December 9, 2004

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 – ELECTRICAL AND INSTRUMENT AND CONTROL SYSTEMS (I&C) SYSTEMS SECTION 3.6 – 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 November 4, 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 Electrical and I&C Section 3.6 of the License Renewal Application. Drafted forms of these RAIs were discussed with the TVA Staff on a telephone conference call on July 28, 2004. This request was not received electronically at BFN until November 9, 2004 and

through discussion with the NRR Project Manager it was agreed upon that a 30 day response from November 9, 2004 was acceptable.

The enclosure to this letter contains the specific NRC requests for additional information and the corresponding TVA response. As discussed with the NRC Staff, TVA's response to RAI 4.4-2 will be transmitted to the NRC by December 21, 2004.

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 9th day of December, 2004.

Sincerely,

Original signed by:

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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 ELECTRICAL AND INSTRUMENT AND CONTROL (I&C) SYSTEMS
SECTION 3.6

(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 ELECTRICAL AND INSTRUMENT AND CONTROL (I&C) SYSTEMS SECTION 3.6

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 November 4, 2004, identified areas where additional information is needed to complete its review.

The specific area requiring a request for additional information (RAI) are related to the Electrical and I&C Systems, Section 3.6 of the License Renewal Application. Drafted forms of these RAIs were discussed with the TVA Staff in a telephone conference call on July 28, 2004. This request was not received electronically at BFN until November 9, 2004 and through discussion with the NRR Project Manager it was agreed upon that a 30 day response from November 9, 2004 was acceptable.

Listed below are the specific NRC requests for additional information and the corresponding TVA responses. As discussed with the NRC Staff, TVA's response to RAI 4.4-2 will be transmitted to the NRC by December 21, 2004.

NRC RAI 3.6-1

Explain the aging effects of temperature (hot spot) and moisture on the existing components including cables during the long non-operational period of Unit 1.

TVA response to RAI 3.6-1

Hot Spot Issues

An evaluation was performed for Units 2 and 3 that systematically evaluated cables close to thermally hot pipes. The evaluation included a definition of hot pipes, criteria that defined the acceptable distance between cables and hot pipes, a plant walkdown, and an evaluation of interactions discovered during the walkdown. Interactions were documented as acceptable

or made acceptable by modifications to the plant. The applicable General Engineering Specification was revised to ensure that future installations did not contain unacceptable interactions between hot pipes and cables. TVA has reviewed the hot spot interaction calculations for the cable-to-hot spot interactions that were previously determined to be acceptable. The calculated temperature of non-EQ cables in-scope for License Renewal in the vicinity of hot pipes was compared to the 60-year acceptable temperature. All non-EQ cables in-scope for License Renewal were found to be acceptable for 60 years. EQ cables within the vicinity of hot pipes will be evaluated as Time Limited Aging Analyses (TLAA).

Unit 1 will use a similar approach as that developed for Units 2 and 3. Unit 1 hot spot interactions will be verified to ensure cables within the vicinity of hot pipes will not exceed their 60-year acceptable temperature.

Moisture

As part of the Aging Effects Evaluations, TVA found no moisture related aging effects for low voltage cables, connections, transmission conductors, or switchyard bus for Units 1, 2, or 3.

TVA did identify a possible aging affect of moisture on medium voltage cables installed in underground conduit banks. This aging effect will be managed for Units 1, 2, and 3 by the "Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements" program.

Additionally, TVA identified moisture intrusion into phase bus housings as a potential aging effect. This aging effect will be managed for Units 1, 2, and 3 by the "Bus Inspection Program".

The LRA evaluations were performed as if Unit 1 had been operating like Units 2 and 3. No additional aging effects for electrical equipment were identified for the Unit 1 non-operational period.

RAI 3.6-2

Discuss if any non-environmental qualification (EQ) cables and connections are excluded from the scope of license renewal. If so, provide a discussion how these excluded cables that share the same conduit and tray with the in-scope cables are treated.

