Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

February 20, 2004

TVA-BFN-TS-424

10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop: OWFN P1-35
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos. 50-259
Tennessee Valley Authority	)	50-260
		50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 1, 2 AND 3 - LICENSE AMENDMENTS AND TECHNICAL SPECIFICATION CHANGES - RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING A REVISION IN THE NUMBER OF EMERGENCY CORE COOLING SYSTEMS REQUIRED IN RESPONSE TO A LOSS OF COOLANT ACCIDENT (TS-424) (TAC NOS. MB8423, MB8424, AND MB8425)

This letter provides TVA's responses to the NRC request for additional information regarding proposed Technical Specification 424 (Reference 1).

On April 11, 2003 (Reference 2), TVA requested a License Amendment and Technical Specification changes to permit modifications that would reduce the number of Emergency Core Cooling System (ECCS) subsystems that are actually available in response to certain design basis Loss of Coolant Accident (LOCA) scenarios. On October 2, 2003, TVA and NRC met at the NRC office in Rockville, Md., to facilitate the review of the submittal.

Since the TVA/NRC meeting, NRC requested additional information to support the review of the submittal. The NRC requests and TVA's responses are enclosed.

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TVA has determined that the provided information does not affect the no significant hazards considerations associated with the proposed amendments and Technical Specification changes. The proposed amendments and Technical Specification changes still qualify for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9).

If you have any questions about this submittal, please contact me at (256) 729-2636.

Sincerely,

T. E. Abney
Manager of Licensing
and Industry Affairs

References:

1. NRC letter, K.N. Jabbour to J.A. Scalice, dated February 2, 2004, "Browns Ferry Nuclear Plant, Units 1, 2 and 3 - Request for Additional Information Related to a Revision in the Number of Emergency Core Cooling Systems Required in Response to a Potential Loss-of-Coolant Accident (TAC NOS. MB8423, MB8424, and MB8425)."

2. TVA letter, T.E. Abney to NRC, dated April 11, 2003, "Browns Ferry Nuclear Plant (BFN) - Units 1, 2 and 3 - License Amendments and Technical Specification Changes - Revision in the Number of Emergency Core Cooling Systems Required in Response to a Loss of Coolant Accident (TS-424)."

cc (Enclosures):
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ENCLOSURE 1
TECHNICAL SPECIFICATION 424
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

NRC REQUEST

(1) A bounding General Electric Company (GE) SAFER/GESTR loss-of-coolant accident (LOCA) analysis was performed for Units 1, 2 and 3. Please identify the differences, if any, among the three units that may impact the LOCA analysis. Confirm that the bounding analysis is valid even though there are differences between the units.

TVA RESPONSE

The current GE SAFER/GESTR LOCA analysis is applicable to all three units. The limiting case in the LOCA analysis is not being changed as a result of Technical Specification 424. During the implementation of the proposed modifications, the configuration of the units will be different. In all cases, the bounding analysis is valid even though there are differences between the units.

NRC REQUEST

(2) The requested modifications are planned to be implemented in February 2005. At the same time TVA is planning to load Framatome fuel in Unit 2, and it is our understanding that the LOCA analysis has been completed using the Framatome evaluation models. Please discuss the limiting case for the LOCA analysis.

TVA RESPONSE

As discussed in TVA's April 11, 2003 submittal of Technical Specification 424, the ECCS performance models for the limiting case design basis accident and assumed single failure are not being changed as part of proposed Technical Specification 424. The number of available ECCS subsystems evaluated in the current Browns Ferry SAFER/GESTR-LOCA Analysis is described in Table 6.5-3 of the Updated Final Safety Analysis Report (UFSAR). No changes to UFSAR Table 6.5-3 are required for the bounding case of a Recirculation suction break, coupled with the assumed single failure of a battery.

TVA has previously used fuel from Global Nuclear Fuel (GNF) at BFN. TVA has received NRC approval[1][2] and is preparing to use fuel assemblies from a different manufacturer (Framatome Advanced Nuclear Power [FANP]) at BFN. The ECCS performance analysis discussed in Technical Specification 424 was performed by General Electric, using NRC generically approved methods, in accordance with the licensing basis at the time of submittal. As part of TVA's transition to Framatome fuel, the ECCS performance is being re-analyzed using Framatome's generically approved methodology. The same complement of ECCS subsystems assumed to be available in Technical Specification 424 are being utilized by Framatome as part of the reload analysis with the new fuel.

