ATTACHMENT 1

Letter from C. R. Steinhardt (WPSC)

To

Document Control Desk (NRC)

Dated

June 1, 1998

Proposed Amendment 156

Introduction
Description of Proposed Changes
Safety Evaluation
Significant Hazards Determination
Environmental Considerations

INTRODUCTION

Wisconsin Public Service Corporation (WPSC) is submitting this Technical Specification (TS) amendment request to revise the minimum roll expansion distances for the F* and elevated F* (EF*) repair criteria. These changes are occurring because the original analyses for F* and EF* were performed using normal operational parameters of the Kewaunee Nuclear Power Plant (KNPP) during the 1995 to 1996 operating cycle, specifically, the operating primary to secondary differential pressure. Since the development of the original analyses, the primary to secondary differential pressure has changed due to steam generator (SG) tube plugging and sleeving. Therefore, WPSC contracted Westinghouse to reevaluate the F* and EF* analyses using the Kewaunee design primary to secondary differential pressure of 1600 psi. Additionally, a minor error was found by Westinghouse in the original calculations for F* and EF*. Westinghouse has corrected the error in the revised evaluation.

The revised repair criteria will continue to allow disposition and repair of tube degradation within the tubesheet. 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, the time the SG is open to the containment environment, and the occupational radiation exposure to plant workers. Application of the revised F* and EF* distances will provide a level of plant protection commensurate with the requirements of Regulatory Guide 1.121. There currently are no F* or EF* repaired tubes in service at KNPP. Therefore, no tubes are currently affected by these changes.

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.

The F* and EF* repair criteria are used to disposition or repair SG tubes with indications of degradation in either the original factory roll expansion within the tubesheet or the unexpanded portion of tube within the tubesheet. The criteria are based on determining the length of

undegraded 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. For degradation occurring above the midthickness of the tubesheet, the minimum engagement length is referred to as the EF* distance. The EF* criterion requires 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. The minimum engagement lengths for the KNPP were originally determined to be 1.12 inches for F* and 1.44 inches for EF* as documented by 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 (included in reference 1 submittal). These lengths did not include non-destructive examination (NDE) uncertainty.

The F* and EF* repair criteria were originally submitted to the NRC as proposed amendment (PA) 142 on July 3, 1996 (reference 1). Supplemental information was submitted to the NRC on July 23, August 28, and September 16, 1996, to support the amendment request. On October 2, 1996, the amendment was approved for use at KNPP by the NRC (reference 2).

During the Fall 1996 refueling outage, WPSC inspected 100 percent of the open, non-sleeved hot leg tubes throughout the entire crevice region with a motorized rotating pancake coil (MRPC) probe. Thirty-four of the 915 tubes inspected in SG A were found to have indications of degradation. Of the 34 tubes, 23 were repaired using the additional roll expansion as allowed by the EF* TS. Of the 1,000 tubes inspected in SG B, 18 tubes were found to have indications. Of the 18 tubes, 14 were repaired using the additional roll expansion. However, due to the extensive amount of SG repairs performed during the 1996 outage, all tubes repaired using the F* and EF* criteria were either removed from service by plugging or repaired by sleeving. This was done in order to eliminate one causal factor (one repair method) in the event primary to secondary leakage occurred during the subsequent operating cycle.

As stated in the previous paragraph, a significant amount of SG repair work occurred during the 1996 refueling outage. Due to these repairs (i.e., tube plugging and sleeving), secondary pressure was reduced following the 1996 outage. The reduction in secondary pressure resulted in an increase in KNPP's primary to secondary differential pressure. Since the original analyses for the F* and EF* repair criteria were performed assuming the normal operating primary to secondary pressure differential prior to the 1996 outage (1565 psi), the analyses needed to be revised if implementation of the F* and EF* was to occur in subsequent outages. Therefore, Westinghouse was contracted to reevaluate the F* and EF* analyses using KNPP's design primary to secondary differential pressure (1600 psi). The revised analyses resulted in a slight decrease in the minimum F* expansion length and a slight increase in the EF* minimum expansion length. The F* minimum length becomes 1.11 (from 1.12) inches and the EF* minimum length becomes 1.51 (from 1.44) inches.

