UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 24, 2009

Mr. Preston D. Swafford
Chief Nuclear Officer and
Executive Vice President
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3 – GENERIC LETTER 2008-01, "MANAGING GAS ACCUMULATION IN EMERGENCY CORE COOLING, DECAY HEAT REMOVAL, AND CONTAINMENT SPRAY SYSTEMS," REQUEST FOR ADDITIONAL INFORMATION (TAC NOS. MD7799, MD7800, AND MD7801)

Dear Mr. Swafford:

On January 11, 2008, the Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems." The GL requested licensees to submit information to demonstrate that the emergency core cooling, decay heat removal, and containment spray systems (hereinafter referred to as the "subject systems") are in compliance with the current licensing and design basis and applicable regulatory requirements, and that suitable design, operational, and testing control measures are in place for maintaining this compliance.

In accordance with Section 50.54(f) of Title 10 of the *Code of Federal Regulations*, GL 2008-01 required that each licensee submit the requested information within 9 months of the date of the GL. On March 2, 2009, the Tennessee Valley Authority (TVA) provided its 9-month submittal consistent with the commitment made in a letter dated July 11, 2008.

A response to the enclosed Request for Additional Information (RAI) is needed before the NRC staff can complete the review. This request was discussed with Mr. Dan Green of your staff on August 21, 2009, and it was agreed that TVA would respond by September 25, 2009.

If you have any questions, please contact me at (301) 415-2315.

Sincerely,

Sara P. Lingam for

Eva A. Brown, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Enclosure: RAI

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U.S. NUCLEAR REGULATORY COMMISSION

REQUEST FOR ADDITIONAL INFORMATION

CONCERNING GENERIC LETTER 2008-01

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3

DOCKET NOS. 50-259, 50-260, 50-296

1. Based on a review of the Tennessee Valley Authority's (TVA's) submittals dated May 9, June 6, July 11, October 11, 2008 and March 2, 2009, the following systems have been identified as emergency core cooling, decay heat removal (DHR), and/or containment spray systems (CSSs) (hereafter referred to as the subject systems), modes or components:

   Emergency Core Cooling System (ECCS)
   - High-pressure coolant injection (HPCI)
   - Core Spray (CS)
   - Low-pressure coolant injection (LPCI) – residual heat removal (RHR) in injection mode
   - Automatic depressurization system (ADS)
   - Suppression pool
   - Condensate storage tank (CST)

   Decay Heat Removal System - RHR in shutdown cooling modes
   Containment Spray System – Drywell and Torus Spray / Cooling modes of RHR/

   Address whether the listing of applicable subject systems, modes and components is complete.

2. The NRC staff reviewed the responses provided in letters dated May 9, 2008, and March 2, 2009. In a letter dated May 28, 2009, to the Nuclear Energy Institute, the NRC provided the criteria used to review the 9-month generic letter (GL) responses. It was indicated in Section 3.3.2 of the NRC's letter that "[c]overage of the subject systems provided by TSs [Technical Specifications] and TS Bases, such as TS Surveillance Requirements (SRs) and clarification of the meaning of 'full of water' should be summarized, and any changes in TSs or TS Bases accomplished after January 11, 2008, should be described and justified. Areas not covered by TSs and TS Bases, such as not providing SRs for ECCS suction piping and not ensuring a void assessment at high points that are not equipped with a vent, should be identified and the process of ensuring adequate coverage should be identified."

   Provide the above information and identify any supplementary actions, such as use of procedures and other processes, to address control of voids in the subject systems that are not covered by TS requirements.

3. In Enclosure 1 to a letter dated October 11, 2008, TVA described its review of the Browns Ferry Nuclear Plant (BFN) licensing basis as follows:

> This review determined that the licensing basis for the ECCS and DHR System is that voiding in these systems is maintained at a level that does not significantly affect their performance when mitigating design basis accidents (DBAs) or while maintaining safe shutdown (SSD). Therefore, to be in compliance with the licensing basis for BFN, voiding in these systems must be maintained at a level that does not significantly affect the performance of these systems when mitigating DBAs or maintaining SSD.

