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SUBJECT: Application for amend to license DPR-43,revising acceptance criteria for indication of tube degredation occurring in tubesheet crevice region of plant SGs.

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July 3, 1996

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U. S. Nuclear Regulatory Commission
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Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Proposed Amendment 142 to the Kewaunee Nuclear Power Plant Technical Specifications:
F*/EF* Steam Generator Tubesheet Region Alternate Repair Criteria

Wisconsin Public Service Corporation (WPSC) is submitting this Technical Specification (TS) amendment request to revise the acceptance criteria for indications of tube degradation occurring in the tubesheet crevice region of the Kewaunee Nuclear Power Plant (KNPP) steam generators (SGs). Existing tube repair criteria apply throughout the entire tube length, and do not take into account the reinforcing effect of the tubesheet on the external surface of the tube in the lower hardroll expansion region. The revised acceptance criteria is based on determining the length of hardroll engagement necessary to resist tube pullout forces during normal operation, test, upset and faulted conditions. The minimum engagement length is referred to as the F* distance for tube degradation occurring in, or adjacent to the existing factory hardroll. In addition, a criterion has been developed to address degradation occurring above the midthickness of the tubesheet. This criterion is referred to as an elevated F*, or EF* distance. The EF* will be implemented by forming an additional roll expansion joint. Application of the F* and EF* criteria for tube degradation occurring within the factory roll expansion, or below the additional field formed roll expansion, will provide a level of plant protection commensurate with the requirements of Regulatory Guide 1.121.

This proposed TS amendment affects TS section 4.2.b, "Steam Generator Tubes." Attachment 1 contains background information, a description of the proposed TS change, a safety evaluation, significant hazards determination, and environmental considerations. Attachment 2 contains the affected TS pages. The technical and licensing bases for the alternate repair criteria are discussed in WCAP-14677, "F* and Elevated F* Tube Alternate Repair Criteria For Tubes With Degradation Within the Tubesheet Region of the Kewaunee Steam Generators," dated June 1996. The qualification of the additional roll expansion joint is discussed in Westinghouse Report

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change distribution: NRCPDR 1 1 NP

SG-96-06-017, "Qualification of Additional Roll Expansion for the Kewaunee Nuclear Power Plant Steam Generators," dated June 1996. A proprietary and non-proprietary version of WCAP-14677 and the accompanying affidavit statement are included as Attachment 3. Westinghouse Report SG-96-06-017 and the accompanying affidavit statement are included as Attachment 4. This report will be submitted in WCAP format within the next four weeks.

Due to the extensive tube plugging performed during the 1995 refueling outage, the KNPP is operating in a reduced power condition. This condition of reduced power operation and the prospects of future derates have a significant impact on the owners of KNPP. WPSC would like to implement the F* and EF* alternate repair criteria during the upcoming refueling outage scheduled to start on September 21, 1996. Therefore, we respectfully request that the NRC staff give this amendment request a high review priority. The results of the staff review will figure significantly into our 1996 outage plans.

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 call a member of my staff if you have any questions or require additional information.

Sincerely,

C. R. Steinhardt
Senior Vice President-Nuclear Power

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

Subscribed and Sworn to
Before Me This 3rd Day
of July 1996

Notary Public, State of Wisconsin

My Commission Expires:
June 13, 1999

50-305 KEWAUNEE WPSC

ATTACHMENTS TO THE PROPOSED AMEND 142 TO T/S F*/EF* STEAM GENERATOR TUBESHEET REGION ALTERNATE REPAIR CRITERIA WCAP 14677, 14678

Rec'd w/ ltr dtd 7/3/96.....9607090253

ATTACHMENT 1

Letter from C. R. Steinhardt (WPSC)

To

Document Control Desk (NRC)

Dated

July 3, 1996

Proposed Amendment 142

Description of Proposed Change
Safety Evaluation
Significant Hazards Determination
Environmental Considerations

