10 CFR 54

November 3, 2004

U.S. Nuclear Regulatory Commission
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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 – AUXILIARY SYSTEMS SECTION 3.3 - RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (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 October 12, 2004, identified areas where additional information is needed to complete its review.

The specific area requiring a request for additional information (RAIs) are related to the aging management of auxiliary systems in Section 3.3 of the license renewal application. Draft forms of these RAIs were discussed with the TVA Staff on a telephone conference call on August 18, 2004.

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

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 forgoing is true and correct. Executed on this 3rd day of November, 2004.

Sincerely,

Original Signed by:

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s://Licensing/Lic/BFN LR Section 3.3 Auxiliary Systems RAI TVA.doc

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 THE AGING MANAGEMENT OF AUXILIARY SYSTEMS IN SECTION 3.3 OF THE LICENSE RENEWAL APPLICATION

(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 THE AGING MANAGEMENT OF AUXILIARY SYSTEMS IN SECTION 3.3 OF THE LICENSE RENEWAL APPLICATION

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The specific area requiring a request for additional information (RAIs) is related to the aging management of auxiliary systems in Section 3.3 of the license renewal application. Drafted forms of these RAIs were discussed with the TVA Staff on a telephone conference call on August 18, 2004.

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

NRC RAI 3.3.2.1-1

Aging management review (AMR) table line items for copper alloy in an inside air (external) environment, for this material/environment combination, the LRA identifies no aging effects requiring management (AERMs) and, consequently, proposes no aging management programs (AMPs). However, the existence of AERMs depends on the particular alloy and whether there is condensation or pooling on the component. For example, high zinc (>15%) alloys in condensation or pooling water may exhibit stress corrosion cracking, selective leaching, or pitting and crevice corrosion. The LRA definition of inside air (external) would support condensation and pooling. Clarify how condensation and pooling were considered in the evaluation of potential aging of susceptible alloys.

TVA RESPONSE TO RAI 3.3.2.1-1

The copper alloy components exposed to an inside air (external) environment were evaluated individually to determine where

condensation could occur. The aging effects evaluation then determined the aging effects/mechanisms based on whether the particular copper alloy is present and whether condensation or periodic wetting occurred. The generic guidelines for copper alloy material/environment/aging effect/aging mechanism determination are provided in the following table. Copper alloy components containing fluid at a temperature below the dew point of the external environment will be subject to condensation.

Aging Effect/Mechanism Determination for Copper Alloys:		
Copper alloy	**Non-wetted environment**	**Wetted environment**
<15% Zn and <8% Al	• Crevice corrosion – No • Pitting corrosion – No • Galvanic corrosion - No • Selective leaching – No • SCC – No • MIC – No	• Crevice corrosion – No • Pitting corrosion – No • Selective leaching – No • SCC – No • If there is a potential source of MIC microbes: - MIC – Yes • If there is no potential source of MIC microbes: - MIC – No • If there is contact with a metal higher in the galvanic series: - Galvanic corrosion – Yes • If there is no contact with a metal higher in the galvanic series: - Galvanic corrosion – No

Aging Effect/Mechanism Determination for Copper Alloys:		
Copper alloy	**Non-wetted environment**	**Wetted environment**
≥15% Zn or ≥8% Al	• Crevice corrosion – No • Pitting corrosion – No • Galvanic corrosion - No • Selective leaching - No • SCC – No • MIC – No	• Selective leaching – Yes • If there is a mechanism/potential for concentrating contaminates: – Crevice corrosion – Yes – Pitting corrosion – Yes – SCC – Yes • If there is no mechanism/potential for concentrating contaminates: – Crevice corrosion – No – Pitting corrosion – No – SCC – No • If there is potential source of MIC microbes: - MIC – Yes • If there is no potential source of MIC microbes: - MIC – No • If there is contact with a metal higher in the galvanic series: - Galvanic corrosion - Yes • If there is no contact with a metal higher in the galvanic series: - Galvanic corrosion – No

