Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

AUG 0 9 2000

TVA-WBN-TS-99-013

10 CFR 50.90

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

Gentlemen:

In the Matter of) Docket No. 50-390
Tennessee Valley Authority)

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - REQUEST FOR ADDITIONAL INFORMATION REGARDING ALTERNATE STEAM GENERATOR TUBESHEET REGION PLUGGING CRITERION (F*) (TAC NO. MA8636)

The purpose of this letter is to provide TVA's response to NRC's request for additional information dated June 15, 2000, concerning the Technical Specification Change WBN-TS-99-013 for an alternate repair criteria for the steam generators. TVA and Westinghouse discussed the enclosed responses with the NRC Project Manager, R. Martin, and the technical reviewer, J. Tsao, in a teleconference on July 19, 2000.

Enclosure 1 provides TVA's response to the NRC's concerns. Enclosure 2 provides marked-up pages showing the clarification to the proposed technical specifications that were requested by the NRC staff. TVA has evaluated the changes in these proposed amended pages and finds that these changes do not effect the initial no significant hazards consideration determination. Enclosure 3 provides the revised technical specification pages which incorporate the clarifications.

D030

AUG 0 9 2000

There are no new commitments in this response. If you should have any questions concerning this matter, please telephone me at (423) 365-1824.

Sincerely,

P. L. Pace
Manager, Site Licensing
and Industry Affairs

Subscribed and sworn to before me
on this 9 day of August, 2000

Judy C. Lancaster
Notary Public

My Commission Expires 2-28-2001

Enclosures
cc (Enclosures):
NRC Resident Inspector
Watts Bar Nuclear Plant
1260 Nuclear Plant Road
Spring City, Tennessee 37381

Mr. Robert E. Martin, Senior Project Manager
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, Maryland 20852

U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, Georgia 30303

Mr. Lawrence E. Nanney, Director
Division of Radiological Health
Dept. of Environment & Conservation
Third Floor, L and C Annex
401 Church Street
Nashville, TN 37243-1532

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1
F-STAR ALTERNATE REPAIR CRITERIA FOR STEAM GENERATOR TUBES
REQUEST FOR ADDITIONAL INFORMATION

By letter dated April 10, 2000, TVA submitted for staff review an amendment to implement an alternate tube plugging criteria in the Watts Bar Nuclear Plant technical specifications (TS). The F-Star (F*) criteria would allow degraded tubes in the tubesheet to remain in service if the tube in the tubesheet has a specified defect-free length (F* distance). The technical basis for the F* criteria is presented in Westinghouse report, WCAP-13084 (proprietary). After a preliminary review, the staff requested the following additional information:

1. In WCAP-13084, Westinghouse discussed potential leakage of F* tubes without providing specific leak rates. Westinghouse/TVA should provide F* tube leak rate data or other evidence to demonstrate the leakage integrity of F* tubes.

Response:

On page 25 of the WCAP, the statement was made that *"No leakage from any of the hydraulic proof test specimens occurred for pressures up to and in excess of faulted operating conditions."* To clarify, no leakage from any of the hydraulic proof test specimens occurred until pressures reached 5,200 psi. This summary referred to Paragraph 2.4 and Table 5 in the document wherein prototypical, top-of-tubesheet-region, tube joint samples were subjected to increasing pressures until leakage, tube ejection or failure outside of the test section, i.e., in the free span above the tubesheet simulant, occurred. The applicability of the proof pressure test samples to the plant is explained in the WCAP, pages 22-25.