TVA response to RAI 3.6-2

In response to RAI 2.5-2, TVA discussed which cables and connections are screened out of the scope of license renewal. The "Accessible Non-EQ Cables and Connections Inspection Program" will inspect for indications of an "Adverse Localized Environment" by visually inspecting accessible cables and connections for signs of jacket surface anomalies such as embrittlement, cracking, melting, discoloration, or swelling. If during the performance of these inspections, a cable or connection that is not in the scope of license renewal displays any of the above described visual signs, an evaluation will be performed to determine if in-scope cables and connections in the same tray or conduit have been also adversely affected. Therefore, cables not within the scope of license renewal can also be used as possible indicators of adverse localized environments.

RAI 3.6-3

It is not clear from the description of AMP B.2.1.3, "Inaccessible Medium Voltage Cables Not subject to 10 CFR 50.49 Environmental Qualification Requirements" which cables are covered by this program.

(a) Please provide a list of cables that are covered under this program.

(b) The operating experience should address plant specific and industry operating experience regarding the water-treeing phenomenon or any expected decrease in the dielectric strength of the conductor insulation.

(c) Also, please provide details (ten elements) of the aging management program.

TVA response to RAI 3.6-3

(a) The specific cables included in the B.2.1.3, "Inaccessible Medium Voltage Cables Not subject to 10 CFR 50.49 Environmental Qualification Requirements" are the medium voltage Residual Heat Removal Service Water pump cables installed in underground conduit duct banks.

(b) Referring to section B.2.1.3, this is a new program that has not been implemented; therefore, no operating experience exists for the program currently. A review of

industry and site operating experience was performed during the Aging Management Review process to identify any new potential aging effects. The results of the review are as follows:

Plant Specific Operating Experience

Browns Ferry operating experience was reviewed to identify applicable aging effects for "Various Organic Polymers" located in an "Adverse Localized Environment" exposed to "Moisture and Voltage." The review included License Event Reports (LER), Problem Evaluation Reports (PER), and Work Orders (WO). The following event was identified as applicable:

BROWNS FERRY NUCLEAR PLANT - CCWP 3C FEEDER CABLE 3PP1144 FAILURE ANALYSIS:

In a 1997, a XLPE insulated CCWP capacitor bank cable failed in-service at BFN. Analysis revealed the most likely cause of the failure is the presence of contaminants which had served as the initiation sites for electrical trees. TVA concluded that the remaining CCWP cables from this manufacturer are probably not at immediate risk unless they are (or have been) routinely dc tested or poorly protected from surges. Unwatering of the ductbank will stop the ingress of further moisture, but full drying of the insulation is likely not achievable. Partial drying will effect stress distribution under dc and surge conditions and will thus enhance remaining life.

No new aging effects were identified from this event.

Industry Operating Experience

Industry operating experience was reviewed to identify applicable aging effects for "Various Organic Polymers" located in an "Adverse Localized Environment" exposed to "Moisture and Voltage." The review included NRC Generic Communications and Requests for Additional Information (RAIs). The following NRC Information Notice was identified as applicable:

NRC Information Notice 2002-12:

On November 11, 2001, at the Oyster Creek Nuclear Power Plant, a 4160-Vac cable failure deenergized a unit

substation for the 480-Vac system, prompting unit shutdown. The licensee replaced the faulted Anaconda Unishield cable with a "Cablec" Cable. On the basis of that evaluation, the licensee concluded that the cable failure resulted from a localized delamination of the cable jacket aggravated by water intrusion into the underground cable conduit, subsequent cable drying, and corona degradation of the insulation [Licensee Event Report 50-219/2001-01, dated January 7, 2002]. It was concluded that the cable failure resulted from manufacturing defect and did not follow the classical water treeing model. TVAN does not utilize Anaconda Unishield cable, but other manufactured types of EPR and XLPE insulated cables.

No new aging effects were identified from this NRC Information Notice.

(c) Ten Element Evaluation for "Inaccessible Medium Voltage Cables Not subject to 10 CFR 50.49 Environmental Qualification Requirements"

Element 1 - Scope of Program
This program applies to inaccessible (e.g., in conduit or direct buried) medium-voltage cables within the scope of license renewal that are exposed to significant moisture simultaneously with significant voltage. Significant moisture is defined as periodic exposures to moisture that last more than a few days (e.g., cable in standing water). Periodic exposures to moisture that last less than a few days (i.e., normal rain and drain) are not significant. Significant voltage exposure is defined as being subjected to system voltage for more than twenty-five percent of the time. The moisture and voltage exposures described as significant in these definitions, which are based on operating experience and engineering judgment, are not significant for medium-voltage cables that are designed for these conditions (e.g., continuous wetting and continuous energization is not significant for submarine cables).

