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

October 19, 2009

Mr. Preston D. Swafford
Chief Nuclear Officer and
Executive Vice President
Tennessee Valley Authority
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNIT 2 – ISSUANCE OF AMENDMENT TO ALLOW USE OF THE W* ALTERNATE REPAIR CRITERIA FOR STEAM GENERATOR TUBES (TS-09-02) (TAC NO. ME1343)

Dear Mr. Swafford:

The Commission has issued the enclosed Amendment No. 318 to Facility Operating License No. DPR-79 for the Sequoyah Nuclear Plant (SQN), Unit 2. This amendment is in response to your application dated May 21, 2009, as supplemented by letters dated August 14 and September 29, 2009.

The amendment revises Technical Specification (TS) Section 6.8.4.k, "Steam Generator (SG) Program," for SQN, Unit 2 to allow the implementation of SG tubing alternate repair criteria for axial indications in the Westinghouse Electric Company explosive tube expansion region below the top of the tubesheet and specify the W* distance for the SG cold-legs.

A copy of the safety evaluation is also enclosed. A notice of issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

Siva P. Lingam

Siva P. Lingam, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-328

Enclosures: 1. Amendment No. 318 to License No. DPR-79
2. Safety Evaluation

cc w/enclosures: Distribution via Listserv

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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-328

SEQUOYAH NUCLEAR PLANT, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 318
License No. DPR-79

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated May 21, 2009, as supplemented by letters dated August 14 and September 29, 2009, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in Title 10 of the *Code of Federal Regulations* (10 CFR) Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. DPR-79 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 318 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance, to be implemented no later than 60 days after issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Thomas H. Boyce, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Facility Operating License
and Technical Specifications

Date of Issuance: October 19, 2009

ATTACHMENT TO LICENSE AMENDMENT NO. 318

FACILITY OPERATING LICENSE NO. DPR-79

DOCKET NO. 50-328

Replace Page 3 of Operating License DPR-79 with the attached page.

Replace the following pages of the Appendix A Technical Specifications with the attached pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
6-10c	6-10c
6-10d	6-10d

(4) Pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess, and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components; and

(5) Pursuant to the Act and 10 CFR Parts 30, 40 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the Sequoyah and Watts Bar Unit 1 Nuclear Plants.

C. This license shall be deemed to contain and is subject to the conditions specified in the Comrnission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

The Tennessee Valley Authority is authorized to operate the facility at reactor core power levels not in excess of 3455 megawatts thermal.

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 318 are hereby incorporated into this license. The licensee shall operate the facility in accordance with the Technical Specifications.

(3) Initial Test Program

The Tennessee Valley Authority shall conduct the post-fuel-loading initial test program (set forth in Section 14 of Tennessee Valley Authority's Final Safety Analysis Report, as amended), without making any major modifications of this program unless modifications have been identified and have received prior NRC approval. Major modifications are defined as:

a. Elimination of any test identified in Section 14 of TVA's Final Safety Analysis Report as amended as being essential;

b. Modification of test objectives, methods or acceptance criteria for any test identified in Section 14 of TVA's Final Safety Analysis Report as amended as being essential;

c. Performance of any test at power level different from there described; and

V_{LRL}	=	lower voltage repair limit
V_{MURL}	=	mid-cycle upper voltage repair limit based on time into cycle
V_{MLRL}	=	mid-cycle lower voltage repair limit based on V_{MURL} and time into cycle
Δt	=	length of time since last scheduled inspection during which V_{URL} and V_{LRL} were implemented
CL	=	cycle length (the time between two scheduled SG inspections)
V_{SL}	=	structural limit voltage
Gr	=	average growth rate per cycle length
NDE	=	95 percent cumulative probability allowance for nondestructive examination uncertainty (i.e., a value of 20 percent has been approved by NRC)

Implementation of these mid-cycle repair limits should follow the same approach as in TS items 6.8.4.k.c.1.a), .b), .c) and .d).