Fuel Oil System

NRC RAI 3.3.2.2-1

LRA Section 3.3.2.2.7 indicates that the one-time inspections will be performed at locations where contaminants would accumulate in the fuel oil system. It appears that this is applicable to the entire system, even though not all components specifically cite this LRA section (via Table 3.3.1 Item 3.3.1.7). Clarify whether this is the case. Also, clarify whether it applies to the copper alloy components in a fuel oil environment, if contaminants can accumulate in these components. If not, provide justification for not performing inspections at all system low points where contaminants could accumulate, or provide aging management for these areas.

TVA RESPONSE TO RAI 3.3.2.2-1

In Table 3.3.2.2, Fuel Oil System, the One-Time Inspection Program is identified as verification of the effectiveness of the Fuel Oil Chemistry Program for components where an aging effect was identified. This includes components throughout the fuel oil systems and not just locations where contaminants accumulate. The second sentence of LRA Section 3.3.2.2.7 should be deleted.

NRC RAI 3.3.2.2-2

In Table 3.3.2.2 of the LRA, numerous line items state that carbon and low alloy steel components in fuel oil experience no AERMs and require no AMPs. This is not consistent with the GALL or with industry experience. Adjacent line items in LRA Table 3.3.2.2 for the same material, environment, and GALL reference, state that the components are subject to loss of material due to microbiologically influenced corrosion (MIC), cite industry experience as the basis for this conclusion, and credit the Fuel Oil Chemistry Program and the One-Time Inspection Program for aging management. Clarify whether these adjacent line items apply to the same components. If so, clarify whether the adjacent line items are intended to state that you consider MIC to be the only aging mechanism instead of the aging mechanisms in GALL. Clarify whether you intend to credit the Fuel Oil Chemistry Program and the One-Time Inspection Program for all carbon steel and low alloy steel components in the system. If not, provide aging management for the carbon steel and low alloy steel components that are not covered by these programs.

TVA RESPONSE TO RAI 3.3.2.2-2

The line items that state that carbon and low alloy steel components in fuel oil experience no aging effects requiring management are there to indicate that some potential aging mechanisms identified in NUREG 1801 are not applicable.
For the example given, rows 58 and 59 of BFN LRA, Table 3.3.2.2, address carbon and low alloy steel pump casings associated with the diesel-driven fire pump (NUREG 1801, Volume 2, Section VII.G.8-a). Section VII.G.8-a lists four aging mechanisms: general, galvanic, pitting, and crevice corrosion. From the aging management review, it was determined that the only aging mechanism applicable to the diesel-driven fire pump's fuel oil pump is microbiologically influenced corrosion. This was documented in the aging management review as:

- General corrosion – No
- Galvanic corrosion – No
- Pitting corrosion – No
- Crevice corrosion – No
- Microbiologically influenced corrosion – Yes

The last aging mechanism, i.e., MIC, forms the basis for row 58 of BFN LRA Table 3.3.2.2. The first four items are documented in row 59 of BFN LRA Table 3.3.2.2 as no aging effect with Note 5 identified. Note 5 states, "General, crevice, pitting and galvanic corrosion are not aging management concerns since water collection does not occur in these components."
The Fuel Oil Chemistry Program and the One-Time Inspection Program are credited as aging managements programs for all carbon steel and low alloy steel components in the Fuel Oil System with a fuel oil internal environment.

Ventilation System

NRC RAI 3.3.2.1.8-1

Table 3.3.2.1.8 that the carbon and low alloy steel ductwork experiences no aging effects. The staff notes that adjacent entries in Table 3.3.2.8 for the same material, environment, and GALL reference, identify a loss of material due to general corrosion. It appears that the applicant takes exception to the GALL's identification that crevice corrosion, pitting corrosion, and MIC are applicable, and instead has determined that general corrosion is applicable. The basis is that the LR scope of the system does not include drip pans and the moisture content of the air does not result in an aggressive environment or pooling water which would promote the other mechanisms. Clarify whether

the adjacent line items refer to the same components, such that the components will receive a one-time inspection for general corrosion. Otherwise, provide additional justification for the determination that carbon and low alloy steel ductwork does not require aging management, or provide aging management.