BFN Element 1 Summary Statement
Medium voltage cables that are installed in underground conduit duct banks and that perform an in-scope intended function (such as the medium-voltage cables to the RHRSW pumps) will be included in the test program.

Is the BFN Program consistent with element 1 of the GALL Program? Yes

Element 2 - Preventive Actions
Periodic actions are taken to prevent cables from being exposed to significant moisture, such as inspecting for water collection in cable manholes and conduit, and draining water, as needed. Medium-voltage cables for which such actions are taken are not required to be tested since operating experience indicates that prolonged exposure to moisture and voltage are required to induce this aging mechanism.

BFN Element 2 Summary Statement
Periodic actions will be taken to prevent cables from being exposed to significant moisture, such as inspecting for water collection in cable manholes and conduit, and draining water, as needed. These actions will be performed as part of the testing described in Element 3.

Is the BFN Program consistent with element 2 of the GALL Program? Yes

Element 3 - Parameters Monitored or Inspected
In-scope, medium-voltage cables exposed to significant moisture and significant voltage are tested to provide an indication of the condition of the conductor insulation. The specific type of test performed will be determined prior to the initial test, and is to be a proven test for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, or polarization index, as described in EPRI TR-103834-P1-2, or other testing that is state-of-the-art at the time the test is performed.

BFN Element 3 Summary Statement
This program will test those inaccessible medium-voltage cables identified as in scope to determine the condition of the conductor insulation by testing the cables. The specific type of test performed will be determined prior to the initial test, and is to be a proven test for detecting deterioration of the insulation system, such as power factor, partial discharge, or polarization index, as described in EPRI TR-103834-P1-2, or other testing that is state-of-the-art at the time.

Is the BFN Program consistent with element 3 of the GALL Program? Yes

Element 4 - Detection of aging effects
In-scope, medium-voltage cables exposed to significant moisture and significant voltage are tested at least once every 10 years. This is an adequate period to preclude failures of the conductor insulation since experience has shown that aging degradation is a slow process. A 10-year inspection frequency will provide two data points during a 20-year period, which can be used to characterize the degradation rate. The first tests for license renewal are to be completed before the period of extended operation.

BFN Element 4 Summary Statement
In this program, affected cables will be tested before the current 40-year licensing term has concluded for each unit and at least once every 10 years thereafter.

Is the BFN Program consistent with element 4 of the GALL Program? Yes

Element 5 - Monitoring and trending
Trending actions are not included as part of this program because the ability to trend test results is dependent on the specific type of test chosen. Although not a requirement, test results that are trendable provide additional information on the rate of degradation.

BFN Element 5 Summary Statement
Trending actions are not included as part of this program because the ability to trend test results is dependent on the specific type of test chosen. Test results that are trendable may be trended to provide additional information on the rate of degradation.

Is the BFN Program consistent with element 5 of the GALL Program? Yes

Element 6 - Acceptance Criteria
The acceptance criteria for each test is defined by the specific type of test performed and the specific cable tested.

BFN Element 6 Summary Statement
During testing, cables shall meet the acceptance criteria of the test being performed.

Is the BFN Program consistent with element 6 of the GALL Program? Yes

Element 7 - Corrective Actions
An engineering evaluation is performed when the test acceptance criteria are not met in order to ensure that the intended functions of the electrical cables can be maintained consistent with the current licensing basis. Such an evaluation is to consider the significance of the test results, the operability of the component, the reportability of the event, the extent of the concern, the potential root causes for not meeting the test acceptance criteria, the corrective actions required, and the likelihood of recurrence. When an unacceptable condition or situation is identified, a determination is made as to whether the same condition or situation is applicable to other inaccessible, in-scope, medium-voltage cables. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address corrective actions.

BFN Element 7 Summary Statement
The TVA Nuclear Quality Assurance Plan, TVA-NQA-PLN89-A, implements the requirements of 10 CFR 50, Appendix B, and is consistent with the summary in Appendix A.2 of NUREG-1800.

Is the BFN Program consistent with element 7 of the GALL Program? Yes

Element 8 - Confirmation Process
As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process.

