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

June 19, 1997

SUBJECT: BROWNS FERRY NUCLEAR PLANT UNITS 2 AND 3 - REQUEST FOR ADDITIONAL INFORMATION REGARDING MULTI-UNIT PROBABILISTIC RISK ASSESSMENT (TAC NO. M74386)

Dear Mr. Kingsley:

On April 14, 1995, the Tennessee Valley Authority (TVA) submitted the multi-unit probabilistic risk assessment (MUPRA) for the Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3. The MUPRA was submitted to fulfill commitments made to the NRC staff to resolve concerns expressed by the staff regarding risk implications of operation of all three reactors at the BFN site. The NRC staff has examined TVA's MUPRA submittal, and has determined additional information will be required to complete its review. The enclosure describes the additional information requested.

We request that you respond to this request within 60 days of receipt of this letter. Please inform us as soon as possible if this schedule is not practical. I can be reached at (301)415-1470 if you have any questions regarding this topic.

Sincerely,

Original signed by

Joseph F. Williams, Project Manager
Project Directorate II-3
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket Nos. 50-260 and 50-296

Enclosure: Request for Additional Information

cc w/Enclosure: See next page

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BROWNS FERRY NUCLEAR PLANT

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BROWNS FERRY NUCLEAR PLANT UNITS 2 AND 3

MULTI-UNIT PROBABILISTIC RISK ASSESSMENT

REQUEST FOR ADDITIONAL INFORMATION

I. APPROPRIATENESS OF MULTI-UNIT PROBABILISTIC RISK ASSESSMENT AS INTEGRATED PLANT EVALUATION OF UNIT 3

I.1 The support systems in a plant (e.g., electric power configuration, service water, dependencies among support systems and relative to front-line systems) play a major role in determining the results of a probabilistic risk assessment (PRA) (e.g., dominant sequences and associated contributors). In regard to Browns Ferry Units 2 and 3, the two units are not symmetrical. The results provided in the multi-unit probabilistic risk assessment (MUPRA) are the results of a PRA of Unit 2 given operation of Units 1 and 3. It is further stated in the MUPRA that this analysis is the bounding configuration. Please address the following:

A. The purpose of the GL 88-20 was to identify "plant-specific" vulnerabilities and cost-effective improvements to reduce or eliminate the vulnerability. In addition, in the generic letter four other objectives are stated which are for each utility, in regard to the examined plant, to (1) develop an appreciation for severe accident behavior, (2) understand the most likely severe accident sequences that could occur at its plant, (3) gain a more quantitative understanding of the overall probabilities of core damage and fission product releases, and (4) if necessary, reduce the overall probabilities of core damage and core damage fission product releases by modifying, where appropriate, hardware and procedures that would prevent or mitigate severe accidents.

Although the MUPRA may be "bounding" in that it models the most restrictive configuration for the site, it does not necessarily identify the most likely accident sequences and contributors that would be associated with any given unit. Please describe how the results of this MUPRA can be applied to Unit 3 in addressing each of the above individual plant examination objectives (e.g., the most likely accident sequences that could occur at Unit 3).

B. Please discuss the degree to which:

(1) Dependencies among systems for Unit 2 are identical to dependencies among systems for Unit 3.

(2) Operating characteristics for the Unit 2 systems are identical to Unit 3; for example, reactor core isolation cooling high turbine exhaust pressure trip point, pump shutoff heads, equipment qualification limits, safety relief valve back pressure closure.

ENCLOSURE

(3) Location of equipment and components for Unit 2 are similar to Unit 3, where location would have a factor in assumptions and assessments on component operability and human performance. For example, elevation of system suction heads in the suppression pool, location of equipment where time and accessibility is a factor.

(4) Instrumentation, alarms, and controls for Unit 2 are similar to Unit 3.

(5) Procedures (e.g., emergency operating procedures, maintenance procedures) for Unit 2 identical to Unit 3.

(6) Upgrades to Unit 2 have been implemented at Unit 3.

(7) Maintenance and test activities for Unit 2 are performed in the same manner and on the same schedule for Unit 3.

C. In the MUPRA (Section 4), it is implied that nine different configurations were quantified. If so, please provide the results (in the form as requested by NUREG-1335, Question II.1) of the quantified model for configuration G (Unit 3 impact given, Unit 1 shutdown and Unit 3 operating).

I.2 Please provide the bases for why the Level 2 results of the Rev. 0 PRA of Unit 2 can be applied to the MUPRA and in addition, how they can be applied to Unit 3. Please include the following:

A. Identify any design differences between the Unit 2 and Unit 3 containments and discuss the importance of these differences to containment performance (e.g., accident progression, source terms, releases).