TVA RESPONSE TO RAI 3.3.2.1.8-1

Reference to Table 3.3.2.1.8 should be Table 3.3.2.8.
The line items that state that carbon and low alloy steel ductwork experiences no aging effects requiring management are there to indicate that crevice corrosion, pitting corrosion, and MIC aging mechanisms identified in NUREG 1801 are not applicable. The same ductwork appears in an adjacent line item where general corrosion is identified. Therefore, in-scope carbon and low alloy steel ductwork will be subject to the One-Time Inspection Program

NRC RAI 3.3.2.1.8-2

Table 3.3.2.1.8 line item related to elastomer - rubber and silicone rubber ductwork in inside air. For this material/environment combination, the applicant claims that there are no AERMs based on industry guidance. The degradation of elastomers depends on the environmental factors such as the temperature, radiation levels, and presence of aggressive chemicals. Degradation can also be caused by wear (for items such as seals and vibration dampers). The applicant is asked to provide additional information on the above factors to justify that there are no AERMs for the elastomers, or to provide aging management for the elastomer components in the ductwork.

TVA RESPONSE TO 3.3.2.1.8-2

Reference to Table 3.3.2.1.8 should be Table 3.3.2.8.
The aging effect requiring management for elastomer - rubber and silicone rubber ductwork in an inside air environment is shown in line item 10 of Table 3.3.2.8 as elastomer degradation. The aging mechanism identified is elastomer degradation due to ultraviolet radiation. The identified aging management program is the System Monitoring Program.
Aging effects due to thermal exposure and ionizing radiation are not identified for the following reasons: Maximum temperature rating for rubber is 130° F and silicone rubber is 275° F per industry guidance. During normal operation, the temperature of the components within the Normal Ventilation System is significantly less than 130° F; therefore, degradation from

thermal exposure is not identified as an aging mechanism requiring management for the period of extended operation. The dose threshold for radiation degradation of rubber is 10^7 Rads and silicone rubber is 10^6 rads. The ionizing radiation the components will receive in the Normal Ventilation System is negligible (much less than 10^6 rads); therefore, degradation from ionizing radiation is not identified as an aging mechanism requiring management for the period of extended operation.

Heating, Ventilation, and Air Conditioning System

NRC RAI 3.3.2.1.9-1

Table 3.3.2.1.9 line items related to elastomer ductwork, fittings, and flexible connectors in inside air. For this material/environment combination, the applicant claims that there are no AERMs based on industry guidance. The degradation of elastomers depends on the environmental factors such as the temperature, radiation levels, and presence of aggressive chemicals. Degradation can also be caused by wear. The applicant is asked to provide additional information on the above factors to justify that there are no AERMs for the elastomers, or to provide aging management for the elastomer components in the ductwork, fittings, and flexible hoses.

TVA RESPONSE TO RAI 3.3.2.1.9-1

Reference to Table 3.3.2.1.9 should be Table 3.3.2.9. The elastomer ductwork, fittings, and flexible connectors in inside air environment as shown in Table 3.3.2.9 include silicone compounds, neoprene compounds, and neoprene coated glass fabric (Dupont's Ventglass) materials. These materials do not have aging effects requiring management due to the following reasons: Maximum temperature rating for neoprene is 160° F, silicone rubber is 275° F, and neoprene coated glass fabric (Ventglass) is 200° F. During normal operation, the temperature of the components within the Heating, Ventilation, and Air Conditioning System is significantly less than 160 °F; therefore, degradation from thermal exposure is not identified as an aging mechanism requiring management for the period of extended operation. The lowest reported dose threshold for radiation degradation of neoprene and silicone rubber is 10^6 rads. The ionizing radiation the components will receive in the Heating, Ventilation, and Air Conditioning System is negligible (much less than 10^6 rads); therefore, degradation from ionizing radiation is not identified as an aging mechanism requiring management for the period of extended operation.