INTRODUCTION

Wisconsin Public Service Corporation (WPSC) is submitting this technical specification (TS) amendment request to revise the acceptance criteria for indications of tube degradation occurring in the tubesheet crevice region of the Kewaunee Nuclear Power Plant (KNPP) steam generators (SGs). Existing tube repair criteria apply throughout the entire tube length, and do not take into account the reinforcing effect of the tubesheet on the external surface of the tube in the lower hardroll expansion region. The revised acceptance criteria is based on determining the length of hardroll engagement necessary to resist tube pullout forces during normal operation, test, upset and faulted conditions. This minimum engagement length is referred to as the F* distance for tube degradation occurring in, or adjacent to the existing factory hardroll. In addition, a criteria has been developed to address degradation occurring above the midthickness of the tubeshcet. This criteria is referred to as an elevated F*, or EF* distance. The EF* will be implemented by forming an additional roll expansion joint starting approximately 4.00 inches below the top of the tubesheet and extending downwards for a length that bounds the minimum engagement length including NDE uncertainty.

For the KNPP SGs, the F* distance has been determined to be 1.12 inches (excluding NDE uncertainty) and the EF* distance is 1.44 inches (excluding NDE uncertainty.) The difference in the two criteria is that the EF* distance takes into account the effect of tubesheet bowing. Application of the F* and EF* criteria for tube degradation occurring within the factory roll expansion, or below the additional, field formed roll expansion, provides a level of plant protection commensurate with the requirements of Regulatory Guide 1.121 for degradation occurring outside of the tubesheet region. The technical and licensing bases for the alternate repair criteria are discussed in WCAP-14677, "F* and Elevated F* Tube Alternate Repair Criteria For Tubes With Degradation Within the Tubesheet Region of the Kewaunee Steam Generators," dated June 1996. The qualification of the additional roll expansion joint is discussed in Westinghouse Report SG-96-06-017, "Qualification of Additional Roll Expansion for the Kewaunee Nuclear Power Plant Steam Generators," dated June 1996. WCAP-14677 and SG-96-06-017 are included as Attachments 3 and 4 respectively.

BACKGROUND

The KNPP has two Westinghouse Model 51 SGs. The SG tubes are constructed of low temperature mill-annealed Inconel 600 and are partial depth rolled into a carbon steel tubesheet at lengths of approximately 1.5 inches in SG A, and 2.5 inches in SG B. The partial depth roll leaves a tube-to-tubesheet crevice region approximately 18 inches long, with an annular gap of 0.007 to 0.008 inch between the external surface of the tube and the tubesheet. The KNPP SGs have experienced tube wall degradation attributed to outside diameter stress corrosion cracking (ODSCC) predominantly in the unexpanded tube length within the tubesheet crevice region. As a result of this degradation significant tube plugging and sleeving has been required. In addition to ODSCC, interpretation of eddy current data from similar plants has shown a potential for

primary water stress corrosion cracking (PWSCC) within the roll expanded portion of the tube in the tubesheet.

During the spring 1995 refueling outage, WPSC inspected 100% of the open (non-sleeved, non-plugged) hot leg tubes throughout the entire crevice region with a motorized rotating pancake coil (MRPC) probe. As a result of this inspection, 78 tubes were removed from service by plugging due to ODSCC. A similar trend of new indieations is predicted for future tube inspections. In accordance with the existing KNPP TSs, indications within the tubesheet crevice region must be removed from service by either plugging the tube, or repairing the tube by sleeving. The purpose of this proposed TS amendment is to revise the acceptance criteria for degradation occurring within the existing; i.e., factory formed, roll expansion portion of the tube, and the unexpanded portion of the tube within the tubesheet crevice region of the KNPP SGs.

It can be shown that tube plugging or tube repair is not required in many cases to maintain SG tube integrity through the application of crack elevation determination, and/or rerolling of the tube material above the crack elevation. Two rerolling locations are being proposed for the KNPP SGs depending on the location of the indication. An additional roll expansion (ARX) can either be formed as a continuance of the existing hardroll expansion; in which case the F* distance criteria applies; or at an elevation above the midthickness of the tubesheet. The higher, or elevated ARX (EARX), will be formed approximately 4.00 inches below the top of the tubesheet and extend downwards for a length that bounds the minimum engagement length including NDE uncertainty. For the EARX joint the EF* criteria applies.