2. W* Methodology

The following terms/definitions apply to the W*.

a) Bottom of WEXTEX Transition (BWT) is the highest point of contact between the tube and tubesheet at, or below the top of tubesheet (TTS), as determined by eddy current testing.

b) W* Distance for the hot-leg tubesheet is the larger of the following two distances as measured from the TTS: (a) 8 inches below the TTS or (b) 7 inches below the bottom of the WEXTEX transition plus the uncertainty associated with determining the distance below the bottom of the WEXTEX transition as defined by WCAP-14797, Revision 2.

c) W* distance for the cold-leg tubesheet is 10.5 inches below TTS.

Service induced flaws identified in the W* distance shall be plugged on detection. Flaws located below the W* distance may remain in service regardless of size.

d. Provisions for SG Tube Inspections.

Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld

at the tube outlet, and that may satisfy the applicable tube repair criteria. The tube-to-tubesheet weld is not part of the tube. In addition to meeting the requirements of d.1, d.2, d.3, d.4, and d.5, below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. An assessment of degradation shall be performed to determine the type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

1. Inspect 100% of the tubes in each SG during the first refueling outage following SG replacement.

2. Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SGs shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.

3. If crack indications are found in any SG tube, then the next inspection for each SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever is less). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

4. GL 95-05 Voltage-Based ARC for TSP

   Indications left in service as a result of application of the TSP voltage-based repair criteria shall be inspected by bobbin coil probe every 24 effective full power months or every refueling outage, whichever is less.

   Implementation of the SG tube/TSP repair criteria requires a 100 percent bobbin coil inspection for hot-leg and cold-leg TSP intersections down to the lowest cold-leg TSP with known ODSCC indications. The determination of the lowest cold-leg TSP intersections having ODSCC indications shall be based on the performance of at least a 20 percent random sampling of tubes inspected over their full length.

5. W* Inspection

   When the W* methodology has been implemented, inspect 100 percent of the inservice tubes in the hot-leg tubesheet and 20 percent of the inservice tubes in the cold-leg tubesheet regions with the objective of detecting flaws that may satisfy the applicable tube repair criteria of TS 6.8.4.k.c.2.

e. Provisions for Monitoring Operational Primary-to-Secondary Leakage.

l. Component Cyclic and Transient Limit

This program provides controls to track the FSAR, Section 5.2.1, cyclic and transient occurrences to ensure that components are maintained within the design limits.

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 318 TO FACILITY OPERATING LICENSE NO. DPR-79

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNIT 2

DOCKET NO. 50-328

1.0 INTRODUCTION

By application dated May 21, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML091530346), as supplemented by letters dated August 14, 2009 (ADAMS Accession No. ML092300090), and September 29, 2009 (ADAMS Accession No. ML092750087), Tennessee Valley Authority (the licensee) submitted a license amendment request to revise the steam generator (SG) tube inspection portion of the Sequoyah Nuclear Plant (SQN), Unit 2 Technical Specifications (TSs). The supplemental letters dated August 14 and September 29, 2009, provided additional information that clarified the application, and did not change the Nuclear Regulatory Commission (NRC or the Commission) staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on July 14, 2009 (74 FR 34048).

The proposed amendment would revise the SQN, Unit 2 TSs to allow use of the SG tube W* (or "W-star") alternate repair criteria (ARC) for the portion of the tube within the cold-leg side of the SG tubesheet. The tubes in the SQN, Unit 2 SGs were explosively expanded into tubesheet with the Westinghouse Electric Company explosive tube expansion (WEXTEX) process. Currently, SQN, Unit 2 has a license amendment that allows use of the W* ARC for the portion of the tube within the hot-leg side of the SG tubesheet. Specifically, the proposed license amendment would revise TS 6.8.4.k, "Steam Generator (SG) Program." The proposed amendment would remain in effect until SG replacement, which is scheduled for October 2012.

The proposed changes include:

1. Clarifying TS 6.8.4.k.c.2.b by specifying that the W* distance listed in this section applies to the hot-leg side of the SG tubesheet.

2. Adding TS 6.8.4.k.c.2.c to define the W* distance for the cold-leg as 10.5 inches below the top of the tubesheet (TTS).

3. Revising TS 6.8.4.k.d.5 to require a 20 percent sample inspection of the inservice cold-leg tubes within the specified cold-leg W* distance.