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1 Technical Specification 421, *Framatome Fuel Design and Storage*, dated February 13, 2003, as supplemented on April 14, 2003. NRC approval of the proposed amendment for all three units was issued on September 5, 2003.

2 Technical Specification 425, *Framatome Fuel - Core Operating Limits Report (COLR) References*, dated April 14, 2003 as supplemented on September 5, 2003 and November 7, 2003. NRC approval of the proposed amendment for Units 2 and 3 was issued on December 30, 2003.

Both fuel vendors (GE and Framatome) perform their LOCA analyses for all three units at BFN using the same set of available ECCS equipment. LOCA analyses are updated for each new core design using NRC approved topical reports by the fuel vendor. Each change in core design is also evaluated in accordance with 10 CFR 50.59. The analyses and results are required to satisfy 10 CFR 50.46 and Appendix K requirements. The cycle specific Reload Licensing Topical Reports for each unit are contained in the Browns Ferry Updated Final Safety Analysis Report.

NRC REQUEST

(3) Technical Specification(TS) Change 424 (revision in the number of ECC subsystems required in response to a LOCA) is requested for the three BFN units, including Unit 1. However, BFN Unit 1 is now defueled and TVA did not finalize the fuel type that will be used in this unit. The bounding analysis (i.e., GE SAFER/GESTR LOCA) submitted in support of the application assumes that BFN Unit 1 will contain GE fuel even though it is currently defueled. Confirm that Unit 1 will contain GE fuel when it will restart or if TVA plans to load Framatome fuel, please submit the Framatome LOCA analysis for Unit 1.

TVA RESPONSE

As discussed in TVA's April 11, 2003 submittal of Technical Specification 424, the ECCS performance models for the limiting case design basis accident and assumed single failure are not being changed as part of proposed Technical Specification 424. Technical Specification 424 requests a change to the BFN Licensing basis to apply the already analyzed complement of available ECCS equipment for a non-limiting case (i.e., the failure of a diesel generator) to another non-limiting case (i.e., the opposite unit false LOCA signal). As such, TS 424 is not dependent on a particular fuel vendor, but changes the input assumptions for the available ECC subsystems for the opposite unit false LOCA signal.

Changes in fuel types are not being addressed by proposed Technical Specification 424. Technical Specification Change 421[3] made the subject Technical Specification sections compatible with both GNF and FANP fuel descriptions and fuel storage analysis methods. Approval of Technical Specification 421 was requested for all three BFN units to allow for the potential future receipt of FANP fuel at Unit 1 without

3 Technical Specification 421, *Framatome Fuel Design and Storage*, dated February 13, 2003, as supplemented on April 14, 2003. NRC approval of the proposed amendment for all three units was issued on September 5, 2003.

further amendment requests. Technical Specification 425[4] revised 5.6.5, Core Operating Limits Report, for Units 2 and 3 to add references to the FANP analytical methods that are used to determine core operating limits. TVA will use a reload batch of FANP fuel for the Unit 3 Cycle 12 core, which is scheduled to begin operation in Spring 2004. Unit 2 use of FANP fuel will follow in 2005.

Both fuel vendors (GE and Framatome) perform their LOCA analyses for all three units at BFN using the same set of available ECCS equipment. LOCA analyses are updated for each new core design using NRC approved topical reports by the fuel vendor. Each change in core design is also evaluated in accordance with 10 CFR 50.59. The analyses and results are required to satisfy 10 CFR 50.46 and Appendix K requirements. The cycle specific Reload Licensing Topical Reports for each unit are contained in the Browns Ferry Updated Final Safety Analysis Report.

The fuel supplier for Unit 1 has not been selected and may include any qualified vendor. If TVA decides to use a fuel vendor other than GNF for Unit 1, a license amendment will be required, and a Technical Specification change similar to the one approved for Units 2 and 3 will be provided for NRC approval.

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4 Technical Specification 425, *Framatome Fuel - Core Operating Limits Report (COLR) References*, dated April 14, 2003 as supplemented on September 5, 2003 and November 7, 2003. NRC approval of the proposed amendment for Units 2 and 3 was issued on December 30, 2003.

