tubes.

F* Distance is the distance of the expanded portion of a tube which provides a sufficient length of undegraded tube expansion to resist pullout of the tube from the tubesheet. The F* distance is equal to 1.12 inches (plus an allowance for NDE uncertainty) and is measured downward from the bottom of the uppermost roll transition. The F* distance applies to roll expanded regions below the midpoint of the tubesheet.

F* Tube is a tube with degradation below the F* distance, equal to or greater than 50%, and has no indications of degradation within the F* distance.

EF* Distance is the distance of the expanded portion of a tube which provides a sufficient length of undegraded tube expansion to resist pullout of the tube from the tubesheet. The EF* distance is equal to 1.44 inches (plus an allowance for NDE uncertainty) and is measured downward from the bottom of the uppermost roll transition. The EF* distance applies to roll expanded regions above the midpoint of the tubesheet.

EF* Tube is a tube with degradation below the EF* distance, equal to or greater than 50%, and has no degradation within the EF* distance.

1. Steam Generator Sample Selection and Inspection

   The in-service inspection may be limited to one steam generator on a rotating schedule encompassing the number of tubes determined in TS 4.2.b.2.a provided the previous inspections indicated that the two steam generators are performing in a like manner.

2. Steam Generator Tube Sample Selection and Inspection

   The tubes selected for each in-service inspection shall:

   a. Include at least 3% of the total number of nonrepaired tubes, in both steam generators, and 20% of the total number of repaired tubes in both steam generators. The tubes selected for these inspections shall be selected on a random basis except as noted below and in TS 4.2.b.2.b.

      Indications left in service as a result of application of the tube support plate voltage-based repair criteria shall be inspected by bobbin coil probe during all future REFUELING outages.

   b. Concentrate the inspection by selection of at least 50% of the tubes to be inspected from critical areas where experience in similar plants with similar water chemistry indicates higher potential for degradation.

c. Include the inspection of all non-plugged tubes which previous inspections revealed in excess of 20% degradation. The previously degraded tubes need only be inspected about the area of previous degradation indication if their inspection is not employed to satisfy 4.2.b.2.a and 4.2.b.2.b above.

Implementation of the steam generator tube/tube support plate repair criteria requires a 100% bobbin coil inspection for hot leg and cold leg tube support plate intersections down to the lowest cold leg tube support plate with known outside diameter stress corrosion cracking (ODSCC) indications. The determination of the lowest cold-leg tube support plate intersections having ODSCC indications shall be based on the performance of at least a 20% random sampling of tubes inspected over their full length.

d. In addition to the sample required in 4.2.b.2.a through 4.2.b.2.c, all tubes which have had the F*, or EF*, criteria applied will be inspected each outage in the uppermost tubesheet roll expanded region. These tubes may be excluded from 4.2.b.2.c provided the only previous wall penetration of >20% was located below the F* or EF* distance. F* and EF* tubes will be inspected for a minimum of 2 inches below the bottom of the uppermost roll transition. The results of F* or EF* tube inspections are not to be used as a basis for additional inspection per Table TS 4.2-2 or Table TS 4.2-3.

e. The second and third sample inspections during each in-service inspection may be less than the full length of each tube by concentrating the inspection on those areas of the tubesheet array and on those portions of the tubes where tubes with imperfections were previously found.

f. If a tube does not permit the passage of the eddy current inspection probe the entire length and through the U-bend, this shall be recorded and an adjacent tube shall be inspected. The tube which did not allow passage of the eddy current probe shall be considered degraded.

The results of each sample inspection shall be classified into one of the following three categories. For non-repaired tubes, actions shall be taken as described in Table 4.2-2. For repaired tubes, actions shall be taken as described in Table 4.2-3.