In the September 29, 2009, letter, the licensee also made regulatory commitments to perform the following:

1. Revise the SG Program to confirm that the bottom of the WEXTEX transition (BWT) for all cold-leg tubes is below the TTS, and that the BWT is no more than 2.88 inches below the TTS. If the BWT is greater than 2.88 inches below the TTS, then the examination will be extended into the tubesheet to ensure at least 7.5 inches, plus measurement uncertainty, of non-flawed tube is inspected.

2. Revise the SG Program to reflect the following leakage methodology for assessing accident induced leakage: (1) If cold-leg indications are not detected during the 20 percent sample inspection, then the licensee will assume the faulted SG contains four top of tubesheet indications (i.e., 0.1 to 1-inch below the expansion transition) in the non-examined tubes that leak at an assumed leakage rate of 0.05 gallons per minute (gpm) per tube, plus each of the inservice Row 1 tubes that have had plugs removed will be assumed to leak at 9×10^{-5} gpm. (2) If cold-leg indications are detected, then the hot-leg W* methodology will be applied to the cold-leg, except 10 percent of the total cumulative quantity of indications from 0 to 10.5 inches below the cold-leg TTS will be assumed to exist from 10.5 to 12 inches below the cold-leg TTS. This calculated quantity will be multiplied by 4.5×10^{-3} gpm to arrive at the leakage estimate from this region, and this value will be added to the leakage resulting from indications below 12 inches from the TTS.

3. Revise the SG Program to require 100 percent of the tubes to be examined from 2 inches above to 10.5 inches below the TTS (+2/-10.5) if a crack-like indication is discovered in the initial 20 percent sample of this area of the SG. If the expanded sample identifies a crack-like indication in the +2/-10.5-inches region, then 100 percent of the cold-leg tubesheets in each SG will be inspected in the +2/-10.5-inches region.

4. Identify in the Steam Generator Tube Inspection Report any flaws that are indentified in the tubesheet region during the inspection of the cold-legs. The Steam Generator Tube Inspection Report will also identify tubes where slippage has occurred and will identify any tube where the BWT is greater than 2.88 inches below the TTS.

2.0 REGULATORY EVALUATION

All pressurized water reactor licensees are required to perform inservice inspection of SG tubes every 18 to 72 effective full-power months. These inspections detect, in part, degradation in the tubes as a result of the SG operating environment. These ISIs may also provide a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken. Tubes with degradation that exceeds the tube repair limits specified in a plant's TSs are removed from service by plugging or are repaired by sleeving, if a sleeving repair procedure has been approved by the NRC for use at the plant. The plant TSs provide the acceptance criteria related to SG tube inspections. The requirements for the inspection of SG tubes are intended to ensure that this portion of the reactor coolant system maintains its structural and leakage integrity. Structural integrity refers to maintaining adequate margins against gross failure, rupture, and collapse of the SG tubes. Leakage integrity refers to limiting primary-to-secondary leakage during normal operation, plant transients, and postulated accidents to ensure that the radiological dose consequences are within acceptable limits.

In reviewing requests of this nature, the NRC staff verifies that the structural and leakage integrity of the tubes will continue to be maintained consistent with the plant design and licensing basis. This includes verifying that the applicable General Design Criteria (GDC) (e.g., GDC 14 and 32) of Appendix A to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, are satisfied and that the structural margins inherent in Regulatory Guide (RG) 1.121, "Bases for Plugging Degraded PWR [pressurized-water reactors] SG Tubes," dated August 1976, are maintained. This also includes verifying that a conservative methodology exists for determining the amount of primary-to-secondary leakage during design-basis accidents. The amount of leakage is limited to ensure that offsite and control room dose criteria are met. The radiological dose criteria are specified, in part, in 10 CFR Part 100 and in GDC 19 of Appendix A to 10 CFR Part 50. The SQN is licensed for the use of an alternate source term in accordance with 10 CFR 50.67 for some design basis accidents. The SQN is designed to meet GDC 14, 19 and 32 (Updated Final Safety Analysis Report Sections 3.1 and 5.2.8).

Section 50.36 of 10 CFR 50 includes the Commission's requirement that TSs shall be included by applicants for a license authorizing operation of a production or utilization facility. Section 50.36 (c) of 10 CFR 50 requires that TSs include items in five specific categories related to station operation. These categories are: (1) safety limits, limiting safety system settings, and limiting control settings; (2) limiting conditions for operation; (3) surveillance requirements; (4) design features; and (5) administrative controls. The proposed change to SQN TS 6.8.4.k is within the 5th category.

