April 5, 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 (LRA) – RESPONSE TO NRC REQUESTS FOR ADDITIONAL INFORMATION (RAIs) 3.1.2.4-7 (AGING MANAGEMENT REVIEW FOR SMALL BORE PIPING AND FITTINGS) AND 3.5-16 (SUBMERGED REINFORCED CONCRETE) (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 LRA, the NRC staff, through a letter dated March 11, 2005, identified additional information needed for RAI 3.1.2.4-7 (Aging Management Review for Small Bore Piping And Fittings) and 3.5-16 (Aging Management Review For Submerged Reinforced Concrete).

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 5th day of April, 2005.

Sincerely,

Original signed by:

T. E. Abney
Manager of Licensing
and Industry Affairs

Enclosure:
cc: See page 3

Enclosure
cc (Enclosure):
State Health Officer
Alabama Department of Public Health
RSA Tower - Administration
Suite 1552
P.O. Box 303017
Montgomery, Alabama 36130-3017

Chairman
Limestone County Commission
310 West Washington Street
Athens, Alabama 35611

(Via NRC Electronic Distribution)
Enclosure
cc (Enclosure):
U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW, Suite 23T85
Atlanta, Georgia 30303-8931

Mr. Stephen J. Cahill, Branch Chief
U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW, Suite 23T85
Atlanta, Georgia 30303-8931

NRC Senior Resident Inspector
Browns Ferry Nuclear Plant
10833 Shaw Road
Athens, Alabama 35611-6970

NRC Unit 1 Restart Senior Resident Inspector
Browns Ferry Nuclear Plant
10833 Shaw Road
Athens, Alabama 35611-6970

cc: continued page 4

cc: (Enclosure)
Margaret Chernoff, Project Manager
U.S. Nuclear Regulatory Commission
(MS 08G9)
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852-2739

Eva A. Brown, Project Manager
U.S. Nuclear Regulatory Commission
(MS 08G9)
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852-2739

Yoira K. Diaz-Sanabria, Project Manager
U.S. Nuclear Regulatory Commission
(MS 011F1)
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852-2739

Ramachandran Subbaratnam, Project Manager
U.S. Nuclear Regulatory Commission
(MS 011F1)
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852-2739

TLE:BAB
Enclosure
cc (Enclosure):
A. S. Bhatnagar, LP 6-C
K. A. Brune, LP 4F-C
J. C. Fornicola, LP 6A-C
R. G. Jones, NAB 1A-BFN
K. L. Krueger, POB 2C-BFN
R. F. Marks, Jr., PAB 1A-BFN
F. C. Mashburn, BR 4X-C
N. M. Moon, LP 6A-C
J. R. Rupert, NAB 1F-BFN
K. W. Singer, LP 6A-C
M. D. Skaggs, PAB 1E-BFN
E. J. Vigluicci, ET 11A-K
NSRB Support, LP 5M-C
EDMS, WT CA-K

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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 REQUESTS FOR ADDITIONAL INFORMATION (RAI) 3.1.2.4-7 (AGING MANAGEMENT REVIEW FOR SMALL BORE PIPING AND FITTINGS) AND 3.5-16 (AGING MANAGEMENT REVIEW FOR SUBMERGED REINFORCED CONCRETE)

(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) 3.1.2.4-7 (AGING MANAGEMENT REVIEW FOR SMALL BORE PIPING AND FITTINGS) AND 3.5-16 (AGING MANAGEMENT REVIEW FOR SUBMERGED REINFORCED CONCRETE)

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NRC's RAI 3.1.2.4-7

BFN LRA Tables 3.1.2.3 and 3.1.2.4 present the aging management review (AMR) for small bore piping and fittings less than 4 inch nominal pipe size (NPS 4) in treated water environment for the reactor coolant system (RCS).

In Section 3.1.2.2.4, the applicant addresses the potential of crack initiation and growth due to thermal and mechanical loading or stress corrosion cracking (SCC) including intergranular stress corrosion cracking (IGSCC), that could occur in small bore piping in the RCS and connected system piping less than NPS 4.

The GALL (NUREG-1801) report recommends that a plant-specific destructive examination or a nondestructive examination (NDE) that permits inspection of the inside surfaces of the piping be conducted to ensure that cracking has not occurred and the component intended function will be maintained during the extended period.