NRC REQUEST

(4) It is our understanding that the diesel generators will be loading only two residual heat removal pumps initially with the preferred pump logic assuming the spurious accident signal in the second unit. Please specify the time delay assumed to prevent overloading of the diesels and the time for the operator actions to start the remaining two pumps, if necessary.

TVA RESPONSE

As part of the LOCA analysis, two Residual Heat Removal (RHR) pumps injecting into a single loop of Low Pressure Coolant Injection (LPCI) and one loop of Core Spray provide acceptable core cooling. No additional RHR pumps are required.

The Preferred Pump logic prevents overloading of the diesel generators during the pump start sequence without manual operator actions. The diesel generator loading sequence and time delays are shown in UFSAR Table 8.5-1. Only one RHR pump, one Core Spray pump, and one RHR Service Water (RHRSW) pump are loaded on a single diesel generator. These pump loads are automatically sequenced to prevent overloading the diesel generator.

TVA's LOCA analysis does not take credit for operator actions within 10 minutes of the accident. Operator actions to provide long-term (greater than 10 minutes) core cooling and diesel generator load management are defined in approved plant procedures. Long-term cooling requirements are satisfied by one loop of Core Spray injecting into the vessel and two RHR pumps and two associated RHRSW pumps providing containment cooling on the accident unit. One RHR pump and an associated RHRSW pump will provide containment cooling on each of the two non-accident units.

NRC REQUEST

(5) On Page E1-8 of the application for TS Change 424, dated April 11, 2003, TVA stated that "Plant systems must be adequate to address accident signals, spurious and valid, in any order (i.e., valid signal followed by a spurious signal in one of the nonaccident units or a spurious signal from the nonaccident unit followed by a valid signal). The pump starting sequence described in the application is the preferred logic assuming a coincident LOCA signal in one unit, spurious LOCA signal in the second unit and loss-of-offsite power (LOOP). Please describe the pump starting sequence for scenarios before and after the LOCA.

TVA RESPONSE

There are five combinations of Spurious Accident Signal and LOCA that could occur between Units 1 and 2:

1. The signals occur at the same time;

2. The Spurious Accident Signal Occurs on Unit 2 after the LOCA on Unit 1;

3. The Spurious Accident Signal Occurs on Unit 2 before the LOCA on Unit 1;

4. The Spurious Accident Signal Occurs on Unit 1 after the LOCA on Unit 2;

5. The Spurious Accident Signal Occurs on Unit 1 before the LOCA on Unit 2;

Each of these combinations are discussed below:

1. As noted in the NRC question, the scenario where the signals occur at the same time was described in TVA's April 11, 2003 submittal.

2. For the case where the Spurious Accident Signal Occurs on Unit 2 after the LOCA on Unit 1:

   The Unit 1 LOCA would start the Unit 1 ECCS pumps in both divisions. The spurious accident signal occurs on Unit 2 and the Unit 1 pumps powered by Division II would be tripped. The two Unit 2 ECCS Division II pumps would then be loaded on Division II. This

sequence is described on Slides 37 through 39 of TVA's October 2nd presentation.

3. For the case where the Spurious Accident Signal Occurs on Unit 2 before the LOCA on Unit 1:

   The Unit 2 Spurious Accident Signal would start the Unit 2 ECCS pumps in both divisions. When the Unit 1 LOCA occurs, the Unit 2 pumps powered by Division I would be tripped. The two Unit 1 Division I ECCS pumps would then be loaded on Division I.

4. The Spurious Accident Signal Occurs on Unit 1 after the LOCA on Unit 2;

   The Unit 2 LOCA would start the Unit 2 ECCS pumps in both divisions. The spurious accident signal occurs on Unit 1 and the Unit 2 pumps powered by Division I would be tripped. The two Unit 1 Division I ECCS pumps would then be loaded on Division I.

5. The Spurious Accident Signal Occurs on Unit 1 before the LOCA on Unit 2;

   The Unit 1 Spurious Accident Signal would start the Unit 1 ECCS pumps in both divisions. When the Unit 2 LOCA occurs, the Unit 1 pumps powered by Division II would be tripped. The two Unit 2 Division II ECCS pumps would then be loaded on Division II.

