June 3, 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 REQUEST FOR ADDITIONAL INFORMATION ON POTENTIAL OPEN ITEM 3.3.2.35-1 (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 an informal request on May 24, 2005, identified additional information needed for potential open item 3.3.2.35-1.

The enclosure to this letter contains the specific NRC request 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 3rd day of June, 2005.

Sincerely,

Original signed by:

William D. Crouch
Acting 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

JEM: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

s://Licensing/Lic/BFN LR Clarification of Bolting Concerns.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) ON POTENTIAL OPEN ITEM 3.3.2.35-1

(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) ON POTENTIAL OPEN ITEM 3.3.2.35-1

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 an informal request on May 24, 2005, identified additional information needed for potential open item 3.3.2.35-1. This enclosure contains the specific NRC request for additional information and the corresponding TVA response.

NRC Potential Open Item 3.3.2.35-1

The staff is concerned that cracking and loss of preload are not identified as aging effects for bolting managed by the bolting integrity program, including bolting subject to high pressure, high temperature or vibration. The bolting integrity AMP should provide for bolting preload control for all bolting within scope of license renewal. This is open item 3.3.2.35-1.

Staff Evaluation of AMR

The BFN LRA AMR tables credit the Bolting Integrity Program for managing loss of bolting function due to various corrosion mechanisms in auxiliary systems bolting. Loss of preload and cracking are not identified as aging effects for bolting in the AMR tables for auxiliary systems.

GALL AMP XI.M18 specifically credits bolting integrity programs developed and implemented in accordance with commitments made in response to NRC communications on bolting events to provide an effective means of ensuring bolting reliability. The program relies on industry recommendations for a comprehensive bolting maintenance, as delineated in EPRI TR-104213 for pressure retaining bolting. The program covers all bolting within the scope of license renewal. The GALL program includes loss of material, cracking and loss of preload as aging effects. Bolting preload control, as delineated in EPRI NP-5769 with exceptions noted in NUREG-1339, is applied to manage loss of preload.

NUREG CR-6679 also identifies loss of preload as an aging effect and the Draft GALL update 2005 includes loss of preload as an aging effect for bolting in ESF, auxiliary and S&PC systems. Further, Section A.1.2.1 of Standard Review Plan NUREG-1800 states, "However leakage from bolted connections should not be considered abnormal events. Although bolting connections are not supposed to leak, experience has shown that leaks do occur, and the leakage could cause corrosion. Thus, the aging effects from leakage of bolted connections should be evaluated for license renewal."

The BFN Bolting Integrity Program, AMP B.2.1.16, is identified as an existing program that takes exceptions to NUREG-1801 XI.M18 evaluation elements. The exceptions affect element 1- scope of the program and possibly element 4 - detection of aging effects. It appears that Element 4 - detection of aging effects is identified as being affected by the exceptions. The applicant credits AMP B.2.1.4 for ASME Section XI inspections of Class 1 and Class 2 bolting.

For auxiliary system closure bolting, the staff is concerned that cracking and loss of preload are not entirely addressed by either ASME Section XI or AMPs B.2.1.16 or B.2.1.4. Although Section XI requires bolt torquing loads to be in accordance with ASME Section III for replacement of Class 1 and 2 bolting, no bolt torquing requirements are specified for Class 3 bolting, non-safety related bolting or bolting that is reused after being removed for maintenance. Section XI does address examination of Class 1 bolting, but no examination is required for Class 2 bolting smaller than 2 inch and Class 3 bolting regardless of size or non-safety related bolting. Section XI does provide for inspection during leakage testing, but this inspection may not necessarily detect loss of preload or flange leakage at other times. GALL AMP XI.M18, Bolting Integrity, does manage cracking and loss of preload in all closure bolting within scope of license renewal. As identified in EPRI NP-5769, preload reduction is caused by a number of factors, including stress relaxation (both at room temperature and elevated temperature), thermal cycling (particularly for gaskets), creep and flow of gasket material during initial compression, vibration and shock, and elastic interactions between separately-tightened bolts. GALL includes high pressure and high temperature systems as being susceptible to crack initiation. Therefore, the applicant should clarify if the bolting integrity AMP is consistent with GALL AMP XI.M18 in regard to managing cracking and loss of preload or explain

how these aging effects are managed by other programs or maintenance practices.

By letter dated October 8, 2004, the applicant provided additional information in response to Audit Inspection Question 310 on bolting activities. The applicant stated that, "Structural bolting procurement activities, receipt inspection and installation (torquing), as defined in TVA procedure GES G-29B-S01, P.S.4.M.4.4, ASME Section III and Non-Section III (Including AISC, ANSI B31.1, and ANSI B31.5) Bolting Material, are considered part of TVA's Bolting Integrity Program and meet the industry recommendations for these activities as delineated in NUREG-1339 and EPRI NP-5769.

