September 27, 1994

Mr. Oliver D. Kingsley, Jr.
President TVA Nuclear and
Chief Nuclear Officer
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

Dear Mr. Kingsley:

SUBJECT: WATTS BAR NUCLEAR PLANT - SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVES (TAC NOs. M77222 AND M77223)

By letter dated September 2, 1994, the NRC staff requested Tennessee Valley Authority (TVA) to provide additional information on the Watts Bar Severe Accident Mitigation Design Alternatives (SAMDA) analysis.

On September 12, 1994, the staff and TVA held a telephone call to clarify the questions in the staff's September 2, 1994, letter. As a result of the telephone call, the staff revised its questions and added two additional questions.

By letter dated September 20, 1994, the staff issued a revised list of information requested. The September 20, 1994, request for additional information superseded the staff's earlier request. Subsequent to the September 20, 1994, letter, the staff has identified several areas in which further information is necessary. The enclosed list of information supplements the staff's September 20, 1994, request. A prompt response is necessary to minimize any possible delay in the completion of this review.

This requirement affects less than ten (10) respondents, and therefore, is not subject to Office of Management and Budget review under Public Law 96-511.

Sincerely,
Original signed by:
Scott F. Newberry, Director
License Renewal and Environmental Review
Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of Nuclear Reactor Regulation

Docket Nos. 50-390
and 50-391

Enclosure: Watts Bar
Revised SAMDA RAI

cc w/enclosures:
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ENCLOSURE

Supplement to Watts Bar SAMDA RAI

15. Based on information provided in Section 3.2.1 of the Value Impact Analysis, it does not appear that averted onsite costs (AOSC) have been considered in determining the cost benefit ratio for any of the design alternatives. It is NRC's current policy that in the consideration of cost-benefit related to design alternatives, averted onsite costs should be accounted for in the cost benefit equation as reductions in the costs associated with the proposed design alternative. (Typical costs include the cost of replacement power, plant cleanup, and decontamination, as well as other costs). In this regard, please provide a reassessment of the potential design improvements considering AOSC where appropriate. In addition to providing the resulting cost benefit ratios, please include your estimates for each of the factors or attributes contributing to the ratio result (e.g., $ value of person-rem averted, implementation costs, AOSC, etc.) such that the NRC would be able to calculate the "Net Benefit" of the proposed design alternative. As part of this response, please identify the preventive and mitigative benefits of each design alternative separately, and provide an accounting of the impact of the design alternative on the frequency of each accident class and release class.

16. In a 9/19/94 telecon, TVA indicated that they will revise the value impact analysis to take credit for the two design alternatives that they have already committed to implement (design alternatives I.1 and II.1). Describe and justify the credit that will be taken for the these design alternatives in terms of reducing the baseline core damage frequency and risk for Watts Bar. Include a discussion of the related human error probabilities and the bases for these values (such as estimated time available for operator actions in representative sequences, and the instrumentation on which the operators are to make their decisions).

17. As described in Section 2.3 of the Value Impact Analysis, both the frequency of large early releases and the early fatality risk is dominated by SGTR events. However, none of the design alternatives considered by TVA appear to be directed at reducing the frequency or consequences of SGTR events. Such design alternatives could include improved instrumentation for responding to SGTR events (N-16 monitors), improved depressurization capabilities or procedures to terminate releases in unisolatable SGTR events, or additional systems to scrub fission product releases or to route these releases back to containment. In view of the importance of SGTR to total risk for Watts Bar, please justify the adequacy of the alternatives considered with respect to this risk contributor. Include an assessment of the feasibility of the above design alternatives in your response, and a cost benefit analysis for any improvements judged feasible.

18. Based on information provided in Section 4.5.7, it appears that the benefits of the reactor depressurization system would be limited to reducing the threat of DCH and induced failure of the steam generator tubes and RCS piping. Please explain why enhanced reactor system depressurization would not offer additional benefits of reducing source terms for unisolated SGTR events by eliminating the driving head.

19. Provide the total frequency of all core damage events that involve reactor coolant pump seal LOCA (as either sequence initiators or consequential events), and a breakdown of this frequency in terms of initiating events and support system failures that contribute to seal failure. Discuss which contributors are eliminated or reduced by each of the RCP seal-related design alternatives.