The existing TS tube repair criteria requires that tubes with indications in the tubesheet crevice region be repaired or removed from service. The revised repair criteria will preclude occupational radiation exposure that would otherwise be incurred by plant workers involved in tube plugging or repair operations. The proposed TS will minimize the loss of margin in the reactor coolant flow through the SG in a loss-of-coolant accident (LOCA) analyses and therefore assist in assuring that minimum flow rates are maintained in excess of that required for operation at full power. Reduction in the amount of tube plugging or repair required can reduce the length of plant outages and the time the SG is open to the containment environment.

Analysis and testing has determined that application of the F* and EF* criteria for the KNPP SGs will not adversely affect tube structural and leakage criteria. Provided below are; a description of the TS change, a safety evaluation, a 10 CFR 50.92 significant hazards determination, and an environmental considerations statement. Attachment 2 contains the affected TS pages, Attachment 3 contains WCAP-14677, and Attachment 4 contains Westinghouse Report SG-96-06-017.

Due to the extensive tube plugging performed during the 1995 refueling outage, the KNPP is currently operating in a reduced power condition. This condition of reduced power operation

and the prospects of future derates have a significant economic impact on the owners of KNPP. WPSC would like to implement the F* and EF* alternate repair criteria during the upcoming refueling outage scheduled to start on September 21, 1996. Therefore, we respectfully request that the NRC staff give this amendment request a high review priority. The results of the staff review will figure significantly into our 1996 outage plans.

DESCRIPTION OF PROPOSED CHANGE

This proposed amendment request will modify KNPP TS Section 4.2.b "Steam Generator Tubes" to redefine the acceptance criteria for tubes experiencing degradation in the tubesheet crevice region. The proposed change will add the definitions required to implement the F* and EF* criteria, and prescribe the portion of the tube subject to the acceptance criteria. The F* and EF* criteria dispositions indications within the tubesheet crevice region of the SGs based on location of the indication, and application of a rerolling procedure above the identified degradation elevation. The rerolling procedure reestablishes the structural and leakage integrity of the tube. Specifically, the proposed changes are as follows:

1. TS 4.2.b will be modified to add a definition for F* Distance, F* Tube, EF* Distance and EF* Tube.

2. New TS 4.2.b.2.d will be added to specify the inspection requirements for F* and EF* tubes. New TS 4.2.b.2.d will read as follows:

   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 (or until it is determined the identified degradation has ceased) 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 the F* or EF* tube inspections are not to be used as a basis for additional inspections per Table TS 4.2-1.

3. Existing TS 4.2.b.2.d and 4.2.b.2.e, are being renumbered to 4.2.b.2.e and 4.2.b.2.f respectively.

4. TS 4.2.b.4, which specifies the depth-based repair criteria, is being modified to exclude the tubesheet crevice region for tubes in which the F* or EF* criteria is applied.

5. New TS 4.2.b.6 will be added to provide F* and EF* repair criteria. New TS 4.2.b.6 will read as follows:

The following criteria are used for the 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 roll transition to the tip of the crack is greater than 1.12" (excluding 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 F* (including 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" (excluding NDE uncertainty.) Any degradation existing below EF* (including uncertainty) is acceptable for continued service.

6. Existing TS 4.2.b.6 is being renumbered to 4.2.b.7 and expanded to include reporting requirements for tubes which are dispositioned using the F* or EF* criteria.

7. The basis for TS Section 4.2 is being modified to discuss the F* and EF* acceptance criteria.

SAFETY EVALUATION

The F* and EF* criteria apply to indications of tube degradation occurring in the tubesheet crevice region of the KNPP SGs. Provided below is a safety evaluation that shows that application of the F* and EF* criteria, and formation of an ARX joint at either the factory roll elevation, or at an elevated location provides adequate structural integrity relative to the guidance of RG 1.121, and leakage integrity relative to 10 CFR part 100 guidelines. For tubes permitted to remain in service through either the F* or EF* criteria, degradation of any extent below the F* or EF* distance is acceptable for continued service. The technical and licensing basis for application of the F* and EF* criteria are contained in WCAP-14677 and the qualification of the additional roll expansion process is discussed in Westinghouse Report SG-96-06-017. Provided below is a summary discussion on the F* and EF* safety basis.