BFN Element 8 Summary Statement
The TVA Nuclear Quality Assurance Plan, TVA-NQA-PLN89-A, implements the requirements of 10 CFR 50, Appendix B, and is consistent with the summary in Appendix A.2 of NUREG-1800.

Is the BFN Program consistent with element 8 of the GALL Program? Yes

Element 9 - Administrative Controls
As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address administrative controls.

BFN Element 9 Summary Statement
The TVA Nuclear Quality Assurance Plan, TVA-NQA-PLN89-A, implements the requirements of 10CFR 50, Appendix B, and is consistent with the summary in Appendix A.2 of NUREG-1800.

Is the BFN Program consistent with element 9 of the GALL Program? Yes

Element 10 - Operating Experience
Operating experience has shown that XLPE or high molecular weight polyethylene (HMWPE) insulation materials are most susceptible to water tree formation. The formation and growth of water trees varies directly with operating voltage. Treeing is much less prevalent in 4kV cables than those operated at 13 or 33kV. Also, minimizing exposure to moisture minimizes the potential for the development of water treeing. As additional operating experience is obtained, lessons learned can be used to adjust the program, as needed.

Element 10 Summary Statement
Industry operating experience was incorporated into the License Renewal process through a review of industry documents to identify aging effects and mechanisms that could challenge the intended function of components within the scope of this program. Review of plant specific operating experience was also performed to identify aging effects experienced. This review involved electronic database searches of plant information including Problem Evaluation Reports (PERs), NRC Communications, Request for Additional Information (RAIs), and Work Orders (WOs). As a result of the search, the following documents were reviewed with no new aging effects identified. IN 86049, RIS 2000-25, and RAIs 1554 thru 1558 (Peach Bottom, Units 1 & 2).

Is the BFN Program consistent with element 10 of the GALL Program? Yes

RAI 3.6-4

With regard to AMP B.2.1.40, "Bus Inspection Program," please provide the following:

(a) Clarify what is meant by in-scope portions of isolated and non-segregated phase bus associated with the unit station service transformers, main transformers, and common station

service transformers. Also, provide a description how the aging of start bus 1A and 1B and shutdown bus 1 and 2 will be managed.

(b) Under Element 3, you have stated that "The bus enclosure will be visually inspected for foreign debris, excessive dust built up, and evidence of water intrusion." Please clarify if this inspection will cover inside of the bus enclosure for foreign debris, excessive dust built up, and evidence of water intrusion. Also, confirm that internal supports and insulators will be inspected for structural integrity and sign of cracks, if not, discuss how the aging of internal supports and insulators will be managed. The acceptance criteria (Element 6) needs to be modified accordingly.

(c) In the operating experience section of your submittal, please address the plant specific and industry operating experience for bus failures.

TVA response to RAI 3.6-4

(a) The sections of isolated and non-segregated phase bus described in section 2.1.8.2 of the LRA which includes the sections of non-segregated phase bus that connect the Common Station Service Transformers to the 4kV Unit Start Board and the Unit Station Service Transformers to the 4kV Unit Boards. Also, described are the sections of isolated phase bus that connect the Unit Station Service Transformers to the Main Transformers.

Start bus 1A and 1B and shutdown bus 1 and 2 are cable buses which will be managed by the Accessible Non-Environmental Qualification Cables and Connections Inspection Program.

(b) The inspection will include the inside of the bus enclosure for foreign debris, excessive dust build up, and evidence of water intrusion. TVA will include a visual inspection of the internal supports and insulators that are visible from the inspection hatches to the Bus Inspection Program. Acceptance criteria include no unacceptable indications of cracks, corrosion, foreign debris, excessive dust buildup, or discoloration, which may indicate overheating or evidence of water intrusion. An "unacceptable indication" is defined as a noted condition or situation that, if left unmanaged, could lead to a loss of intended function.

(c) The Bus Inspection Program is a new program; therefore no operating experience exists for this program. Operating experience of bus failures, both industry and plant specific, was reviewed during the Aging Management Review process.