20. Provide a more detailed discussion and cost breakdown for the independent RCP seal cooling system evaluated as design alternative IV.2. Discuss the feasibility of using an existing hydro test pump for seal injection, and provide a cost benefit analysis for this alternative.

21. Please describe how importance analyses were used to derive risk reduction estimates for the three design alternatives related to improved hydrogen control (V.1, V.5, and V.9). The reported risk reduction worth of hydrogen burns for early containment failures (0.99635) appears to be inconsistent with the 3 perecent contribution of hydrogen burn to early failure reported in Table 3 of the Executive Summary.

22. Design alternatives V.3 (filtered vent) and V.4 (core retention device) would not generally be effective in eliminating the risk associated with containment failures at vessel breach. However, the risk reduction estimates reported in Sections 4.5.3.4 and 4.5.4.4 appear to take full credit for eliminating this component of risk. Please provide an estimate of risk reduction for each of these design alternatives assuming no credit for eliminating containment failure at vessel breach.

23. The existing hydrogen igniters would need to be powered from an AC independent power system in order to derive the risk reduction benefit estimated for design alternative V.9 (adding AC independent air return power supplies). Clarify whether this design alternative includes connecting both the air return fans and the existing hydrogen igniters to the new power supply.

24. Steam Generator Tube Ruptures (SGTRs): Table 3 on page ES-6 indicates that SGTRs contribute 76 percent to large early releases. The staff in SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor Designs", required applicants for design certification to assess design features to mitigate the amount of containment bypass leakage that could result from SGTRs. Provide an assessment of the following design features that could mitigate the releases associated with SGTRs:

    a. a highly reliable (closed loop) steam generator shell-side heat removal system that relies on natural circulation and stored water sources

    b. a system which returns some of the discharge from the steam generator relief valve back to the primary containment

    c. an increased pressure capability on the steam generator shell side with a corresponding increase in the safety valve setpoints

25. Section 4.5.1 discusses installation of an additional active deliberate hydrogen ignition system. Provide an assessment for addition of passive means for controlling hydrogen production, such as passive hydrogen recombiners or passive hydrogen igniters. (Ref.: Electric Power Research Institute, "Qualification of Passive Autocatalytic Recombiners for Combustible Gas Control in ALWR Containments," April 8, 1993.)

26. Section 4.5.2 discusses installation of an active reactor cavity flooding system with substantial costs. More modest enhancements could be envisioned.

    a. Provide an assessment of the potential for reactor cavity flooding using water from dead-ended volumes, the condensed blowdown of the reactor coolant system, or secondary system by drilling pathways in the reactor vessel support structure to allow drainage from the steam generator compartments, refueling canal, sumps, etc. to the reactor cavity. Provide as assessment for allowing drainage of water from melted ice into the reactor cavity. The equilibrium water levels within the reactor cavity from the RCS condensate and melted ice should be assessed to determine if they could potentially prevent reactor vessel melt-through (external vessel cooling) or just provide cooling for core debris in the reactor cavity.

    b. Discuss the potential for reactor cavity flooding through overflow of cavity compartments with systems such as diesel driven fire pumps.

27. Section 4.5.4 discusses installation of a core retention device; however, it is unclear whether the device is designed to protect the containment liner from core dispersion under high pressure sequences or protect the liner beneath the reactor cavity in low pressure sequences. Provide a separate discussion of the system aspects for these two different scenarios.

28. Provide an assessment of any new innovative methods of protecting the containment liner from core debris, such as Core-Melt Source Reduction System. (Ref.: Forsberg, C.W., Beahm, E.C., and Parker, G.W., 1993, "Core-Melt Source Reduction System to Terminate LWR Core-Melt Accidents," ASME/JSME Nuclear Engineering Conference - Volume 1.)

29. Appendix B, p. B-4 discusses use of the diesel fire systems for injection to the containment sprays or the steam generators. Where is this system evaluated in the value-impact assessment? Provide a thorough discussion of the necessary procedures for accomplishing this and cost estimates for spool pieces, etc. It doesn't appear as though this system was considered in enhancement V.2, Reactor Cavity Flooding System, V.8, Independent Containment Spray System, or its benefits for providing hydrogen mixing.

Mr. Oliver D. Kingsley, Jr.
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WATTS BAR NUCLEAR PLANT

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