The gas concern covers all conditions where operability is necessary to maintain safe operation of the subject systems. As it is not limited to DBAs or maintaining SSD, address all conditions where operability of the subject systems is necessary to maintain safe operation during all modes including shutdown operation.

4. Provide the technical basis for not considering the potential for gas accumulation in suction piping or that voids cannot exist in the suction piping.

5. On page E1-4 of Enclosure 1 to the October 11, 2008, submittal, TVA indicated that,

> Pump discharge void volume acceptance criteria was based on maintaining pressure pulsations less than that which would cause a discharge pipe relief valve to lift or result in a hydraulic force that causes pipe stress to exceed allowable values. In order to meet these criteria, there must be no sudden changes in flow as the ECCS and DHR System Pumps start and compresses voids in the discharge pipe. These criteria are usually met when the discharge pipe has been filled to the isolation valve as this prevents an abrupt stopping of flow.

It concluded that, in an otherwise full pipe system, voids due to unfavorable pipe slope and bow in nominally horizontal pipe or trapped due to flow obstructions (e.g., orifice plates) are gradually compressed and do not result in an unacceptable pressure transient during pump start.

Provide the meaning of "these criteria are usually met." Address what is meant by "sudden changes in flow."

6. On page E1-4 of Enclosure 1 to the October 11, 2008, submittal, TVA indicated that an analysis of ECCS piping downstream of the injection valves was completed and, with the exception of HPCI piping, air in this piping will have no adverse consequences related to accident conditions and, even if small voids did exist, the pressure transient would not be greater than the normal injection pressure. The configuration of the HPCI pipe was stated to allow all voids upstream of the discharge isolation valve to be swept to the condensate storage tank during periodic pump tests. The discharge pressure of the HPCI pump is greater than the primary system pressure and BFN concluded that flow

through the discharge pipe to the reactor vessel does not stop during a DBA. It concluded that pressure transients due to voids in the HPCI discharge pipe will be mild. Simply slowing the flow can cause a pressure pulse. For example, there will be an increase in kinetic energy associated with the increased flow rate that results from initial void compression followed by later transfer of kinetic energy into potential energy that manifests itself as a pressure increase as the void compression rate decreases. The energy transfer may result in a pressure pulse.

Provide the basis for concluding that it is necessary for the flow to stop to cause a pressure pulse.

7. On page E1-4 of Enclosure 1 to the October 11, 2008, submittal, TVA indicated that a portion of the DHR system suction pipe from the primary system is located inside containment and, at the time of the July 11 2008 submittal, the survey of this pipe was deferred until the next refueling outage for each unit. Further, TVA stated that the configuration of this pipe and its distance from the DHR system pump suction would prevent it from containing a void large enough to cause a loss of the DHR system pumps when they take suction from the primary system. BFN also stated that the DHR system pumps have not become gas bound with their suctions aligned to the primary system for shutdown cooling and, therefore, this pipe is no longer required to be surveyed in upcoming refueling outages.

   Provide the maximum void volume that could be held up in the DHR system pipes. Given the operating experience indicating that licensees are continuing to discover subject system voids that potentially jeopardize operability where a problem was not previously identified, how does historically not having pumps become gas bound justify a conclusion that there will not be a void problem?

8. On page E1-7 of Enclosure 1 to the October 11, 2008 submittal, TVA indicated that the survey of the ECCS and DHR system discharge pipe identified some locations that could contain a void due to unfavorable pipe slope or pipe bow. However, it also stated that voids at these locations are either swept to the pressure suppression chamber or CST during periodic pump tests or are well below the size that would result in significant pressure pulsations. For example, the largest possible void in the CS pump discharge pipe that is not swept during periodic pump tests was stated to have a maximum cross section of 7 percent of the pipe flow area. TVA also stated that portions of the pipe segments were inspected by ultrasonic testing (UT) and no voiding was identified.

   a. Provide the basis for concluding that there are no voids in the pipe segments that were not inspected by UT;

   b. Provide the basis for the statement that 7 percent of the pipe flow area is the maximum cross section;

   c. Address what the item b) maximum cross section translates to in terms of void volume;

d. Provide the criteria that form the basis that the voids are well below the size that would result in significant pressure pulsations, and,

e. Provide the Froude numbers associated with dynamic venting of the discharge pipes.