Westinghouse also corrected a minor error in the original calculation for F* and EF*. The error related to the interference fit contact pressure due to bending. Westinghouse discovered the error during the evaluation to increase differential pressure to 1600 psi. The error caused the F* minimum engagement length to be slightly longer than was necessary. Westinghouse estimates the corrected original F* distance to be 1.10 inches. Therefore, the required F* distance would have been a few mils less than the 1.12 inches making that TS length conservative. The EF* length also contained the same error. Westinghouse estimates the corrected original EF* length to be 1.49 inches. This is approximately 0.05 inches longer than the original analysis. Westinghouse concluded that several conservative assumptions in the calculation provide margin which more than offsets this length difference.

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. Specifically, the proposed changes are as follows:

1. The TS 4.2.b definitions for "F* Distance" and "EF* Distance" will be changed to specify the revised value for length of non-degraded tube expansion necessary. Additionally, the definitions of "F* Tube" and "EF* Tube" will be revised to clarify that the 50 percent in the definition is meant to be for throughwall degradation, not the F* and EF* distances.

2. TS 4.2.b.2.d will be revised to clarify that "outage" means "in-service inspection."

3. TS 4.2.b.6.a will be revised to specify the revised value for the minimum distance from the bottom of the uppermost roll transition to the tip of the crack.

4. TS 4.2.b.6.b will be revised to specify the revised value for the minimum distance from the bottom of the uppermost roll transition to the tip of the crack.

The basis for TS Section 4.2 is also being modified to include the changes in length for the F* and EF* acceptance criteria. The reference to the WCAP report will be revised to reflect current revision and issue date. Administrative changes are also being made to the TS and basis section.

SAFETY EVALUATION

Prior to the F* and EF* repair criteria, tube repair criteria applied throughout the entire tube length and did not take 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 resistance to both tube rupture and tube collapse is significantly increased

by the presence of the tubesheet. Additionally, 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. Therefore, the F* and EF* repair criteria were developed to account for the reinforcing effects of the tubesheet. The criteria were developed using analytical models and test data samples prepared in a manner consistent with the original SG design. The original analyses are documented in WCAP-14677 and Westinghouse Report SG-96-06-017. These changes were originally proposed by WPSC in July 1996 (reference 1) and approved for use by the NRC in October 1996 (reference 2).

The original analysis for the F* and EF* repair criteria were developed using a normal operating primary to secondary pressure differential of 1565 psi. Due to SG tube plugging and repair, the normal operating primary to secondary pressure differential has increased. Therefore, the F* and EF* repair criteria were reevaluated using KNPP design primary to secondary differential pressure of 1600 psi. The reevaluation used the same methodology as the first analyses. The change in differential pressure resulted in slight changes in the minimum length of hardroll. The changes in F* and EF* hardroll lengths do not change the structural or leakage integrity of the original analysis. Provided below is a safety evaluation that describes how application of the slight changes in the F* and EF* hardroll lengths provides adequate structural integrity relative to the guidance of Regulatory Guide (RG) 1.121. The safety evaluation also describes how the leak restriction maintains off-site doses within a small fraction of 10 CFR part 100 guidelines and control room doses within GDC 19 criteria.

