February 14, 2003

Mr. J. A. Scalice
Chief Nuclear Officer and
Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 — REQUEST FOR ADDITIONAL INFORMATION REGARDING TECHNICAL SPECIFICATION (TS) CHANGE REQUEST NO. 00-14, "PRESSURE TEMPERATURE LIMITS REPORT (PTLR) AND REQUEST FOR EXEMPTION FROM THE REQUIREMENTS OF 10 CFR PART 50, APPENDIX G" (TAC NOS. MB6436 AND MB6437)

Dear Mr. Scalice:

By letter dated September 6, 2002, the Tennessee Valley Authority submitted proposed revisions for Sequoyah Nuclear Plant, Units 1 and 2 TS 3/4.49.1, Pressure/Temperature Limits, Reactor Coolant System, and TS 3/4.4.12, Low Temperature Over Pressure Protection Systems. The TS change request also included two exemptions from the requirements of Title 10 of the Code of Federal Regulations, Part 50, Appendix G. The revisions would relocate the TSs into a PTLR format in accordance with the U.S. Nuclear Regulatory Commission's (NRC's) Generic Letter 96-06, "Relocation of the Pressure Temperature Limit Curves, and Low Temperature Overpressure," in addition to making other changes to amend and upgrade certain TSs to standard TS requirements for Westinghouse plants. As a result of our review, the NRC staff requests that the licensee provide additional information.

The NRC staff discussed the enclosed questions with Mr. James Smith, of your staff, in a conference call on January 29, 2003. Draft versions of the questions were transmitted to the licensee prior to the conference call on January 22, 23, and 24, 2003. Mr. Smith agreed to respond to the enclosed questions by March 14, 2003.

Please have your staff contact Christopher Gratton at (301) 415-1055, if there are any questions regarding the enclosed questions.

Sincerely,

***/RA/***

Raj K. Anand, Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-327 and 50-328

Enclosure: As stated

cc w/enclosure: See next page

Please have your staff contact Christopher Gratton at (301) 415-1055, if there are any questions regarding the enclosed questions.

Sincerely,

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Raj K. Anand, Project Manager, Section 2
Project Directorate II
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REQUEST FOR ADDITIONAL INFORMATION (RAI)

PRESSURE-TEMPERATURE LIMIT REPORTS (PTLRS)

AND ASSOCIATED EXEMPTIONS FOR SEQUOYAH, UNITS 1 AND 2

DOCKET NOS. 50-327 AND 50-328

The questions and comments contained in this RAI were developed by the Materials and Chemical Engineering Branch of the Office of Nuclear Reactor Regulation based upon submittals made by the licensee on September 6, and December 19, 2002. Several plant-specific reports, prepared by Westinghouse, were included in these submittals to support the technical basis for the proposed PTLRs and exemption requests. To the extent practical, the questions and comments that follow have been associated with identified plant-specific reports, the proposed PTLRs, or other documentation in the licensee's September 6, and December 19, 2002, submittals to assist the licensee in establishing the context of the question or comment. However, the licensee is also expected to evaluate whether their response to any question or comment would affect any other parts of their submittal beyond the documentation with which the original question is associated.

WCAP-15984, "Reactor Vessel Closure Head/Vessel Flange Requirements Evaluation for Sequoyah, Units 1 and 2"

1. Regarding the discussion on page 4-1, "These results [the stresses for boltup and steady-state operation given in Table 4-1] were taken from a finite element analysis of the heatup/cooldown process, and the boltup was determined to be the most limiting time step for the entire heatup/cooldown transient."

   Provide a summary which identifies how the finite element analysis (FEA) was performed, including important analysis variables (e.g., mesh size/element used, convergence criteria, thermal transient time step magnitude, boundary conditions, etc.). The level of detail provided should be such that the U.S. Nuclear Regulatory Commission (NRC) staff will have reasonable assurance regarding the acceptability of the licensee's FEA process and input variables. Provide stress analysis results (consistent with the level of detail provided in Table 4-1) and throughwall temperature distributions at twenty evenly distributed points along the most limiting heatup/cooldown transient which was analyzed.