9. On page E1-7 of Enclosure 1 to the October 11, 2008, submittal, TVA indicated that there is one pipe segment in the Unit 3 HPCI system that, due to unfavorable pipe slope, could contain a void whose maximum cross section exceeds 20 percent of the pipe flow area. However, it also stated that the average void cross section in this pipe segment could not exceed 20 percent of the pipe flow area.

a. Provide the maximum HPCI pipe cross sectional area that can be voided;

b. Provide the maximum volume of the void that could accumulate in this pipe;

c. Provide the acceptance criteria for this void location and how they were determined; and,

d. Address whether TVA intends to correct the condition so that a void cannot accumulate in this location or to add a vent to eliminate a void if it should occur.

10. On page E1-7 of Enclosure 1 to the October 11, 2008, submittal, TVA indicated that as some pipe segments in the discharge pipe were identified that have unfavorable pipe slope or pipe bow, the operating procedures are being revised to require UT inspection or dynamic venting of some of these locations should this pipe be drained. Address which locations are not being addressed and why that is acceptable.

11. On page E1-7 of Enclosure 1 to the October 11, 2008, submittal, TVA indicated that there is a short length of HPCI discharge pipe in the steam tunnel that was not surveyed. The survey of this pipe was identified as being deferred until the next refueling outage for each unit. Further it was indicated that due to the configuration of this pipe, it cannot contain a void that exceeds acceptance criteria. Therefore, TVA intends to no longer survey this pipe in upcoming refueling outages.

a. Address whether the short length of the HPCI discharge pipe discussed will be surveyed in the next outage;

b. Provide the volume of void that could be contained in the steam tunnel piping that was not surveyed;

c. Provide the acceptance criteria and how they were determined; and,

d. Provide a justification for not surveying this pipe given that there may be other voids in the discharge pipe that may interact to exceed allowable criteria.

12. On page E1-7 of Enclosure 1 to the October 11, 2008, submittal, TVA indicated that voids in pipe downstream of the HPCI injection isolation valves do not adversely affect

system performance and the survey of this pipe was deferred until the next refueling outage for each unit. Therefore, TVA does not intend to survey this pipe in upcoming refueling outages.

Address why the pipe will no longer be surveyed and provide a basis for the conclusion that the identified voids do not adversely affect system performance.

13. Provide the basis for the conclusion that the survey of the ECCS and DHR system pipe did not identify the need for additional vent capability. Although no voids were detected during this survey, address what precludes void formation in the future.

14. Consistent with Section 3.3.5 of the NRC's May 28, 2009, letter, provide a summary of those procedures that:

    a. Describe the TS surveillances for the subject systems;

    b. Describe the fill and vent operations used for the subject systems;

    c. Describe the design engineering process related to gas accumulation; and,

    d. Describe the ECCS and related system operations.

15. Following the walkdowns described in the March 2, 2009, submittal, the RHR and CS system operating instructions 1-OI-74 and 1-OI-75, respectively, that address fill and vent operations, were revised to address venting of piping downstream of the injection valves. However, on page E-5, Item 4 of the submittal lists the procedures changes as applying to all piping and adds UT inspection to dynamic venting. Clarify the extent of those procedure changes or "enhancements" identified in the submittal.

16. On page E1-10 Enclosure 1 to the October 11, 2008, submittal, TVA stated that the ECCS and DHR system operating procedures are being revised to require UT inspection or dynamic venting of locations that could contain a significant void should the discharge piping be drained. Provide a quantitative definition of "significant void."

17. Training was not identified in the GL but is considered to be a necessary part of applying procedures and other activities when addressing the issues identified in the GL. Provide a brief discussion on training including what training is currently provided, to whom, on what frequency, and whether additional changes to the training program are intended to be made.

18. On page E1-10 Enclosure 1 to the October 11, 2008, submittal, TVA stated BFN states that "procedures . . . are being revised to require that, for an extended gas release in the ECCS and DHR System, a report is entered into the Corrective Action Program." Define "an extended gas release." Provide the justification for not entering the Corrective Action Program every time a void is identified during operation.

If you have any questions, please contact me at (301) 415-2315.

Sincerely,

/RA SLingam for/

Eva A. Brown, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

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