F* Criterion

The F* value calculated for the KNPP SGs is based on determining the minimum length of undegraded hardroll engagement required to resist the tube pullout forces during normal operation and faulted conditions, whichever provides the largest value. Therefore, the applied loads are balanced by the load carrying ability of the hardrolled tube for the above conditions. For F*, the normal operating conditions require larger engagement lengths than the faulted conditions. Therefore, the change in the assumption for the normal operating primary to secondary differential pressure affects the KNPP licensed F* engagement length. By increasing the primary to secondary pressure differential, the calculated minimum engagement distance for F* becomes 1.11 inches (excluding NDE uncertainty). The differential pressure change affects the analysis load, the end effect resistance, and the net axial resistance. The combination of these effects causes the calculated F* value to decrease slightly. The F* value of 1.11 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 new F* distance provides the same level of plant protection as the original analysis of F* since the appropriate safety factors of RG 1.121 were applied in both analyses.

For SGs with partial depth tube expansion, such as 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 and provide for sufficient leakage resistance. The evaluation described above to determine the minimum engagement length ensures that tube pullout during normal and faulted conditions will not occur. The reevaluation of the F* distance determined that the increase in primary to secondary differential pressure for normal operation does not change the negligible leakage condition of F*. The original analysis determined that for accident conditions, leakage was also negligible in comparison to the maximum allowable primary to secondary leakage following a main steam line break event. Therefore, the proposed change to the F* criterion will continue to provide leakage resistance during normal operation and at SLB conditions such that off-site doses will not exceed a small fraction of 10 CFR 100 guidelines and control room doses will remain within the GDC 19 criteria.

There are no changes in application of the F* criterion. The F* criterion remains applicable to indications in the existing factory hardroll, and an additional roll expansion (ARX) performed as a continuation of the existing hardroll joint. The F* criterion developed for KNPP supports the assumption that tube degradation of any kind and any extent, including a complete circnmferential separation of the tube at the F* elevation, will not adversely affect the tube structural or leakage integrity during all plant conditions.

EF* Criterion

The EF* criterion was developed to address degradation occurring above the midthickness of the tubesheet. The EF* repair criterion is 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* repair criteria is that the EF* takes into account the effect of tubesheet bowing above the neutral bending axis of the tubesheet. As with the F* criterion, the application of EF* does not change.

The EF* minimum engagement length, like the F* engagement length, is bounded by normal operating conditions rather than accident conditions. Therefore, changes in the assumed normal operating differential pressure effect the KNPP licensed EF* engagement length. The new EF* distance for the KNPP SGs has been determined to be 1.51 inches (excluding NDE uncertainty). The increase in the normal operating primary to secondary differential pressure caused an increase in the analysis load and decreases in the end effect resistance and the net axial resistance. The

combination of these effects resulted in a slight increase in the calculated EF* distance. This new distance was calculated using the same methodology as that used in the original analysis EF*. Therefore, the EF* distance provides the same level of protection as the original since the RG 1.121 safety factors have been consistently applied. Additionally, the calculation of the EF* length used the same methodology as the F* calculations. The difference in length between F* and EF* is due to the inclusion of the tubesheet bow effect which does not influence the tubesheet near the primary face.

The reevaluation of the EF* engagement length determined that the increase in the normal operating primary to secondary differential pressure does not change the negligible leakage condition of EF*. As with the new F* engagement length, the original analysis determined that for accident conditions, leakage was also negligible in comparison to the maximum allowable primary to secondary leakage following a main steam line break event. Therefore, the proposed change to the EF* criterion will continue to provide leakage resistance during normal operation and at SLB conditions such that off-site doses will not exceed a small fraction of 10 CFR 100 guidelines and control room doses will remain within the GDC 19 criteria.

Safety Evaluation Conclusion

Both the F* and the EF* repair criteria were reevaluated for an increased normal operating primary to secondary pressure differential. The revised analyses assume 1600 psi which is the KNPP design primary to secondary differential pressure. This change in assumed differential pressure only effected the analyses of the engagement lengths for F* and EF* at normal operating parameters. For both F* and EF*, the normal operating parameters produce the largest required engagement length and, therefore, bound the faulted condition engagement length. The new engagement lengths are 1.11 inches (excluding NDE uncertainty) for F* and 1.51 inches (excluding NDE uncertainty) for EF*. Both of these values were calculated using safety factors consistent with RG 1.121. Therefore, the new lengths provide structural integrity which meets the RG requirements. All of the conclusions, besides the minimum engagement length values, remain the same for the new analyses.