By letter dated March 16, 2005, the applicant responded to an NRC clarification request on bolting. For valve closure bolting not within the RCPB, the applicant clarified that stress relaxation is a thermal effect that results in loss of preload. The applicant explained that stress relaxation is a design driven effect that would be detected and corrected early and is not considered an applicable aging effect in non-RCPB valve closure bolting. The applicant stated that installation procedures are in place that specify proper bolting installation practices and bolt torque values. In this letter, the applicant also clarified that non-RCPB bolting is not susceptible to SCC as the yield strength is less than 150 ksi. Further the applicant explained that crack initiation and growth due to cyclic loading is not considered a license renewal concern due to high cycle fatigue, since it would be discovered and corrected during the current licensing period.

Staff Evaluation of Applicant's Response

The staff reviewed the applicant's response and agrees that loss of preload in auxiliary system closure bolting should be managed by proper bolting installation practices and torque values supplemented by inspections. The staff also concurs that proper bolting practices and the selection of bolting less than 150 ksi should result in auxiliary system closure bolting not being susceptible to SCC.

However, the staff does not agree that cracking and loss of preload are not aging effects for license renewal, unless the applicant demonstrates that these potential adverse effects will be corrected prior to the period of extended operation. Section B.2.1.16 of the LRA states that the BWR fleet of plants, including BFN, has experienced bolting degradation

issues. Plant specific and industry operating experience should be reviewed to determine if the applicant's bolting practices are effective in precluding loss of preload and cracking for all auxiliary system closure bolting within the scope of license renewal. For example, despite implementation of bolting practices, recent industry operating experience such as LER 2005-01 for Fermi 2 demonstrate the importance of sufficient bolt torque to prevent major gasket leakage in BWR auxiliary systems such as RBCCW. The applicant is requested to review operating experience and submit the results of any self assessments, inspections or maintenance activities to determine if closure bolting in auxiliary systems will be effectively managed for cracking and loss of preload. This information should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the component intended function(s) will be maintained during the period of extended operation. If by a review of operating experience, the applicant can not demonstrate that effective bolting practices are in place to manage cracking and loss of preload in auxiliary system closure bolting, the applicant should commit to a bolting integrity program consistent with GALL or explain how these aging effects are managed by other programs or maintenance practices.

TVA Response to Open Item 3.3.2.35-1

Although cracking and loss of preload are not identified as aging effects requiring management for the period of extended operation at BFN, plant procedures implement the recommendations of NUREG-1339, "Resolution to Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants," for pressure boundary bolting in the scope of license renewal. BFN plant procedures address material and lubricant selection, design standards, and maintenance good bolting practices in accordance with those referenced in EPRI NP-5769, with the exceptions noted in NUREG-1339, and EPRI TR-104213.

The staff concern that cracking and loss of preload are not identified as aging effects for bolting managed by the bolting integrity program is addressed below; however, first a discussion of operating experience as related to the BFN bolting aging effects evaluation is appropriate.

The NRC noted that BFN LRA, Section B.2.1.16 states, "The BWR fleet of plants, including BFN, has experienced bolting degradation issues." The only aging effect identified during the plant operating experience review that was performed as

part of the aging management review was loss of material due to general corrosion of carbon and low-alloy steel bolting. The plant operating experience review identified no instances where this general corrosion resulted in component failure. The determination developed based on TVA's evaluation of plant and industry operating experience was that no aging mechanisms or effects beyond those previously identified by NUREG-1801 and industry guidance documents were identified. NUREG-1801 and EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3," identified cracking as an aging effect only for high strength bolting and did not identify loss of preload as an aging effect for non-Class-1 bolting. This is consistent with the BFN operating experience review. Note that the EPRI 1003056 determination that cracking is an aging effect only for high strength bolting and that loss of preload is not an aging effect for non-Class-1 bolting was in part based on an extensive operating experience review of the nuclear power industry.

Cracking

As previously discussed in responses to RAIs 3.2-1 and 3.4-1 (Reference 1) and 3.1.2.3-1 (Reference 2), stress corrosion cracking occurs through the combination of high stress (both applied and residual tensile stresses), a corrosive environment, and a susceptible material. For bolted closures and fasteners, a susceptible material is bolting having a high yield strength of > 150 ksi. In addition, stress corrosion cracking of high yield strength bolted closures in BWRs requires a corrosive environment that is typically attributed to leakage of pressure boundary joints or exposure to wetted ambient environments and the use of thread lubricant containing MoS_2 (molybdenum disulfide).