The NRC previously approved a permanent W* amendment for Sequoyah (ADAMS Accession No. ML051160009), in License Amendment 291, that only applied to tubes on the hot-leg side of the SG.

3.0 TECHNICAL EVALUATION

As discussed above, the proposed amendment would revise the SQN TS to limit the scope of inspection on the cold-leg side of the SG tubesheet, thereby allowing any flaws which may exist in the uninspected region to remain in service (i.e., providing an ARC for the uninspected region). Based on operational history and a technical analysis provided by Westinghouse (Reference 1), the specific parameters of the cold-leg W* ARC are slightly different than those of the hot-leg.

3.1 Background

The SGs at SQN, Unit 2 are Westinghouse model 51 SGs. Each SG contains 3,388 mill-annealed Alloy 600 tubes. Each tube has a nominal outside diameter of 0.875 inches and a nominal wall thickness of 0.050 inches. The tubes are supported by a number of carbon steel tube support plates and Alloy 600 anti-vibration bars. Each SG tube was roll-expanded, at each end, for approximately 2.75 inches into the bottom of the tubesheet, and then both tube ends were explosively expanded into the full depth of the 21-inch thick tubesheet with the WEXTEX process. Each tube was also welded to the primary side of the tubesheet near the tube end, which provides a leak tight boundary and resistance to tube pullout. The WEXTEX process forms an interference-fit joint between the tube and tubesheet. The transition from the expanded to the unexpanded portion of the tube is referred to as the WEXTEX transition, or the expansion transition.

The current TSs do not take into account the reinforcing effect of the tubesheet on the external surface of the expanded tubes. The presence of the tubesheet provides radial constraint to the tube that precludes the tube's deformation beyond the inside diameter of the tubesheet bore hole. In addition, the intimate proximity of the tube-to-tubesheet joint significantly reduces the leakage from through-wall defects below the BWT.

Based on these considerations, power reactor licensees have proposed, and the NRC has approved, ARC for SG tube defects located in the lower portion of the tubesheet, when these defects are a specific distance below the BWT or the TTS, whichever is lower.

The W* methodology defines the "W* distance" as that distance below which any type or combination of tube degradation is considered acceptable, that is, even if inspections below this region identified degradation, the regulatory requirements pertaining to tube structural and leakage integrity would be met, provided there were no flaws within the W* distance. The W* distance is determined by adding the "W* length" to the location of the BWT. The W* length is determined by calculating the minimum amount of undegraded tubing necessary to prevent axial pullout of the tube from the tubesheet and to maintain primary-to-secondary leakage within allowable limits. Tube pullout requirements are based on the end-cap loads generated by the primary-to-secondary differential pressure. In addition to the W* length, nondestructive examination (NDE) uncertainties must be accounted for to determine the W* distance. These uncertainties include, but are not limited to, the uncertainties in determining the location of the BWT and the total inspection distance below this point (i.e., W* length). These uncertainties are addressed in the W* methodology (Reference 2).

To address leakage and structural integrity concerns, the cold-leg W* distance is defined as 10.5 inches below the TTS. In response to an RAI from the NRC staff, the licensee committed to perform an inspection to confirm that all cold-leg BWTs are below the TTS but not lower than 2.88 inches below the cold-leg TTS.

The generic W* analysis presented in WCAP-14798, Revision 2 (Reference 2), uses bounding values for secondary system pressure and primary temperature to determine the required W* length for two regions of the tube bundle. This analysis considered the forces acting to pull the tube out of the tubesheet (i.e., from the internal pressure in the tube) and the forces acting to keep the tube in place. These latter forces are a result of friction and the forces arising from (1) the residual preload from the WEXTEX expansion process, (2) the differential thermal expansion between the tube and the tubesheet, and (3) internal pressure in the tube within the tubesheet. In addition, the effect of tubesheet bow, due to pressure and thermal differentials across the tubesheet, was considered, since this bow causes distortion of the tubesheet holes from the secondary face to approximately the midpoint of the tubesheet, and potentially reduces the ability of the tube to resist tube pullout. The amount of tubesheet bow varies across the tube bundle with tubes in the periphery of the SG (referred to as Zone A tubes) experiencing less bow than tubes in the interior of the SG tube bundle (referred to as Zone B tubes). In fact, the analysis provided indicates that the W* length for Zone A tubes is 5.5 inches and the W* length for Zone B tubes is 7.5 inches. In addition to the W* length, the analysis also considered the uncertainties associated with NDE.