Plant Specific Operating Experience

Browns Ferry operating experience was reviewed to identify applicable aging effects for "Metallic Bus, Transmission Conductors, and High-Voltage Insulators" exposed to "Inside Air." The review included License Event Reports (LER), Problem Evaluation Reports (PER), Work Orders (WO), and interviews with TPS and site electrical personnel. The following LER was identified as applicable:

LER 96-005-00

MG SET TRIPPED AND CAUSED RECIRCULATION PUMP 3A TO TRIP. ROOT CAUSE WAS A BUS BAR ON THE 3A MG SET WAS MISSING A 2 INCH BAR SECTION DUE TO VIBRATIONAL FORCES. CORRECTIVE ACTIONS INCLUDE: (1) BUS BARS AND GENERATOR COLLECTOR RINGS WERE REPLACED, (2) OTHER MG SETS WERE INSPECTED, (3) MAINTENANCE MEN REVIEWED THIS EVENT FOR EXPERIENCE INFORMATION.

This event has identified a new aging effect/mechanism of Loosening of Fastening Hardware as a result of vibration which is evaluated in the section titled "other" below.

Industry Operating Experience

Industry operating experience was reviewed to identify applicable aging effects for "Metallic Bus, Transmission Conductors, and High-Voltage Insulators" exposed to "Inside Air." The review included NRC Generic Communications and Requests for Additional Information (RAIs). Review of RAIs identified a new aging effect associated with bolted phase bus bar connections requiring an aging effects evaluation. Review of NRC Generic Communications identified the following as applicable:

NRC Information Notice 2000-14: NON-VITAL BUS FAULT LEADS TO FIRE AND LOSS OF OFFSITE POWER

At Diablo Canyon Unit 1, a phase-to-phase electrical fault occurred in a 12-kv non-Class 1E electrical bus duct from the unit auxiliary transformer to the switchboards that are supplied the reactor coolant pumps and the circulating water pumps. The fault caused a turbine trip and consequent reactor trip. The factors determined to cause the problem were inconsistent silver plating, currents approaching bus capacity, undersized splice plates, torque relaxation of connecting bolts, and undetected damage from a 1995 explosion of Auxiliary Transformer 1-1.

The factor of torque relaxation of connecting bolts has the potential to cause a similar event at BFN.

Other:

Aging Effect/Mechanism: Loosening of Fastening Hardware/Vibration

This new aging effect/mechanism identified specifically to BFN is a result of a review of site operating experience, LER 96-005-00. LER 96-005-00 identified an event, for results see section titled "operating experience" above, which resulted in loosening of fastening hardware for a section of bus due to vibration. Vibration is an aging mechanism resulting from the movement induced into bus from equipment (i.e. MG sets, fans, etc.).

Results:

Vibration is not a concern for phase bus. There is no equipment to cause vibration located within the evaluation boundary for phase bus with regards to SBO. Therefore, vibration resulting in loosening of fastening hardware is not an applicable aging effect/mechanism at BFN.

RAI 3.6-5

In LRA Section 3.6.2.3.1, you have concluded that no AMP is required for fuse holders. However, please address the following:

(a) On page 3.6-6, it is stated that fuse holders are protected by their location within a controlled environment. Discuss

how a controlled environment provides protection of fuse holders. The discussion should include temperature, humidity, and radiation level of controlled environment.

(b) Fatigue may be caused by frequent cycling of fuses when subject to significant loading which would cause the clips to expand and contract and to experience fatigue failure. Discuss why this condition is not a concern.

(c) In order to make an aging management decision, the actual condition of the fuse holders needs to be evaluated to assess the extent of use. Please perform a visual inspection of the fuse holders and provide your findings or explain why an assessment of their current condition is not necessary.

TVA response to RAI 3.6-5

(a) A controlled environment, as it pertains to fuse holders, is one where the fuse holder is installed in an enclosure that protects the fuse holder from exposure to moisture and chemical contamination. Enclosures at BFN are designed and selected for the environment in which they are installed. National Electrical Manufacturers Association (NEMA) Standards imposed during the design process ensures the enclosure is suited for the environment in which it is installed. In addition, conduits entering the enclosure are sealed, along with unused knockouts. Enclosure tops and non-welded seams are sealed, along with enclosure and component mounting screws/bolts. Door gaskets supplied with NEMA enclosures are acceptable, or the enclosure door is sealed utilizing engineering approved maintenance instructions.