Potentially susceptible mechanical bolting materials include alloy steels (ASTM A354 Grade BD, A540 and A574) and high yield strength heat-treated alloy steels (heat-treated 4130, 4140 and 4340 material). High yield strength heat-treated alloy steel bolting materials are not specified for flanged connections at BFN. High strength bolting of vendor-supplied equipment has not been identified for mechanical components (such as pump casing studs or valve body/bonnet studs) where the material specifications are available. The use of MoS_2 thread lubricant is not allowed by site and engineering procedures. Therefore, any maintenance on this mechanical equipment would result in the use of non-MoS_2 thread lubricant. A review of the BFN operating experience did not identify any instances where mechanical component failure was

attributable to stress corrosion cracking of high strength pressure boundary bolting.

Therefore, the aging effect "loss of bolting function" was not identified at BFN because both the susceptible material and corrosive environment portions of the stress corrosion crack mechanism are not present. This is consistent with NRC staff's evaluation as presented in this open item that states, "The staff also concurs that proper bolting practices and the selection of bolting less than 150 ksi should result in auxiliary system closure bolting not being susceptible to SCC."

Loss of Preload

In accordance with EPRI 1003056, Appendix F, loss of preload is a design driven effect and not an aging effect requiring management. The bolting at BFN is standard grade B7 carbon steel, or similar material, except in rare specialized applications such as applications where stainless steel bolting is utilized. Loss of preload due to stress relaxation (creep) would only be a concern in very high temperature applications (> 700°F) as stated in the ASME Code, Section II, Part D, Table 4. There is no BFN bolting that operates at >700°F. Therefore, loss of preload due to stress relaxation (creep) is not an applicable aging effect.

Other issues that may result in pressure boundary joint leakage are improper design or maintenance issues. Improper bolting application (design) and maintenance issues are current plant operational concerns and are not related to aging effects or mechanisms that require management during the period of extended operation. To address these bolting operational concerns, BFN has taken actions to address NUREG-1339, "Resolution to Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants." These actions include the implementation of good bolting practices in accordance with those referenced in EPRI NP-5769, with the exceptions noted in NUREG-1339, and EPRI TR-104213 to address the potential for joint failure such that it is not a concern for the current or extended operating term. Proper joint preparation and make-up in accordance with industry standards is expected to preclude loss of preload. A review of the BFN operating experience did not identify any instances where mechanical component failure was attributable to loss of pressure boundary bolting preload.

Therefore, the aging effect "loss of preload" was not identified at BFN because operating temperatures are significantly less than the temperature required for stress relaxation and the remaining non-aging operational concerns are addressed by normal design and maintenance practices. This is consistent with EPRI 1003056 and NUREG-1801.

Fermi 2 LER 2005-001

Fermi 2 LER 2005-001, which was identified in the NRC open item, was reviewed to identify potential aging effects that are different than those considered in the BFN aging effects evaluation. The cause of this event was inadequate gasket compression due to inadequate original equipment manufacturer design information. Contributing causes included:

1. insufficient initial bolt torque to establish adequate gasket compression,
2. insufficient bolt torque to maintain adequate gasket compression,
3. wrong gasket width,
4. flatness of tube sheet surfaces,
5. improper gasket adhesive,
6. bolt spacing too wide,
7. inadequate reassembly instructions,
8. inadequate testing, and
9. tube plug weld interference with end bell fit.

None of the identified causes or contributing causes are related to or caused by an aging mechanism. The causes for the described event were a combination of design and maintenance errors. As noted in the LER corrective actions, the only end bell gaskets reworked were those that had been repaired by plant personnel using similar techniques and materials. In particular, it is noted that those end bell gaskets that had never been reworked, in place for approximately 21 years, were not considered susceptible to this failure mechanism. This is indicative of a design/maintenance problem, not an aging problem that would predict failures on the oldest gaskets, not the newest.

References

1. TVA Letter to U.S. Nuclear Regulatory Commission, Document Control Desk, "Browns Ferry Nuclear Plant (BFN) – Units 1, 2, and 3 License Renewal Application – Mechanical Systems Sections 3.2 and 3.4 – Response to NRC Request for Additional Information (RAI) (TAC Nos. MC1704, MC1705, and MC1706)" dated December 16, 2004

2. TVA Letter to U.S. Nuclear Regulatory Commission, Document Control Desk, "Browns Ferry Nuclear Plant (BFN) – Units 1, 2, And 3 - License Renewal Application – Reactor Vessel and Internals Mechanical Systems Sections 3.1, 4.2, And B.2.1 – Response to NRC Request for Additional Information (RAI) (TAC NOS. MC1704, MC1705, AND MC1706)" dated January 31, 2005