June 6, 2002

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 ON TECHNICAL SPECIFICATION CHANGE NO. 00-06, TRITIUM PRODUCTION CORES (TAC NOS. MB2972 AND MB2973)

Dear Mr. Scalice:

The subject Technical Specification Amendment Request was submitted to the U.S. Nuclear Regulatory Commission (NRC) for review and approval on September 21, 2001, by the Tennessee Valley Authority (TVA). The proposed license amendments would change the Technical Specifications for Sequoyah Nuclear Plant (SQN), Units 1 and 2, to allow SQN to provide irradiation services for the U.S. Department of Energy (DOE). This change would allow SQN to insert tritium producing burnable absorber rods into the SQN reactor cores to support DOE in maintaining the nation's tritium inventory. The NRC staff is in the process of reviewing TVA's submittal.

As discussed during a conference call with your staff on June 4, 2002, the NRC staff requires responses to the enclosed Request for Additional Information to proceed with its review. During the call, Mr. Jim Smith of the SQN Licensing Staff stated that TVA would respond to this request by July 3, 2002.

Please have your staff contact me at (301) 415-2010 if there are any questions regarding the enclosed request.

Sincerely,

/RA/

Ronald W. Hernan, Senior Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosure: Request for Additional Information

cc w/enclosure: See next page

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

June 6, 2002

SUBJECT: SEQUOYAH NUCLEAR PLANT (SQN), UNITS 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION ON TECHNICAL SPECIFICATION CHANGE NO. 00-06, TRITIUM PRODUCTION CORES (TAC NOS. MB2972 AND MB2973)

Dear Mr. Scalice:

The subject Technical Specification Amendment Request was submitted to the U.S. Nuclear Regulatory Commission (NRC) for review and approval on September 21, 2001, by the Tennessee Valley Authority (TVA). The proposed license amendments would change the Technical Specifications for Sequoyah Nuclear Plant (SQN) Units 1 and 2 to allow SQN to provide irradiation services for the U.S. Department of Energy (DOE). This change would allow SQN to insert tritium producing burnable absorber rods into the SQN reactor cores to support DOE in maintaining the nation's tritium inventory. The NRC staff is in the process of reviewing TVA's submittal.

As discussed during a conference call with your staff on June 4, 2002, the NRC staff requires responses to the enclosed Request for Additional Information to proceed with its review. During the call, Mr. Jim Smith of the SQN Licensing Staff stated that TVA would respond to this request by July 3, 2002.

Please have your staff contact me at (301) 415-2010 if there are any questions regarding the enclosed request.

Sincerely,

/R/A

Ronald W. Hernan, Senior Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosure: Request for Additional Information

cc w/enclosure: See next page

<u>DISTRIBUTION</u>:

PDII-2 Reading File	OGC	PUBLIC	ACRS
KJabbour (A)	JWermiel	RHernan (Paper)	BClayton (Paper)
FAkstulewicz	PFredrickson	MKowal	MPadovan
SWeerakkody	SJones		

ADAMS Accession No.ML021570479

OFFICE	PDII-2\PM	PDII-2\LA	PDII-2\SC (A)
NAME	RHernan	BClayton	KJabbour
DATE	06/4/02	06/4/02	06/5/02

OFFICIAL RECORD COPY

REQUEST FOR ADDITIONAL INFORMATION

TRITIUM PRODUCTION CORE

SEQUOYAH NUCLEAR PLANT

DOCKET NOS. 50-327 and 50-328

1. In Sections 1.5.3, 2.4.3 and 2.4.4 of the Sequoyah Nuclear Plant (SQN) Topical Report, the licensee states that compliance with departure from nucleate boiling (DNB) criterion was demonstrated through evaluations performed using standard U.S. Nuclear Regulatory Commission (NRC)-approved reload analytical methods. Please provide a summary of the results of these evaluations with respect to DNB ratio (DNBR) margins and bypass flow for the tritium producing burnable absorber rod (TPBAR) core. Please provide a comparison of DNBR margin and bypass flow for cores with and without TPBARs. Also, discuss any DNBR penalties associated with the TPBARs.