Leakage for both F* and EF* remains negligible at normal operating conditions. The expected leakage at faulted conditions also remains negligible in regards to the calculated maximum allowable primary to secondary leak rate following a SLB. Although there were no changes to the calculated engagement length for F* and EF* under faulted conditions (no new analysis was necessary for SLB), leakage for faulted conditions was reviewed since WPSC recently reevaluated the maximum allowable primary to secondary leak rate calculation. The maximum allowable leak rate was reduced from 34 gpm to 12.85 gpm (the new leak rate is currently under review by the NRC). The amount of leakage expected at faulted conditions from F* and EF* repaired tubes is a small percentage of the 12.85 gpm permissible during a SLB and is considered negligible. Therefore, it can be concluded that leakage will be restricted such that off-site doses will not

exceed a small fraction of 10 CFR part 100 and control room doses will not exceed GDC 19 criteria. Again, all of the conclusions for the revised analyses remain the same.

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 changes to the minimum engagement lengths for F* and EF* do not change any of the conclusions of the original F* and EF* analyses. The technical justification for the repair criteria has not changed due to changes in the engagement lengths. The calculated engagement lengths continue to preclude tube pullout and rupture during all postulated conditions. Based on the geometry of the Model 51 SG, tube rupture type release rates are not expected for a postulated failure at an F* or EF* repair location. Engagement lengths were calculated such that structural integrity of the repaired tube meets the RG 1.121 requirements. Therefore, application of the new F* and EF* distances will not increase the probability of an accident previously evaluated.

   The new calculated engagement lengths continue to preclude primary to secondary leakage during all conditions. Leakage for both F* and EF* remains negligible at normal operating conditions. The amount of leakage expected at faulted conditions from F* and EF* repaired tubes remains a small percentage of the maximum allowable leak rate during a SLB and is considered negligible. Therefore, it can be concluded that leakage will be restricted such that off-site doses will not exceed a small fraction of 10 CFR part 100 and control room doses will not exceed GDC 19 criteria. Therefore, the proposed change to the F* and EF* distances will not increase the consequences 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 changes in F* and EF* distances does not introduce any significant changes to the plant design basis. As with the original acceptance of the amendment for using the original F* and EF* criteria, use of the proposed F* and EF* engagement lengths 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, implementation of the proposed engagement lengths for F* and EF* will not create the possibility of a new or different kind of accident.

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

The calculation for the new F* and EF* minimum engagement lengths used the same methodology as the original F* and EF* analysis. The only change was the assumed normal operating primary to secondary differential pressure. The new assumed differential pressure is the design differential pressure for the KNPP SGs. The calculation for the engagement lengths continues to use the appropriate safety factors from RG 1.121. The revised F* and EF* engagement lengths continue to preclude tube pullout at all plant conditions and to maintain the structural integrity of the tube. Additionally, primary to secondary leakage during all plant conditions is precluded as described in the preceding sections. Since the structural and leakage integrity is not changed by the proposed changes in engagement length, the margin of safety is not significantly reduced.

Additionally, use of the F* and EF* repair criteria will decrease the number of tubes removed from service by plugging or repaired by sleeving. Since both plugging and sleeving reduce reactor coolant flow margin, implementation of the F* and EF* repair criteria helps to maintain that flow margin.

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 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 the proposed amendment.