F* Criteria

For the F* criteria, an evaluation was performed to determine the minimum length of hardroll engagement required to resist tube pullout forces during normal operation, test, upset and faulted conditions for the KNPP SGs. This length of sound roll expansion needed to prevent pullout during all plant conditions is termed the pullout load reaction length (PLRL.) Existing tube repair criteria apply throughout the entire tube length, not taking into account the reinforcing effect of the tubesheet on the external surface of the tube in the lower hardroll expansion joint. The presence of the tubesheet enhances the integrity of degraded tubes in that region by precluding tube deformation beyond the expanded outside diameter. The roll expansion of the tube into the tubesheet provides a barrier to significant leakage for throughwall indications in the tube in the expanded region. Alternate plugging/repair criteria approved for implementation at similar plants include provisions which account for the support of the tubesheet in the portion of the tubes below the top of the tubesheet. The F* criteria was developed using analytical models and test data samples prepared in a manner consistent with the original SG design.

For SGs with partial depth tube expansion, e.g., the KNPP SGs, the design of the tube-to-tubesheet expansions helps to preclude significant leakage, even for the case of a postulated circumferentially separated tube at the top of the roll transition. For tube rupture type release rates to be realized, the postulated separated tube would have to be axially displaced approximately 18 inches, or relocation of the break location to above the top of the tubesheet, such that sufficient primary to secondary flow area is provided to support release rates estimated in the Updated Safety Analysis Report (USAR). Therefore, the proposed criteria must prevent axial tube displacement, while at the same time providing for sufficient leakage resistance during faulted conditions such that the offsite doses following a main steam line break (SLB) outside of containment does not exceed 10% of the 10 CFR part 100 guidelines considering all sources of leakage.

The length of original mechanical expansion required to prevent tube axial displacement and which provides for positive leakage restriction (leaktight) during faulted conditions has been determined to be 1.12 inches (excluding NDE uncertainty.) This value provides for safety factors consistent with RG 1.121; refer to WCAP-14677. The F* value of 1.12 inches for the KNPP SGs is conservative in that the beneficial tightening effects due to tubesheet bow near the tubesheet primary face are not included.

The F* criteria is applicable to indications in the existing factory hardroll, and an ARX performed as a continuation of the existing hardroll joint. The F* criteria developed for KNPP supports the assumption that tube degradation of any kind and any extent, including a complete circumferential separation of the tube at the F* elevation, will not adversely affect the tube structural or leakage integrity during all plant conditions. The F* criteria as developed by Westinghouse for the KNPP SGs has been licensed at a number of other plants with both 7/8 inch and 3/4 inch OD tubing.

EF* Criteria

A criterion has been developed to address degradation occurring above the midthickness of the tubesheet. This criteria is referred to as elevated F*, or EF*. The EF* will be implemented by forming an elevated ARX (EARX) joint starting at approximately 4.00 inches below the top of the tubesheet and extending downwards for a length that bounds the minimum engagement length and NDE uncertainty. The difference between the F* and EF* criteria is that the EF* takes into account the effect of tubesheet bowing above the neutral bending axis of the tubesheet. The EF* distance for the KNPP SGs has been determined to be 1.44 inches (excluding NDE uncertainty.)

Historical information from the KNPP SG inspections indicates that extensive axial ODSCC has been experienced in the tubesheet crevice region. In most of these cases, the tube can be rerolled above the indication providing a new joint with leakage resistance and structural integrity even for the case where the tube is postulated to experience a complete circumferential separation below the EARX. Development of the EF* criteria and rerolling process included simulating the effects of various consistency sludge loadings in the crevice region, along with both thermal and cyclic loading influences. The results of these tests are summarized below.

Process Description

The EF* rerolling process is applied in the upper portion of the tube within the tubesheet. The new upper roll transition formed by the EARX process is located a minimum of 4.00 inches below the top of the tubesheet. The minimum EF* distance required which satisfies the structural and leakage criteria is 1.44 inches, excluding eddy current uncertainty. Following the rerolling, the EF* length will be inspected using current state-of-the art technology.

Test Program Description

The intent of the reroll testing program, as described in Westinghouse Report SG-96-06-017, was to verify the efficacy of the process to supply the necessary structural and leakage integrity in the presence of various forms of crevice sludge. Three types of sludge loadings were used. These were:

1. Soft sludge, partially filling the tube to tubesheet crevice,
2. Hard sludge, partially filling the tube to tubesheet crevice.
3. Hard sludge, completely filling the tube to tubesheet crevice.

