August 20, 2004

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

SUBJECT: REQUEST FOR ADDITIONAL CLARIFICATION REGARDING SEVERE ACCIDENT MITIGATION ALTERNATIVES FOR THE BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3 (TAC NOS. MC1768, MC1769, AND MC1770)

Dear Mr. Singer:

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed Tennessee Valley Authority's (TVA) July 7, 2004 response to a request by the NRC staff dated April 28, 2004, for additional information regarding severe accident mitigation alternatives (SAMAs) for the Browns Ferry Nuclear Plant, Units 1, 2 and 3. The NRC staff requests additional clarification on several issues. This additional information is needed to complete the staff's SAMA review for license renewal. Enclosed is the staff's request for additional information or clarification.

We request that you provide your responses to these RAIs by September 20, 2004, in order to support the license renewal schedule. If you have any questions, please contact me at (301) 415-1191 or email at MTM2@nrc.gov.

Sincerely,

/RA/
Michael T. Masnik, Senior Project Manager
Environmental Section
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260 and 50-296

Enclosure: As stated

cc w/enclosure: See next page

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BFNP SAMA Follow-up Items for Discussion with Tennessee Valley Authority

Part I. Questions Pertaining to the July 7, 2004, Tennessee Valley Authority (TVA) Submittal

Numbering of the following questions is consistent with the numbering in the July 7, 2004, TVA submittal.

1c. The core damage frequency (CDF) for each unit decreased significantly from the individual plant examination (IPE), Revision 0 to the probabilistic safety assessment (PSA) Revision 0 update and then increased in the extended power uprate (EPU) PSA revision. The response to the staff's April 28, 2004 request for additional information (RAI) 1c summarized the changes made to each of these models. Identify which of these changes had the most significant impact on CDF.

1d. The response to RAI 1d indicates that Table III-5 in Attachment E-4 refers to the definition of the key plant damage states (KPDSs) in the IPE and the corresponding definition of cases for which MAAP runs were made at that time. It also states that the plant damage state (PDS) assignment rules used to identify the PDS for each Level 1 accident sequence remain the same as the IPE. It is also stated in the original submittal (Attachment E-4, Section III.B, p.E-416) that the KPDSs are the same as in the 1992 IPE submittal.

A comparison of the KPDSs identified for the severe accident mitigation analysis (SAMA) analysis with those listed in the IPE indicates that there are some differences including: 8 KPDSs in the SAMA analysis and either 9 or 10, depending on table of the IPE; 3 KPDSs in the IPE that are not included in the SAMA list and 2 KPDSs in the SAMA list that are not in the IPE. KPDS PIH is described in the response to RAI 1d and has a frequency of 1E-12 versus 3E-05 in the IPE. It is stated that station blackouts sequences are mapped to KPDS MIB since drywell sprays (DWS) can operate due to the crosstie with Unit 3's electric power.

a. Provide a version of Table III-5 which includes the Level I sequences that are the major contributors to the KPDSs.

b. Discuss the discrepancies between the KPDSs used for the SAMA analysis versus those identified for the IPE.

c. Discuss why the frequency of KPDS PIH has been reduced by six orders of magnitude with the PDS assignment rules being the same as for the IPE.

d. Discuss the modeling of use of the electric cross tie to Unit 3 for Unit 2 station black out (SBO). Wouldn't DWS fail for some of the SBO sequences? To what KPDSs are these sequences assigned?

1d. The response to RAI 1d indicates that the release categories (RC) used in the MACCS2 analysis have a one-to-one relationship with the KPDSs. In the IPE, the KPDSs are mapped to key RCs utilizing a containment event tree. The discussion in Section 4 of the IPE appears to indicate that KPDSs may be assigned to more than one RC.

a. Discuss the basis for assigning a one-to-one relationship between KPDSs and RCs.

b. Describe the source of the release fractions for the RCs as shown in Table II-4. If these are based on MAAP analysis, please provide a comparison of the accident sequence analyzed with the major contributors to the PDS/RC and discuss the relevance, conservatism and nonconservatism of the sequence analyzed and chosen to be representative of the PDS/RC.

1f. The response to RAI 1f states that neither KPDSs MIA nor OIA are expected to lead to containment failure, but that these KPDSs are nevertheless assumed to lead to early and late containment failure, respectively. Discuss the rationale for assuming these KPDSs lead to containment failure, particularly given the relaxations on the use of drywell sprays in Revision 2 of the Emergency Procedure and Severe Accident Guidelines, and given that this assumption results in the intact containment release mode contributing over 50% of the total person-rem dose.

2b. The SAMAs listed for large early release frequency (LERF) 10 are not appropriate for the described category. B12 is for anticipated transient without scram (ATWS) and G17 has to do with tripping pumps if not needed for loss of heating ventilation and air conditioning (HVAC). Provide additional justification that this contributor is addressed by candidate SAMAs.

