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SUBJECT: Proposed Amend 137 to Licenses DPR-43, incorporating voltage based repair criteria into TSS, per NRC GL 95-05 & industry position on probe wear & new variability.

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February 19, 1996

10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Proposed Amendment 137 to the Kewaunee Nuclear Power Plant Technical
Specifications for a Steam Generator Tube Support Plate Voltage-Based Repair Limit

- References:
- 1) Letter from R.J. Laufer (NRC) to M.L. Marchi (WPSC), dated April 17, 1995.
 - 2) NRC Generic Letter 95-05: "Voltage-Based Repair Criteria For Westinghouse Steam Generator Tubes Affected By Outside Diameter Stress Corrosion Cracking," Dated August 3, 1995.
 - 3) Letter from Alex Marion (NEI) to Dr. Brian Sheron (NRC), dated January 23, 1996.
 - 4) Letter from Alex Marion (NEI) to Dr. Brian Sheron (NRC), dated January 23, 1996.

Wisconsin Public Service Corporation (WPSC) is submitting this Technical Specification (TS) amendment request to allow application of a voltage-based repair limit for the Kewaunee steam generator (SG) tube support plate (TSP) intersections experiencing outside diameter stress corrosion cracking (ODSCC). Currently, the Kewaunee Nuclear Power Plant (KNPP) is operating with an interim voltage-based repair criteria based on the guidance provided in draft NRC Generic Letter 94-XX, and KNPP TS amendment number 118; reference 1. The purpose of this proposed amendment is to permanently incorporate the voltage-based repair criteria into the TSs in accordance with NRC Generic Letter 95-05, and the industry position on probe wear, and new probe variability, references 2, 3 and 4 respectively.

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This proposed amendment affects TS section 4.2 and the associated basis. Attachment 1 contains background information, a description of the proposed change, a safety evaluation, significant hazards determination, and environmental considerations. Attachment 2 contains the affected TS pages. Technical Specification Section 4.2 is also affected by proposed amendment number 136.

In accordance with the requirements of 10 CFR 50.36(b), this submittal has been signed and notarized. A copy of this submittal has been transmitted to the State of Wisconsin as required by 10 CFR 50.91(b)(1). Please feel free to contact a member of my staff if you have any questions or require additional information.

Sincerely,



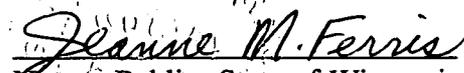
Clark R. Steinhardt
Senior Vice President - Nuclear Power

SLB

Attach.

cc - US NRC, Region III
US NRC Senior Resident Inspector
Mr. Lanny Smith, PSCW

Subscribed and Sworn to
Before Me This 19th Day
of February, 1996


Notary Public, State of Wisconsin

My Commission Expires:

June 13, 1999

ATTACHMENT 1

Letter from C. R. Steinhardt (WPSC)

To

Document Control Desk (NRC)

Dated

February 19, 1996

INTRODUCTION

Wisconsin Public Service Corporation (WPSC) is submitting this proposed Technical Specification (TS) amendment request to allow the application of a voltage-based repair limit for the Kewaunee steam generator (SG) tube support plate (TSP) intersections experiencing outside diameter stress corrosion cracking (ODSCC). Currently, the Kewaunee Nuclear Power Plant (KNPP) is operating with an interim voltage-based repair criteria based on the guidance provided in draft NRC Generic Letter (GL) 94-XX, and KNPP TS amendment number I18. The purpose of this proposed amendment is to permanently incorporate the voltage-based repair criteria into the TSs in accordance with NRC GL 95-05, and the industry position on probe wear and new probe variability. Application of this criteria will be supplemented by additional tube inspection requirements, a reduced operating leakage limit and projected end-of-cycle main steam line break (MSLB) leakage and conditional burst probability calculations.

BACKGROUND

The KNPP SGs are Westinghouse model 51. The SGs are constructed of mill annealed Inconel 600 7/8 inch diameter tubing with carbon steel drilled-hole TSPs. These SGs do not have a flow distribution baffle plate. Degradation occurring at the tube sheet crevices and tube-to-TSP intersections has necessitated significant tube sleeving and plugging. Inservice inspection results and tubes pulled in 1990 and 1993 have identified intergranular stress corrosion cracking on the OD of the tubes in the crevice regions. This form of degradation is referred to as ODSCC.