By letter dated October 8, 2004, the applicant submitted its formal response to the consistent with GALL audit, stating that:

Combinations of NDE, including visual, ultrasonic, and surface techniques are performed following procedures consistent with the ASME Code and 10 CFR 50, Appendix B. For small bore piping less than NPS 4, including pipe, fittings, and branch connections, a plant-specific destructive examination of replaced piping due to plant modifications or NDE that permits inspection of the inside surfaces of the piping is to be conducted to ensure that cracking has not occurred.

Either destructive examination or NDE that is capable of detecting inside surface cracking is required. Since there are ultrasonic testing (UT) inspectable, full penetration butt welds within the scope of license renewal, BFN has chosen not to perform destructive examination of socket welds. BFN has not identified butt welds in ASME Class 1 piping 1-inch NPS and less. Therefore, 1-inch NPS and less piping will not be selected for small-bore piping NDE examination. This sample population provides adequate indication of whether inside diameter cracking is occurring in small-bore piping. However, the sample selection criteria used for butt welded NPS piping less than 1 inch is not representative for socket welded piping.

Therefore, provide the technical bases: (1) for concluding that NDE will detect adverse conditions in full penetration butt welds in piping 1-inch NPS or greater before adverse conditions develop in socket welded piping, for 1-inch NPS and less; and (2) for not crediting destructive examination of replaced piping due to plant modifications for aging management of socket welded piping, NPS 1 and less.

TVA's Response to RAI 3.1.2.4-7

NUREG 1800, Aging Management Program XI.M32, "One-Time Inspection," does not specify an inspection program for socket welded piping. The requirement is to evaluate piping less than 4 inches NPS to confirm that crack initiation and growth due to stress corrosion cracking (SCC) or cyclic loading is not occurring. NUREG 1800, Aging Management Program XI.M32, "One-Time Inspection," Evaluation and Technical Basis Section, Detection of Aging Effects, states that for small-bore piping less than 4 inches NPS, including pipe, fittings, and branch connections, a plant-specific destructive examination of replaced piping due to plant

modifications or NDE that permits inspection of the inside surfaces of the piping is to be conducted to ensure that cracking has not occurred.

The BFN One-Time Inspection Program will evaluate a sample of welds in small-bore piping less than 4 inches NPS for internal surface cracking by NDE as specified by NUREG 1800, Aging Management Program XI.M32, "One-Time Inspection." The BFN One-Time Inspection Program sample will be selected from full penetration butt welds where ultrasonic testing can be performed. The basis for this sample population is:

- this sample will evaluate the welds with the most susceptibility to the aging effects of stress corrosion cracking and thermal fatigue;
- this sample will evaluate the welds with the most significant consequences and risks; and
- this sample will allow the welds to be identified, scheduled, and performed in a systematic manner.

Socket weld cracking generally occurs due to weld defect propagation by vibrational fatigue. Stress corrosion cracking and thermal fatigue rarely cause socket weld failures. Vibration induced socket weld failures is a design issue that has been observed in the nuclear power industry and can result in crack initiation and growth. Vibration-induced fatigue is fast acting and is typically detected early in a component's life. Corrective measures typically include actions to preclude recurrence of the failure mechanism. Corrective actions to preclude recurrence may involve modifications to the plant, such as addition of supplemental restraints to a piping system, shortening the vent piping, replacement of tubing with flexible hose, etc. Based upon these measures, cracking due to vibration-induced fatigue is not considered an aging effect for the period of extended operation.

Previously, plants have excluded piping based strictly on consequences of the potential pipe failure. Although this was not done in the BFN Risk Informed ISI Program, a plant specific calculation demonstrates that BFN can tolerate 2-inch NPS and smaller breaks with normal makeup. At BFN, all Class 1 piping was included in the BFN Risk Informed ISI Program. No welds less than 4 inches NPS were identified as high risk. The BFN One-Time Inspection Program sample will select full penetration butt welds where ultrasonic testing can be performed. The butt welds are more susceptible to stress corrosion cracking and thermal fatigue, which are the

primary crack initiation and growth aging mechanisms. This sample also allows a selection of the most risk-significant small-bore piping locations (i.e., locations with the highest susceptibility to cracking and highest consequences of failure) to be identified, scheduled, and performed in a systematic manner, rather than attempting to track modifications for 20 years while awaiting the possible removal of a piece of small-bore piping containing a weld for destructive testing.

