UNITED STATES
NUCLEAR REGULATORY COMMISSION
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March 30, 2011

Mr. Ashok S. Bhatnagar
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SUBJECT: WATTS BAR NUCLEAR PLANT, UNIT 2 – SUPPLEMENTAL REQUEST FOR ADDITIONAL INFORMATION REGARDING SEVERE ACCIDENT MANAGEMENT DESIGN ALTERNATIVES REVIEW (TAC NO. MD8203)

Dear Mr. Bhatnagar:

By letter dated October 14, 2010 (Agencywide Documents Access and Management System Accession No. ML102910629), the Tennessee Valley Authority (TVA) submitted an updated severe accident management design alternatives (SAMDA) analysis for Watts Bar Nuclear Plant, Unit 2. In response to a request for additional information (RAI) from the Nuclear Regulatory Commission (NRC) staff, TVA responded in a letter dated January 31, 2011 (Accession No. ML110340347) to questions regarding this analysis.

In an effort to complete the NRC staff review, enclosed is an RAI regarding the SAMDA analysis.

A response is required 14 days from the date of this letter.

If you should have any questions, please contact me at 301-415-2048.

Sincerely,

Patrick D. Milano, Sr. Project Manager
Watts Bar Special Projects Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-391

Enclosure:
Request for Additional Information

cc w/encl: Distribution via Listserv

SUPPLEMENTAL REQUEST FOR ADDITIONAL INFROMATION

WATTS BAR NUCLEAR PLANT, UNIT 2

SEVERE ACCIDENT MITIGATION DESIGN ALTERNATIVES

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-391

By letter dated January 31, 2011, the Tennessee Valley Authority (TVA) provided a response to the Nuclear Regulatory Commission (NRC) staff regarding questions related to TVA's Updated Analysis of Severe Accident Mitigation Design Alternatives (SAMDAs) for Watts Bar Nuclear Plant (WBN), Unit 2. In its review of this information, the NRC staff requires further information and clarification on TVA's response. The information listed in the following request for additional information (RAI) refers to the RAI responses in the January 31, 2011, letter.

1. RAI 1.a

   a. Provide the core damage frequency (CDF) and the large early release frequency (LERF) for the WBN Unit 2 model reviewed in November 2009 by the Westinghouse Owners Group (WOG).

   b. The only difference between the model reviewed by the WOG and the independent plant examination (IPE) model appears to be changes made to resolve findings and observations. Describe the most significant changes made in the peer-reviewed model to obtain the IPE model.

2. RAI 1.f

   The response did not address the assumptions concerning the availability of WBN Unit 1 components/systems for both dual-unit and Unit 2 initiating events. Discuss how the availability of Unit 1 systems during Unit 1 outages is accounted for in evaluating WBN Unit 2 CDF and LERF.

3. RAI 1.h

   a. The response to the RAI states "The following peer cert findings remain open and are considered documentation related (i.e., are judged to not have the potential for significant change to model results or risk ranking): ..." Among the findings listed, the following, from the description in the IPE, do not appear to be limited to just documentation:

   (1) 1-4 (DG [diesel generator] load sequencer) – states certain failures are missing from the logic model,

   (2) 2-11 (T-H [thermal-hydraulic] timing for HRA [human reliability analysis] cues, no simulator runs) – does this mean the runs were not performed, or that they were performed but not documented, and

   (3) 5-1 (Optimistic room heatup times used).

Provide further justification that each of these items is only a documentation issue and that final resolution is unlikely to impact the SAMDA evaluation.

b. TVA stated (p. E1-13), with reference to internal flooding, that "the current model is judged to be adequately bounding for this application," which is based on conservatisms in the flooding model described in the response. While this may be true, there are a large number of open internal flood findings from the peer review and an updated flooding analysis is to be included in the next model update. Section 3.7 (p. 70) of the WBN Unit 2 IPE submittal states that two sets of sensitivity studies were performed on the internal flooding analysis, with one set focused on evaluating alternative design/procedural changes that would significantly impact (i.e., reduce) the flood related CDF and LERF while the other was designed to address epistemic uncertainties identified in the WBN internal flooding probabilistic risk assessment (PRA). Provide a description of these studies, their results and conclusions, and how the results and conclusions support the conclusion that the current flooding model is bounding for the SAMDA application.

4. RAI 2.a.ii and iii

The response to these RAIs discussing mapping the containment event tree (CET) end states to release categories states (p. E1-37) that "Single linked-fault tree Level 2 End State gates are defined for each of the major contributors to each of the 4 Release Categories." Describe what is meant by "major," what is left out of the quantification of release categories, and the significance of contributors not accounted for in the release categories.