2. In Section 2.4.3 of the SQN Topical Report, the licensee lists the following items as being significant differences between the SQN design as compared to the generic tritium production core evaluated in the NRC Safety Evaluation Report (SER) (NUREG-1672):

   a. SQN assumes a feed batch of 96 Mark-BW fuel assemblies instead of 193 and 140 VANTAGE+^{TM} fuel assemblies. This represents a batch size larger than current SQN reload cores.

   b. Two ^{6}Li concentrations are used instead of one. Concentrations slightly higher (0.032 gm/in) and slightly lower (0.029 gm/in) than that in the generic Tritium Production Core Topical Report (TPCTR) analysis (0.030 gm/in) were used.

   c. A singular, longer ^{6}Li poison column length of 132 inches, centered with respect to the fuel stack was used. The TPCTR analysis used 127.5- and 128.5-inch lengths, and the Watts Bar lead test assemblies used a 142-inch length.

   d. Gadolinia (Gd_2O_3) was used as integral burnable absorber instead of IFBA (ZrB_2); fuel enrichment was slightly reduced in the fuel pellets that contain gadolinia.

   e. Burnable poison rod assemblies containing B_4C-Al_2O_3 pellets were used on the periphery for fluence control in the equilibrium fuel cycle instead of TPBARs.

   f. As few as 12 TPBARs on a single cluster were used in the transition cycle whereas no fewer than 20 per cluster were used in the TPCTR analysis.

   g. No fuel rod enrichment zone loading was employed except for fuel rods containing gadolinia.

   For each of the above differences please summarize the technical justification for the difference, and discuss how acceptance criteria of Standard Review Plan (NUREG-0800) Section 4.3 are satisfied considering these differences.

3. On page 2-6 of the SQN Topical Report the licensee discusses changes to the CASMO-3 and NEMO computer codes. The licensee modified the cross section libraries and the cross section generation process in the CASMO-3 and NEMO computer codes to include isotopes important for TPBAR cores (tritium, helium and lithium isotopes). Please discuss how these code changes were demonstrated to be accurate through either a verification or benchmarking program and verify that any code changes made are within any code restrictions or limitations identified in the NRC staff SERs for these codes. Also, justify the use of ENDF-B/V rather than ENDF/B-VI (BNL-NCS-17541) cross-section libraries.

4. On page 2-8 of the SQN Topical Report the licensee states that for core power distribution control, acceptable margins to the F_Q and $F_{\Delta H}$ peaking limits are maintained such that the design bases continue to be met. Please quantify the margins remaining to the peaking limits for a tritium producing core at SQN.

5. SQN is proposing a significant increase in boron concentration in the Refuel Water Storage Tank (RWST) and the cold leg accumulators.

    a. Please discuss the NRC approved methodology used to calculate the proposed boron concentrations for the RWST and the cold leg accumulators. Provide a reference to the NRC staff SER for this methodology.

    b. The upper range of the proposed boron concentration in the RWST and the accumulators is 3800 ppm. Please discuss the technical basis for an upper limit on boron concentration for SQN, including the possibility of crystallization anywhere in the reactor coolant system and any associated auxiliary systems or equipment.

    c. Please discuss the impacts of the increased RWST boron concentration on SQN refueling operation and procedures. Include in this discussion the impact on the likelihood and severity of a boron dilution event during refueling operations.

6. On page 2-10 of the SQN Topical Report, the licensee states that, “the axial length and position, the number of TPBARs per cluster, and the TPBAR ^{6}Li loadings should be considered as representative and among the parameters at the core designer’s discretion to modify as necessary to achieve tritium production, design margin, and energy production goals.” Please discuss the administrative controls that are placed on the design such that safety limits are not exceeded, and the training that analysts receive for designing tritium producing cores.

7. On page 2-12 of the SQN Topical Report - To determine that the amount of tritium produced per rod will remain within the allowable maximum and minimum values the licensee considered uncertainties in various parameters. Please discuss the methodology used to ensure these uncertainties are conservative and applied conservatively.

8. On page 2-13 of the topical report, the licensee states that conservative augmentation factors were defined and applied to the limiting power peaking factors when peaking margins were calculated. These augmentation factors were applied to account for the effects of flux peaking caused by axial gaps between absorber pellets in a pellet stack or

between pellets in adjacent pencils. NUREG-1672 established a nuclear requirement that gaps between pellets shall cause power peaking of less than 3 percent for burnups less than 10,000 MWD/MTU and less than 5 percent for burnups above 10,000 MWD/MTU. Please discuss how these augmentation factors were calculated and applied, and the power peaking margins available.

9. To accommodate TPBARs, the licensee determined that four rod cluster control assemblies must be relocated in order to ensure shutdown margin requirements are satisfied. Please provide the technical basis for this proposed change, including a discussion of the analyses performed in support of this proposed modification and the NRC-approved methods used to perform these analyses. How does this modification impact the results of the Updated Final Safety Analysis Report, Chapter 15, transient analyses? Does the licensee plan to submit this proposed modification to the NRC for review and approval as part of a separate license amendment request package?

