Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

Brian O'Grady
Vice President, Browns Ferry Nuclear Plant

September 6, 2005

10 CFR 54

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop: OWFN P1-35
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos. 50-259
Tennessee Valley Authority	)	50-260
		50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 1, 2, AND 3 LICENSE RENEWAL APPLICATION (LRA) - RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI) CONCERNING FOLLOW-UP TO RAIs 4.7.7-1 AND 4.7.7-2 (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 August 2, 2005, requested additional information as follow-up to RAIs 4.7.7-1 and 4.7.7-2.

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

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Some of the information in Enclosure 1 is proprietary to General Electric (GE). GE requests that the proprietary information in the enclosure be withheld from public disclosure in accordance with 10 CFR 9.17(a)(4), 10 CFR 2.390(a)(4), and 10 CFR 2.390(b)(1). An affidavit supporting this request is included in Enclosure 1. A non-proprietary version of this response is contained in Enclosure 2.

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

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

Sincerely,

Brian O'Grady

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

ENCLOSURE 2

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)
CONCERNING FOLLOW-UP TO RAIs 4.7.7-1 AND 4.7.7-2

(Non-Proprietary Version)

(See Attached.)

[[_______________]] shows where proprietary information has been redacted.

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) CONCERNING FOLLOW-UP TO RAIs 4.7.7-1 AND 4.7.7-2

(Non-Proprietary Version)

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 August 2, 2005, requested additional information as follow-up to RAIs 4.7.7-1 and 4.7.7-2.

The NRC's follow-up to RAIs 4.7.7-1 and 4.7.7-2 and TVA's response to each are provided below.

NRC Follow-up to RAI 4.7.7-1

Figure 1 of the applicant's submittal dated June 29, 2005, compares the stress relaxation for the BFN core plate hold-down bolts, to the stress relaxation from the data derived from springs and bent beam stainless steel specimens. The staff request that the applicant provide information regarding the values of neutron flux and temperature at which the bent beam and spring test specimens were exposed, and compare them to the neutron flux and temperature values of the BFN's core plate hold-down bolts. If the neutron flux and temperature values for the BFN core plate hold-down bolts are different than that for the bent beam and spring test specimen data, evaluate the impact of these differences on the predicted stress relaxation values of the BFN core plate hold-down bolts.

TVA Response to Follow-up to RAI 4.7.7-1

As discussed in the RAI follow-up, Figure 1 displays the relaxation data that was used to develop the relaxation design curves used at GE to assess the stress relaxation in the core plate bolts and presented in Reference 1. As stated, the data was based on several different sets of exposure tests that were conducted using either austenitic stainless steels or nickel alloys.

Temperature characteristics: The first parameter is the temperature at which the tests' irradiation was conducted. More than 80% of the tests, shown in Figure 1 (from Reference 1) were conducted at a temperature of 550°F. The available documentation substantiates that the majority of these were conducted in an operating BWR environment. The other tests, which were conducted at either 570 or 600°F, could produce more relaxation. Since such a large portion of the data was conducted at typical BWR operating conditions, the data temperature can be viewed as being fully representative of the BFN core plate bolts. In addition, the other data sets measured at the higher temperatures did not support a discernable temperature dependence.

Flux Effects: While the cumulative fluence information was available as part of the original test reports and the GE Design Curve documentation, the flux conditions were not directly available. Many of the tests were associated with springs which had reached fluences ranging from ~8×10^{20} to 8×10^{21} n/cm^2. Based on a reasonable time of exposure, the flux would be expected to range from ~7×10^{12} to 9×10^{13} n/cm^2/s. The fluxes that were defined for two of the smaller sets of test data were 2.7×10^{14} and 2×10^{17} n/cm^2/s, respectively. A review of the data over these 4 orders of magnitude showed no discernable flux dependence. However, the neutron flux levels were at least 100 times higher than that experienced by the BFN core plate bolts.

Impact of the Temperature and Flux Differences on the Core Plate Bolts: As stated above, the temperature data were very representative of the BFN core plate bolts. The neutron flux data, however, were measured in specimens subjected to fluxes ranging from ~1×10^{13} to 2×10^{17} n/cm^2/s. This is higher than the 2×10^{10} n/cm^2/s average flux experienced by the BFN core plate bolts themselves. Given the large range of higher flux for which the properties are the same, the impact of the lower flux to which the bolts are exposed is viewed to be negligible. This is supported in greater detail in the following section.

