January 6, 2005

10 CFR 54

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 RENEWAL APPLICATION – CHEMISTRY CONTROL PROGRAM SECTION B.2.1.5 – RESPONSE TO NRC REQUEST FOR ADDITONAL INFORMATION (RAI) (TAC NOS. MC1704, MC1705, AND MC1706)

By letter dated December 31, 2003, TVA submitted, for NRC review, an application pursuant to 10 CFR 54, to renew the operating licenses for the Browns Ferry Nuclear Plant, Units 1, 2, and 3. As part of its review of TVA's license renewal application, the NRC staff, by letter dated December 7, 2004, identified areas where additional information is needed to complete its review.

The specific areas requiring a request for additional information (RAI) are related to the Chemistry Control Program, Section B.2.1.5 of the License Renewal Application (LRA).

The enclosure to this letter contains the specific NRC requests for additional information and the corresponding TVA response.

If you have any questions regarding this information, please contact Ken Brune, Browns Ferry License Renewal Project Manager, at (423) 751-8421.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 6th day of January 2005.

Sincerely,

Original signed by

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Enclosure:
cc: See page 3

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cc: continued page 4

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ENCLOSURE

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3
LICENSE RENEWAL APPLICATION (LRA),

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI),
RELATED TO CHEMISTRY CONTROL PROGRAM SECTION B.2.1.5

(SEE ATTACHED)

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3
LICENSE RENEWAL APPLICATION (LRA),

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI), RELATED TO CHEMISTRY CONTROL PROGRAM SECTION B.2.1.5

By letter dated December 31, 2003, the Tennessee Valley Authority (TVA) submitted, for NRC review, an application pursuant to 10 CFR 54, to renew the operating licenses for the Browns Ferry Nuclear Plant, Units 1, 2, and 3. As part of its review of TVA's license renewal application, the NRC staff, by letter dated December 7, 2004, identified areas where additional information is needed to complete its review.

The specific areas requiring a request for additional information (RAI) are related to the Chemistry Control Program, Section B.2.1.5 of the License Renewal Application (LRA).

Listed below are the specific NRC requests for additional information and the corresponding TVA responses.

NRC RAI B.2.1.5-1

The Chemistry Control Program described in Section B.2.1.5 of the LRA is consistent with the program in NUREG-1801 XI.M2 with two exceptions: (a) monitoring and control of water chemistry is based on the BWR Water Chemistry Guidelines-Revision 2000 in EPRI Report TR-13515-R2, instead of the BWR Water Chemistry Guidelines-Revision 1993 in EPRI Report TR-13515, and (b) hydrogen peroxide is not monitored to mitigate degradation of structural materials. These two exceptions affect the following three program elements in the water chemistry program: scope of program, parameters monitored, and confirmation process. Please describe how these changes will affect the water chemistry program and its effectiveness.

TVA Response to NRC RAI B.2.1.5-1

(a) The BFN Chemistry Control Program is based upon the guidance provided by the EPRI BWR Water Chemistry Guidelines. TVA Corporate Chemistry and BFN Chemistry personnel are members of the EPRI BWRVIP committee that develop the guidelines; this allows the site to be proactive in enacting chemistry control recommendations. This ensures that BFN is utilizing the latest recommendations based on industry operating experience and expertise. By utilizing later editions of the EPRI BWR Water Chemistry Guidelines, BFN ensures that the Chemistry Control Program incorporates the latest guidance on minimizing aging effects and thus meets or exceeds the recommendations contained in NUREG-1801.

As was previously stated in the License Renewal Application (LRA) Section B.2.1.5, monitoring and control of water chemistry is based on the BWR Water Chemistry Guidelines-Revision 2000 in EPRI Report TR-103515-R2; or later revisions or updates of these reports as approved by the staff. TR-103515-R2 incorporated new information to develop proactive plant-specific water chemistry programs to minimize intergranular stress corrosion cracking (IGSCC). In the "License Renewal Safety Evaluation Report for the Peach Bottom Atomic Power Station, Units 2 and 3" (Accession No. ML030370189), the NRC found EPRI TR-103515-R2 acceptable because the program is based on updated industry experience and plant-specific and industry-wide operating experience that confirms the effectiveness of the RCS chemistry program. The BFN units are similar to the Peach Bottom units. Therefore, the NRC conclusion reached for Peach Bottom is applicable to BFN.