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 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 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 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.a.1.C 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 WCAP-11643, "Kewaunee Steam Generator Sleeving Report (Mechanical Sleeves)," CEN-413-P, "Kewaunee Steam Generator Tube Repair Using Leak Tight Sleeves," or WCAP-13088, Revision 3, "Westinghouse Series 44 and 51 Steam Generator Generic Sleeving Report."

b. Any Westinghouse mechanical hybrid expansion joint (HEJ) sleeve which, upon inspection, exhibits wall degradation of 31% or more shall be plugged or repaired prior to returning the steam generator to service. For disposition of parent tube indications (PTI), the following requirements will apply:

1. HEJ sleeved tubes with circumferential indications located within the upper hardroll lower transition shall be inspected with a non-destructive examination (NDE) technique capable of measuring the sleeve ID difference between the sleeve hardroll peak diameter, and the sleeve ID at the elevation of the PTI. If this diameter change is $\geq$ 0.003" (plus an allowance for NDE uncertainty), the indication may remain in service provided the faulted loop steam line break (SLB) leakage limit from all sources is not exceeded. A SLB leakage allowance of 0.025 gpm shall be assumed for each indication left in service regardless of length or depth. For tubes where the diameter difference is > 0.013", SLB leakage can be neglected.

2. HEJ sleeved tubes with a sleeve ID difference of < 0.003" (plus an allowance for NDE uncertainty) between the sleeve ID hardroll peak diameter and sleeve ID at the elevation of the PTI shall be plugged or repaired prior to returning the steam generator to service.

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

4. HEJ sleeved tubes with parent tube indications located outside of the parent tube pressure boundary as defined on Figure TS 4.2-1 may remain in service.

c. Any Combustion Engineering leak tight sleeve which, upon inspection, exhibits wall degradation of 40% 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 region.

d. Any Westinghouse laser welded sleeve which, upon inspection, exhibits wall degradation of 25% 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.

5. Tube Support Plate Plugging Limit

The following criteria are used for the disposition of a steam generator tube for continued service that is experiencing predominantly axially oriented outside diameter stress corrosion cracking confined within the thickness of the tube support plates. At tube support plate intersection, the repair limit is based on maintaining steam generator tube serviceability as described below:

a. Degradation attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with bobbin voltage $\leq$ 2.0 volts will be allowed to remain in service.

b. Degradation attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with a bobbin voltage > 2.0 volts will be repaired or plugged except as noted in TS 4.2.b.5.c below.

c. Indications of potential degradation attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with a bobbin voltage > 2.0 volts but $\leq$ the upper voltage repair limit, may remain in service if a rotating pancake coil inspection does not detect degradation. Indications of outside diameter stress corrosion cracking degradation with a bobbin voltage > the upper voltage repair limit will be plugged or repaired.

d. If an unscheduled mid-cycle inspection is performed, the following repair limits apply instead of TS 4.2.b.5.a, b and c. The mid-cycle repair limits are determined from the following equation:

$$V_{MURL} = \frac{V_{SL}}{1.0 + NDE + Gr\left(\frac{CL - \Delta t}{CL}\right)}$$

$$V_{MLRL} = V_{MURL} - (V_{URL} - 2.0)\left(\frac{CL - \Delta t}{CL}\right)$$

Where:

V_{MURL} = mid-cycle upper voltage repair limit based on time into cycle
V_{SL} = structural limit voltage
NDE = 95% cumulative probability allowance for NDE uncertainty
Gr = average growth rate per cycle length
CL = cycle length (time between scheduled inspections)
Δt = length of time since last scheduled inspection during which V_{URL} and V_{LRL} were implemented
V_{MLRL} = mid-cycle lower voltage repair limit based on V_{MURL} and time into cycle
V_{URL} = upper voltage repair limit

Implementation of these mid-cycle repair limits should follow the same approach as in TS 4.2.b.5.a, b and c.

NOTE: The upper voltage repair limit is calculated according to the methodology in Generic Letter 95-05 as supplemented.