Cracking due to ultraviolet radiation and ozone is not an applicable effect for neoprene and silicone compounds per industry guidance and industry operating experience; therefore, degradation from ultraviolet radiation is not identified as an aging mechanism requiring management for the period of extended operation.

NRC RAI 3.3.2.1.9-2

Table 3.3.2.1.9 line item related to copper alloy heat exchangers in inside air (external). The applicant claims that there are no AERMs for this material environment combination. The staff notes that the component intended functions are pressure boundary and heat transfer. The staff also notes that the LRA states there is condensation in the heat exchangers (Note 3 of Table 3.3.2.1.9). Therefore, there is the potential for corrosion and loss of heat transfer in the copper alloy heat exchanger components. There is also the potential for particulate fouling. The applicant is asked to provide additional justification for determining that there are not AERMs for these heat exchanger components, including loss of heat transfer, or to provide aging management.

TVA RESPONSE TO RAI 3.3.2.1.9-2

References to Table 3.3.2.1.9 should be Table 3.3.2.9.
For those heat exchangers where condensation potentially exists, corrosion and fouling were identified. These aging effects are shown in line items 127/130 and 128/133 of Table 3.3.2.9. Note that line items 127/128 are not labeled correctly. The Freon note should be deleted from these line items and added to line items 131/132. This was identified and corrected in response to Question 434 from the NRC consistent with the GALL audit (Browns Ferry Nuclear Plant (BFN) - Units 1, 2, And 3 License Renewal Application – Response to NRC Request for Additional Information (RAI) Developed During the License Renewal Audit Inspections for Comparison to Generic Aging Lessons Learned (GALL) During Weeks of June 21, 2004 and July 26, 2004, dated October 8, 2004). These cooling coils are internal to the ventilation ductwork and are identified with an air/gas (internal) environment).

The heat exchanger inside air (external) environment, line item 135 of Table 3.3.2.9, was identified for the condensation coils in the Freon cycle. In this situation, air flow is used to cool the Freon. Since the air flow is heated by this heat transfer, condensation on the exterior of the coils will not occur and loss of material is not identified as an aging mechanism

requiring management for the period of extended operation. Air side fouling of cooling coils that have no condensation mechanism is only a problem for fin type heat exchangers. The Freon condensation coils do not have cooling fins and, therefore, fouling is not identified as an aging mechanism requiring management for the period of extended operation.

Emergency Equipment Cooling Water System

NRC RAI 3.3.2.1.20-1

Table 3.3.2.1.20 of the LRA identifies heat exchanger components made from copper alloy exposed to inside air (external) with an intended functions of pressure boundary and heat transfer. The LRA identifies that there are no AERMs for this component. This is contrary to industry experience, since condensation and pooling can result in loss of material for certain copper alloys and since particulate fouling can contribute to loss of heat transfer. Provide justification that the heat exchanger components will not experience aging effects, including loss of heat transfer, or provide an AMP to address this AERM.

TVA RESPONSE TO RAI 3.3.2.1.20-1

Reference to Table 3.3.2.1.20 should be Table 3.3.2.20.
The heat exchangers identified in LRA Table 3.3.2.20 for the Emergency Equipment Cooling Water System (067) are the core spray pump room coolers and the RHR pump room coolers. The copper alloy material exposed to inside air (external) is the u-bend connectors for the internal cool coil. Since these u-bend connectors may be below the room atmosphere dew point, loss of material should be identified. The tube u-bends connectors are external to room coolers and therefore heat transfer is not an intended function. Since heat transfer is not an intended function, fouling of the surface is not an aging effect requiring management. The following is the corrected line item for the heat exchanger copper alloy/inside air (external) commodity grouping.