B. Discuss how the plant damage states from the Rev. 0 PRA can be applied to the MUPRA when the accident sequences from the MUPRA are different from the Rev. 0 PRA. Address how these differences would change the Rev. 0 Level 2 PRA results (e.g., early containment failure frequency).

II. <u>TECHNICAL QUALITY OF MUPRA</u>

II.1 Since the MUPRA was based on the "Unit 2 Rev. 1A PRA," which has not been submitted to the NRC, and because the MUPRA submittal does not provide the information as requested in NUREG-1335, please provide the information requested in Sections 2.1, 2.2 and 2.3 of NUREG-1335 including information requested in Supplement 1 (addressing each of the containment performance improvement items) to Generic Letter 88-20.

II.2 The MUPRA only provided the bases for human actions regarding loss of heating, ventilation, and air conditioning. The human-error probabilities (HEPs) for these recovery actions appear extremely low. Please address the following concerns:

A. It does not appear that a "plant-specific" human reliability analysis was performed. Values appear to have been lifted from THERP [technique for human error rate prediction] tables without consideration of plant-specific performance shaping factors (e.g., training, quality of procedures, difficulty of task, availability of tools, etc.).

B. It is not apparent that THERP was correctly applied. For example:

(1) The level of personnel redundancy credited seems excessive relative to proper application of THERP: crediting reactor operator, senior reactor operator and shift technical advisor also see Item (a) above).

(2) The credit of "compelling" signal in THERP encompasses the success/failure of the various individuals; that is, given a compelling signal, the crew will fail to respond with a probability of 1E-4. It is not a recovery factor given that an individual previously failed to respond.

(3) In the event "ACCOM," the event DIAG in the MUPRA is failure to evaluate the cause of cooling loss. However, in THERP, Table 20-3 provides the HEP of the control room crew failing to diagnose that the event occurred, not the cause of why the event occurred.

(4) It is not clear that time was appropriately treated in the analysis. For example, was the time for responding to the annunciators accounted for in the hour and was the time needed to successfully accomplish the task considered relative to the total time available? How was it determined that 1 hour was sufficient to diagnose and respond to the cause of the loss of cooling? It is not clear how (i) the total time available to the operators to recognize the event and recover before failure occurred was estimated and what was included in the estimation, (ii) the time that is needed to perform all the necessary actions was estimated and what was included in the estimation, and (iii) the time remaining for the event to be recognized and diagnosed was estimated and what was included in the estimation.

C. Typically, the human error dominates over the hardware failure. However, with such low HEPs, the hardware can become the dominant factor in failure to recover. Please indicate if and how these failures were considered? If not considered, please provide basis for exclusion indicating how sequence frequencies and contributors were not impacted.

D. It is not clear in the quantification of the "ACCOM" event if repair of equipment was credited. If so, what was the basis in determining that the failure could be repaired and how was this probability factored into the analysis?

E. In what core damage accidents were these human actions credited? Please indicate what impact the credit of these human actions had on the core damage frequency including identifying the most likely accidents (e.g., were accident sequences truncated as a result of crediting these human actions?).

II.3 Please indicate the extent to which the items above in Question II.2 apply to the other human actions modeled in the Rev. 1A PRA and the MUPRA and how they were addressed. In addition, please describe how the context of the various accident sequences was considered in the analysis of each human action.

II.4 Please indicate where plant-specific data (i.e., initiating event frequencies and component data) was used in the Rev. 1A PRA and MUPRA. Provide the basis for use of generic data where plant-specific data was not used. Discuss the applicability of the Unit 2 plant-specific data for Unit 3, particularly in the quantification of component unavailabilities (out for maintenance).

II.5 The results of the MUPRA indicate that 39% of the core damage frequency is due to loss of residual heat removal. The progression of the accident generally appears to be as follows:

- Initiating event occurs
- Emergency core cooling system (ECCS) successful
- RHR fails
- Operator vents containment
- ECCS fails from net positive suction head problems due to venting
- Core damage occurs because no credit for coolant injection with sources other than suppression pool

Typically, there is some system (such as control rod drive, condensate, service water cross-tie) that can be used in conjunction with containment venting. Failure to model these systems can result in a distorted view of the dominant sequences and contributors to core damage frequency. Please indicate what would be the impact to the core damage frequency and the new resulting dominant accident sequences and associated contributors if credit were given for these other systems.