The aging mechanisms of temperature and radiation are not applicable to the fuse clip portion of fuse holders, but are applicable to the polymeric base material. Polymeric materials of fuse holders utilized at BFN were evaluated as insulated connections and are acceptable for the extended period of operation in the environments in which they are presently installed. None of the polymeric material's 60-year bounding temperature or radiation values were exceeded in any plant space where fuse holders are installed at BFN. See response to 3.6-5(c) below.

(b) Mechanical stress due to forces associated with electrical faults and transients are mitigated by the fast action of

circuit protective devices at high currents. However, mechanical stress due to electrical faults is not considered a credible aging mechanism at BFN since such faults are infrequent and random in nature.

TVA uses a number of criteria in fuse selection; including the rating shall not be less than 100% of non-continuous load and not less than 125% of the continuous load, not to exceed the derated ampacity of the circuit conductors, and any derating due to environment (elevated temperatures due to HELB, etc).

Fuse holders in use at BFN are designed to withstand the ratings of the fuses they house. Based on the above discussion, fuses at BFN are selected to ensure they are operated below their rated load. Thus by design, fuse holder clips and connections are protected from fatigue failure due to thermal cycling.

Industry operating experience as documented in NUREG-1760 "Aging Assessment of Safety-Related Fuses used in Low- and Medium-Voltage Applications in Nuclear Power Plants," identified that fuse failures due to thermal cycling are attributed to the fuse element, not fuse holder clips. NUREG-1760 documents no instances of fuse holder clip fatigue failures attributed to thermal cycling.

Based on the above discussion, fuse holder clip fatigue failure due to thermal cycling is not considered a credible aging mechanism for fuse holders at BFN.

(c) A visual inspection was performed to assess the condition of fuse holders at BFN. The inspection sample included fuse holders located in the worst environmental conditions, i.e., in junction boxes exposed to outdoor weather conditions. The fuse holder clips had no visual signs of corrosion or degradation. Non-metallic portions of the fuse holder had no visual signs of degradation.

RAI 3.6-6

Accessible Non-EQ cables and connections inspection program (B.2.1.1) which is consistent with GALL XI.E1 will manage the aging effects so that the cables will perform their intended functions for the extended period of operation. Power uprate at Browns Ferry Nuclear (BFN) may change the plant design environment. Additionally, fire retardant cable coating

(flamastic) has been applied to unqualified cables. Provide a discussion why the above mentioned program is applicable to BFN.

TVA response to RAI 3.6-6

EPU

In a letter to the NRC dated February 19, 2004, Browns Ferry Nuclear Plant (BFN) – Units 1, 2 and 3 – January 28, 2004 Meeting Follow-Up-Additional Information. In the section titled "EFFECTS OF PLANNED POWER UPRATE ON THE LICENSE RENEWAL APPLICATION (LRA)" TVA stated the following:

"The results presented in the BFN LRA conservatively bound the Units 1, 2, and 3 current licensing basis (CLB) power levels (3293 MWt, 3458 MWt, 3458 MWt, respectively). TVA expects to submit a license amendment request for operation at 3952 MWt for Units 1, 2 and 3 in June, 2004. All evaluations in support of the LRA are valid at the uprated power level, except those associated with Section 4.3, Metal Fatigue."

All electrical components required for License Renewal that are sensitive to changes in environmental parameters were evaluated to the EPU environmental parameters.

TVA submitted the Browns Ferry EPU applications for Units 2 and 3 on June 25, 2004 and for Unit 1 on June 28, 2004. These submittals validate the License Renewal Application.

Flamemastic

The scope of the program will include a representative sample of accessible cable and connections that are not coated with Flamemastic. The sample will include cables in the drywell and turbine building.

The sample will include cables in raceways located in the drywell that are qualified to the IEEE 383-1974 flame test and not coated with Flamemastic. Also, cables in raceways located in the Turbine Building that are and are not qualified to the IEEE 383-1974 flame test and not coated with Flamemastic will be included.

RAI 3.6-7

On Page 3.6-13, you have stated that to prevent formation of aluminum oxide on bolted connection surface, the connections

have a silver plating and are covered with grease to prevent air from contacting the connection surface. Discuss the grease replacement program including frequency of grease application.