Table 3.3.2.20:Emergency Equipment Cooling Water System (067) - Summary of Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG - 1801 Vol. 2 Item	Table 1 Item	Notes

Heat Exchangers	PB	Copper Alloy	Inside Air (external)	Loss of material due to pitting, crevice, and galvanic corrosion	System Monitoring Program (**B.2.1.39**)	VII.I.1-b	None	F, 1

Reactor Core Isolation Cooling System

NRC RAI 3.3.2.1.23-1

Table 3.3.2.1.23 of the LRA identifies heat exchanger components made from copper alloy exposed to inside air (external) with an intended functions of pressure boundary and heat transfer. The LRA identifies that there are no AERMs for this component. This is contrary to industry experience, since condensation and pooling can result in loss of material for certain copper alloys and since particulate fouling can contribute to loss of heat transfer. Provide justification that the heat exchanger components will not experience aging effects, including loss of heat transfer, or provide an AMP to address this AERM.

TVA RESPONSE TO RAI 3.3.2.1.23-1:

Reference to Table 3.3.2.1.23 should be Table 3.3.2.23.
The heat exchangers identified in LRA Table 3.3.2.23 for the Reactor Core Isolation Cooling System (071) are lube oil heat exchangers that are cooled by pump discharge. The copper alloy material exposed to inside air (external) is the connectors for the lube oil lines going to the internal copper tubes. The temperature of the lube oil internal to these connections is higher than room temperature and therefore condensation will not occur. With no condensation, the identification of no aging effects in an inside air (external) environment is consistent with NRC and industry guidance.

Bolting Commodity Group

NRC RAI 3.3.2.1.35-1

The LRA does not consider cracking as an applicable AERM for the nickel alloy bolting (i.e., in the sampling and water quality system). Nickel alloys are susceptible to stress corrosion cracking under certain environmental conditions. Provide additional information on the nickel alloy bolting to justify that cracking will not occur.

TVA RESPONSE TO RAI 3.3.2.1.35-1

Nickel-alloy bolting, similar to stainless steel bolting, is subject to cracking under severe environmental conditions such as high temperature and being buried or submerged (potential, depending on type of external water). Nickel-alloy bolting in the Sampling and Water Quality System is not subject to this severe environment; therefore, cracking was not identified.

B.2.1.39 Systems Monitoring Program

NRC RAI B.2.1.39-1

LRA Section B.2.1.39 describes the existing plant specific systems monitoring program that includes periodic visual inspections of systems' and components' material condition, operation, and configuration. The LRA AMR tables identify the material and aging effect requiring management for each component crediting the systems monitoring program. The AMR identifies the main aging effect managed by the systems monitoring program as loss of material due to general corrosion on the external surfaces of carbon steel, low alloy steel, cast iron and cast iron alloy materials exposed to inside air or outside air environments. The AMR identifies that external surfaces of elastomers used in ductwork and flexible connectors are also managed by the systems monitoring program for elastomer degradation due to ultraviolet radiation or thermal exposure. The staff requires additional information concerning specific elements of AMP B.2.1.39.

a) Element 4, Detection of Aging Effects, identifies that the systems monitoring program includes visual inspections to identify material condition on a periodic basis. Clarify if visual inspections are required for all surfaces of all components and systems crediting this program or if only selected portions of systems and components are to be inspected. The SRP-LR recommends that, when sampling is used to inspect a group of SCs, the basis for the inspection population and sample size should be provided. If a sampling approach is used, provide justification that the sample size is adequate. Also, clarify how external surfaces of systems that are either covered by insulation or are located in normally inaccessible areas are to be visually inspected. The SRP-LR recommends that the method or technique used to detect the aging effect be appropriate to ensure that the component intended function(s) will be adequately maintained. Clarify how elastomer degradation, such as hardening and loss of strength, would be detected

by visual inspections, prior to loss of its intended function. Also, clarify how external surface inspections using the systems monitoring program would detect internal aging effects caused by exposure to treated water for the flexible connectors in the diesel generator system.