Table 5 shows that the lowest-pressure sample which leaked did so at a primary-to-secondary side pressure differential (ΔP) of 5,200 psi (5200 psig internal, i.e., primary side, pressure and 0 psig external, i.e., secondary side, pressure). This was approximately 3.7 times the steam generator (SG) primary-to-secondary side maximum normal operating/upset transient ΔP of 1400 psi per page 14 and Table 3 of the WCAP, and approximately 2.0 times the feedline break (FLB) ΔP. All of the other samples leaked, experienced tube ejection or tube burst in the free span (showing that the limiting effects were within the tubesheet simulant, i.e., F*, region) at higher ΔPs than the 5,200 psi pressure level. These eight data points show the validity of the projection of zero leakage for F* tubes. On page 25, it

is stated that "*In actuality, as the test results substantiate, for as little as 0.5 inch of hardroll engagement, the hardrolled joint would be expected to be leak tight, i.e., the plant would not be expected to experience leak sources emanating below F*.*" The nature of leakage is such that for zero leakage in the test, the length of the joint is meaningless with respect to leakage resistance. The length could be 0.5, 1.00 or 2.00 inches; the length for a leaking test section only affects the leakage rate. All of the samples support the expected zero leakage in the plant.

Therefore, the plant joints are neither expected to leak during the two most stringent of the four types of SG conditions, i.e., normal operation and during the limiting accident condition, FLB, nor during any other type of condition.

2. On page 26 of WCAP-13084, it is stated that the leakage limit in the Watts Bar technical specifications is 0.35 gpm. However, in this amendment, TVA proposed a leakage limit of 150 gallons per day per steam generator, which is equivalent to 0.104 gpm. Clarify the discrepancy between the 0.35 gpm in WCAP-13084 and the proposed TS requirements of 150 gpd.

Response:

In this request for a TS amendment (WBN-TS-99-013), TVA did not propose any changes to the primary-to-secondary leakage. However, if primary-to-secondary leakage is changed by other technical specification changes, this inconsistency will not affect any leakage calculations. The 0.35 gpm referred to in the WCAP is not used in any leakage calculations as we do not expect leakage from F* tubes. The primary to secondary leakage value is proposed to be decreased in the WBN technical specification amendment request (WBN-TS-014) for the alternate repair criteria for outside diameter stress corrosion cracking (ODSCC) which was also submitted to NRC on April 10, 2000.

3. Based on date of WCAP-13084 and recent experience with changes in design conditions in nuclear plants, confirm that the pressure and temperature loadings used in WCAP-13084 are

consistent with the current plant operation and design basis conditions at the Watts Bar Nuclear Plant.

Response:

The design normal operating ΔP for F* was 1400 psi and is still valid. The RCS design pressure used for F* was 2650 psia and is still valid. This value was used to analyze the dilation of the tubesheet holes during bowing of the tubesheet. The design temperature used for F* was 600°F. The WBN RCS design temperature is 650°F and secondary design temperature is 600°F. In WCAP-13084, page 13, the thermal expansion mismatch between the Inconel 600 tubing and the carbon steel tubesheet is analyzed for its affects between ambient and 600°F. Because the Inconel has a greater coefficient of thermal expansion, 600°F was used (using 650°F would have increased the radial stress in the tubing due to thermal expansion increasing the force required for tube-pull-out and, therefore, 600°F is conservative). Obviously, physical dimensions used in the F* analysis have not changed and therefore, are still conservative.

The design values for the F* analysis have been compared to the WBN present design values and have been found to be conservative.

This question may also relate to the minor changes to fluid conditions in the SG due to small power uprates. In these uprates or for any other change of normal operation SG fluid conditions, the conditions formally known as the "design conditions" are not changed. For instance, an important design condition such as the primary side design pressure is 2500 psia and this is not changed in power uprates. What are changed, for instance, are the SG steam conditions, i.e., pressure and temperature, at normal operations. The fluid conditions at accident conditions, notably FLB which is important for F*, are not changed in a small power uprate.

The small power uprate that was performed for WBN Unit 1 by Westinghouse and submitted by TVA on June 7, 2000, was specifically analyzed for F*. It was found that a 1.4% power uprate did not change the F* length per WCAP-13084 because of the two candidate F* lengths, i.e., at normal operation and FLB, the greater length was continued to be set by the FLB condition and the FLB condition being a

transient, was unaffected by uprate. The F* length, without uncertainties in NDE, remains at 1.06 inches.