6. F* and EF* Tubesheet Crevice Region Plugging Criteria

The following criteria are to be used for disposition or repair of steam generator tubes experiencing degradation in the tubesheet crevice region.

a. Tubes with indications of degradation within the roll expanded region below the midpoint of the tubesheet may remain in service provided the distance from the bottom of the uppermost roll transition to the tip of the crack is greater than 1.12" (plus an allowance for NDE uncertainty). This criteria is called the F* criteria and applies to the factory roll expansion, or to additional roll expansions formed as an extension of the original roll. Any degradation existing below the F* (plus an allowance for NDE uncertainty) is acceptable for continued service.

b. Indications of degradation not repairable by 4.2.b.6.a may be repaired using the EF* criteria. The EF* region is located a minimum of 4" below the top of the tubesheet, and is formed by an additional roll expansion of the tube in the originally unexpanded length. Tubes with indications of degradation within the EF* region may remain in service provided the distance from the bottom of the uppermost roll transition to the tip of the crack is greater than 1.44" (plus an allowance for NDE uncertainty). Any degradation existing below EF* (including uncertainty) is acceptable for continued service.

7. Reports

a. Following each in-service inspection of steam generator tubes, if there are any tubes requiring plugging or repairing, the number of tubes plugged or repaired shall be reported to the Commission within 30 days. This report shall include the tubes for which the F* or EF* criteria were applied.

b. The results of the steam generator tube in-service inspection shall be included in the Annual Operating Report for the period in which this inspection was completed. This report shall include:

1. Number and extent of tubes inspected.

2. Location and percent of wall-thickness penetration for each indication of a degradation.

3. Identification of tubes plugged.

4. Identification of tubes repaired.

c. Results of a steam generator tube inspection which fall into Category C-3 require prompt (within 4 hours) notification of the Commission consistent with 10 CFR 50.72(b)(2)(i). A written follow up report shall be submitted to the Commission consistent with Specification 4.2.b.7.a, using the Licensee Event Report System to satisfy the intent of 10 CFR 50.73(a)(2)(ii).

d. For implementation of the voltage-based repair criteria to tube support plate intersections, notify the NRC staff prior to returning the steam generators to service should any of the following conditions arise:

1. If estimated leakage based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution exceeds the leak limit (determined from the licensing basis dose calculation for the postulated main steamline break) for the next operating cycle.

2. If circumferential crack-like indications are detected at the tube support plate intersections.

3. If indications are identified that extend beyond the confines the tube support plate.

4. If indications are identified at the tube support plate elevations that are attributable to primary water stress corrosion cracking.

5. If the calculated conditional burst probability based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution exceeds 1×10^{-2}, notify the NRC and provide an assessment of the safety significance of the occurrence.

The hydraulic equivalency ratios for the application of normal operating, upset, and accident condition bounding analyses have been evaluated. Design, installation, testing, and inspection of steam generator tube sleeves requires substantially more engineering than plugging, as the tube remains in service. Because of this, the NRC has defined steam generator tube repair to be an Unreviewed Safety Question as described in 10 CFR 50.59(a)(2). As such, other tube repair methods will be submitted under 10 CFR 50.90; and in accordance with 10 CFR 50.91 and 92, the Commission will review the method, issue a significant hazards determination, and amend the facility license accordingly. A 90-day time frame for NRC review and approval is expected.

Technical Specification 4.2.b.5

The repair limit of tubes with degradation attributable to outside diameter stress corrosion cracking contained within the thickness of the tube support plates is conservatively based on the analysis documented in WCAP-12985, "Kewaunee Steam Generator Tube Plugging Criteria for ODSCC at Tube Support Plates" and EPRI Draft Report TR-100407, Rev.1, "PWR Steam Generator Tube Repair Limits - Technical Support Document for Outside Diameter Stress Corrosion Cracking at Tube Support Plates." Application of these criteria is based on limiting primary-to-secondary leakage during a steam line break to ensure the applicable 10 CFR Part 100 limits are not exceeded.

The voltage-based repair limits of TS 4.2.b.5 implement the guidance in Generic Letter 95-05 and are applicable only to Westinghouse-designed steam generators with outside diameter stress corrosion cracking (ODSCC) located at the tube-to-tube support plate intersections. The voltage-based repair limits are not applicable to other forms of tube degradation nor are they applicable to ODSCC that occurs at other locations within the steam generators. Additionally, the repair criteria apply only to indications where the degradation mechanism is predominantly axial ODSCC with no indications extending outside the thickness of the support plate. Refer to GL 95-05 for additional description of the degradation morphology.

