Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37384-2000

July 30, 2003

10 CFR 50.90

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

Gentlemen:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) - RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) REGARDING TECHNICAL SPECIFICATION (TS) CHANGE 03-01, "REVISION OF BORON REQUIREMENTS FOR COLD LEG ACCUMULATORS AND REFUELING WATER STORAGE TANKS"

This letter provides additional information requested by Nuclear Regulatory Commission's (NRC's) draft RAI to support review of SQN TS Change 03-01. The enclosure provides TVA's response to the NRC staff questions.

This letter is being sent in accordance with NRC RIS 2001-05. There are no commitments contained in this submittal.

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Please direct questions concerning this issue to me at (423) 843-6672 or Pedro Salas at (423) 843-7170.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 30th day of July, 2003.

Sincerely,

James D. Smith
Licensing Supervisor

Enclosure
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ENCLOSURE

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
SEQUOYAH NUCLEAR PLANT (SQN)
TECHNICAL SPECIFICATION (TS) CHANGE NO. 03-01

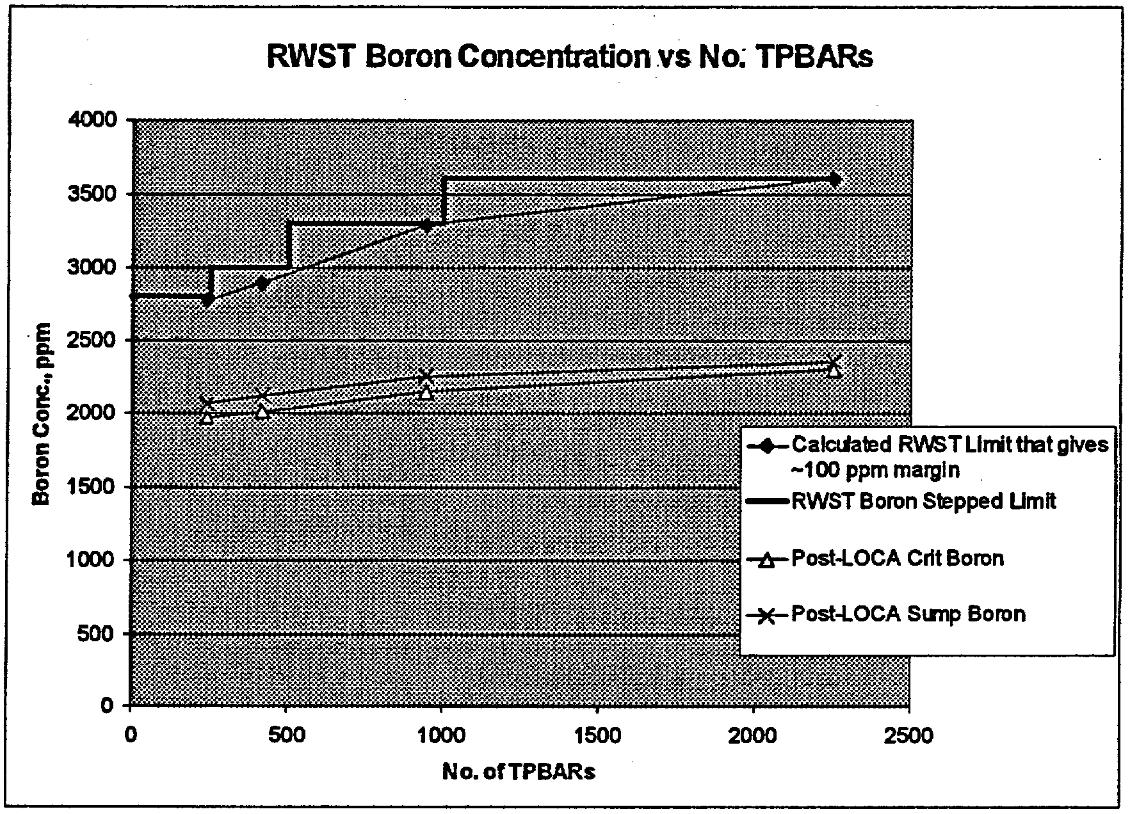
NRC Question 1

For each of the proposed TPBARs ranges listed on page E1-4 of the LAR, please provide quantitative results which demonstrate that the boron concentration range is adequate to maintain subcriticality following a LOCA. Specifically, please provide post-LOCA sump boron concentration vs. post-LOCA critical boron concentration.