The governing condition for F*, for normal operation/upset (aka, normal transient) condition per page 14 of the WCAP, is a conservatively selected $\Delta P_{PRIMARY-TO-SECONDARY}$ of 1400 psi and it occurs during the loss of load transient. In the uprate, and considering other changes in normal operation conditions over the years, the current calculation is: $\Delta P_{MAX-\ PRIMARY-TO-SECONDARY}$ = [P_{PRI} = 2560 psi (limited by the relief valves)] - [P_{SEC} = $\approx$1225] = $\approx$1335 psi. The maximum $\Delta P_{PRIMARY-TO-SECONDARY}$ of 1400 psi used in the WCAP continues to be conservative to this value.

For thermal expansion tightening, per page 13 of the WCAP, the 600°F tube temperature continues to be conservative at the uprate conditions.

The tubesheet hole diameters remain unchanged in the uprate; the dilation due to bending of the tubesheet, at the limiting condition, the FLB condition, is unchanged in the uprate.

4. The proposed F* distance is 1.06 inches excluding NDE (nondestructive examination) uncertainties. TVA stated that the NDE uncertainties are 0.28 inch, 0.30 inch, and 0.34 inch for the 115 mil pancake coil, 80 mil pancake coil, and plus point coil, respectively. Describe how these NDE uncertainties were obtained and the process that will be used in the future for determining NDE uncertainties.

Response

The determination of F-Star crack tip dimension uncertainties were developed based on a test program involving multiple (5) analysts. A total of 17 test samples were prepared by producing flaws in tubes that were each roll expanded into a tubesheet collar simulant. In some cases the test samples were eddy current tested in a bench top configuration while other samples were configured into a steam generator mockup. Once the data was collected, the analysts received specific instruction as to the data evaluation methodology and technique. The data evaluations were done without prior knowledge of the flaw locations relative to the bottom of the roll transition (i.e., "blind"

NDE test). The analysis results were evaluated at one-sided, 95% probability, 95% confidence levels, using standard formulas (mean + $k\sigma$) for evaluation of samples from normally distributed populations. The procedure involves determination of the distance from the bottom of the roll transition (BRT) to the top of tubesheet using the bobbin coil analysis from the production bobbin data and the distance from the crack tip to the top of the tubesheet (CRT), using the RPC analysis. The total uncertainty represents the combined BRT location relative the top of tubesheet minus CRT dimension relative to top of tubesheet, thus defining the length of sound roll engagement, evaluated at one-sided, 95/95 levels. The described technique represents the most conservative evaluation of combined inspection methods. For example, use of a dual bobbin/RPC "combo" probe is expected to produce total uncertainties of 25 to 50% less than the values stated for the 3 coils above due to the slow speed of the combo probe and ability to more accurately calibrate the probe speed.

It should be noted that the final uncertainty value is dominated by the standard deviation and chosen probability and confidence factors. The mean errors for all analysts were essentially zero. For the 5 analysts in the test, the mean measurement errors for each analyst using the +Pt coil were 0.01 inch, -0.05 inch, 0.02 inch, 0.00 inch, and 0.00 inch, with the error defined as measured - truth = error.

WBN is planning to utilize the +Point probe for the Unit 1, Cycle 3 inspection.

Future NDE determination are expected to use a similar methodology.

5. On page 23 of WCAP-13084, it is stated that during the pressure test, two test tubes with shorter F* distance than the proposed F* distance were expelled from the collar. The two test tubes did not slowly release from the collar, i.e., overcoming friction and/or galling, but were suddenly expelled. The expulsion was attributed to the loss of pressure tightening of the rolled joint resulting from the presence of water between the test tube and the collar. In the field, if there is a through-wall indication below the F* distance in a F* tube, water may leak between the tube and tubesheet. Under such a scenario, joint strength may be adversely affected. Discuss how the methodology for

establishing the F* distance accounted for this source of loss of joint strength.