3.2 SQN Proposal

The licensee's basis for a permanent amendment related to the W* ARC is documented in the license amendment request and in Reference 2. Operating conditions assumed in the generic WCAP analysis of Reference 2, bound the operating conditions at SQN such that the W* distance calculated using plant-specific conditions would be less than the W* distance identified in Reference 2. For example, the generic analysis assumes a cold-leg temperature of 525 °F, whereas the cold-leg operating temperature at SQN, Unit 2 is 544 °F. Therefore, the generic analysis provides less thermal tightening of the WEXTEX joint than would actually be present in the SGs. The secondary system pressure assumed for the generic analysis also provides for less pressure tightening of the WEXTEX joint compared to the limiting operating plant conditions.

The proposed amendment uses a leakage methodology that is more conservative than that presented in Reference 2. For example, the proposal requires all tubes with service-induced degradation in the W* distance to be plugged upon detection. The proposed amendment uses essentially the same leakage model that was used in the amendment that approved W* for the hot-leg side of the SGs, except that the current proposal adds additional margin on the W* distance beyond the W* length.

The following sections summarize the NRC staff's evaluation of the proposed W* proposal in terms of maintaining SG structural and leakage integrity.

3.3 Tube Structural Integrity

The NRC staff has previously reviewed and approved the structural integrity component of the W* ARC related to SQN in License Amendment 291 (ADAMS Accession No. ML051160009). For all flaws left in service using the proposed ARC, the confinement of the tubesheet will prevent structural failure by burst. Use of the W* ARC will also ensure that tube pullout from the tubesheet, under the limiting conditions specified, is precluded. Therefore, the NRC staff finds that any flaws returned to service as a result of implementing the W* criteria will not compromise tube structural integrity.

3.4 Tube Leakage Integrity

The NRC staff has previously reviewed and approved the leakage integrity component of the W* ARC related to SQN in License Amendment 291 (ADAMS Accession No. ML051160009). In the current W* amendment proposal, the licensee states that all cold-leg service-induced degradation from the TTS to the W* distance of 10.5 inches will be plugged, which is a more conservative distance than used in previous W* amendments. Since the licensee has proposed the W* distance as 10.5 inches from the TTS (rather than from the BWT or the TTS, whichever is lower), the licensee has committed to verify that the cold-leg BWTs are not greater than 2.88 inches below the TTS, which ensures that the 10.5-inch W* distance contains the minimum required amount of undegraded tubing (7.5 inches). If a BWT is found greater than 2.88 inches below the TTS, then the examination will be extended into the tubesheet to ensure at least 7.5 inches, plus measurement uncertainty, of non-flawed tube is inspected.

The licensee also provided a regulatory commitment to revise the SG Program to assess leakage from the cold-leg side of the SG with the following methodology.

1. If no indications are found within the cold-leg W* distance of 10.5 inches, then the total W* cold-leg assumed leakage will consist of the sum of the following:

    a. Each inservice Row 1 tube that has had a plug removed will be assumed to leak at a rate of $9x10^{-5}$ gpm.

    b. Four tubes will be assumed to leak near the TTS (i.e., 0.1 to 1 inch below the BWT) at a rate of 0.05 gpm per tube.

2. If indications are found within the cold-leg W* distance of 10.5 inches, then the total W* cold-leg assumed leakage will consist of the sum of the following:

    a. The total cumulative quantity of indications within the cold-leg W* distance of 10.5 inches will be multiplied by 10 percent and this quantity will be the number of indications assumed to exist in the region from 10.5 to 12 inches below the cold-leg TTS. This calculated quantity will be multiplied by 4.5×10^{-3} gpm to arrive at the leakage estimate from 10.5 to 12 inches below the cold-leg TTS.

    b. For leakage in the region more than 12 inches below the TTS, the licensee will multiply the number of inservice tubes in the SG with the lowest number of plugged tubes by 9×10^{-5} gpm, to arrive at the leakage estimate from more than 12 inches below the cold-leg TTS.