Both leak and axial load capability tests were conducted. The samples used for leak and structural integrity verification were either thermally cycled or load (fatigue) cycled to simulate the effects of actual plant operation on the reroll join region. For the leakage and structural integrity tests the samples were initially leak tested, cycled and then leak tested to determine the

effects of thermal or load cycling on the leakage characteristics. Two different roll lengths were used for the verification testing. These rolled lengths were significantly less than the expected field produced roll length, and therefore provide for conservative test results compared to actual plant conditions. Further conservatism was applied in the leakage testing as the samples used multiple drilled holes in the tube below the EARX joint for the simulation of the postulated leak path. Use of drilled holes is conservative compared to corrosion cracks. Drilled holes provide for little pressure head loss whereas corrosion cracks have a substantial resistance to flow. In the case of the structural integrity testing the tubes were separated by machining below the reroll joint, therefore, the tube below the ARX provided no additional structural integrity.

The axial end cap load applied to the samples for the fatigue testing was calculated using both pressure and temperature components. Thermal loads were calculated assuming the tube fixed at the top of the tubesheet due to crevice packing thereby giving the largest possible thermal loads. Upon shutdown, a tensile load is applied between the fixity locations due to thermal growth mismatch. For pressure effects the tube is assumed to be loaded due to the end cap load at operating conditions which is tensile, and this tensil load is maintained during shutdown. The combined effects of pressure end cap loading and thermal growth were summed to determine the fatigue load. This fatigue load is externally conservative as the tubes are fixed at the top of the tubesheet and the tube support plate intersections at KNPP.

Test Program Results

Of the samples leak tested prior to cycling, the average leak rate from all samples tested at 615°F at a differential pressure of 2650 psi was 1.2 drops per minute (dpm), or 0.00002 gpm. The average leak rate of only those samples which leaked was 3.3 dpm, or 0.00004 gpm.

Following application of over 29,000 fatigue cycles, the average of the samples which leaked was 3.6 dpm, 0.00005 gpm, and the average of all samples was 1.8 dpm, 0.00002 gpm. The consistency of these results, i.e., pre/post cycling, indicates that the reroll joint will not be adversely affected by plant conditions.

The three times normal operating pressure end cap load for KNPP is 2921 lb. A total of eight samples, using both hard and soft sludge, were axially loaded to determine tensile load capability. These samples had EARX roll lengths less than the expected field produced roll lengths, and only approximately 77% of the minimum required EF* length. In most cases the structural integrity samples were not loaded to failure, but loaded to the point that the acceptance limit was surpassed. The test loads for seven of these samples exceeded 3124 lb, while four of the samples had test loads exceeding 5500 lb. One sample (hard sludge, fully packed crevice), however exhibited a first slip load of 1540 lb. The peak load for this sample was not established. This sample had a roll length of only 1.00 inch, or 0.44 inch less than the minimum required EF* length. The roll length of this sample was also slightly less than the other samples, all of which had loads exceeding the three times normal operating pressure

differential pressure limit. Previous test data submitted to the NRC for other programs indicates that the roll length is not proportional to the load capability. Considering the minimum loads of the seven remaining samples, the 1.44 inch EF* length for the EARX joint is adequate to provide structural and leakage integrity.

Conclusions of Leakage Testing

Normal Operation:

Postulated leakage from the E* or EF* tubes can potentially influence both operational and dose considerations. The KNPP TSs for operational leakage limit is currently 150 gpd per SG. Since there are less than 1,000 non-sleeved tubes in either SG, potential contribution to primary-to-secondary leakage by application of the F* or EF* criteria is negligible. The flow resistance through the corrosion cracks is substantial and would provide for a greatly reduced driving head at the tube to tubesheet interface. Additionally, the secondary pressure, acting as a back pressure, may be sufficient to preclude leakage during normal plant conditions.

Postulated SLB:

The average leak rate for samples subjected to fatigue cycling, and leaked, was only 0.00005 gpm. Approximately 20,000 EF* or F* tubes would have to be postulated to leak to increase the primary-to-secondary leakage during a main SLB to 1 gpm assuming no operator action to limit primary side pressure. Since there are less than 1,000 non-sleeved tubes in either SG, contribution to primary-to-secondary leakage by application of F* or EF* can be neglected.