Implementation of TS 4.2.b.5 requires a derivation of the voltage structural limit from the burst versus voltage empirical correlation and the subsequent derivation of the voltage repair limit from the structural limit (which is then implemented by this surveillance).

The voltage structural limit is the voltage from the burst pressure/bobbin voltage correlation, at the 95 percent prediction interval curve reduced to account for the lower 95/95 percent tolerance bound for tubing material properties at 650°F (i.e., the 95 percent LTL curve). The voltage structural limit must be adjusted downward to account for potential flaw growth during an operating interval and to account for NDE uncertainty. The upper voltage repair limit, V_{URL}, is determined from the structural voltage limit by applying the following equation:

$$V_{URL} = V_{SL} - V_{GR} - V_{NDE}$$

Where V_{GR} represents the allowance for flaw growth between inspections and V_{NDE} represents the allowance for potential sources of error in the measurement of the bobbin coil voltage. Further discussion of the assumptions necessary to determine the voltage repair limit are discussed in GL 95-05.

The mid-cycle equation should only be used during unplanned inspection in which eddy current data is acquired for indications at the tube support plates.

Technical Specification 4.2.b.6

Tubes with indications of degradation in either the original factory roll expansion in the tubesheet or the unexpanded portion of tube within the tubesheet may be dispositioned for continued service or repaired through application of the F* or EF* criteria. The F* and EF* criteria are described in WCAP-14677[7]. The F* and EF* criteria are established using guidance consistent with RG 1.121. Neither the F* or EF* criteria will significantly contribute to offsite dose following a postulated main steam line break such that contributions from these sources need to be included in offsite dose analyses. Inherent to these criteria is the ability to perform an additional roll expansion of the tube, either as an extension of the original factory roll expansion, in which case F* criteria applies, or in the area starting approximately 4" below the top of the tubesheet, in which case EF* criterion apply. The additional roll expansion procedure can be applied over existing degradation, provided the F* or EF* requirements for non-degraded roll expansion lengths of 1.12" (plus an allowance for NDE uncertainty) and 1.44" (plus an allowance for NDE uncertainty), respectively, are satisfied. The NDE uncertainty applied to the F* and EF* distance is a function of the eddy current probe and technique used. Current state-of-the art inspection technology will be used with implementation of the F* and EF* criteria. The uncertainty in such inspections has been shown to be as small as 0.06", however, for field application, an eddy current uncertainty of 0.20" will be applied. Any and all indications of degradation existing below the F* or EF* distance is acceptable for continued service.

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[7]WCAP 14677, F* and Elevated F* Tube Alternate Repair Criteria for Tubes With Degradation Within the Tubesheet Region of the Kewaunee Steam Generators, June 1996 (Proprietary).

Technical Specification 4.2.b.7

Category C-3 inspection results are considered abnormal degradation to a principal safety barrier and are therefore reportable under 10 CFR 50.72(b)(2)(i) and 10 CFR 50.73(a)(2)(ii).