10. For an extended shutdown near End of Life the buildup of ^{3}He through tritium decay can have a significant impact on core reactivity. On page 2-16 of the SQN Topical Report the licensee states that the reactivity effects of an extended shutdown will be evaluated for each reload cycle in the cycle-specific reload safety evaluation and that guidance will be provided on the identification of conditions that could result in the need to reassess core power distribution limits and operational data prior to resumption of full-power operation following an extended shutdown. Please discuss the type of guidance which will be provided to the analyst and how each of these requirements will be administratively controlled.

11. In Section 2.4.4 of the SQN Topical Report the licensee states that the BWCMV-A and the BWU Critical Heat Flux correlations were utilized in performing DNBR analyses. Please provide technical justification regarding the applicability of these correlations for Babcock & Wilcox 17x17 fuel with the production TPBARs designed for SQN.

12. The licensee developed a 24-channel LYNXT model to evaluate the local coolant and surface temperature conditions within the thimble tubes occupied by TPBARs. Please provide a discussion and the technical basis for the lateral crossflow resistance factors applied between the thimble tube channels and surrounding channels.

13. In Section 2.15.2 of the SQN Topical Report the licensee states that all non-LOCA key safety analysis parameters for a core with TPBARs remain bounded by the parameters used in the current applicable safety analysis for SQN. The licensee does not provide any discussion regarding the magnitude of the impact that the TPBARs have on these key safety analysis parameters. Please discuss the impact of the TPBARs on the margin remaining to the assumed key safety analysis parameters. Include in this discussion the impacts of the change in most negative Doppler-only power coefficient at hot zero power conditions (discussed on page 2-14 of the SQN Topical Report).

14. In Section 2.15.5.1 of the topical report the licensee states that “there are instances when the thimble/TPBAR can be heated, rather than cooled by the fluid in the surrounding channels.” Please discuss these conditions and the expected increase in TPBAR temperatures. Why are these temperatures acceptable?

15. With respect to calculation of TPBAR temperatures, assumptions 2.15.5.1.5 and 2.15.5.1.7 of the SQN Topical Report include the following two statements which are not clear and need to be better defined, ". . . lack of significant steam flow" and ". . . low heatup rates." Please provide a more detailed quantitative discussion of what is meant by these two statements, including technical justification for these assumptions.

16. In Section 2.15.5.1 of the SQN Topical Report the licensee states that the boundary conditions (fuel rod temperatures and fluid conditions) for the TPBAR temperature calculations are taken from the Appendix K LOCA analyses of record. Modeling of the downcomer region and downcomer boiling have recently been shown to substantially impact peak clad temperature (PCT) and oxidation following a loss-of-coolant accident (LOCA), especially for ice condenser containments. Please discuss how the downcomer region and downcomer boiling are modeled in the SQN LOCA Appendix K evaluation model, and discuss any potential adverse impacts this modeling may have on PCT, oxidation, and TPBAR temperatures and oxidation.

17. Please provide references to the approved LOCA analysis methodologies applied for SQN. Also provide a statement that SQN and its vendor have ongoing processes which assure that LOCA analysis input values for peak cladding temperature-sensitive parameters bound the as-operated plant values for those parameters.

18. Please provide a complete description of the boric acid accumulation evaluation model that is used to establish compliance with Title 10, *Code of Federal Regulations*, Section 50.46(b)(5) and provide a complete assessment of model conservatisms and non-conservatisms. In addition, please compare your evaluation model prediction to your procedures for initiating hot-leg injection and assess conservatisms and non-conservatisms associated with the procedures.

19. Section 2.15.6.5 of the SQN Topical Report discusses the Steam Generator Tube Failure event. The licensee states that a conservative analysis of the potential offsite doses resulting from this accident is presented, including an updated thermal and hydraulic analysis, and that this analysis incorporates conservatively updated assumptions. Please provide a discussion of the updated thermal and hydraulic analysis that was performed to address TPBARs, including a comparison of the updated to the previous assumptions, and the updated sequence of events. Also, please provide the basis for assuming two TPBARs fail.

20. Regarding the thermal-hydraulic evaluation of the TPBARs discussed in Section 3.6:

    a. Please provide a listing of the NRC-approved analytical codes and methods used to evaluate the bypass flow and thermal performance of the TPBARs.

    b. Please quantify the margins remaining for thermal hydraulic acceptance criteria.

    c. Please discuss any uncertainty considered in these evaluations and provide justification for not applying additional uncertainties to power, temperature and pressure, which are assumed to be at nominal conditions. This is of particular interest for the no bulk boiling requirement which appears to have very little margin.

d. Please provide a profile for the bounding axial power shape that was used for these analyses and discuss how it was conservatively selected.