Conclusions of Structural Testing

Pullout integrity testing of roll lengths significantly less than the minimum EF* distances of 1.12 inches and 1.44 inches, excluding NDE uncertainty, demonstrates that structural integrity greater than three times normal operating pressure differential as specified in RG 1.121 will be provided. As the KNPP tubes are expected to be fixed at the tube support plate intersections due to corrosion, and the resistive loads supplied by this fixity are expected to exceed several thousand pounds, there is an inherent margin to the structural integrity requirements. In reality, further margin exists since the structural integrity testing used tubes circumferentially separated below the reroll joint. The axially oriented degradation occurring in the KNPP SGs will not affect the axial load capability of the tubes. Therefore, the in-situ condition of the tubes is such that the combined structural integrity characteristics of the original factory roll expansion plus the reroll will effectively be summed. This effect will provide for structural integrity characteristics exceeding the most limiting theoretical end cap load integrity recommended by RG 1.121.

Consistent with all other F* analysis programs, the EF* length of 1.44 inches for the KNPP SGs, was determined by analysis methods and validated by testing. The EF* length of 1.44 inches determined for the KNPP SGs was established using normal operating conditions with the appropriate safety factor from RG 1.121. The EF* length for faulted plant conditions is less than 1.44 inches. Analysis of tubesheet bow effects, pressure effects, and thermal expansion effects indicates that the combined influences of these three inputs for an elevation of 4.00 inches below the top of the tubeshcet results in a positive, or tightening effect. Therefore, the difference in length between F* and EF* is due to the inclusion of tubesheet bow effect which does not influence the tubesheet near the primary face.

SIGNIFICANT HAZARDS DETERMINATION

This proposed change was reviewed in accordance with the provisions of 10 CFR 50.92 to show no significant hazards exists.

1) Operation of the KNPP in accordance with the proposed license amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

The supporting technical justification for the revised acceptance criteria, WCAP-14677 and Westinghouse Report SG-96-06-017, show that the tubesheet enhances the tube integrity in the region of the hardroll by precluding tube deformation beyond its initial expanded outside diameter. The resistance to both tube rupture and tube collapse is strengthened by the presence of the tubesheet in that region. The result of the hardroll of the tube into the tubesheet is an interference fit betwcen the tube and the tubesheet. Tube rupture can not occur because the contact between the tube and tubesheet does not permit sufficient movement of tube material. In a similar manner, the tubesheet does not permit sufficient movement of tube material to permit buckling collapse of the tube during postulated LOCA loadings.

The type of degradation for which this criteria has been developed (cracking with an axial or near axial orientation) has been found not to greatly reduce the axial strength of the tube. An evaluation including analysis and testing has been done to determine the strength reduction for axial loads with simulated axial and near axial cracks. This evaluation provides the basis for the acceptance criteria for tube degradation subject to either the F* or EF* criteria.

Test data has shown that the length of roll expansion defined as F* is sufficient to preclude tube pullout and tube primary to secondary leakage during all plant conditions. Similar data are developed to validate the EF* criteria as was used for the F* criteria. The length of the roll expansion required for application of EF* is sufficient to preclude significant leakage from tube degradation below the EARX. The existing TS leakage rate requirements and accident analysis assumptions remain unchanged in the unlikely event that significant leakage from this region

does occur. Any tube leakage occurring within the tubesheet crevice region is fully bounded by the existing SG tube rupture analysis included in the KNPP USAR. Leak test data indicates that approximately 20,000 EF* tubes would be required to contribute up to 1 gpm primary to secondary leakage during a postulated SLB. The total number of tubes that can remain in service will be limited such that the primary-to-secondary leakage during a postulated SLB will not exceed a small fraction of the 10 CFR part 100 limits. For KNPP this has been calculated to be 34.0 gpm for the faulted loop. As the maximum number of tubes at KNPP that the EF* could be applied to is less than 1,000 per SG, any primary-to-secondary leakage emanating from the EF* tubes will be sufficient small that their overall contribution can be neglected. Therefore, the proposed alternate acceptance criteria will not increase the consequences of an accident previously evaluated.