ATTACHMENT 2

Letter from C. R. Steinhardt (WPSC)

To

Document Control Desk (NRC)

Dated

June 1, 1998

Proposed Amendment 156

Strikeout TS Pages:

TS 4.2-3
TS 4.2-4
TS 4.2-10
TS B4.2-7

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~~ 1.11 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% throughwall, 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~~1.51 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% throughwall, 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 TS 4.2.b.2.a and TS 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 TS 4.2.b.2.a through TS 4.2.b.2.c, all tubes which have had the F*, or EF*, criteria applied will be inspected each ~~outage~~in-service inspection in the uppermost tubesheet roll expanded region. These tubes may be excluded from TS 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. In addition to the sample required in TS 4.2.b.2.a through TS 4.2.b.2.c, all laser weld repaired sleeved tubes will be inspected at the first in-service inspection following the repair. Subsequent inspections will include a minimum sample size consistent with TS 4.2.b.2.a.

During the first in-service inspection and each subsequent in-service inspection, at least 20% of the laser weld repaired sleeved tubes will be inspected using an ultrasonic inspection technique. The laser weld repaired tubes inspected with the ultrasonic technique shall be selected on a random basis. Actions based on the results of the ultrasonic inspection shall be as described in Table TS 4.2-3.

f. 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.

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"~~1.11 inches (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 TS 4.2.b.6.a may be repaired using the EF* criteria. The EF* region is located a minimum of ~~4"~~ inches 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"~~1.51 inches (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.

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.[10] 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" inches 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 ~~1.121.11~~ inches (plus an allowance for NDE uncertainty) and ~~1.441.51~~ inches (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" inches, however, for field application, an eddy current uncertainty of 0.20" inches will be applied. Any and all indications of degradation existing below the F* or EF* distance is acceptable for continued service.

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.

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[10] WCAP 14677, Revision 1, F* and Elevated F* Tube Alternate Repair Criteria for Tubes With Degradation Within the Tubesheet Region of the Kewaunee Steam Generators, ~~June 1996~~May 1998 (Proprietary).

ATTACHMENT 3

Letter from C. R. Steinhardt (WPSC)

To

Document Control Desk (NRC)

Dated

June 1, 1998

Proposed Amendment 156

Affected TS Pages:

TS 4.2-3
TS 4.2-4
TS 4.2-10
TS B4.2-7

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 1.11 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% throughwall, 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 1.51 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% throughwall, 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 TS 4.2.b.2.a and TS 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 TS 4.2.b.2.a through TS 4.2.b.2.c, all tubes which have had the F*, or EF*, criteria applied will be inspected each in-service inspection in the uppermost tubesheet roll expanded region. These tubes may be excluded from TS 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. In addition to the sample required in TS 4.2.b.2.a through TS 4.2.b.2.c, all laser weld repaired sleeved tubes will be inspected at the first in-service inspection following the repair. Subsequent inspections will include a minimum sample size consistent with TS 4.2.b.2.a.

During the first in-service inspection and each subsequent in-service inspection, at least 20% of the laser weld repaired sleeved tubes will be inspected using an ultrasonic inspection technique. The laser weld repaired tubes inspected with the ultrasonic technique shall be selected on a random basis. Actions based on the results of the ultrasonic inspection shall be as described in Table TS 4.2-3.

f. 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.

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 1.11 inches (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 TS 4.2.b.6.a may be repaired using the EF* criteria. The EF* region is located a minimum of 4 inches 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 1.51 inches (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.

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.[10] 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 inches 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 1.11 inches (plus an allowance for NDE uncertainty) and 1.51 inches (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 inches, however, for field application, an eddy current uncertainty of 0.20 inches will be applied. Any and all indications of degradation existing below the F* or EF* distance is acceptable for continued service.

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.

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[10]WCAP 14677, Revision 1, F* and Elevated F* Tube Alternate Repair Criteria for Tubes With Degradation Within the Tubesheet Region of the Kewaunee Steam Generators, May 1998 (Proprietary).

ATTACHMENT 4

Letter from C. R. Steinhardt (WPSC)

To

Document Control Desk (NRC)

Dated

June 1, 1998

Proposed Amendment 156

Westinghouse Proprietary Authorization Letter and Affidavit
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