TVA response to RAI 3.6-7

Grease is a consumable item that is applied each time a bolted connection is made, thereby, precluding oxidation of the connection surface and maintaining good conductivity at the bus connections. Connections are routinely surveyed using infrared scan for hot spots which are indicative of a degraded connection. If a hot spot at a connection is discovered, corrective actions are taken to repair the connection.

RAI 3.6-8

Additionally, torque relaxation for bolted connections is a concern for switchyard bus connections and transmission conductors connections. An electrical connection must be designed to remain tight and maintain good conductivity through a large temperature range. Meeting this design requirement is difficult if the material specified for the bolt and the conductor are different and have different rates of thermal expansion. For example, copper or aluminum bus materials expand faster than most bolting materials. If thermal stress is added to stresses inherent at assembly, the joint members or fasteners can yield. If plastic deformation occurs during thermal loading (i.e., heatup) when the connection cools, the joint will be loose. Provide a discussion why torque relaxation for bolted connection is not a concern for BFN.

TVA response to RAI 3.6-8

Bolted switchyard bus and transmission conductor connections at BFN utilize Belleville washers which have torque applied until the Belleville washer is flat, not to exceed limits specified by bolt size. In accordance with EPRI TR-104213, Bolted Joint Maintenance & Application Guide, section 7.2.2, "Increased temperature difference in electrical bolted joints is due to high short circuit ratings or increased current duration. The temperature of an electrical bolted joint will rise and the stress will increase with increasing current duration. If this temperature increase is not taken into consideration, loose, failure prone joints will result. Belleville washers selected to be flat or almost flat at the installation torque may be used to accommodate the temperature increase."

Connections are routinely surveyed using infrared scan for hot spots which are indicative of a degraded connection. If a hot spot at a connection is discovered, corrective actions are taken to repair the connection.

A review of plant specific OE did not reveal any age related issues associated with bolted switchyard bus or transmission conductor connections. Therefore, torque relaxation of bolted switchyard bus and transmission conductor connections is not a concern for BFN.

RAI 4.4-1

Provide a list of components covered under the EQ TLAA.

TVA response to RAI 4.4-1

Cable from the following manufacturers:

American Insulated Wire - Low Voltage Control and Power

Anaconda Cable Co. – Instrumentation, Low Voltage Control and Power

Boston Insulated Wire - Instrumentation

Brand-Rex Company - Low Voltage Control and Power, Instrumentation

Continental (Anaconda) - Instrumentation, Low Voltage Control and Power

Eaton Cable - Instrumentation

Essex Cable - Low Voltage Control and Power

Essex Group, Inc. - Low Voltage Control and Power

Essex International, Inc. - Low Voltage Control and Power

General Cable Corporation - Medium Voltage Power, Low Voltage Control and Power

ITT Surprenant Cable - Instrumentation

Okonite Company – Medium Voltage Power, Low Voltage Control and Power, Instrumentation

Phelps Dodge Cable - Low Voltage Control and Power

Rockbestos Company - Low Voltage Control and Power, Coaxial, Instrumentation

Rome Cable - Low Voltage Control and Power

Rome (Cyprus) - Low Voltage Control and Power

Simplex Wire & Cable Co. - Medium Voltage Power, Low Voltage Control and Power

Sumitomo Electric Industries, Ltd. - Low Voltage Control and Power

Tamaqua - Products Cable Corp. - Low Voltage Control and Power

Times Wire and Cable - Instrumentation

Triangle/PWC Inc. - Medium Voltage Power, Low Voltage Control and Power

Conduit Seals from the following manufacturers:

CONAX Corp. – Type ECSA N-Series

Rosemount Inc. – Types 353C and 353C1

Coaxial Connectors from the following manufacturer:

CONAX – Type HN

Handswitches from the following manufacturers:

Cutler-Hammer – Model 10250T

General Electric – Model CR2940

Flow switches from the following manufacturer:

Static-O-Ring – Model 103AS

Flow/Level switches from the following manufacturer:

Fluid Components Inc. – Models FR72-45A, FR72-4HTR-DLL, and FR72-1R

Level Switches from the following manufacturer:

Magnetrol – 291 Series and 402 Series

Pressure Switches from the following manufacturer:

Static-O-Ring – Models 5N6, 6N6, 12N6, and NQ series.