As previously discussed, tube rupture and pullout is not expected for tubes using either the F*, or EF* acceptance criteria. Based on the geometry of a Model 51 SG, tube rupture type release rates are not expected for a postulated failure of an EF* tube. Axially oriented degradation, similar to that occurring in the KNPP SGs, will not affect the axial load bearing capability of the tube. The F* and EF* distances, and rerolling processes, were qualified to bound the worst case occurrence, a complete circumferential crack. The resistance to pullout afforded by both the original factory roll expansion, and the reroll joint will both effectively contribute to the overall pullout resistance of the tube thus assuring structural integrity. Therefore, application of the revised acceptance criteria will not increase the probability of an accident previously evaluated.

2) The proposed license amendment request does not create the possibility of a new or different kind of accident from any accident previously evaluated.

Implementation of the proposed F* or EF* acceptance criteria does not introduce any significant changes to the plant design basis. Use of these criteria will not introduce a mechanism that will result in an accident initiated outside of the tubesheet crevice region. As previously discussed, the structural integrity of F* and EF* tubes will be maintained during all plant conditions. Any hypothetical accident as a result of tube degradation in the tubesheet crevice region of the tube will be bounded by the existing tube rupture analysis. Therefore, application of the revised acceptance criteria for indications within the tubesheet crevice region will not create the possibility of a new or different kind of accident.

Strain gauge testing of tubes fixed at the top of the tubesheet and subsequently rerolled according to the EF* criteria indicates that the maximum theoretical tensile loading which can be applied to a tube which is fixed at the top of the tubesheet during operation is effectively reduced to approximately zero stress condition. The mechanism of the roll expansion causes an upward thrust of the tube material which acts opposite in direction to the tensile load applied by the fixed condition. Therefore, application of the EF* process and criteria is not expected to act as a rapid stress corrosion crack initiator.

3) The proposed license amendment does not involve a significant reduction in the margin of safety.

The use of either F* or EF* acceptance criteria has been demonstrated to maintain the integrity of the tube bundle commensurate with the requirements of RG 1.121 under normal and postulated accident conditions. The safety factors used in verification of the strength of the degraded tube are consistent with the safety factors in the ASME Boiler and Pressure Vessel Code used for SG design. Practical application of the EF* criteria shows that the tube degradation morphology occurring in the tubesheet region of the KNPP SGs is predominately axially oriented. As the load bearing capability of a tube has been previously shown to not be significantly affected by axially oriented degradation (part of the basis of the L* criteria), the resistive load capabilities of both the original factory roll expansion and the EF* reroll region will both contribute to the pullout load capabilities of the tube. Furthermore, tube fixity at the tube support plates will act to increase the margins to pullout provided by the EF* and F* criteria. The F* distance has been shown to prevent primary-to-secondary leakage during all plant conditions. The EF* distance has been verified by testing to be greater than the length of roll expansion required to preclude significant leakage during normal and postulated accident eonditions. The leak testing acceptance criteria are based on the primary-to-secondary leakage limits in the TSs and the USAR accident analyses. The EF* distance is determined using the same methodology as for the F* criterion. Inherent to the establishment of the EF* distance of 1.44 inches value is the assumption that the tube is circumferentially separated at the 1.44 inch distance below the bottom of the EARX. The methodology for establishing the EF* and F* distance is to use end effect strength reduction factors for transition region and crack proximity areas. These strength reduction factors are built into the F* and EF* distance criteria for KNPP.

Implementation of the alternate acceptance criteria in the tubesheet crevice region will decrease the number of tubes which must be removed from service by plugging, or repaired by sleeving. As both plugs and sleeves reduce the reactor coolant flow margin, implementation of the F* and EF* criteria will help to maintain that flow margin. Based on the above discussion, the proposed TS change will not result in a significant reduction in the margin of safety.

ENVIRONMENTAL CONSIDERATIONS

This proposed amendment request involves a change to the inspection requirement with respect to the installation or use of a facility component located within the restricted area. WPSC has determined that the proposed amendment involves no significant hazards consideration and no significant change in the types of effluent that may be released offsite 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 recordkeeping, 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 the proposed amendment.