b) Element 6, Acceptance Criteria, identifies that during a system or component visual inspection, system engineers use their knowledge to evaluate system physical attributes and operational characteristics. The SRP-LR recommends that the acceptance criteria, such as ASME codes, and its basis be described. Clarify the acceptance criteria applied in the inspection or evaluation of degradation reported as a result of the system monitoring inspection.

c) Element 10, Operating Experience, identifies that the systems monitoring program and system heath reports have identified age related degradation and material conditions of systems and components. The SRP-LR recommends that operating experience with existing programs should be discussed. Identify specific operating experience that provides objective evidence to support the conclusion that the systems monitoring program is effective in managing aging effects on the external surfaces of systems and components within scope of the program. If independent assessments have been performed to evaluate the effectiveness of the systems monitoring program, describe the scope and results of these assessments.

TVA RESPONSE TO RAI B.2.1.39-1

The System Monitoring Program is an existing plant-specific program that has no comparable NUREG-1801 program. Therefore, a precedence review to a previously approved license renewal program was prepared. The selected reference program is the H. B. Robinson Systems Monitoring Program (H. B. Robinson LRA, Section B.3.17). The NRC review is documented in the Safety Evaluation Report Related to the License Renewal of the H. B. Robinson Steam Electric Plant, Unit 2, August 2003 (Section 3.0.3.11).

The BFN Systems Monitoring Program is a condition monitoring program that includes periodic visual inspections of systems' and components' material condition, operation, and configuration. System visual inspections identify degraded conditions prior to the loss of the systems' and components' intended function. The system visual inspections are performed on a periodic basis and provide for data collection on systems and components for monitoring and trending to ensure timely

detection of aging effects. Both the BFN and the Robinson programs perform visual inspection of accessible components during system walkdowns to detect the effects of aging. This approach was accepted in the Robinson SER.

Visual inspections should encompass all or part of the total accessible system, such that the entire system is covered over time. Portions of the system, inaccessible during power operation, should be walked down during refueling outages or forced outages. The accessible portions are indicative of system material condition. NEDP-20, Conduct of the Engineering Organization, provides system walkdown guidance. Per NEDP-20, the System Engineer shall perform periodic system walkdowns to maintain a current awareness of system condition and performance and to obtain data for system performance monitoring. NEDP-20 includes the following guidelines:

- A walkdown is a detailed look at system parameters, material condition, operation, and configuration, degraded components, outstanding work activities, and unauthorized Temporary Alterations (TAs) or design changes.
- A walkdown should include periodic observation of surveillance activities, infrequently performed tests/evolutions and maintenance activities.
- A walkdown should focus on those aspects of system material condition that might not be noted during routine work activities by operations and maintenance personnel.
- System and component vents and drains are not leaking. There is no evidence of steam or water leakage or material wastage.
- No evidence of bolt torque relaxation.
- There is no missing or damaged insulation. Insulation is not discolored indicating a potential leak.
- Surface condition of structural welds appears satisfactory.
- Coatings and painting is satisfactory. No touch-up painting is needed on components, piping, or supports.

The Browns Ferry System Monitoring Program includes System Health Reports which provide a periodic review of systems and components operating experience. The System Monitoring Program and System Health Reports have identified age related degradation and material conditions on systems and components and document the degradation with Problem Evaluation Reports (PERs) and Work Orders (WOs). The effectiveness of the corrective actions are evaluated and documented in the system

health reports. The Browns Ferry System Monitoring Program through the use of PERs and WOs track and trends corrective actions and provides objective evidence to support a determination that the effects of aging will be adequately managed so that the systems and components intended function will be maintained during the period of extended operation. For the one example where the Systems Monitoring Program was identified for the detection of internal aging effects caused by exposure to treated water for the flexible connectors in the Diesel Generator System, the identified aging management program is incorrect. The internal aging effects are managed by the One-Time Inspection Program and the external surfaces aging effects are managed by the System Monitoring Program.