In 1993 three tube sections (total of five TSP intersections) were removed from SG B with a range of tube-to-TSP indications; the maximum was 2 volts. These specimens were examined nondestructively, burst tested, and then examined destructively. The burst pressure of the corroded TSP regions were well above the safety limitations with a range of 9,537 to 9,756 psig. The corrosion micro-cracks of the burst opening were 12 to 18% deep on average over micro-crack lengths of 0.27 to 0.42 inch. These burst pressure test results are in the upper 95% prediction interval of the APC burst pressure versus bobbin voltage correlation. (Reference EPRI Draft Report TR-100407, Revision 1, Figure 3-2.)

Application of the proposed voltage-based repair criteria for the tube-to-TSP intersections experiencing ODSCC will allow tubes with sufficient structural and leakage integrity to remain in service. The technical and regulatory basis for the voltage-based repair criteria are contained in EPRI Draft Report TR-100407, Revision 1, and WCAP-12985, Revision 2, "Kewaunee Steam Generator Tube Plugging Criteria for ODSCC at Tube Support Plates."

The proposed criteria will be in accordance with GL 95-05 with the exception of probe wear and new probe variability. These will be implemented in accordance with the industry position papers submitted to the NRC by the Nuclear Energy Institute (NEI) on January 23, 1996. Specifically, attachment I of the GL will be implemented as follows:

Section 1: Introduction

The repair criteria will be applied to predominately axial ODSCC indications at the tube-to-TSP intersections (within the TSP thickness) of the SG tube bundle. Any other type of tube degradation or any other location in the tube bundle shall continue to be evaluated in accordance with the existing KNPP TSs. The observation of circumferential cracks, or primary water stress corrosion cracking (PWSCC) associated with TSP indications, or ODSCC extending beyond the TSP thickness will be reported to the NRC before the plant is returned to power.

The voltage-based repair criteria will not be applied to the following atypical tube-to-TSP intersections of the SG tube bundle:

- At locations where tubes with degradation would substantially deform or collapse during postulated loss-of-coolant-accident (LOCA) and safe-shutdown-earthquake (SSE) loading. Analysis done for KNPP demonstrate that no tube locations need to be excluded from the voltage-based repair criteria on this basis.
- At tube-to-TSP intersections with dent signals exceeding 5.0 volts (bobbin). Any indication confirmed by RPC will be repaired.
- At tube-to-TSP intersections where mix residuals could mask a 1.0 volt bobbin coil ODSCC indication. Any indications confirmed by RPC will be repaired.
- At tube-to-TSP intersections where copper deposits interfere with bobbin coil signals. Any indications confirmed by RPC will be repaired.

Section 2: Tube Integrity Evaluation

There are three principal engineering analyses that will be performed during each cycle of operation with the 2.0 volt repair criteria:

- Prediction of SG bobbin voltage population distribution.
- Calculation of SG tube leakage during a postulated main steamline break (MSLB).
- Calculation of SG tube burst probability during a postulated MSLB.

The latest approved EPRI database (7/8 inch diameter tubing), using the NRC approved data exclusion criteria, will be applied in the voltage correlations used to calculate the leak rate, burst probability and upper voltage repair limit. The calculations will be performed in accordance with the GL using the methodology detailed in WCAP-14277, "SLB Leak Rate and Tube Burst Probability Analysis Methods for ODS/CC at TSP Intersections." In addition, the upper voltage repair limit used to repair indications independent of RPC confirmation will be determined at each refueling outage based on the guidance of Section 2.a.2 of the GL.

Section 3: Inspection Criteria

All inservice SG tubes will be inspected with a bobbin coil during each normally scheduled refueling outage. The inspection will include all hot-leg side tube-to-TSP intersections and all cold-leg side intersections to the extent of any known ODS/CC. Data acquisition and analysis will be performed in accordance with the methodology included as Appendix A to WCAP-12985, Revision 2, dated March 1993. The supplementary guidance of Section 3 of GL 95-05 will be applied with the two exceptions discussed below. Any indication with a bobbin voltage exceeding 2.0 volts shall be inspected with a RPC and be repaired if the bobbin indication is confirmed by RPC. Any indication will be repaired regardless of RPC inspection results if the bobbin voltage exceeds the upper voltage repair limit as obtained per Section 2.a.2 of the GL.