Technical Support for the Use of the Current Stress Relaxation Data to Evaluate Core Plate Bolt Relaxation: The effect of radiation on microstructure is the driving force for stress relaxation with neutron fluence. The primary effect of radiation is to harden the material through the creation of vacancy and interstitial defects in the crystal lattice. These defects affect creep and segregation within the material which will increase the strength, produce stress relaxation and lead to very narrow changes in the local composition at grain boundaries (Reference 2). The actual evolution of the microstructure is a complex process. Additionally, the data on materials under Light Water Reactor (LWR) conditions {i.e., temperature less than 350°C (662°F), fluences in the 0.5 to 5 dpa (~6 x 10^{19} to ~6.6 x 10^{20} n/cm^2) and attributable to a LWR neutron spectrum} is limited (Reference 3). Below this fluence level, degradation is just starting to occur. Following a short-term transient, the creep strain at constant load is very linear with fluence (which in turn is integrated flux over time) (Reference 4). Scott showed that the LWR operating flux/temperature region is one broadly associated with processes of limited microstructural dimension that in turn is associated with radiation-induced segregation (RIS) (Figure 2) (Reference 3). The continuity of these processes to lower flux levels is very much implied by Figure 2 for LWR material changes. Therefore, extrapolation of the higher flux data to the core plate region is fully justified and appropriate. Consistent with other microstructural processes, higher temperature and higher fluxes would be expected to produce bigger changes. The lower flux conditions would produce no additional effect on the relaxation behavior.

Limited Evaluations of Component Relaxation: The GENE stress relaxation curves have also been used to design and evaluate other core components. Specifically, core plate plugs contain an X-750 spring that will experience a flux similar to that of the core plate bolts. In some limited studies, efforts have been made to measure the spring relaxation after removal (Reference 5). These studies have confirmed that the relaxation is consistent with the design curve. Therefore, the observations add confidence that the behavior at lower flux is consistent with the design curve.

Summary:

In summary, the temperature and fluxes associated with the design basis data are appropriate for use in predicting stress relaxation in the BFN core plate bolts. The test data was all generated at temperatures from 550 to 600°F and, therefore, is fully representative of BWR operating conditions. The nuclear spectrum is also similar to that for the core plate bolt region. While the test data was generated at higher fluxes than present in the core plate region, the applicability of the data for use in the core plate bolt assessment is supported by mechanistic understanding as well as component test results.

References:

1. Letter from W. D. Crouch (TVA) to USNRC, "Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3, License Renewal Application (LRA) Response to NRC Request for Additional information (RAI) Concerning Follow Up to Section 4.7.7 Time Limited Aging Analysis RAIs (TAC NOS. MC1704, MC1705 and MC1706), dated June 29, 2005.
2. G.S. Was and P.L. Andresen: "Irradiation-Assisted Stress Corrosion Cracking in Austenitic Alloys," Journal of Metals, April 1992.
3. P. Scott: "A review of irradiation assisted stress corrosion cracking," Journal of Nuclear Materials, Vol. 211, pp. 101-122, 1994.
4. "BWRVIP-99: BWR Vessel and Internals Project: Crack Growth Rates in Irradiated Stainless Steels in BWR Internals Components," TR-1003018, December 2001.
5. "Revision of Core Support Plate Plug Service Life", NEDC-32120P, July 1992 (GE Proprietary Information).

[[______________]]