2. Regarding the information provided on page 4-2 on the effect of thermal aging:

   a. Provide the chemical composition (weight percent copper and nickel) of the Sequoyah, Unit 1 and Unit 2, reactor pressure vessel (RPV) closure head region materials.

   b. Recent work supported by the NRC's Office of Nuclear Regulatory Research has led to the development of new RPV embrittlement models which incorporate terms that have the effect of a "thermal aging" (time-at-temperature) function (original work documented in NUREG/CR-6551, "Improved Embrittlement

Enclosure

Correlations for Reactor Pressure Vessel Steel"). The most recent version of the proposed embrittlement model is included below, along with suggested input value definitions:

Shift in $RT_{NDT} = A * f(T_c) * f(P) * f_1(\varphi t) + B * f(Ni) * f(Cu) * f_2(\varphi t) + Bias$

where: $A = 8.86 \times 10^{-17}$ for welds
$9.30 \times 10^{-17}$ for forgings
$12.7 \times 10^{-17}$ for plates

$f(T_c) = \exp(19310 / [T_c + 460])$

$f(P) = (1 + 110 * P)$

$f_1(\varphi t) = (\varphi t)^{0.4601}$

B = 230 for welds
132 for forgings
156 for plates
206 for plates in Combustion Engineering fabricated RPVs

$f(Ni) = (1 + 2.40 * Ni^{1.250})$

$f(Cu) = 0$, if $Cu < 0.072$ wt%
$= (Cu - 0.072)^{0.659}$

$$f_2(\varphi t) = 0.5 + 0.5 * \tanh([\log\{\varphi t + 4.579 \times 10^{12} * t\} - 18.265] / 0.713)$$

Bias = 0, t < 97, 000 hrs
= 9.4 °F, t > 97, 000 hrs

and: $T_c$ = In this application, the temperature of the coolant at the RPV flange
P = Material phosphorous content, wt%
$\varphi t$ = Neutron fluence at RPV flange at EOL [end of life]
($10^{15}$ n/cm$^2$ as a nominal value, unless information exists which would suggest that the fluence at the flange could be marginally greater)
Ni = Material nickel content, wt%
Cu = Material copper content, wt%
t = Time of full power operation at end of license conditions in hours (nominally 280000 hrs)

Making the conservative assumption that the embrittlement model equation may be directly applied to the evaluation of thermal aging effects for RPV flange materials (with the effective neutron fluence set to a nominally small value), evaluate what the predicted shift in $RT_{ndt}$ would be for the Sequoyah, Unit 1 and Unit 2, RPV closure head region materials, and provide the predicted final $RT_{ndt}$ values for these materials at the current end of license condition for the units.

Assess what impact these values would have on the conclusions drawn in WCAP-15984 and the licensee's exemption request.

3. Regarding the discussion on page 5-1 on the basis for the reference flaw size:

   Provide information that explains what RPV head flange region inservice inspections (when the inspections were conducted, the extent of coverage achieved, ultrasonic transducers used, etc.) have been conducted at Sequoyah, Units 1 and 2, relative to the discussion in WCAP-15984 regarding the quality of inspections cited to support the assumed reference flaw size. More specifically, provide an evaluation that demonstrates how the inspections conducted at Sequoyah, Units 1 and 2, support the assumption of a 0.1T flaw size in the flange evaluation.

<u>Sequoyah, Unit 1 and Unit 2, Draft PTLRs, WCAP-15293, Revision 1, "Sequoyah Unit 1 Heatup and Cooldown Curves for Normal Operation and PTLR Support Documentation," and WCAP-15321, Revision 1, "Sequoyah Unit 2 Heatup and Cooldown Curves for Normal Operation and PTLR Support Documentation"</u>

4. Regarding Item 2.1.2.a. in each unit's PTLR, it is stated that a maximum heatup rate of 100 °F in any one-hour period is permitted. However, a heatup limit curve (Fig. 2-1 in either PTLR) is only given for a rate of 60 °F per hour. Either modify Item 2.1.2.a in each proposed PTLR or explain why Item 2.1.2.a in each unit's PTLR should not be changed to 60 °F in any one-hour period.