The exceptions are probe wear, discussed in Section 3.c.3, and new probe variability, discussed in Section 3.c.2. These will be implemented in accordance with the industry position papers submitted to the NRC staff by NEI on January 23, 1996. Specifically, probe wear will be controlled as follows:

Monitoring of probe wear using a wear standard will follow normal industry practices associated with probe recalibration requirements and frequency. Normal field practice involves applying the ASME standard at each reel change, at each probe change due to application of probe rejection criteria, or after 4 hours of service for a given probe. If the probe does not satisfy the voltage variability criterion for wear of plus or minus 15%, all locations which exhibited flaw signals with amplitudes greater than or equal to 75% of the repair voltage limit shall be re-examined with a new, acceptable probe. The signal amplitudes obtained with the new probe shall be those used in the alternate repair criteria methodology.

Section 4: Tube Removal and Examination/Testing

The KNPP program for tube removal and examination will comply with the guidance of Section 4 of the GL. Three tubes, for a total of five intersections, were removed from the KNPP SGs in 1993 for initial application of the voltage-based repair limit. A minimum of

two TSP intersections will be removed from the KNPP SGs during the 1996 refueling outage to support continued application of the voltage-based repair criteria. Subsequent tube removals will either be in accordance with the frequency specified in the GL, or an alternate NRC endorsed industry program.

Section 5: Operational Leakage

The operational leakage limit will be maintained at 150 gpd through either SG when the voltage-based repair criteria is applied. Steam generator tubes with known leaks will be repaired prior to returning the SGs to service. Measures will remain in place to ensure timely detection, trending and response to rapidly increasing leaks.

Section 6: Reporting Requirements

KNPP will follow the reporting requirements of Section 6 of the GL.

DESCRIPTION OF THE PROPOSED CHANGE

This PA modifies KNPP TS 4.2.b "Steam Generators", to permanently incorporate the requirements for application of a voltage-based repair criteria. The proposed TS wording is similar to that provided in Attachment 2 of the GL with minor changes since KNPP has custom TSs. The changes are as follows:

- TS 4.2.b.2.a and c include inspection requirements for the TSPs experiencing ODSCC.
- TS 4.2.b.4 clarifies that the depth-based plugging limit does not apply for TSP intersections experiencing ODSCC.
- TS 4.2.b.5 specifies the voltage-based repair criteria for the TSP intersections.
- TS 4.2.b.6.d specifies the reporting requirements for implementation of the voltage-based repair requirements.

Concurrent with these changes the appropriate basis pages have been revised and are being submitted for your information.

SAFETY EVALUATION

In developing the voltage-based plugging criteria, Regulatory Guide (RG) 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes" and RG 1.83, "Inservice Inspection of PWR Steam Generator Tubes" were used as the bases for determining that SG tube integrity considerations are maintained within acceptable limits. RG 1.121 describes a method acceptable to the NRC staff for meeting General Design Criteria (GDC) 2, 14, 15, 31 and 32 by reducing the probability and consequences of SG tube rupture. This is accomplished by determining the limiting safe conditions of degradation in SG tubing beyond which tubes should be repaired or removed from service by plugging. This RG uses safety factors on loads for tube burst that are consistent with the requirements of Section III of the ASME Boiler and Pressure Vessel Code.

For degradation occurring at SG tube-to-TSPs, tube burst criteria are inherently satisfied during normal operating conditions by the presence of the support plate. The presence of the TSP enhances the integrity of the degraded tubes in that region by precluding tube deformation beyond the diameter of the drilled hole. It is not certain that the TSP would function to provide a similar constraining effect during accident condition loadings. Therefore, no credit is being taken for the presence of the TSP under accident loading conditions for implementation of the 2 volt plugging criteria. Conservatively, the existing data base burst testing shows that the safety requirements for tube burst margins during both normal and accident condition loadings can be satisfied with bobbin coil signal amplitudes of about 8.82 volts or less, regardless of the depth of tube wall penetration. RG 1.83 describes a method acceptable for implementing GDC 14, 15, 31 and 32 through periodic inservice inspection for the detection of significant tube wall degradation.

No tube leakage is expected to occur during normal operating conditions with the application of a 2 volt plugging criteria even with the presence of through wall cracks. This is the case because the ODSCC occurring at the TSPs in the Kewaunee SGs are short tight, axially oriented micro cracks. Industry data shows that no leakage has been observed during normal operating conditions in the field for crack indications with signal amplitudes less than 6.5 volts. Relative to the expected leakage during accident condition loadings, the limiting event with respect to primary-to-secondary leakage is a postulated MSLB event. Field and laboratory data show minimal leakage for TSP intersections with amplitudes less than 10.0 volts.