2d/3. The contribution to CDF from loss of raw cooling water (RCW) initiators has increased by a factor of 76 and accounts for 20% of CDF in the multi-unit PRA (see RAI 3 response). Although this contribution could be reduced by taking credit for the residual heat removal (RHR) cross-tie, this would not solve all problems on loss of RCW. Provide the importance of the RCW system. Address whether a low cost SAMA involving use of fire water would be effective for this risk contributor.

3. The response to RAI 3 states that higher CDF values for three unit operation would be anticipated due to shared systems including: diesel generators, emergency equipment cooling water system (EECW), residual heat removal service water system (RHRSW) and raw cooling water. It addresses the variation in the "all unit operating adjustment factor" from sequence to sequence by considering the conservatism in the multi-unit PRA analysis for those initiating events with factors greater than 4. While the diesel generators are demanded by the loss of offsite power (LOSP) initiator and the raw cooling water system is a support system initiator, the impact of three unit operation on sequences that involve the EECW and RHRSW are not specifically addressed. If the importance of these systems are sufficiently high and the impact of 3 unit operation on their availability is sufficiently high, SAMAs that affect these systems could have an impact greater than the factors based on the total CDF. What is the ratio of the importance of the Unit 2 EECW and RHRSW systems (that is, the CDF involving failures of these systems) in the multi-unit probabilistic risk assessment (MUPRA) to that in the1995 PRA? Should SAMAs for these systems be considered?

In the response to RAI 3, the impact of 3 unit operation on the CDF due to the small turbine building flood is discussed. The meaning of the last sentence is not clear. To what is the factor of 5.5 applied?

4a. In the response to RAI 4a, the total control room fire CDF is given as 3.05E-06. In addition, the impact of a redundant remote shutdown panel is given as a reduction in CDF of 2.66E-07.

a. The safety evaluation report/technical evaluation report (SER/TER) for the individual plant examination of external events (IPEEE) gives a total control room fire CDF of 5.6E-06 due to the inclusion of fires in Unit 1 panels causing control room evacuation. Discuss the appropriateness of this value versus the RAI response estimate of 3.05E-06.

b. The reduction in control room fire CDF due to a redundant remote shutdown panel is less than 10%. Explain how this was determined. Why is it so small?

c. Are there any less extensive candidate SAMAs that would impact the fire risk than a redundant remote shutdown panel?

5a/b. The fire CDF is estimated at 9.8E-6 for Unit 2 in the Browns Ferry Nuclear Plant (BFNP) IPEEE and 1.24E-05 in the SER/TER. The Unit 2 fire IPEEE utilizes the IPE/PRA, Revision 1 for the quantitative portion of the analysis. What is the total CDF for this revision of the internal events PRA? Similarly, for the Unit 3 fire IPEEE, a version of the above Unit 2 IPE/PRA, Revision 1 was used for the quantitative portion of the analysis. What is the internal events CDF for the PRA used in the Unit 3 fire IPEEE?

6. Uncertainty for ATWS sequences could be greater than the factor of 3 considered, and perhaps as high as a factor of 10. If this broader uncertainty range were considered, SAMA BO6 might be cost beneficial. Discuss whether consideration of a broader uncertainty range would impact the conclusion regarding ATWS-related SAMAs.

<u>Part II. Additional questions</u>

1. In response to an informal staff request, TVA provided electronic versions of the Unit 2 Summary Report, Revision 1, January 2003, and the Unit 3 Summary Report, Revision 1, January 2003, as referenced in the Environmental Report. The CDF in the Unit 2 report is 2.7E-6 per year. In response to RAI 1.c, TVA mentions PSA summary reports dated February 2004, and which provide a Unit 2 CDF of 2.6E-6 per year. Please address this discrepancy, and provide any later documents.

2. In the NRC assessment of SAMAs for BFNP, we have made some alternative assumptions regarding benefits in external events, and as a result, have identified 7 SAMAs that are within a factor of 3 of being cost beneficial (this factor relates to the uncertainty). These SAMAs are:

B01 - Automate depressurization
B06 - Automate standby liquid control (SLC) initiation
B11 - Improve direct current (DC) reliability

G04 - Enhance ability to cross-tie service water
G12c - Add redundant DC control power
G17 - Procedure to trip unneeded residual heat removal/ core spray (RHR/CS) pumps on loss of room ventilation
SAMA from RAI 12g - Procedure to align low pressure coolant injection (LPCI) or core spray to the condensate storage tank (CST)

Provide additional information to justify why these SAMAs should not be implemented. This could include more realistic estimates of: implementation costs, risk reduction (in internal events), risk reduction in external events, or other factors such as operational considerations.

3. Please provide an explanation of the methods and assumptions used to estimate the projected population within 50 miles input to the MACCS calculations. The environmental report (ER) only provides a reference to a TVA calculation.

4. Please provide an explanation of the methods and assumptions used to develop the economic data input to the MACCS calculations (e.g., land values within the 50 mile region). Also provide a table showing the economic impact of each release category as predicted by MACCS and used to develop the values for "Sum of Annual Economic Risk" in the ER, Table IV-2.

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