EPRI periodically updates the water chemistry guidelines as new information becomes available. BFN Chemistry is in the process of implementing the most current revision of the BWR Water Chemistry Guidelines (Revision 2004, BWRVIP-130 in EPRI Report TR-1008192). Significant changes to the BFN Chemistry Control Program going to revision 2004 involve the following: reduction of feedwater iron concentration limits to reduce crud formation on the fuel and improve the effectiveness of zinc injection; reduction of recommended zinc concentration in RCS to address fuel integrity issues; review of other chemistry parameter limits and targets, and monitoring frequencies to meet recommendations. BFN will continue to be involved with the EPRI BWRVIP and incorporate new EPRI chemistry control recommendations as they are developed.

(b) Hydrogen peroxide is not monitored in the reactor coolant system at Browns Ferry. Analysis for hydrogen peroxide is not recommended in the EPRI BWR Chemistry Guidelines. Modeling of water chemistry radiolysis through the BWR circuit has provided an understanding of the amount of hydrogen addition needed for mitigation of component IGSCC. Although wet chemical methods are available for peroxide analysis, decomposition to water and oxygen in the sample lines is very rapid and reliable data is exceptionally difficult to obtain. Recombination with hydrogen also occurs in the sample lines due to the use of noble metals application at Browns Ferry. Peroxide concentration, therefore, can best be estimated at various locations in the system using the radiolysis modeling. Intergranular stress corrosion cracking (IGSCC) of BWR components is controlled through the addition of hydrogen to suppress the formation of the oxidizing radiolytic products. Operating limits for HWC are set to ensure adequate hydrogen is added to maintain the ECP < -230 mV(SHE).

NRC RAI B.2.1.5-2

Section B.2.1.5 of the LRA states that experience with the reactor coolant system chemistry is similar to the experience of the industry. However, sufficient details are not provided to characterize the specific operating experience in BFN Units 1, 2, and 3. Please provide information about the existing operating experience at BFN Units 1, 2, and 3. List the major incidents related to water chemistry with the frequency of their occurrence.

TVA Response to NRC RAI B.2.1.5-2

BFN reactor coolant system (RCS) chemistry activities manage loss of material and cracking of components exposed to reactor coolant and steam through measures, based on EPRI TR-103515, Revision 2, BWR Water Chemistry Guidelines, that monitor and control reactor coolant chemistry. These activities include monitoring and controlling of reactor coolant water chemistry to ensure that known detrimental contaminants are maintained within pre-established limits. Reactor coolant is monitored for indications of abnormal chemistry conditions. If such indications are found, then measurements of impurities are conducted to determine the cause, and actions are taken to address the abnormal chemistry condition. Whenever corrective actions are taken to address an abnormal chemistry condition, sampling is utilized to verify the effectiveness of these actions. The RCS chemistry activities provide reasonable assurance that intended functions of components exposed to reactor coolant and steam are not lost due to loss of material or cracking aging effects.

Review of BFN chemistry records revealed that the EPRI Action Level 3 criteria were not exceeded at any time during the 5 years considered. BFN short-term transients had no significant impact on reactor vessel and reactor coolant system components. In addition, these transients had no impact on the acceptability of the Chemistry Control Program as an effective aging management tool for the renewal term.

Minor water chemistry excursions were noted. For example, minor excursions, above Action Level 1, occurred during unit startups. In addition, several instances of condensate demineralizer resin leakage have occurred in the 1999 to 2004 time period on Units 2 and 3 due to bleed-through of old septa and deficiencies in design/installation of new septa. Once the intrusions were identified, the source of resin was isolated and sulfates were returned to normal levels.

Some instances of RCS sulfate concentration in Units 2 and 3 RCS exceeding Action Level 1 were observed in 2003 and 2004. There were no instances where Action Level 2 limits were exceeded. The majority of the elevated concentrations have been due to resin intrusions.

During wet lay-up, the Unit 1 reactor coolant system was operated primarily as a closed loop system (i.e. the RWCU system in-service, low system volume loss, infrequent make-up and with the RPV head in place). A review of the Unit 1 RCS chemistry data shows that chemistry limits were maintained within acceptable levels.

During BFN Unit 3 Cycle 11 Refueling Outage in March 2004, a light coating of unusual crud deposits was observed during a visual inspection of the Steam Dryer surface. The deposits were similar in color and consistency to those found at Perry Nuclear Station in April 2003. The same VT-3 examiner evaluated both deposits. The crud deposits noted on the interior surfaces of the Browns Ferry Unit 3 reactor pressure vessel and steam dryer were characterized as extremely hard and tenacious and were only observed on stainless steel surfaces of the steam dryer. The unusual deposits around Main Steam nozzle N3-C were observed to only adhere to the vessel interior stainless steel cladding. Exposed carbon steel areas of the Main Steam nozzle did not show any signs of unusual deposits. GE previously evaluated the Perry deposits for their potential effect on safety and potential qualitative performance impact of the deposits on the reactor pressure vessel (RPV) and RPV components above the water level, the main steam lines up to and including the outboard main steam isolation valves (MSIVs). GE also evaluated whether it is necessary to remove these deposits prior to plant restart. The GE conclusion was that the deposits represent no safety concern and that the deposition is largely a commercial issue in regard to the potential for steam dryer fouling and moisture carryover. Additionally, water chemistry information from the crud deposit events at Perry and Browns Ferry has been communicated to EPRI for possible inclusion in a future revision of the BWR Water Chemistry Guidelines. The Site Chemistry Department will monitor any future changes for potential impact to the reactor vessel water chemistry at Browns Ferry.