In support of the voltage repair limit a Kewaunee specific calculation was performed to determine the maximum permissible primary-to-secondary leakage during a postulated MSLB event. The evaluation considered both pre-accident and accident initiated iodine spikes. The results of the evaluation show that the accident initiated spike yielded the limiting leak rate. This case was based on a limit of 30 rem thyroid dose at the site boundary and initial primary and secondary coolant iodine activity levels of 1.0 $\mu\text{Ci/gm}$ and 0.1 $\mu\text{Ci/gm}$ dose

equivalent iodine-131, respectively. A leak rate of 34.0 gpm was determined to be the upper limit for allowable primary to secondary leakage in the SG in the faulted loop. The SG in the intact loop was assumed to leak at a rate of 0.1 gpm (150 gpd.)

The combined effects of a LOCA plus SSE on the SGs were assessed as required by GDC 2. This issue was addressed for the Kewaunee SGs through the application of leak-before-break (LBB) principles to the primary loop piping. Based on the results of this analysis, it is concluded that the LBB is applicable to the Kewaunee primary loops and, thus, the probability of breaks in the primary loop piping is sufficiently low that they need not be considered in the structural design basis of the plant. Excluding breaks in the primary loops, the LOCA loads from the large branch lines were also assessed and found to be of insufficient magnitude to result in SG tube collapse. Based on these analyses results, no tubes are expected to collapse or deform to the degree that secondary-to-primary in-leakage would be increased over currently expected levels. On this basis no tubes need to be excluded from the voltage-based repair criteria for reasons of deformation resulting from combined LOCA and SSE loadings.

Application of the voltage-based repair limit will be supplemented with a projected EOC, MSLB leakage calculation and conditional burst probability assessment. The methodology for performing these calculations will be consistent with that discussed in the GL. Should the projected MSLB leakage be exceeded, the highest voltage indications will be repaired or removed from service until the projected leakage is less than or equal to 34.0 gpm.

Based on the above discussion, application of a voltage-based repair limit will ensure that the radiological consequences from the tubes remaining in service both under normal and postulated accident conditions will not exceed a small fraction of the 10 CFR 100 limits.

SIGNIFICANT HAZARDS DETERMINATION

This proposed change was reviewed in accordance with the provisions of 10 CFR 50.92 to show no significant hazards exist. The proposed change will not:

- 1) Involve a significant increase in the probability or consequences of an accident previously evaluated.

Testing of model boiler specimens for free span tubing (no TSP restraint) at room temperature conditions show burst pressures in excess of 5,000 psig for indications of ODSCC with voltage measurements as high as 19 volts. Burst testing performed on five intersections pulled from the Kewaunee SGs with up to a 2 volt indication showed measured tube burst in the range of 9,537 to 9,756 psig. Burst testing performed on pulled tubes from other plants with up to 7.5 volt indications show burst pressures in excess of 6,300 psi at

room temperatures. Correcting for the effects of temperature on material properties and the minimum strength levels, tube burst capability significantly exceeds the safety factor requirements of RG 1.121.

Tube burst criteria are inherently satisfied during normal operating conditions due to the presence of the TSP. Test data indicates that tube burst cannot occur within the TSP, even for tubes with through wall EDM notches 0.75 inch long, when the notch is adjacent to the TSP. Since tube burst is precluded during normal operating conditions, the criterion that must be satisfied to demonstrate adequate tube integrity is a safety margin of 1.43 times MSLB pressure differential. The BOC structural limit for 7/8 inch diameter tubing is 8.82 volts. Applying an allowance of 20.5% for NDE uncertainty and 50% for crack growth rate over an operating cycle results in a voltage repair limit of 5.4 volts. The proposed repair limit of 2 volts is very conservative when compared to the 5.4 volts taking into account the low average growth rates experienced at Kewaunee and the high tube burst pressures.

Relative to the expected leakage during accident condition loadings, a plant specific calculation was performed to determine the maximum primary-to-secondary leakage during a postulated MSLB event. The evaluation considered both pre-accident and accident initiated iodine spikes. The results of the evaluation show that the accident spike yielded the limiting leak rate. This case was based on a 30 rem thyroid dose at the site boundary and initial primary and secondary coolant activity levels of 1.0 $\mu\text{Ci/gm}$ and 0.1 $\mu\text{Ci/gm}$ dose equivalent iodine -131, respectively. A leak rate of 34.0 gpm was determined to be the upper limit for allowable primary to secondary leakage in the SG in the faulted loop. The SG in the intact loop was assumed to leak at a rate of 0.1 gpm (150 gpd).