The leakage rate calculated above will be combined with the assessed leakage rate from all other sources to ensure that the total leakage rate is less than the plant-specific allowable limits. In addition, the licensee will be required to assess whether the results of the inspection were consistent with expectations with respect to the number of flaws and their severity. In the event that the results are not consistent, the licensee will be required to describe proposed corrective actions. On this basis, the NRC staff finds that the licensee has an acceptable methodology for assessing leakage below the W* distance, thereby ensuring leakage integrity can be maintained.

3.5 Additional Issues

Since the original NRC staff approval of W* for the hot-leg, additional issues have been raised in the NRC staff's review of a similar methodology that is applicable to plants with tubes that have been hydraulically expanded into the tubesheet. This latter methodology is referred to as H*. The NRC staff considered the issues that were raised in the context of the review of the H* methodology in its review of the SQN application for W* on the cold-leg. Specific issues considered included the coefficient of thermal expansion (CTE) values for Alloy 600 and SA-508 used in the analyses; the assumptions made regarding the crevice pressure profile between the tube and the tubesheet in the finite element model; and how the finite element model addressed divider plate cracking, which is an issue that has been found in some non-U.S. plants.

The licensee addressed these issues in their submittal. For example, in the H* review (Reference 3), the NRC staff questioned the conservatism and appropriateness of the CTE values used in the assessments. To address this issue, a CTE test program was performed. This test program confirmed the appropriateness and conservatism of the proposed values for the CTE. As a result the NRC staff concluded that the CTE values used were acceptable.

The licensee also evaluated the divider plate cracking issue that some non-U.S. plants have experienced and then evaluated whether the finite element model had adequately accounted for the effect cracking in the divider plate weld would have on tubesheet bending. The results of the analysis showed that the assumptions made in the finite element analysis were conservative and bounding for the divider plate cracking issue. Based on the finding that the finite element assumptions were bounding and conservative, the NRC staff concluded that the assumptions regarding the divider plate cracking were acceptable.

The H* review also raised an issue with respect to the conservatism of the relationship for determining a uniform diameter change that would produce the same change to the average tube-to-tubesheet contact pressure as would the actual non-uniform diameter changes from the 3D finite element analyses, and whether the tubesheet bore displacement eccentricities are sufficiently limited such as to ensure that the tube-to-tubesheet contact is maintained around the entire tube circumference. Although this latter issue was not fully resolved in the H* review, the NRC staff concludes that there is sufficient conservatism embodied in the proposed W* distance to ensure acceptable margins against tube pullout for the remaining life of the SGs, which is approximately 3 years based on the scheduled replacement of the SGs in 2012. This conclusion is based on a qualitative assessment of the conservatisms in the analyses as discussed in section 3.6 and the limited number of reported indications of cracking on the cold-leg side of the SGs in all SGs.

In summary, the NRC staff considered the issues identified during the H* review in the review of this proposal and concludes that there is sufficient conservatism embodied in the proposed W* distance to ensure acceptable margins against tube pullout for the remaining life of the SGs.

3.6 Summary

The NRC staff's approval of the licensee's proposal is based on the licensee demonstrating that applicable structural integrity and leakage integrity requirements will be met. This approval is based, in part, on inspections and conservative assumptions involving the licensee's implementation of the W* repair criteria including:

1. The licensee is performing inspections and plugging all cold-leg tubes with service-induced degradation to a minimum depth of 10.5 inches below the cold-leg TTS.

2. The generic W* distance for the most limiting cold-leg Zone B tubes (interior of tube bundle) will be applied to the entire cold-leg side of the SG, which is conservative for the cold-leg Zone A tubes (peripheral tubes). On the cold-leg side, a generic W* distance of 10.5 inches is being used, which bounds the W* length for both the Zone B and A tubes on the cold-leg side of the SG (provided the BWT is less than 2.88 inches below the TTS).

3. The generic W* distances were determined using bounding parameters (i.e., secondary-side pressure and primary-side temperature) resulting in more conservative W* distances than would be obtained using plant-specific operating parameters. The generic W* distances were also determined from lower bound tube pull forces for WEXTEX expansions (based on a smooth tubesheet hole) in order to maximize the W* distance and bound the variability in WEXTEX expansions.