Response:

These tubes ejected only at grossly high pressures, compared to the highest possible fluid pressure differentials (ΔPs) in the SG. The lowest pressure at which expulsion occurred in the test was 14,700 psi. This was approximately 10.5 times the maximum normal operation ΔP in the plant. The joint experienced no measurable leakage at any lower differential pressure. The other expelled-tube sample experienced expulsion at an even higher ΔP, i.e., 19,300 psi; this was an even more conservative result than the first example. These two tests were performed with the intent of identifying the limiting pressure retaining capability of the joint. It must be anticipated that the pressure cannot be increased without bound. The tube specimens were reinforced on the outside to prevent their bursting during the test. Both of the test pressures are greater than the burst pressure of a similar non-degraded tube.

Fluid will not enter a metal-to-metal interface, the two parts of which are pressed together with a contact pressure higher than the fluid pressure. Table 3 in the WCAP shows that the joint metal-to-metal pressure at Normal operation is 4,335 psi and 3,807 psi at FLB. Due to the ΔP of the primary side water in the plant being significantly less than these values at the respective conditions, it is not credible to expect water intrusion and the postulated resulting loss of F* length joint strength.

Recognize that there are situations where some small amount of leakage would be expected to occur. There may be significant asperities on the tubesheet side of the joint that might not be entirely filled by tube material during the rolling process. In this case there could be a torturous leak path. However, the semi-filled asperities would then be expected to increase the strength of the joint because shearing of actual tube material would have to occur for the tube to be expelled from the tubesheet. In addition, it would be unlikely that the total area involved would be significant enough to materially reduce the net interface pressure.

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1
F-STAR ALTERNATE REPAIR CRITERIA FOR STEAM GENERATOR TUBES
REQUEST FOR ADDITIONAL INFORMATION

6. Recently, Westinghouse found an error in elevated F* distance calculation. The error was attributed to an error in the tubesheet bowing loads. By letter dated April 19, 2000, the staff approved an amendment to change elevated F* distance in the Prairie Island technical specifications. Discuss how it was ensured that this error does not apply to the F* distance calculation in WCAP-13084 for the Watts Bar plant.

Response:

All of the F* evaluations were surveyed relative to the Prairie Island issue. None of the earlier F* evaluations, such as Watts Bar, were affected. The total number of affected plants was two, Prairie Island being one of them.

7. Once an F* tube is identified, the proposed TS requires inspection of all F* tubes by rotating pancake coil or its equivalent in every outage. However, it is not clear to the staff how F* tubes are identified initially or how new F* tubes would be identified in subsequent outages. Discuss the inspection sample, sample expansion criteria, the probe that will be used in the identification process, and the requirements or commitments that are applicable to this inspection.

Response:

The F* criteria has no required inspection except that when the F* criteria is utilized to leave cracks in service, these tubes must be inspected in future outages. Watts Bar's inspection plan includes a 100% inspection 2 inches above and 2 inches below the top of the tubesheet using a plus point coil. Cracks identified using the plus point coil will be further evaluated utilizing the F* criteria. A 100% full length bobbin coil inspection will also be performed. Expansion plans will be in accordance with the EPRI Guidelines.

8. The proposed TS 5.7.2.12.d (proposed page 5.0-16) stated that F* tubes may be excluded from inspections samples. However, there is no clear TS wording to exclude F* tubes from C-1, C-2, and C-3 categories in the TS. Confirm that

F* tubes will be excluded from the inspection result categories.

Response:

These tubes will not be excluded from the C-1, C-2, C-3 categories. Tubes with indications that require plugging by the F* criteria will be considered defective and will be included in calculations for C-1, C-2, C-3 categories. Tubes with indications that remain in service via F* criteria will be considered structurally sound tubes and would not be considered defective or degraded, therefore, would not be in the C-1, C-2, C-3 category calculations.