5. RAI 2.a.iv

a. The discussion of the determination of release category characteristics (i.e. source terms) indicates that the SEQSOR methodology was used. This methodology does not calculate release fractions from first principles but uses input from other calculations and has been used in the past for Sequoyah. The WBN Unit 2 IPE submittal discusses the use of Modular Accident Analysis Program (MAAP) 4.0.7 for the LERF analysis. Clarify the origin of the source terms used for the SAMDA analysis. Note that in the July 23, 2010, TVA response to RAI 2.f, TVA took the position that results from MAAP analysis were more valid than those from SEQSOR. Clarify this apparent change in TVA's position.

b. The discussion of the source terms states that the, "The source terms for each set of accident characteristics are weighted in accordance with the % contribution for each release type in Table 2.a.iv-3." This process is valid only if the consequences of the releases are linear with respect to the source terms. This is not necessarily true. Provide support that this process provides a valid estimate of consequences.

c. The discussion of release category definitions and contributors in response to RAI 2.a.ii and iii indicates that early steam generator tube ruptures (SGTRs) are assigned to the BYPASS release category under the contributor LERF-SGTR (SLERF) corresponding to the SLERF CET end state. The WBN Unit 2 IPE indicates that thermally induced SGTRs make up 32 percent of the WBN Unit 2 LERF. The SLERF end state is not

included in the RAI revised model dominant CET end states listed in Table 2.a.iv-2. It is noted that plant damage state (PDS) bin 4B1, which, according to Table 2.a.i-2, is made up of large SGTR sequences, is not represented in the dominant CET end states. Clarify the reason for this and describe the SGTR contribution to WBN Unit 2 consequences.

d. The development of the RAI revised source term characteristics given in Table 2.a.iv-3 includes four contributors to the late release category, whereas Table 2.a.iv-2 identifies six dominant CET end states from three different PDS bins. Explain the development of the four late release category contributors and their weighting.

e. Table 2.a.iv-6 gives the October 2010 RAI offsite population dose for release category III as 8.19E06 person-rem. This is a significant increase over the original October 2010 result of 1.13E06 person-rem, and when multiplied by the release category frequency of 1.3E-05 per year gives an annual population dose of 107 person-rem. This is a factor of 10 higher than that given in Table 5.c-1. Confirm that the value in Table 2.a.iv-6 should be 8.19E05 person-rem.

f. Provide the revised Off-Site Exposure Cost and Off-Site Economic Cost used to develop the maximum averted cost risk (MACR) as given in Section 5.1 and 5.2 of the October 14, 2010, RAI response submittal (and On-Site Exposure Cost in Section 5.3 and On-Site Cleanup and Decontamination Cost and Replacement Power Cost in Section 5.4 if these have changed for any reason) of the October 14, 2010, submittal.

6. RAI 2.c

The response to RAI 1.a (p. E1-4) gives the WBN Unit 2 LERF as 1.70E-06 per year while the sum of release categories 1 and 2 frequencies is 1.61E-06. Discuss the reasons for this difference.

7. RAI 4.a.i

a. The last paragraph on page E1-80 indicates that all basic events with a risk reduction worth (RRW) of 1.007 or higher were reviewed for all types of SAMDAs – hardware and operator error improvement. Confirm that the reference to an RRW of 1.007 in this paragraph is an error and should be an RRW of 1.026, since the following paragraph states that the review is "further extended" down to an RRW of 1.007.

b. In Table 4ai-1, no SAMDAs are identified for SEQFD2A-A and SEQFD2B-B. The justification appears to be the citation of the entry for diesel generator failure, which is addressed by a number of SAMDAs ranging from a new 2 MW DG to bypassing DG trips. None of these directly address the sequencer failure such as the possibility of manual loading of the DG following sequencer failure. Sequencer failures contribute a total of about 2.3 percent to the CDF, which would correspond to a benefit of approximately $200,000 at the 95th percentile. Discuss this possibility.

8. RAI 4.a.ii

The response to this RAI develops a lower RRW cutoff, apparently based on only RC2 on the stated basis that reducing the LERF frequency had the greatest impact for bypass sequences (i.e., RC2). RC2, however, due to its low frequency, contributes only a small amount (~1 percent) to the overall MACR and consequently eliminating the risk completely would only have a very small benefit (approximately $120,000). How the lower RRW cutoff values given were determined is not clear. Also, the basis (RC2 or both RC1 and RC2) for the event ranking and the associated RRW values in Table 4.a.ii-1 is not clear. The importance of the events in Table 4.a.ii-1 appear to be essentially the same (after converting RRW to F-V) as in Table 15.h of the October 14, 2010, submittal. Provide additional clarification on these issues.