4. The most limiting region of the tube bundle is Zone B, which is in the interior of the tube bundle. If tubes in this region began to pull out of the tubesheet, they would be constrained by contact with neighboring tubes. As a result, the likelihood that a tube would pull out of the tubesheet is small. This effect was not considered in the development of the W* distance and adds conservatism to the evaluation. There have been very few indications of cracking on the cold-leg side of the SGs.

5. The licensee's tubes are most likely experiencing denting at the tube support plates which would further restrain tube pullout and would likely prevent the axial pressure load necessary to cause tube pullout. This effect was not considered in the development of the W* distance and adds conservatism to the evaluation.

6. The licensee will project that any postulated indications between 10.5 inches and 12 inches below the TTS are circumferential, 100 percent through-wall over 360 degrees, and occur in one SG, which is a conservative assumption.

7. Flaws postulated below the W* distance are assumed to be leaking although industry operating experience has demonstrated negligible leakage under normal operating conditions, even when cracks are located in a tube-to-tubesheet expansion transition zone.

The NRC staff concludes the licensee's proposed methodology for assessing structural and leakage integrity for flaws in the tubesheet region is acceptable. Therefore, the NRC staff concludes that the licensee's proposal to limit the tube inspection scope in the cold-leg tubesheet is an acceptable approach. In addition, the NRC staff concludes the clarification that the existing W* criteria is applicable to the hot-leg tubesheet is also acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Tennessee State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (74 FR 34048, July 14, 2009). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES:

1. Tennessee Valley Authority letter, TVA-SQN-TS-09-02, "Sequoyah Nuclear Plant (SQN) - Unit 2 - Technical Specifications (TS) Change 09-02 - W* Alternate Repair Criteria (ARC) for Steam Generator (SG) Tubes Cold Leg," dated May 21, 2009, transmitting Westinghouse Electric Company (WEC) letter LTR-SGMP-09-35, "Application of W* Alternate Repair Criteria to Sequoyah Unit 2 Cold Leg Tubes," dated March 25, 2009, ADAMS Accession No. ML091530346.

2. WEC report, WCAP-14798-NP, Revision 2, "Generic W* Tube Plugging Criteria for 51 Series Steam Generator Tubesheet Region WEXTEX Expansions," March 2003, ADAMS Accession No. ML041970453.

3. NRC letter, "Vogtle Electric Generating Plant, Units 1 and 2, Issuance of Amendments Regarding Technical Specification (TS) Section 5.5.9, "Steam Generator Program," And TS 5.6.10, "Steam Generator Tube Inspection Report," For Interim Alternate Repair Criteria," dated September 24, 2009, ADAMS Accession No. ML092170782.

Principal Contributor: A. Johnson

Dated: October 19, 2009

October 19, 2009

Mr. Preston D. Swafford
Chief Nuclear Officer and
Executive Vice President
Tennessee Valley Authority
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNIT 2 – ISSUANCE OF AMENDMENT TO ALLOW USE OF THE W* ALTERNATE REPAIR CRITERIA FOR STEAM GENERATOR TUBES (TS-09-02) (TAC NO. ME1343)

Dear Mr. Swafford:

The Commission has issued the enclosed Amendment No. 318 to Facility Operating License No. DPR-79 for the Sequoyah Nuclear Plant (SQN), Unit 2. This amendment is in response to your application dated May 21, 2009, as supplemented by letters dated August 14 and September 29, 2009.

The amendment revises Technical Specification (TS) Section 6.8.4.k, "Steam Generator (SG) Program," for SQN, Unit 2 to allow the implementation of SG tubing alternate repair criteria for axial indications in the Westinghouse Electric Company explosive tube expansion region below the top of the tubesheet and specify the W* distance for the SG cold-legs.

A copy of the safety evaluation is also enclosed. A notice of issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Siva P. Lingam, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-328

Enclosures: 1. Amendment No. 318 to License No. DPR-79
2. Safety Evaluation

cc w/enclosures: Distribution via Listserv

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ADAMS Accession No. ML092810333 *via email NRR-058

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