TS 4.2.b.7.d implements several reporting requirements recommended by GL 95-05 for situations which NRC wants to be notified prior to returning the steam generators to service. For TS 4.2.b.7.d.3 and 4, indications are applicable only where alternate plugging criteria is being applied. For the purposes of this reporting requirement, leakage and conditional burst probability can be calculated based on the as-found voltage distribution rather than the projected end-of-cycle voltage distribution (refer to GL 95-05 for more information) when it is not practical to complete these calculations using the projected EOC voltage distributions prior to returning the steam generators to service. Note that if leakage and conditional burst probability were calculated using the measured EOC voltage distribution for the purposes of addressing GL Sections 6.a.1 and 6.a.3 reporting criteria, then the results of the projected EOC voltage distribution should be provided per GL Section 6.b(c) criteria.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO AMENDMENT NO. 129 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 letter dated July 3, 1996, as supplemented on July 23, August 28, and September 16, 1996, Wisconsin Public Service Corporation (WPSC), the licensee, requested a revision to the Kewaunee Nuclear Power Plant (KNPP) Technical Specifications (TS). The proposed amendment would revise KNPP TS Section 4.2.b, "Steam Generator Tubes," and its associated basis, by specifying an "F-star" (F*) and "Elevated F-star" (EF*) distance within the tubesheet, below which indications of degradation would not affect the structural and leakage integrity of a steam generator tube. As a result, tubes with known degradation below the F*/EF* distance in the tubesheet would not require plugging or repair. The function of the F* and EF* distances is the same; however, EF* differs from F* in that the EF* repair criterion applies only to those tubes with a tubesheet hardroll located completely above the original expansion joint in the upper half of the tubesheet.

The licensee supported its requests with a Westinghouse report WCAP-14677, "F* and Elevated F* Tube Alternate Repair Criteria For Tubes With Degradation in the Tubesheet Region of the Kewaunee Steam Generators," (Proprietary). To support its repair methodology, the licensee also supplied WCAP-14679, "Qualification of Additional Roll Expansion for the Kewaunee Nuclear Power Plant Steam Generators," (Proprietary).

The licensee stated that the proposed changes will provide adequate assurance of steam generator tube integrity because the presence of the tubesheet in conjunction with the hardroll process significantly reduces the potential for tube structural failure and primary-to-secondary leakage. The presence of the tubesheet constrains the tube and complements the integrity of the tube by minimizing the amount of deformation a tube can undergo beyond its expanded outside diameter. The proximity of the tube and tubesheet, due to the hardroll expansion, limits the amount of primary-to-secondary leakage. The F* criterion provides a similar level of protection for tube degradation in the tubesheet as that afforded by Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes," for degradation located outside the tubesheet region.

The July 23, August 28, and September 16, 1996, submittals provided clarifying information that did not change the initial proposed no significant hazards consideration determination published in the July 31, 1996, Federal Register.

2.0 DISCUSSION AND EVALUATION

2.1 Licensee's Evaluation

F* Engagement Distance Determination

The F* criteria provide for sufficient engagement of the tube-to-tubesheet hardroll such that forces that could be developed during normal or accident conditions would be successfully resisted by the elastic preload between the tube and the tubesheet. Below the F* distance, no significant axial tube forces will be transmitted further down the tube. Thus, the F* distance will be sufficient to anchor the tube in the tubesheet. The analysis in WCAP-14677 determined a distance, designated F*, below the bottom of the roll transition for which tube degradation of any extent does not necessitate a repair of the affected tube for the Kewaunee steam generators.

In order to evaluate the applicability of any developed criterion for indications within the tubesheet, some postulated type of degradation must necessarily be considered. For this evaluation it was postulated that a circumferential severance of a tube could occur. This was accomplished by taking no credit for undegraded tubing located below the F* distance. Implicit in the assumption of a circumferential tube severance is the consideration that degradation of any extent could be demonstrated to be tolerable below the location determined acceptable for all postulated loading conditions.

The assessment in WCAP-14677 determined the limiting axial tube loads under normal operating and accident conditions. In addition, the analysis determined the resistive capability of the hardroll interference fit to axial pullout as a function of the length of hardroll. The F* distance was determined by equating this to the maximum postulated loads. F* was determined to be equal to 1.12 inches. Under primary-to-secondary differential pressure loading, the tubesheet may deflect upward dilating the tubesheet holes in the upper half of the tubesheet. This would reduce the frictional forces between the tube and tubesheet. The analysis to determine F* did not account for the potential reduction in joint due to the bowing effect because this repair criterion only applies to roll expansions located in the lower half of the tubesheet.

The proposed change designates a portion of the tube for which tube degradation of a defined type does not necessitate remedial action. As noted above, the area subject to this change is in the original or additional expanded portion of the tube within the tubesheet of the steam generators. The licensee has proposed an F* length of 1.12 inches. Sound roll expansion of 1.12 inches will satisfy all applicable recommendations of Regulatory Guide 1.121 with regard to tube burst integrity.