NRC RAI B.2.1.5-3

Section B.2.1.5 of the LRA indicates that BFN Units 1, 2, and 3 have a hydrogen water chemistry program (HWC). Provide a brief description of the program and what role it plays in the plant's chemistry control program.

TVA Response to NRC RAI B.2.1.5-3

BFN implemented HWC on Unit 2 in December of 1999 and on Unit 3 in August of 2000. Hydrogen Water Chemistry will be implemented on Unit 1 following the unit restart. Hydrogen Water Chemistry (HWC) is used to reduce the Electrochemical Potential (ECP) and dissolved oxygen (DO) in the reactor vessel. The reduction of DO will reduce the propensity and migration of environmentally assisted corrosion such as Intergranular Stress Corrosion Cracking (IGSCC). HWC modifies the chemical environment in the BWR recirculation piping and core regions in order to prevent IGSCC. Because of radiolytic decomposition of water that occurs in the core, the level of DO in the recirculation water rises to 100 to 300 ppb. Dissolved oxygen concentrations at these levels are sufficient (plus chloride or sulfate) to cause IGSCC in stainless steel. The addition of hydrogen encourages recombination of hydrogen and oxygen and reduces the oxygen concentration to a level where IGSCC does not occur.

The HWC Injection System injects hydrogen at the suction of the three condensate booster pumps to mitigate IGSCC in the recirculation piping and reactor vessel internals. The hydrogen causes a reduction in dissolved oxygen concentration in the vessel core region and recirculation water. Addition of hydrogen to the feedwater results in an excess ratio of hydrogen to oxygen at the entrance to the offgas system.

In order to maintain the offgas system near its normal operating level, a flow rate of oxygen equal to one half the injected hydrogen flow rate is injected into the offgas system upstream of the catalytic recombiner. On the shutdown of the system, a time delay is allowed for continued oxygen injection after the hydrogen injection is stopped to allow the residual hydrogen to reach the recombiners. Because the oxygen concentration is reduced in the steam, the condensate oxygen concentration is also reduced. To counter this effect, a small amount of oxygen is injected into the suction of the condensate pumps to keep the condensate oxygen concentration within limits. Non-condensable gases in the reactor water, including hydrogen, flow out of the reactor with the steam. Hydrogen must be continuously added to the feedwater to maintain the required levels in the reactor vessel and recirculation piping.

Hydrogen, oxygen, and non-condensibles in the main condenser are removed by the steam jet air ejector (SJAE). In the offgas system, catalytic recombination is used to recombine hydrogen and oxygen gases. With hydrogen injection, the gas mixture reaching the offgas recombiner would be high in hydrogen. As a result, oxygen must be added to the offgas system to maintain a 2:1 ratio of hydrogen to oxygen for recombination.

Dual hydrogen/oxygen monitors are used on the condensate system to help assess the adequacy of hydrogen and oxygen feed rates. An Orbisphere oxygen monitor is used online for monitoring reactor water dissolved oxygen.

ECP monitoring is not used at BFN. A General Electric radiolysis/ECP computer model has been used to determine the required hydrogen injection rates for BFN. Noble metals chemical addition reduces the hydrogen injection rate required to prevent IGSCC by a factor of approximately six. During normal operation, BFN feedwater dissolved oxygen concentration is approximately 10-15 ppb without oxygen addition. The oxygen limit is 15 ppb to 200 ppb to limit wall thinning due to flow accelerated corrosion. Also, Fuel warranty limits specify a final feedwater oxygen concentration of 20 ppb to 200 ppb. HWC will increase the transport of metallic radionuclides Co-58, Co-60, Mn-54 and Fe-59 due to the change in water chemistry associated with HWC. This could lead to higher out-of-core and outage dose rates. However, BFN is using depleted zinc injection to minimize any increase in dose rates.

The original HWC Systems installed on Units 2 and 3 were designed for hydrogen flow rates up to 120 scfm and oxygen flow rates up to 60 scfm. With implementation of noble metals injection, the system will not need to operate beyond 30 scfm of hydrogen and 15 scfm of oxygen to achieve the same reduction in potential for stress corrosion cracking.