21. Section 3.7 of the NRC Staff SER (NUREG-1672) for the TPCTR states that “The higher reactivity worth of the lithium-6 in the TPC [tritium production core] relative to boron-10 used to control core reactivity, and the current experience base in producing lithium-6 enriched aluminate, impose a tight lithium-6 loading tolerance of 0.030 g/inch ±4.2 percent (±0.00125 g/inch) on an individual pencil basis.” Section 3.7 of the SQN Topical Report revises this to a range of 0.028 to 0.040 ±0.00125 g/inch. Please provide the technical justification for this change, including the methods used to assess the change and the impacts on core reactivity.

22. Section 3.7.3 of the SQN Topical Report includes a discussion of operation with catastrophic TPBAR failure. Please provide an outline of the types of decisions the operators will need to consider in order to ensure that power operation could continue without adverse consequences to fuel design and safety limits.

23. Table 4-1 of the SQN Topical Report, Section 5.4.7 summarizes the plant specific evaluation performed to determine the net effect of TPC on residual heat removal (RHR) System cooling capability.

    a. Did this analysis consider the increased heat load from the spent fuel pool cooling system as a result of TPBARs being stored in the spent fuel pool?

    b. Please quantify the impacts of a TPC on the time required for the RHR system to cool the reactor coolant system assuming both two-train (normal) and single-train cooldowns.

24. SQN is requesting a number of Technical Specifications associated with Spent Fuel Pool Storage requirements (TS 5.6), including restrictions for each storage region, fuel types which can be stored in each region, acceptable spent fuel loading patterns, limiting burnup requirements by region and fuel type, and other changes. SQN has not submitted any technical justification for these proposed changes. Please provide the technical justification for all of the Spent Fuel Pool Technical Specifications changes being requested. For the proposed changes, include:

    a. A summary of applicable design features, licensing basis and relevant regulatory standards and acceptance criteria.

    b. A discussion on the analyses performed including a reference to NRC-approved methodology and the applicability of the methodology.

    c. Results of the analyses supporting the proposed TS changes and demonstrating that any acceptance criteria and regulatory requirements are satisfied.

25. The submittal states that the calculated fluence values were calculated using methods recommended in Regulatory Guide (RG) 1.190. In addition it states that the best estimate values used were determined using a bias factor calculated by comparing calculated surveillance capsule dosimetry. Please clarify:

a. Whether a staff approved methodology was used for the estimation of the 48 effective full-power years fluence values

b. If the measured dosimetry data used for the estimation of the bias factor were plant specific data, and

c. If the peak vessel fluence values calculated for the recent 1.3 percent power uprate were affected by the introduction of the TPBARs

26. Table 3.3-1 in the TPCTR listing 12 functional requirements, how does the licensee address the compliance to these requirements for the TPBAR in 550-effective-full-power day exposure?

27. Please address plant specific evaluations required for the TPBARs in a tritium production core as described in Table 3.3-6 of the TPCTR.

28. The consolidation of TPBARs, including related accidents and their potential consequences, were not addressed in NUREG-1672. In Enclosure 4 to its letter of September 21, 2001, the Tennessee Valley Authority (TVA) stated that no more than 24 TPBARs would be damaged for all credible impact scenarios involving a fully-loaded (300 TPBARs) consolidation canister. Based on design features and operating practices that would be applied to handling of consolidation canisters, TVA stated that the maximum credible kinetic energy of a consolidation canister would be less than that of a dropped fuel assembly and that damage to more than 24 TPBARs was precluded for all credible impact scenarios. Accordingly, the consequences from a fuel-handling accident involving a fuel assembly containing an inventory of 24 TPBARs would bound fuel-handling accidents involving a consolidation canister.

    This approach appears to be neither consistent with regulatory guidance for review of fuel handling facilities (RG 1.13, “Spent Fuel Storage Facility Design Basis,” Safety Guide 25, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors,” and Sections 9.1.4, 9.4.2, and 15.4.7 of NUREG-0800, “USNRC Standard Review Plan”) nor regulatory guidance for review of heavy-load handling systems (NUREG-0612, “Control of Heavy Loads at Nuclear Power Plants”). The regulatory guidance for review of fuel handling facilities specifies that the maximum potential release due to an unrestrained drop of a light load from its maximum potential height be evaluated and the resultant consequences are within regulatory limits. The regulatory guidance for review of heavy-load handling systems specifies a complete set of design features and operational controls to ensure reliable performance of the load handling system in preventing damage to important structures, systems, and components. The information in Enclosure 4 to the letter dated September 21, 2001, does not address the maximum potential release from a consolidation canister, nor does it describe implementation of a complete set of design features and operational controls to ensure reliable performance of the load handling system in preventing damage to important structures, systems, and components.