5. Regarding Section 4.0 in each unit's PTLR, why is American Society for Testing and Materials (ASTM) Standard E208 (on nil-ductility reference temperature testing) noted? It would seem that, in terms of an applicable ASTM Standard which might be of interest under the subject of "Reactor Vessel Material Surveillance Program" that ASTM Standard E23 (on notched bar impact testing), if anything, would be a more suitable reference. Either modify Section 4.0 in each unit's PTLR or explain why the current reference to ASTM E208 is considered to be more appropriate.

6. In Tables 5-1, 5-2, and 5-3 of each unit's PTLR, it would be more clear if the heat numbers for each surveillance material and RPV forgings and welds were provided in each table. The heat-to-heat association of surveillance material with RPV materials is a critical component in the Regulatory Guide 1.99, Revision 2 (RG 1.99, Rev. 2) evaluation process.

7. Regarding Tables 5-5, 5-6, and 5-7 of each unit's PTLR:

   a. Why are margin terms in the table for the use of Position 1.1 and Position 2.1 shown to be equivalent? Per RG 1.99, Rev. 2, when credible surveillance data is used, the "$\sigma_\Delta$ term" in the margin calculation may be halved. It is not clear how the results shown in the tables for "Position 2.1" are consistent with PTLR methodology cited in WCAP-14040-A, Rev. 2. If the licensee's evaluation is intending to reference additional NRC staff guidance into the evaluation of each unit's surveillance data (in which case the evaluation given as "Position 2.1" for each material may not actually follow the specific outline of Position 2.1 in

RG 1.99, Rev. 2), this additional staff guidance should be clearly referenced in each unit's PTLR methodology.

b. Based on the proposed Sequoyah, Unit 1 and Unit 2, PTLR methodology, the results from the evaluation of whether the Sequoyah, Unit 1 and Unit 2, surveillance data is, or is not, credible should be clearly stated in the PTLR, although the actual calculations which support the credibility evaluation may be referenced from elsewhere. Based on this determination, there should also be an indication given in Tables 5-5, 5-6, and 5-7 of which position (1.1 or 2.1) is considered by the licensee to be the licensing basis calculation for each material.

8. It appears that throughout each unit's PTLR, conservative fluence values have been used (i.e., a single, peak fluence location was determined for the entire vessel then that value was used for the evaluation of all RPV materials). Confirm whether or not this understanding is correct. If so, at a minimum, a footnote should be added to Tables 5-5, 5-6, and 5-8, which explains that the neutron fluence values cited in the PTLR are not the actual, calculated peak values for each forging or weld.

9. Regarding Table 2-2 in each unit's PTLR, provide the 1/4 T $K_{IT}$ and 1/4 T metal temperature for each data point listed for the 100 °F per hour cooldown transient curve.

10. Regarding Table 2-1 in each unit's PTLR, provide the 1/4 T metal temperature, 3/4 T $K_{IT}$, and 3/4 T metal temperature for each data point listed for the 60 °F per hour heatup transient curve.

11. Has the information that is currently in Sequoyah, Unit 1 and Unit 2, Final Safety Analysis Reports been reconciled with information in the PTLR methodology documentation (e.g., information on fluence calculation methodology)? If a reconciliation of information in the PTLR methodology has been completed, please state so. If not, please summarize your process for ensuring that such a reconciliation will be completed in a timely manner relative to the issuance of the PTLR.

12. Consistent with the guidance in Generic Letter (GL) 96-03, it appears that all Sequoyah, Unit 1 and Unit 2, surveillance capsule reports should be clearly referenced in each unit's respective PTLR (see the Table in GL 96-03, Item 2, Column 3). The licensee's current submittal does not include all of these references. The licensee should either add the appropriate references or explain why they are not necessary.

13. Consistent with GL 96-03 Table, Item 6, Column 3, specific minimum temperature requirements should be listed on the pressure temperature limit figures in the PTLRs. For clarity, the licensee should consider whether the numeric value for boltup temperature (50 °F) should be added to the figure in each PTLR.

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