TVA Response

Detailed calculations were performed for representative example tritium production core designs with 240, 416, 944, and 2256 tritium producing burnable absorber rods (TPBARs). The post-loss of coolant accident (LOCA) sump boron concentration requirement for each was evaluated over a burnup range from beginning of cycle to 250 effective full power days using conservative TPBAR post-LOCA leaching assumptions (discussed in more detail in response to Question 2). For each TPBAR core design, the limiting post-LOCA critical boron concentration was determined as shown below in the figure of refueling water storage tank (RWST) boron concentration verses number of TPBARs. The required RWST boron concentration that would result in a post-LOCA sump boron concentration, which maintained about 100 parts per million (ppm) margin to the post-LOCA critical boron concentration, was iteratively derived for each TPBAR configuration. For each evaluated RWST concentration, the cold leg accumulator (CLA) boron concentration was assumed to be 100 ppm less than the RWST concentration (even though the CLAs are filled from the RWST and will initially be at the same boron concentration as the RWST). This assumption allows for some CLA check valve inleakage for the end of cycle operation when the reactor coolant system boron concentration is reduced. The assumption is consistent with current TS requirements. This 100 ppm margin was over and above what is normally retained for non-TPBAR core licensing calculation conservatisms (such as boron anomaly, previous cycle burnup variations, etc.). From the calculated RWST limit points for each TPBAR core design, a RWST and CLA stepped limit was then conservatively derived

that could be used to bound various ranges of TPBAR configurations. These values were used to define the tables proposed for the insertion into TS 3.5.5.



NRC Question 2

In section 4 of the LAR, the licensee states that the required boron concentration considers the "reactivity holddown effect," and the effects of possible leaching of lithium following a LOCA. Please, provide a description of how these effects impact the boron concentration requirements, and provide representative values which demonstrate the magnitude of the impact on the required boron concentration for the proposed TPBARS ranges.

TVA Response

Topical Report BAW-10237 (included as Enclosure 4 in TVA's TS Change Request 00-06, dated September 21, 2001) discusses the effects of TPBARs on post-LOCA sump boron concentration. At sufficiently high LOCA initial condition peaking and burnup conditions, TPBAR failure can occur. Up to 50 percent ^{6}Li

absorber loss can occur due to leaching, as well as 100 percent ^{3}He loss, and up to 12 inches of $LiAlO_2$ pellets can be lost because of TPBAR rupture. For each of the TPBAR core designs evaluated, the approved NEMO code was used to determine representative LOCA initial condition assembly and pin power distributions at various core burnups. These power distributions were calculated near the positive and negative axial flux difference (AFD) limits. Then the power distributions were conservatively augmented to be representative of the limiting power distributions that would define the operational AFD limits (required by TS 3/4.2.1). Next, using the augmented pin powers adjacent to each of the TPBARs, the TPBAR maximum cladding temperature was determined. Using conservative pre-determined relationships between TPBAR clad temperature, exposure, and tritium production, the number of TPBAR failures was calculated. Each failure conservatively assumes 100 percent ^{3}He loss, 100 percent ^{6}Li removal in the 12-inch region around the failure, and 50 percent ^{6}Li loss over the remainder of the entire TPBAR length (approximately 132 inches total TPBAR length). The resulting changes in isotopics were then input to a NEMO calculation to determine the critical boron concentration at the post-LOCA failure conditions.

The reactivity impact of the TPBAR failures is illustrated in Table 1, showing results from the 944 TPBAR case, with and without TPBAR failures.

Table 1
Comparison of Post-LOCA Sump Margin With and Without TPBAR Failures - 944 TPBAR Case.