9. Proposed TS 5.7.2.12.f.f (Insert A) states that a minimum of 1.5 inches of the tube into the tubesheet from the top of the tubesheet shall be inspected.

(1) This inspection approach is inconsistent with the F* distance measurement. According to the proposed TS, the F* distance is measured from the bottom of the roll transition or the top of the tubesheet, whichever is lower in elevation. Clarify the discrepancy.

Response:

See revised technical specification markup to page 5.0-18 which added "or bottom of the roll transition, which ever is lower."

(2) The staff believes that an inspection distance of 1.5 inch may be insufficient. TVA indicated that the F* distance plus NDE uncertainty would be as much as 1.40 inches. There is only 0.1 inch difference between the F* distance and the 1.5 inch inspection length. A flaw that is outside of but close to the F* distance may grow into the F* distance zone during the cycle. Therefore, the inspection length should consider the growth potential of a flaw. Clarify if the 1.5 inch inspection length considered the growth of the flaw.

Response:

The F* distance calculation assumes a complete circumferential separation of the tube below the F* distance. The inspection distance of 1.5 inches

exceeds the sum of the F* distance of 1.06 inches plus the upper bound measurement uncertainty allowance of 0.34 inch by 0.1 inch. Circumferential cracks within the tubesheet expanded region have historically been observed at a single elevation, and have not been known to grow in oblique directions resulting in a helical pattern up the tube.

The calculation of the F* distance includes allowances for reduced radial contact loads due to crack tip effects for 100% throughwall (TW) cracks located at the limit of the F* distance. Given the conservatisms included in the F* distance calculation and that any postulated growth into the F* region would likely be well less than 100% TW between inspections, the 1.5 inches inspection distance is adequate. Furthermore, axial crack development within the expanded tubesheet region has been limited to the roll overlap areas. This overlap length is approximately 0.25 inch and is mechanically defined by the hardroll tooling. These overlap areas occur at 1-inch intervals below the BRT. Finally, axial cracking within the F* region, if it did occur, would not diminish the axial load carrying capability of the tube material. In conclusion, it is judged that the addition of 0.1 inch to the upper bound measurement uncertainty is sufficient for application at WBN.

10. TS 5.7.2.12.b.d specifies that "...F* distance is 1.06 inches (plus an allowance for NDE uncertainty) ..." The NDE uncertainty was discussed in the April 10, 2000, letter but not specified in the TS nor in the Westinghouse topical report, WCAP 13084. The NDE uncertainty needs to be included in the TS because F* distance plus the NDE uncertainty value is a TS safety limit.

Response:

See attached revised technical specification markup.

ENCLOSURE 2

WATTS BAR NUCLEAR PLANT (WBN)
UNIT 1

PROPOSED TECHNICAL SPECIFICATION (TS) CHANGE WBN-TS-99-014
REVISED MARKED PAGES

I. AFFECTED PAGE LIST

5.0-16
5.0-19
Insert a for page 5.0-18

II. MARKED PAGES

See Attached

5.7 Procedures, Programs, and Manuals

5.7.2.12 Steam Generator (SG) Tube Surveillance Program (continued)

c) A tube inspection (pursuant to Specification 5.7.2.12.f) shall be performed on each selected tube. If any selected tube does not permit the passage of the eddy current probe for a tube inspection, this shall be recorded and an adjacent tube shall be selected and subjected to a tube inspection and

ADD

d) In addition to the samples required in 5.7.2.12.b.2.a) through c), all tubes which have had the F* criterion applied will be inspected in the tubesheet region. These F* tubes may be excluded from 5.7.2.12.b.2.a, provided the only previous wall penetration of greater than 20% was located below the F* distance of **1.40 inches (which includes NDE uncertainty)** extending from either the bottom of the steam generator tube roll transition or the top of the tubesheet, whichever is lower in elevation.

c. Examination Results - The results of each sample inspection shall be classified into one of the following three categories:

C-1 Less than 5% of the total tubes inspected are degraded tubes and none of the inspected tubes are defective.