Limitation of Primary-To-Secondary Leakage

The presence of the hardroll presents a significant resistance to flow of primary-to-secondary or secondary-to-primary water for tubes with degradation which has progressed fully through the thickness of the tube wall in the expansion joint. In effect, no leakage would be expected if a sufficient length of hardroll is present. Because of the difficulty in accurately depth sizing stress tube corrosion crack indications located below the top of the tubesheet, the proposed TSs require that no indications of cracking can be present within the F* distance in tubes to which the F* criterion is applied. This requirement has the effect of preventing the start of a leak path.

The issue of leakage within the F* region up to the top of the roll transition includes the consideration of postulated accident conditions. The relationship between the tubesheet region leak rate at the most limiting postulated accident conditions relative to that for normal plant operating conditions has been assessed. For the postulated leak source within the roll expansion, increasing the differential pressure on the tube wall increases the driving head for the leak; however, it also increases the tube to tubesheet loading. Thus, for a through-wall flaw located within the roll expansion that is left in service in accordance with the F* repair criterion, any leakage under accident conditions would be less than that experienced under normal operating conditions.

An assessment of the primary-to-secondary leakage is included in WCAP-14677. Through-wall degradation located below the F* distance is not expected to contribute to leakage due to the absence of a leak path. However, if a leak path were assumed to be present the anticipated leakage is expected to be low.

EF* Engagement Distance Determination

The application of the EF* repair criteria applies only to those tubes where a new hardroll joint is installed above the midpoint of the tubesheet. Under positive primary-to-secondary differential pressure, the upward deflection of the tubesheet (tubesheet bowing) will cause a reduction in the structural capability to resist axial pull-out forces from that under non-bowing conditions. The EF* distance is determined in a manner similar to F* with the exception that tubesheet bowing effects are included in the analysis. When the reduction in tube-to-tubesheet interference fit from bowing is included, the resulting EF* distance is 1.44 inches.

Qualification of additional roll expansion

In support of the proposed F*/EF* amendment, the licensee submitted WCAP-14679, "Qualification of Additional Roll Expansion for the Kewaunee Nuclear Power Plant Steam Generators." This document summarizes the results from a qualification test program to assess the structural and leakage integrity of roll expanded joints introduced above the original hardroll expansion. To return tubes defective by the depth-based repair limits to service, the licensee will introduce a field-installed hardroll immediately above the original hardroll. The tube will be accepted for continued service based on either the F* or EF* repair criteria. For field repairs where the hardroll is

located entirely below the mid-height of the tubesheet thickness F* applies. Thus, the newly expanded length of tubing must be of sufficient length to provide the necessary F* distance. In addition, field-installed hardrolls will be inspected to verify that the new expanded tube region is defect-free. For field repairs where a hardroll joint is installed above the mid-plane of the tubesheet, the new hardroll must meet the requirements of the EF* criteria in order for the tube to be returned to service. WCAP-14679 experimentally verified that the conclusions of the F* and EF* analyses remain valid for field-installed hardrolls.

One factor that could affect the integrity of the repair is the presence of sludge between the outer tube wall and the tubesheet bore. In the qualification test program, the adverse effects on the tube-to-tubesheet joint due to the presence of sludge were evaluated. Sludge with a similar chemical composition as that found in the Kewaunee steam generators was used to simulate possible conditions between the tube and tubesheet bore during the testing. Tubes were hardrolled into a tubesheet collar for testing with both wet and dry sludge conditions. Simulated tubesheet crevices were either fully or partially packed with sludge to simulate a range of conditions.

Several different tests were conducted to verify acceptability of F* and EF* tubes. These included static and cyclic (thermal and mechanical) loading in addition to leakage resistance testing. Based on the results of the test program, the licensee concluded field-installed hardroll joints would have adequate structural integrity. In addition, the leakage is predicted to be significantly less than the leakage requirements in the plant TS.