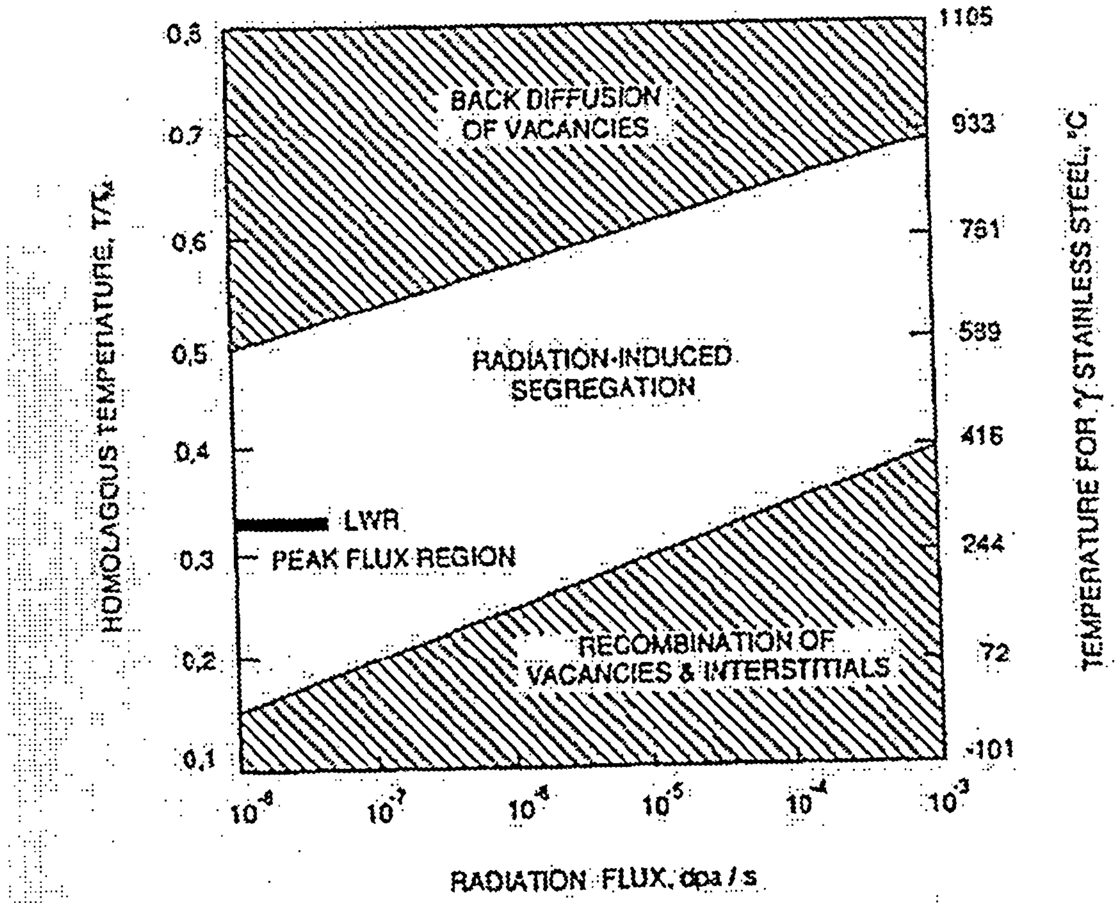

Figure 2: Relationship of microstructural related radiation induced processes as a function of flux and temperature (from Scott, Reference 3). Note: 10^{-8} dpa/s is equivalent to ~1×10^{13} n/cm^2/s.

NRC Follow-up to RAI 4.7.7-2

The bending stresses in the hold-down bolts result from the horizontal loads acting on the core plate. Some of these loads may depend on the pre-loading of the hold-down bolts. The core plate is also subjected to vertical loads, which could possibly cause portions of the core plate rim to separate from the shroud support, as a result of smaller bolt pre-loads.

Show that under Scenario 3 of BWRVIP-25, the axial and bending stresses for the mean and highest loaded hold-down bolts will not exceed the ASME Section III allowable stresses for Pm and Pm+Pb, as a result of a 20% reduction in the specified bolt pre-load. State clearly the assumptions on which the analysis was based.

TVA Response to Follow-up to RAI 4.7.7-2

BFN's current licensing basis (as contained in FSAR 3.3.5.3.1) states "The two considerations important to the core support evaluation are sliding of the core support and buckling of the supporting beams. Evaluations have determined that the core support will not slide under the postulated accident conditions with preload on the holddown bolts. Additional resistance to sliding is provided by aligners which further stablize the core support."

The hypothetical basis applied for the BWRVIP-25, Scenario-3 analysis, uses low bolt pre-load, and no friction. The Browns Ferry plant-specific values of pre-load and friction are high enough to prevent sliding of the core plate and separation from the core plate rim.

The following calculation is provided to demonstrate that:

- High margin exists in the End-of-Life preload in the core plate bolt. Hence, neither sliding nor separation of the core plate from the core plate rim is a concern.
- The core plate bolts are adequately preloaded (based on end-of-life relaxation) to resist expected external vertical and horizontal loads for all operating conditions.

Since, separation and sliding of the core plate is precluded, the bolts are subject to only axial loads and no bending loads. This essentially satisfies the intent of Scenario 3 of BWRVIP-25 (i.e., determination of the core plate bolts loads with no credit for aligner pins, and the rim weld assumed cracked).

[[_______________]]

As can be seen from the above, there is adequate stress margin available to accommodate any non-uniform load sharing among the bolts. Also, there is adequate margin in the end-of-life pre-load in the bolts to prevent sliding of the core plate.

[[_______________]]

General Electric Company

AFFIDAVIT

I, George B. Stramback, state as follows:

(1) I am Manager, Regulatory Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Attachment 2 to GE letter GENE 0000-0015-9859-017, Larry King (GE) to Ken Brune (TVA), *Responses to NRC Follow Up Questions To Section 4.7.7 Core Plate Hold Down Bolts,* dated August 15, 2005. The proprietary information in Attachment 2, *GE Responses to NRC License Renewal RAIs 4.7.7-1 and 4.7.7-2,* is identified by a double underline inside double square brackets. In each case, the superscript notation[3] refers to Paragraph (3) of the enclosed affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, resulting in potential products to General Electric;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a., and (4)b, above.

(5) To address 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

8) The information identified in paragraph (2), above, is classified as proprietary because it contains detailed results of GE analytical models, methods and processes, and design data, which GE has developed, and applied to perform evaluations of the behavior of aging materials used in the GE Boiling Water Reactor ("BWR"). The development of these methods, processes, and data was achieved at a significant cost to GE, on the order of a million dollars.

The development of the evaluation process along with the interpretation and application of the results is derived from the extensive experience database that constitutes a major GE asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the

original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GE.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GE would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GE of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this the 15th day of August 2005.

George B. Stramback
General Electric Company