C-2 One or more tubes, but not more than 1% of the total tubes inspected are defective, or between 5% and 10% of the total tubes inspected are degraded tubes.

C-3 More than 10% of the total tubes inspected are degraded tubes or more than 1% of the inspected tubes are defective.

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

d. Supplemental Sampling Requirements - The tubes selected as the second and third samples (if required by Table 5.7.2.12-1) may be subjected to a partial tube inspection provided:

1. The tubes selected for these samples include the tubes from those areas of the tube sheet array where tubes with imperfections were previously found, and

2. The inspections include those portions of the tubes where imperfections were previously found.

(continued)

5.7 Procedures, Programs, and Manuals

5.7.2.12 Steam Generator (SG) Tube Surveillance Program (continued)

initial MODE 1 operation using the equipment and techniques expected to be used during subsequent inservice inspections.

h) Tube Inspection - An inspection of the SG tube from the point of entry (hot leg side) completely around the U-bend to the top support of the cold leg; and

i) Unserviceable - The condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of an Operational Basis Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break accident as specified in Specification 5.7.2.12.f.

ADD

j) F* Distance is the distance into the tubesheet from the bottom of the steam generator tube roll transition or the top of the tubesheet, whichever is lower in elevation (further into the tubesheet), that has been conservatively chosen to be **1.40 inches (which includes NDE uncertainty)**.

k) F* Tube is the tube with degradation equal to or greater than 40%, below the F* distance and not degraded (i.e., no indications of degradation) within the F* distance.

2. The SG shall be determined OPERABLE after completing the corresponding actions (plug all tubes exceeding the plugging limit and all tubes containing through-wall cracks) required by Table 5.7.2.12-1.

h. Reports - The content and frequency of written reports shall be in accordance with Specification 5.9.9.

(continued)

INSERT A

PAGE 5.0-18

f) Plugging Limit means the imperfection depth at or beyond which the tube shall be removed from service and is equal to 40% of the nominal tube wall thickness. This definition does not apply to the portion of the tube in the tubesheet below the F* distance provided the tube is not degraded within the F* distance for F* tubes.

- For tubes to which the F* criteria is applied, a minimum of 1.5 inches of the tube into the tubesheet from the top of the tubesheet **or from the bottom of the roll transition, whichever is lower in elevation,** shall be inspected using rotating pancake coil eddy current technique or an inspection method shown to give equivalent or better information on the orientation and length of cracking. A minimum of **1.40 inches (which includes NDE uncertainty)** of continuous, sound expanded tube must be established, extending from either the bottom of the roll transition or the top of the tubesheet, whichever is lower in elevation, to the uppermost extent of the indication.

ENCLOSURE 3

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT (WBN)
UNIT 1

PROPOSED TECHNICAL SPECIFICATION (TS) CHANGE WBN-TS-99-013
REVISED PAGES

I. AFFECTED PAGE LIST

5.0-16
5.0-18
5.0-19

II. REVISED PAGES

See attached.

5.7 Procedures, Programs, and Manuals

5.7.2.12 Steam Generator (SG) Tube Surveillance Program (continued)

c) A tube inspection (pursuant to Specification 5.7.2.12.f) shall be performed on each selected tube. If any selected tube does not permit the passage of the eddy current probe for a tube inspection, this shall be recorded and an adjacent tube shall be selected and subjected to a tube inspection and

d) In addition to the samples required in 5.7.2.12.b.2.a) through c), all tubes which have had the F* criterion applied will be inspected in the tubesheet region. These F* tubes may be excluded from 5.7.2.12.b.2.a, provided the only previous wall penetration of greater than 20% was located below the F* distance of 1.40 inches (which includes NDE uncertainty) extending from either the bottom of the steam generator tube roll transition or the top of the tubesheet, whichever is lower in elevation.

c. Examination Results - The results of each sample inspection shall be classified into one of the following three categories:

C-1 Less than 5% of the total tubes inspected are degraded tubes and none of the inspected tubes are defective.