TVA's loading calculations assume the worst case time delays. Regardless of whether the spurious accident signal occurs before, concurrent with, or after the real accident sequence, Division I pumps will be dedicated to Unit 1 and Division II pumps will be dedicated to Unit 2. The Preferred Pump logic ensures a proper loading sequence without manual operator actions.

NRC REQUEST

6) The current Units 1 and 2 ECC system preferred pump logic was designed to initiate in the event of a potential LOCA coincident with LOOP and coupled with a spurious accident signal from the nonaccident unit. Please confirm that the five rows in the tables on pages E1-12, E1-13, E1-21, and E1-23 under the column with the heading "Assumed Failure" be interpreted as follows?

A LOCA coincident with a LOOP coupled with the loss of a battery

A LOCA coincident with a LOOP coupled with the opposite unit false LOCA signal

A LOCA coincident with a LOOP coupled with the failure of a LPCI injection valve

A LOCA coincident with a LOOP coupled with the loss of a diesel generator

A LOCA coincident with a LOOP coupled with the loss of a HPCI.

If not, please describe the sequence of events modeled.

TVA RESPONSE

The stated interpretation of the table is correct. As described in Updated Final Safety Analysis Report Section 14.6.3.1, *Loss of Coolant Accident (LOCA)- Initial Conditions and Assumptions*:

The analysis of this accident is performed using the following assumptions:

a. The reactor is operating at the most severe condition at the time the recirculation pipe breaks, which maximizes the parameter of interest: primary containment response, fission product release, or Core Standby Cooling System requirements.

b. A complete loss of normal AC power occurs simultaneously with the pipe break. This additional condition results in the longest delay time for the Engineered Safeguards.

NRC REQUEST

7) Although it appears they should be identical, there are differences between the tables on E1-21 and E1-23 in the number of low pressure coolant injection (LPCI) systems remaining after a diesel generator single failure. There are identical differences between the tables on pages E1-12 and E1-13, but the text on page E1-12 indicates that the table on page E1-12 is incorrect, insofar as it does not really reflect the current state of the plant. Please discuss these discrepancies.

TVA RESPONSE

The single failure evaluation for a Recirculation suction line break with the assumed failure of a Diesel Generator is presented in the submittal in the following manner:

PAGE	SCENARIO	SYSTEMS REMAINING
E1-12	Systems currently assumed to be available in the SAFER/GESTR LOCA analysis prior to the proposed modifications.	ADS, 1LPCS, HPCI, 2LPCI (2 pumps into 1 loop)
E1-23	Systems that will be assumed to be available in the SAFER/GESTR LOCA analysis after the proposed modifications.	ADS, 1LPCS, HPCI, 2LPCI (2 pumps into 1 loop)
E1-13	Systems actually available prior to the proposed modifications.	ADS, 1LPCS, HPCI, 3LPCI (3 pumps into 2 loops)
E1-21	Systems actually available after the proposed modifications.	ADS, 1LPCS, HPCI, 3LPCI (3 pumps into 2 loops)

As can be seen from the comparison provided above, there are no changes in either the subsystems actually available, or in the subsystems that are assumed to be available in the SAFER/GESTR LOCA analysis, for a Recirculation suction line break with the assumed failure of a Diesel Generator.

As discussed on Page E1-10 of the submittal and in TVA's October 2nd presentation, the BFN LOCA analysis assumes less subsystems are available than that which would be actually available in the plant. For a Recirculation suction line break with the assumed failure of a Diesel Generator, 3 RHR pumps would actually be available to inject into 2 LPCI loops. However, the LOCA analysis only assumes 2 pumps would be available to inject into 1 loop.

The table and the submittal accurately reflect the subsystems assumed to be available in the analysis and the subsystems actually available.

NRC REQUEST

8. Describe the interlock logic that would detect the LOCA signal and initiate the alternative diesel loading.

TVA RESPONSE

Two initiating functions are used for the RHR and Core Spray System (Reference UFSAR Sections 7.4.3.4.2, *Core Spray System Initiating Signals and Logic*, and 7.4.3.5.2, *LPCI Initiating Signals and Logic)*:

- Reactor vessel low water level;
- Primary containment (drywell) high pressure plus low reactor vessel pressure.