Application of the voltage-based repair limit will be supplemented with a projected EOC MSLB leakage calculation and conditional burst probability assessment. The methodology for performing these calculations will be in accordance with the GL. Should the projected MSLB leakage be exceeded indications will be repaired or removed from service until the projected leakage is less than or equal to 34.0 gpm.

Application of the voltage-based repair limit will not adversely affect SG tube integrity. Therefore, the proposed amendment will not increase the probability or consequences of an accident previously evaluated.

- 2) Create the possibility of a new or different kind of accident from any previously evaluated.

Implementation of the proposed voltage-based repair limit will not reduce the overall safety or functional requirements of the SG tube bundles. The tube burst criteria will be satisfied during normal operating conditions by the presence of the TSPs. The RG 1.121 criteria that must be satisfied during accident loading conditions is 1.43 times MSLB differential

pressure. Conservatively, the existing data base of burst testing shows that the tube burst margins can be satisfied with bobbin coil signal amplitudes of about 8.82 volts or less regardless of the depth of tube wall penetration.

The proposed repair criteria will be supplemented with a reduced operating leakage requirement of 150 gpd through either SG to preclude the potential for excessive leakage during operating conditions. The 150 gpd restriction will provide for timely leakage detection and plant shutdown in the event of the occurrence of an unexpected single crack resulting in leakage that is associated with the longest permissible crack length. The operating leakage limit is based on leak-before break considerations, critical crack length and predicted leakage.

The SG tube integrity will continue to be maintained through inservice inspections and primary-to-secondary leakage monitoring. Therefore, the proposed change will not create the possibility of a new or different kind of accident.

3) Involve a significant reduction in the margin of safety.

Application of the voltage-based repair criteria has been demonstrated to maintain tube integrity commensurate with the RG 1.121 criteria. RG 1.121 describes a method acceptable to the staff for meeting GDCs 2, 14, 15, 31 and 32. This is accomplished by determining the limiting degradation of SG tubing as established by inservice inspection, beyond which tubes should be removed from service. Upon implementation of the repair criteria, even under the worst case conditions, the occurrence of ODSCC at the TSPs is not expected to lead to a SG tube rupture event during normal or faulted conditions. The most limiting event would be a potential increase in leakage during a MSLB event. Excessive leakage during a MSLB is precluded by verifying that the expected EOC crack distribution of ODSCC indications at TSP locations would result in an acceptably low primary-to-secondary leakage. Therefore, the radiological consequences from tubes remaining in service is a small fraction of the 10 CFR 100 limits.

The combined effects of a LOCA plus SSE on the SGs were assessed as required by GDC 2. This issue was addressed for the Kewaunee SGs through the application of leak-before-break (LBB) principles to the primary loop piping. Based on the results of this analysis, it is concluded that the LBB is applicable to the Kewaunee primary loops and, thus, the probability of breaks in the primary loop piping is sufficiently low that they need not be considered in the structural design basis of the plant. Excluding breaks in the primary loops, the LOCA loads from the large branch lines were also assessed and found to be of insufficient magnitude to result in SG tube collapse. Based on these analysis results, no tubes are expected to collapse or deform to the degree that secondary-to-primary in-leakage

would be increased over currently expected levels. On this basis no tubes need to be excluded from the voltage-based repair criteria for reasons of deformation resulting from combined LOCA and SSE loadings.

Addressing the RG 1.83 considerations, implementation of the voltage-based repair criteria will include a 100% bobbin coil probe inspection of all tube-to-TSP intersections with known ODSCC down to the lowest cold leg TSP identified. This will be supplemented by a reduced operating leakage limit, enhanced eddy current data analysis guidelines, MRPC inspection requirements and a projected EOC voltage distribution. It is concluded that the proposed change will not result in a significant reduction in the margin of safety.

ENVIRONMENTAL CONSIDERATIONS

This proposed amendment involves a change to the inspection requirements with respect to the installation or use of a facility component located within the restricted area. Wisconsin Public Service Corporation has determined that the proposed amendment involves no significant hazards considerations and no significant change in the types of any effluent that may be released off site and that there is no significant increase in individual or cumulative occupational radiation exposure. Accordingly, this proposed amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). This proposed amendment also involves changes in record keeping, reporting or administrative procedures or requirements. Accordingly, with respect to these items, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(10). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with this proposed amendment.