C-2 One or more tubes, but not more than 1% of the total tubes inspected are defective, or between 5% and 10% of the total tubes inspected are degraded tubes.

C-3 More than 10% of the total tubes inspected are degraded tubes or more than 1% of the inspected tubes are defective.

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

d. Supplemental Sampling Requirements - The tubes selected as the second and third samples (if required by Table 5.7.2.12-1) may be subjected to a partial tube inspection provided:

1. The tubes selected for these samples include the tubes from those areas of the tube sheet array where tubes with imperfections were previously found, and

2. The inspections include those portions of the tubes where imperfections were previously found.

(continued)

5.7 Procedures, Programs, and Manuals

5.7.2.12 Steam Generator (SG) Tube Surveillance Program (continued)

b) A seismic occurrence greater than the Operating Basis Earthquake, or

c) A loss-of-coolant accident requiring actuation of the Engineered Safety Features, or

d) A main steam line or feedwater line break.

f. Acceptance Criteria

1. Terms as used in this specification will be defined as follows:

a) Degradation - A service-induced cracking, wastage, wear, or general corrosion occurring on either inside or outside of a tube;

b) Degraded Tube - A tube containing imperfections greater than or equal to 20% of the nominal wall thickness caused by degradation;

c) % Degradation - The percentage of the tube wall thickness affected or removed by degradation;

d) Defect - An imperfection of such severity that it exceeds the plugging limit. A tube containing a defect is defective;

e) Imperfection - An exception to the dimensions, finish, or contour of a tube from that required by fabrication drawings or specifications. Eddy-current testing indications below 20% of the nominal tube wall thickness, if detectable, may be considered as imperfections;

f) Plugging Limit means the imperfection depth at or beyond which the tube shall be removed from service and is equal to 40% of the nominal tube wall thickness. This definition does not apply to the portion of the tube in the tubesheet below the F* distance provided the tube is not degraded within the F* distance for F* tubes.

For tubes to which the F* criteria is applied, a minimum of 1.5 inches of the tube into the tubesheet from the top of the tubesheet or from the bottom of the roll transition, whichever is lower in elevation, shall be inspected using rotating pancake coil eddy current technique or an inspection method shown to give equivalent or better information on the orientation and length of cracking. A minimum of 1.40 inches (which includes NDE uncertainty) of continuous, sound

(continued)

5.7 Procedures, Programs, and Manuals

5.7.2.12 Steam Generator (SG) Tube Surveillance Program (continued)

expanded tube must be established, extending from either the bottom of the roll transition or the top of the tubesheet, whichever is lower in elevation, to the uppermost extent of the indication.

g) Preservice Inspection - An inspection of the full length of each tube in each SG performed by eddy current techniques prior to service to establish a baseline condition of the tubing. This inspection shall be performed prior to initial MODE 1 operation using the equipment and techniques expected to be used during subsequent inservice inspections.

h) Tube Inspection - An inspection of the SG tube from the point of entry (hot leg side) completely around the U-bend to the top support of the cold leg; and

i) Unserviceable - The condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of an Operational Basis Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break accident as specified in Specification 5.7.2.12.f.

j) F* Distance is the distance into the tubesheet from the bottom of the steam generator tube roll transition or the top of the tubesheet, whichever is lower in elevation (further into the tubesheet), that has been conservatively chosen to be 1.40 inches (which includes NDE uncertainty).

k) F* Tube is the tube with degradation equal to or greater than 40%, below the F* distance and not degraded (i.e., no indications of degradation) within the F* distance.

2. The SG shall be determined OPERABLE after completing the corresponding actions (plug all tubes exceeding the plugging limit and all tubes containing through-wall cracks) required by Table 5.7.2.12-1.

h. Reports - The content and frequency of written reports shall be in accordance with Specification 5.9.9.

(continued)
Amendment