Industry precedence for this sample methodology is included in the NRC's SER for the Dresden/Quad Cities LRA. The NRC's SER determined that the identified sample population of 2-inch NPS and larger butt welded piping was bounding for consequences and risk for small-bore piping less than NPS 4.

NRC's RAI 3.5-16

In LRA Table 3.5.2.12, the applicant states that no aging management is required for submerged reinforced concrete. Plant-specific Note 5 states that for cracking, loss of bond, loss of material (spalling, scaling) due to corrosion of embedded steel in concrete for inaccessible areas, no plant-specific aging management is required. Plant-specific Note 6 states that for increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack of concrete for inaccessible areas, no plant-specific aging is required.

During the BFN on-site AMR audit, the staff noted that a submerged component is not necessarily inaccessible. If the submerged component is accessible, it is expected that the component will be managed by the Inspection of Water Control Structures Program (B.2.1.37). The applicant was asked to identify all the submerged concrete components in the Intake Pumping Station; provide the technical basis for designating these components as being inaccessible; identify all the submerged concrete structures that will be inspected under AMP B.2.1.37; and describe the implementing details of the inspection of submerged structures included in the AMP B.2.1.37.

By letter dated October 8, 2004, the applicant stated:

(1) Browns Ferry groundwater and Wheeler Reservoir water sample measurements presented in the response to the consistent with GALL audit Question 297 have confirmed that parameters are well below threshold limits that could cause

concrete degradation (i.e., an aggressive environment does not exist).

(2) It is not credible to postulate that some environmental event will occur in the future that would affect the quality of groundwater in the vicinity of Browns Ferry, and that a change in the environment due to a chemical release would be considered as an "abnormal event". The applicant noted that NUREG-1800, "Standard Review Plan for the Review of License Renewal Applications for Nuclear Power Plants," states that aging effects from abnormal events need not be postulated specifically for license renewal.

(3) In-scope submerged concrete exposed to Wheeler Reservoir water is not readily accessible for inspection. Several in-scope submerged concrete common areas outside of individual pump bays where continuous flow make diver entry unsafe would require a multiple unit outage to inspect.

(4) Browns Ferry will perform a one-time inspection of the in-scope submerged concrete in one individual pump bay to confirm the absence of aggressive environmental aging effects and that a loss of intended function has not occurred due to aggressive environment aging effects. Browns Ferry will also continue to perform periodic inspections of accessible concrete in an inside air environment and outside air environment for in-scope structures with the Structures Monitoring Program.

After the review of the above response, including the facts that an aggressive environment does not exist for Browns Ferry groundwater, and continuous water flow in several in-scope submerged concrete common areas outside of individual pump bays makes diver entry unsafe, the staff requests the applicant to provide the following additional information and the corresponding plant-specific commitment and the UFSAR supplement.

1. A discussion of past inspection findings, and repairs and maintenance experience for BFN’s submerged reinforced concrete structures (e.g., intake structure)

2. Referring to the discussion columns of Items III A6.1-b, and III A6.1-d in GALL Volume II (NUREG-1801), provide a discussion of the pertinent BFN submerged reinforced concrete test data (as available) which demonstrate that the conditions stated in the above referenced GALL discussion columns are fully met.

3. A detailed description of the above indicated one-time inspection of the in-scope submerged concrete in one individual pump bay including: method of inspection; concrete elements and parameters or types of degradation to be inspected; criteria for judging the observed types, extent and severity of reinforced concrete degradation which would trigger BFN's commitment to an AMP for BFN submerged concrete with a periodic inspection provision and an inspection frequency, and a BFN schedule for implementing the one-time inspection program.

4. A discussion of the methods that will be employed to ensure that the raw service water in close proximity to the intake structure remains non-aggressive to the submerged concrete during the extended period of operation (e.g., periodic monitoring of the raw water for pH, chloride concentration, sulfate concentration, abrasive particulates, detrimental organic agents).

TVA's Response to RAI 3.5-16

(1) BFN' submerged concrete operating experience:

A baseline inspection for the BFN Structures Monitoring Program was established in 1997 and included the Intake Pumping Station and Gate Structure No. 3. Baseline inspections and subsequent BFN Structures Monitoring Program inspections included accessible interior and exterior concrete surfaces of the Intake Pumping Station and Gate Structure No. 3. Only the Intake Pumping Station has submerged concrete that is in the scope of license renewal. Although the Intake Pumping Station submerged concrete was not inspected, there is reasonable assurance that the submerged concrete results would be consistent due to a lack of an aggressive environment and use of the same concrete specifications for the construction as the accessible portions of the Intake Pumping Station.