In order to complete its review, the NRC staff requests that TVA provide either of the following evaluations:

(a) An evaluation of the maximum potential radiological consequences from a fuel-handling accident involving a consolidation canister. This evaluation should consider potential releases resulting from an unrestrained drop of a light load from its maximum potential height and address all potential impact combinations involving fuel assemblies and loaded consolidation canisters.

(b) An evaluation comparing design features, operational controls, and analyses planned for implementation with those specified in the applicable section of NUREG-0612. This evaluation should address each specified item separately by describing what is planned for implementation and the basis for any difference in scope or depth relative to what is specified in NUREG-0612.

29. Section 9.1.4.3.5, “Shipping Cask Integrity,” of the SQN Final Safety Analysis Report describes that the radioactivity release from a fuel shipping cask drop event would be bounded by the release from the design-basis fuel handling accident. In Enclosure 4 to its letter of September 21, 2001, the TVA described that the loaded TPBAR shipping cask would be removed from the cask loading pit prior to completion of packaging for transportation. It is not clear that the radiological consequences from a dropped TPBAR shipping cask would be bounded by the evaluation of a fuel-handling accident involving a fuel assembly containing TPBARs. A review of the licensing basis for SQN indicates that the auxiliary building crane has not been designed to single-failure proof standards specified in NUREG-0554, “Single-Failure Proof Cranes for Nuclear Power Plants,” and, therefore, shipping cask drops are credible design basis events.

In order to complete its review, the NRC staff requests that TVA provide either of the following evaluations:

(a) An evaluation of the maximum potential radiological consequences from a TPBAR shipping cask drop prior to sealing the cask and certifying it for shipment. This evaluation should consider the maximum lift height and maximum potential tritium release resulting from a drop of that height.

(b) an evaluation comparing design features, operational controls, and analyses planned for implementation during TPBAR shipping cask lifts with those specified in the applicable section of NUREG-0612. This evaluation should address each specified item separately by describing what is planned for implementation and the basis for any difference in scope or depth relative to what is specified in NUREG-0612.

30. Although the change in spent fuel pool decay heat load resulting from irradiation of TPBARs is marginal, TVA has proposed a significant increase in the maximum spent fuel pool decay heat load. The additional decay heat load would result from fuel transfers to the spent fuel pool with shortened decay times. By utilizing margin in cooling capability associated with conservative values for component cooling water temperature and heat exchanger performance, the additional heat load does not result in an increase in spent fuel pool temperature. However, this change does significantly

reduce the time-to-boil following a loss of spent fuel pool cooling and increase the maximum rate of coolant loss by evaporation. These changes reduce the overall reliability of evaporative cooling. Describe administrative controls that are or will be in place that ensure the reliability of the forced cooling system will be consistent with its importance to safety under high heat load conditions, such as the minimum required availability of forced cooling trains and associated support system trains (e.g., service water and component cooling water).

Mr. J. A. Scalice
Tennessee Valley Authority

SEQUOYAH NUCLEAR PLANT

cc:
Mr. Karl W. Singer, Senior Vice President
Nuclear Operations
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Jon R. Rupert, Vice President (Acting)
Engineering & Technical Services
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Richard T. Purcell
Site Vice President
Sequoyah Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Soddy Daisy, TN 37379

General Counsel
Tennessee Valley Authority
ET 11A
400 West Summit Hill Drive
Knoxville, TN 37902

Mr. Robert J. Adney, General Manager
Nuclear Assurance
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Mark J. Burzynski, Manager
Nuclear Licensing
Tennessee Valley Authority
4X Blue Ridge
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Pedro Salas, Manager
Licensing and Industry Affairs
Sequoyah Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Soddy Daisy, TN 37379

Mr. D. L. Koehl, Plant Manager
Sequoyah Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Soddy Daisy, TN 37379

Mr. Russell A. Gibbs
Senior Resident Inspector
Sequoyah Nuclear Plant
U.S. Nuclear Regulatory Commission
2600 Igou Ferry Road
Soddy Daisy, TN 37379

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

County Executive
Hamilton County Courthouse
Chattanooga, TN 37402-2801

Ms. Ann P. Harris
341 Swing Loop Road
Rockwood, Tennessee 37854