Temperature Elements from the following manufacturer:

Weed – Models SP611-1A-A-3-C-2.75-4D4-2, N9017D-1B-SP, 1B1D/612D-1A-C-6-C-17-0-0, 8B1D/612D-1A-C-6-C-16.5-0-0, and 1B1D-612D-1A-C-6-C-16.5-0-0

Temperature Switches from the following manufacturers:

Fenwal – 17002-Series and 17023-Series

Static-O-Ring – Models 201TA, 205N6, and 203N6

Valve Flow Monitoring System from the following manufacturer:

Technology for Energy Corp. (TEC) - 2273A (Accelerometer), 504A (Charge Converter), 160-2 (Transient Shield), and 2273-C2 (Cable Assembly)

Limit Switches from the following manufacturers:

NAMCO – Models EA-180 and EA-740

Honeywell/Microswitch – Models OP-AR, OPD-AR, and OPD-AR-30

Motors from the following manufacturers:

General Electric – Models 5K6348XC23A, 5K6336XC198A, and 5K6348XC116A

Reliance – Model TEFC-XT

Motor Operated Valves from the following manufacturer:

Limitorque - AC/IPC Models SMB-000, -00, -0, -2, & SB-3

AC/OPC Models SMB-00 through SMB-5T
DC/OPC Models SMB-000, -00, -1, -2, -3, -4T, and SB-0

Electrical Penetration Assemblies (EPA) from the following manufacturers:

Conax – Models 7504-10001-03, -04, -05, and 7FO2-10000-01

General Electric - 100 Series, and Canister Type 238X600RH

A/C Units from the following manufacturer:

Ellis-Watts – Model C360

Damper Motor Actuators from the following manufacturers:

Honeywell – Model M445A9011

Raymond Controls (RCS) Texsteam Inc. – Control Sure Model 24-10-4

Solenoid Valves from the following manufacturers:

VALCOR – Models V526-529-2, V526-5940-24, and V526-5950-15

ASCO – Models 206-380, 206-381, 206-832, NP8300, NP8316, NP8320, NP8314, HV 266000-7J, and HVA-90-405-2A, NPEF8300 Series

Automatic Valve Corp. – Model C-5497-2

Target Rock – 81NN-001, 81NN-002, 92Z520-001, 92Z526-001, 92Z527-001, and 1/2 SMS-5-02-5

Cable Splices/Seal Kits from the following manufacturer:

Raychem - WCSF-N Series, Seal Kit Models NPKV, NPKC, NPKP, NPKS, NMCK, NCBK, NESK, NMCK8, and NHVT

Terminal Blocks from the following manufacturer:

General Electric – Models CR151A, CR151B, EB-5, and EB-25

Transformers from the following manufacturer:

Brown Boveri – Model VPE

Pressure Transmitters from the following manufacturers:

Rosemount – 1153-Series, 1154-Series, and 1159-Series

TOBAR – Model 32PA1

Gould - PD3200-100 Series

Weed – DTN 2010 Series

RAI 4.4-2

Section 4.4 of the LRA identified Environmental Qualification of Electric Equipment as a time-limited aging analysis (TLAA) requiring an evaluation by 10 CFR 54.21(c)(1). The provisions of 10 CFR 50, Appendix A, General Design Criteria (GDC) 4 require that all equipment related to safety be designed to accommodate the environmental effects of postulated accidents. Similarly, NRC SRP 3.11 (NUREG-0800) applies equally to mechanical and electrical equipment. For mechanical equipment in the LRA that are required to be evaluated as a environmental qualification (EQ) TLAA, provide a discussion on the materials that are sensitive to environmental effects (e.g., seals, gaskets, lubricants, fluids for hydraulic systems, diaphragms, and wear cycle aging from lubricant deterioration) and the aging analyses that will be or have been conducted to satisfy the requirements of 10 CFR 54.21(c)(1) for the period of extended operation.

TVA response to RAI 4.4-2

This response will be issued in a future TVA response letter to be submitted by December 21, 2004.

RAI 4.4-3

Will the current requirements of 10 CFR 50.49 be applied in the qualification of the new components?

TVA response to RAI 4.4-3

The current requirements of 10 CFR 50.49 will be applied to all new components required to be environmentally qualified.