Following installation of a rerolled joint, the rerolled region of the tube will be inspected using a qualified inspection technique. The purpose of the inspection is to confirm the integrity of newly installed joint and to verify that the additional roll expanded tube is defect free within the F*/EF* region.

Inspection of F* and EF* Tubes

The F* and EF* distances determined in WCAP-14677 are the lengths of roll expanded tubing necessary to ensure adequate structural and leakage integrity. For field application of the proposed repair criteria, it is necessary to measure the F* and EF* distances using nondestructive examination (NDE) techniques. The licensee has proposed to inspect F*/EF* joints using an eddy current inspection technique. An error is introduced when measuring with such methods. Consequently, F* and EF* distance measurements will be increased by 0.2-inches to account for NDE uncertainty. An uncertainty of 0.2-inches is proposed as a bounding value for actual uncertainty values determined through qualification testing using a representative field inspection system.

During each inspection outage, the F*/EF* distance of all newly installed hardrolled joints and all previously declared F*/EF* tubes will be inspected using qualified inspection techniques. The purpose of the inspections is to verify the integrity of the F*/EF* distances. Length measurements of F* and EF* distances will be increased by the proposed value of 0.2-inches to account for uncertainty in the inspection method.

2.2 Staff Evaluation

Based on its review of the licensee's proposal, the staff has determined that the proposed changes will provide adequate assurance of steam generator tube integrity because: 1) the presence of the tubesheet in conjunction with the hardroll process significantly reduces the potential for tube structural failure and primary-to-secondary leakage; 2) the presence of the tubesheet constrains the tube and complements the integrity of the tube by minimizing the amount of deformation a tube can undergo beyond its expanded outside diameter; and 3) the proximity of the tube and tubesheet, due to the hardroll expansion, limits the amount of primary-to-secondary leakage. Therefore, the staff concludes that tubes can be left in service with eddy current indications of pluggable magnitude that are below the F* or EF* distances provided the tube is not degraded within the F* or EF* distance, respectively.

3.0 Proposed TS Changes

The licensee proposed the following changes in the TS to implement the F* and EF* repair criteria.

1. Proposed Changes to TS 4.2.b "Steam Generator Tubes"

   The definition of Repaired Tube is modified to state that the definition does not apply to the portion of the tube located below the F* or EF* distance provided the tube is not degraded within the F* distance for F* tubes and within the EF* distance for EF* tubes.

   Definitions are included in TS 4.2.b to define the F* and EF* distances and F* and EF* tubes.

2. Proposed New TS 4.2.b.2.d

   A new requirement is included in the Steam Generator Tube Sample Selection and Inspection section to require an inspection of hardroll expansion of F* and EF* tubes at each inservice inspection. The results of these inspections are not to be used as a basis for additional tube inspections.

3. Proposed Changes to TS 4.2.b.4 "Plugging Limit Criteria"

   The depth-based plugging limit criteria in TS 4.2.b.4 are modified to state that these criteria do not apply to degradation in the tubesheet crevice region in which the F* and EF* criteria are applied.

4. Proposed New TS 4.2.b.6 "F* and EF* Tubesheet Crevice Region Plugging Criteria

   This section is added to specify the repair criteria to be used for disposition or repair of steam generator tubes experiencing degradation in the tubesheet crevice region.

5. Proposed Changes to TS 4.2.b.7 "Reports"

The in-service inspection report summarizing the results of the inspection of the steam generators will include the tubes for which the F* or EF* criteria were applied.

6. Proposed Revision to Bases Section

The Bases for TS Section 4.2 have been revised to add discussions consistent with the changes described above.

The staff has reviewed the TS changes discussed above and finds that they consistently incorporate the F* and EF* criteria as previously discussed in this safety evaluation and will provide adequate assurance of steam generator tube integrity. Therefore, the proposed changes are acceptable.

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 involves a change to a requirement with respect to the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 or changes a surveillance requirement. 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 (61 FR 40031). 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.

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Date: October 2, 1996