Each of the RHR and Core Spray initiating signals is sensed by four independent detectors. These detectors input to divisional analog trip unit (ATU) cabinets. The ATUs initiate trip signals to actuate relays arranged in a one-out-of-two-twice logic. The instruments that are used to initiate the RHR and Core Spray Systems are the same that initiate the ECCS Preferred Pump Logic. Once an initiation signal is received by the ECCS control circuitry, the signal is sealed in until manually reset. The ECCS Preferred Pump signal is sealed in until the accident signals (spurious and real) are reset in both units.

NRC REQUEST

9. Section 7.4.3.4.2 of the BFN Updated Final Safety Analysis Report states that the ECC system is initiated by (1) low vessel water level, or (2) low vessel pressure and high drywell pressure. Please confirm that there are no other signals that potentially may actuate the ECC system.

TVA RESPONSE

As discussed above, two initiating functions are used for the RHR and Core Spray System (Reference UFSAR Sections 7.4.3.4.2, *Core Spray System Initiating Signals and Logic*, and 7.4.3.5.2, *LPCI Initiating Signals and Logic)*:

- Reactor vessel low water level;
- Primary containment (drywell) high pressure plus low reactor vessel pressure.

As discussed in UFSAR Section 7.4.3.3.2, *Automatic Depressurization System Initiating Signals and Logic*, the initiating signals for the Automatic Depressurization System are reactor vessel low-water level, and primary containment (drywell) high pressure or a sustained reactor vessel low-water level signal will provide the initiating signal after a time delay.

As discussed in UFSAR Section 7.4.3.2.2, *HPCI Initiation Signals and Logic*, HPCI is automatically started by the reactor vessel low-water level or primary containment (drywell) high pressure. Either initiation signal can start the HPCI system.

NRC REQUEST

10. Discuss how the changes made to the logic for the ECC systems required in response to a LOCA conforms to Title 10 *Code of Federal Regulations* (CFR) Section 50.55a(h)(2) requirements.

TVA RESPONSE

The 10 CFR 50.55a(h) requirements are:

> Protection and safety systems. (1) IEEE Std. 603-1991, including the correction sheet dated January 30, 1995, which is referenced in paragraphs (h)(2) and (h)(3) of this section, is approved for incorporation by reference by the Director of the Office of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51.
>
> 2) Protection systems. … For nuclear power plants with construction permits issued before January 1, 1971, protection systems must be consistent with their licensing basis or may meet the requirements of IEEE Std. 603-1991 and the correction sheet dated January 30, 1995.

TVA's proposed modifications are in conformance with 10 CFR 50.55a(h)(2) and the BFN licensing basis. The BFN licensing basis for ECCS protection systems is described in Updated Final Safety Analysis Report (UFSAR) Sections 8.9, *Safety Systems Independence Criteria and Bases for Electrical Cable Installation*, and 7.4, *Emergency Core Cooling Control and Instrumentation*. These systems are designed to meet the intent of the IEEE proposed criteria for Nuclear Power Plant Protection Systems (IEEE-279-1971).

NRC REQUEST

11. Discuss the conformance with respect to the separation and isolation of the logic systems including the planned isolation devices and cables that were used previously to cross-connect Divisions I and II.

TVA RESPONSE

The BFN licensing basis is described in Section 8.9, *Safety Systems Independence Criteria and Bases for Electrical Cable Installation*, of the Updated Final Safety Analysis Report. The modified logic is consistent with the BFN licensing basis. The deletion of the RHR redundant pump start logic will allow removal of the cross connect signals between Division I and Division II RHR logic systems. The internal wiring associated with the cross connect signals will be physically deleted and the relays will be either removed or spared in place. The cables will be disconnected and spared in place.

NRC REQUEST

12. Discuss the loading of the diesel with the new load. Is this loading different from the one approved previously by the Nuclear Regulatory Commission staff during Unit 2 restart after the 1985 shutdown? Please discuss the acceptability of the new diesel loading, if the loading is different from the one approved previously.

TVA RESPONSE

Diesel Generator loading analysis results are not changed by Technical Specification 424. There are no changes in the load sequencing, time delays, or major loads from the RHR, Core Spray or RHRSW pumps. The load analysis assumes that only one RHR, one Core Spray, and one RHRSW pump are loaded on a diesel generator. The major loads sequenced on to the Diesel Generators are the same for either unit. Technical Specification 424 assigns two Diesel Generators to the accident unit with its required loads and two Diesel Generators to the non-accident unit with its required loads.