9. RAI 4.d

The response to this RAI provides a good review of fire risk contributors and potential actions that might be taken to reduce these risks. In Table 4.d-1, newly identified SAMDA 314, "Enhance training for local control of AFW [auxiliary feedwater] given station blackout, loss of control air, or fires affecting AFW LCVs [level control valves]," is indicated to have already been implemented, citing previous commit to SAMDAs 285 and 299. While these SAMDAs cite enhancements to training in a general sense, neither appears to specifically address the training enhancement needed for SAMDA 314. Provide a specific citation that incorporates the requirements of SAMDA 314.

10. RAI 4.e.ii

The response to this RAI indicates that one reason that SAMDA 29 is not feasible is that the use of a diesel-driven fire pump for injection would require AC power to provide DC power after battery depletion to allow the power-operated relief valves (PORVs) to remain open. It would appear that a much smaller AC power source would suffice to allow the PORVs to remain open than that which would be required to operate the residual heat removal and other pumps to provide cooling. Further it is stated that depressurization to the point of allowing the fire pump would be challenging for the operator. Such actions are, however, proceduralized in TVA procedure SAG-2 (7/23/10 response to original SAMDA RAIs, p. E1-41). While a recirculation path may ultimately be needed, it is conceivable that containment flooding would not be an issue until very late in the scenario. Provide additional discussion of this SAMDA to support its screening.

11. RAI 4.e.v

The response to this RAI indicates that the significant room cooling failures are the centrifugal charging pump (CCP) area, the turbine-driven auxiliary feedwater pump room and the DG switchgear rooms. Provide the status of procedures and/or availability of necessary portable equipment (such as fans and ducting) that would reduce the likelihood of equipment failures due to room cooling failures for each of these areas. If not included in procedures or portable equipment is not available, discuss the feasibility and cost benefit of such SAMDAs addressing these failures. While as is stated for SAMDA 337, that for the CCP area there are no direct alarms or indications in the control room concerning the room

cooling failure, it is possible that the room cooling failures would be discovered by other means such that having portable fans available would provide a benefit.

12. RAI 5.e

The response to this RAI concerning SAMDA 70 discusses changing the cognitive portion of the human error for events HAFR1 and HAAF1. It is noted that the former event is incorporated in several dependent human error events including HRADEP-POST-221 and –180. Clarify whether these dependent human errors changed when the benefit of this SAMDA was determined. If not, discuss the impact of these changes on the result, noting that this SAMDA has a benefit/cost ratio of 0.99 considering uncertainty. Note also that if the 95th percentile to point estimate ratio of 2.78 is used in the uncertainty analysis instead of the 2.70, which is the ratio of the 95th percentile value to the mean, this SAMDA becomes slightly cost beneficial. Provide a revised evaluation of this SAMDA that accounts for these issues and the stated conservatism in the benefit calculation.

13. RAI 5.f

It is noted that there is no reduction in CDF for SAMDA 93. The usual purpose of containment venting is to prevent core damage for loss of containment heat removal sequences where the functioning core injection systems would fail upon containment over pressure failure. The importance of these sequences for WBN Unit 2 is not known. Discuss the reason why there is no CDF reduction for this SAMDA.

14. RAI 5.g

The response to this RAI discusses a number of different sensitivity studies for the assumptions used to evaluate SAMDA 110. Several results are provided, none of which correspond with that given in Table 2.a.iv-8 for this SAMDA. Clarify this and indicate the external events multiplier used in the response to this RAI.

15. RAI 6

This RAI requested an assessment of the impact of uncertainty on the Phase I screening of SAMDAs due to either excessive cost or very low benefit similar to that given in response to the original RAI 7.a. The response to this new RAI does not provide this assessment. While Table 19 of the October 14, 2010, SAMDA submittal is cited, this table addresses the impact of uncertainty on the Phase II cost benefit analysis not the Phase 1 screening. The current marginal MACR is a factor of 2.6 times that on which the original screening was performed, while the risk profile of the current PRA is considerably different from that used in the original screening. These changes could impact the judgments made in the Phase I screening without requiring a Phase II cost evaluation. Provide the requested assessment.

16. Cover Letter

With respect to SAMA 58, TVA has committed to follow the progress and experience with the new Westinghouse seal package design, and if proven reliable during operation, to install the new package at WBN Unit 2. While it is true that SAMDAs 215 and 226 are mutually exclusive and installation of the new seal would preclude the necessity for other

means of reducing reactor coolant pump seal failures such as SAMDA 215 or 226, there is no commitment to implement either SAMDA 215 or 226 (which are cost beneficial considering uncertainty) should the new seal design not be implemented at WBN Unit 2. Describe the process TVA would use to evaluate SAMDAs 215 and 226 in the eventuality that SAMA 58 is not implemented.

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