Defect evaluations performed since the baseline inspection and subsequent inspections are documented in the 2002 Structures Monitoring Program results. Below is a highlight of plant specific operating experience for concrete elements at the Intake Pumping Station and Gate Structure No. 3. None of the identified indications were considered significant or affected the function of the structure.

- Intake Pumping Station: Very minor concrete surface cracks
- Gate Structure No. 3: Very minor concrete surface cracks and spalling

Additionally, to capture plant operating experience for these structures, work orders (WOs), the site Correction Action Program and site Licensing Event Reports (LERs) were reviewed for various operating periods:

- Work Orders between 1991 and 2004 were reviewed to determine if any corrective maintenance or repairs were performed on the Intake Pumping Station (IPS). A total of 2633 WOs were reviewed for that period and no work activities were found involving the submerged concrete for this structure.
- The site's Correction Action Program was reviewed for the IPS to identify any adverse conditions of the structure, with emphasis on the submerged concrete. A total of 1790 reports were reviewed for a time period between 1994 and 2004, with none being identified for the IPS submerged concrete.
- Licensing Event Reports were reviewed for a period between 1985 and 2004 and none were identified affecting the IPS.

(2) GALL conditions for III A6.1-b (increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide) & III A6.1-d (cracking, loss of bond, loss of material (spalling, scaling) due to corrosion of embedded steel):

See further evaluations in LRA section 3.5.2.2.2.1, item 2 and LRA section 3.5.2.2.2.2 for discussion on these issues.

(3) Submerged concrete one-time inspection:

The following elements apply to the one-time inspection for submerged concrete:

a. Scope of One-Time Inspection:

In-scope submerged concrete in one individual pump bay of the Intake Pumping Station. The submerged concrete surfaces will be inspected.

b. Preventative Measures:

The one-time inspection specifies no preventive actions.

c. Parameters Monitored or Inspected:

The following concrete aging effects will be inspected during the one-time inspection of submerged concrete at the intake pumping station (IPS).

- Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide
- Expansion and cracking due to reaction with aggregates
- Cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel
- Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack

The Intake Pumping Station will be periodically inspected for loss of material (spalling, scaling) and cracking due to the effects of freeze-thaw at the waterline where icing conditions could occur (see GALL audit question 368). The periodic inspection for aging effects due to freeze thaw will be included in the BFN Structures Monitoring Program.

d. Detection of Aging Effects:

Visual inspections of structural conditions will be used as the method used to detect aging effects. An inspection checklist consistent with those used for Structures Monitoring Program will be used. All defects will be required to be identified and documented on the inspection checklists for review and evaluation by the Responsible Engineer (BFN Structures Monitoring Program Engineer). Individuals trained and experienced with the BFN Structures Monitoring Program will perform the inspections.

e. Monitoring and Trending:

The submerged concrete at the Intake Pumping Station will be inspected prior to the extended period of operation.

f. Acceptance Criteria:

The acceptance criteria of the BFN Structures Monitoring Program will be used. BFN Structures Monitoring Program acceptance criteria are based upon Responsible Engineer (BFN Structures Monitoring Program Engineer) review and classification of the results as acceptable, acceptable with deficiencies, and unacceptable respectively. These performance criteria ensure that the structure:

- remains capable of meeting its design basis and performing its intended function; and
- will not result in a loss of intended function due to a degraded condition or aging effect.

If the submerged concrete fails to meet the acceptance criteria, a Cause Determination Evaluation will be performed. If acceptance criteria are not meet, two additional pump bays will be inspected prior to the extended period of operation. If one or more of the additional pump bays fails to meet its acceptance criteria, then submerged concrete at the Intake Pump Station will be inspected periodically consistent with BFN Structures Monitoring Program requirements.

(4) Periodic monitoring of raw service water:

Prior to entering the period of extended operation, BFN will initiate periodic monitoring of the raw service water in close proximity to the Intake Pumping Station for the requirements of an aggressive environment as described in NUREG-1557. Periodic monitoring will be consistent with the BFN Structures Monitoring Program inspection frequency.