		With TPBAR Failures:			No TPBAR Failures:		
	Post-LOCA Sump Concentration	Post-LOCA Critical Boron	Sump Margin	TPBAR Failures	Post-LOCA Critical Boron	Sump Margin	Failed TPBAR worth
EFPD	ppm	ppm	ppm	percent	ppm	ppm	ppm
4	2267.8	2121	146.8	0	2121	146.8	0
25	2263.6	2083	180.6	1.7	2080	183.6	3
50	2261.5	2063	198.5	9.3	2049	212.5	14
100	2257	2157	100	97.5	1991	266	166
150	2252.6	2108	144.6	98.3	1941	311.6	167
250	2236.5	1991	245.5	100	1820	416.5	171

NRC Question 3

In section 5 of the LAR, the licensee proposes to add a footnote to applicable TS pages stating that the number of TPBARs in the reactor core is contained in the Core Operating Limits Report (COLR) for each fuel cycle. Please, explain why appropriate modifications to TS sections 6.9.1.10 and 6.9.1.14a to include the number of TPBARs in COLR was not included with the LAR.

TVA Response

The number of TPBARs is an input to the analysis used to determine the operating limits for the rector core. The analysis models found in TS 6.9.1.14a use the TPBAR quantity as a core property similar to the enrichment of the fuel rods and the number and placement of burnable poison rods. The number of TPBARs is not a result of the analysis for the core and is not a variable that can be monitored or controlled by the plant operators. The other parameters that are determined by these analysis models and are controlled during the fuel cycle are listed in TS 6.9.1.14 and are associated with specific TS sections. The TSs require these parameters to be controlled within the COLR requirements. Therefore, since the number of TPBARs is not a parameter that is controlled during a fuel cycle but is used as an input to the analysis that determines core operating limits, this number does not apply to Section 6.9.1.14 of the TSs. It is appropriate for the TPBAR number to be placed in the COLR as this document is readily available to the operators and is cycle specific. This ensures that the operators can quickly determine the quantity of TPBARs for compliance with the proposed boron concentration requirements and that they are applicable to the current core operating cycle.

NRC Question 4

The staff is concerned that design and manufacturing tolerances could introduce uncertainty or overlap at the range boundaries. For example, consider the boundary between the ranges of 251-500 TPBARs and 501-1000 TPBARs. Because the lithium (^{6}Li) concentration can vary from 0.028 gm/inch to 0.032 gm/inch, a core loaded with 500 TPBARs with ^{6}Li concentrations of 0.032 gm/inch would require a higher boron concentration than a core loaded with 501 TPBARs with ^{6}Li concentrations of 0.028 gm/inch. Please, provide a discussion of the assumptions or conservatisms included in the analyses

which ensure that the boron concentrations at the TPBAR range boundaries are conservative.

<u>TVA Response</u>

The various analyzed TPBAR core designs used either 0.029 gram/inch or 0.032 gram/inch ^{6}Li (or a combination of the two). For the 944 TPBAR design, the TPBARs were all loaded to 0.032 gram/inch. The 2256 TPBAR design was comprised of 60 percent of 0.032 gram/inch ^{6}Li and 40 percent of 0.029 gram/inch ^{6}Li. The 2256 TPBAR design represented the upper limit of TPBARs that could be implemented. Not all core locations could be loaded at the higher 0.032 gram/inch ^{6}Li loading and still meet cycle lifetime requirements. Therefore, a full 0.032 gram/inch loading would not be utilized and the 60/40 percent loading was considered the maximum practical loading. Thus, the 3300 and 3600 ppm RWST range boundaries covering 500 to 1000 and greater than 1000 TPBARs, respectively, were calculated using the highest practical ^{6}Li loadings and are therefore conservative.

The 240 and 416 TPBAR designs were calculated using 0.029 gram/inch ^{6}Li. Another calculation was performed to determine the increase in required post-LOCA critical boron concentration due to increasing the ^{6}Li from 0.029 to 0.032 gram/inch. For the 240 TPBAR design, the increase was 4 ppm. For the 416 TPBAR design, the increase was 7 ppm. These values are smaller than the difference between the calculated RWST limit and the stepped limits shown in the above figure of RWST boron concentration verses number of TPBARs. Also, the values are well within the 100-ppm margin that sets the post-LOCA sump boron concentration described in the response to Question 1. Finally, the post-LOCA sump boron concentration is always confirmed on a cycle-specific basis. Therefore, any variations in ^{6}Li would be specifically analyzed, and the appropriate RWST and corresponding CLA boron concentration would be verified.