November 21, 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 CLARIFICATION FOR BFN's USE OF LINDE 80 WELD MATERIAL ON UNIT 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 October 12, 2005, identified additional information needed concerning the use of Linde 80 weld material on Unit 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 21st day of November, 2005.

Sincerely,

Original signed by:

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Manager of Licensing
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Enclosure:
cc: See page 3

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cc: continued page 4

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s://Licensing/Lic/Submit/Subs/BFN LR Clarification for Linde 80 weld material.doc

ENCLOSURE

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3
LICENSE RENEWAL APPLICATION (LRA)

RESPONSE TO NRC REQUEST FOR CLARIFICATION FOR
BROWNS FERRY USE OF LINDE 80 WELD MATERIAL ON UNIT 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 CLARIFICATION FOR
BFN's USE OF LINDE 80 WELD MATERIAL ON UNIT 1

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NRC Request

The limiting beltline circumferential weld - heat # 406L44 for BFN Unit 1 is made of Linde 80 material. According to Section B.3.4 of the BWRVIP-74, "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation," report, fracture toughness of the weld shall be established by using J-R curve based on the values of copper and fluence. In the LRA, the applicant provided EMA for this weld by using figure 2 of the RegGuide 1.99 which is not appropriate for Linde 80 weld. Therefore, the staff requests that the applicant revise the Table 4.2.1.1 of the LRA to indicate that the EMA analysis for the circumferential Linde 80 weld in BFN Unit 1 complies with the requirements specified in Section B.3.4 of the BWRVIP-74 report, and submit any calculations to substantiate its claim of compliance with this method.

TVA Response To NRC Request

Since no upper shelf energy value was available, the J-R curve for heat # 406L44 was calculated using copper content and fluence in accordance with the methodology originally applied in the Equivalent Margin Analysis (Reference 1). The copper content and fluence for the BFN Unit 1 Linde 80 weld are 0.27% and 1.33E18 n/cm^2 (¼ thickness), respectively.

The mean J-R curve for Linde 80 weld material can be represented by the following equation, which is equation 4-2 of Reference 1:

$$J_d = C1(\Delta a)^{C2}\{\exp[C3(\Delta a)^{C4}]\}$$ (in-lb/in²) (See **Note 1**.)

where

J_d = the deformation J-Integral

lnC1 = a1+a2*Cu(ϕt)^{a5}+a3*T

C2 = d1+d2(lnC1)

C3 = d4+d5(lnC1)

C4 = -0.0491 (per Table 4-2 of Reference 1)

Cu = copper content in percent = 0.27

Δa = crack growth, inches

Note 1: The results of the calculation are multiplied by 1,000 to obtain the correct units. See example calculation.

The values for the constants a1, a2, a3, a5, d1, d2, d4, and d5 were obtained from Table 4-2 of Reference 1 as follows:

a1 = 2.413	d1 = 0.077
a2 = - 0.506	d2 = 0.116
a3 = - 0.0025	d4 = - 0.0812
a5 = 0.634	d5 = - 0.0092
T = 550°F	ϕt = fluence at ¼ thickness, n/cm^{2}x10^{18} (1.33 for BFN)

Example Calculation (crack growth = 0.10 inches)

lnC1 = 2.413- 0.506*0.27*1.33$^{0.634}$ - 0.0025*550

lnC1 = 0.874

C1 = 2.397

C2 = 0.077 + 0.116*0.874

C2 = 0.178

C3 = - 0.0812-0.0092*0.874

C3 = - 0.0892

$J_d = 2.397*(0.10)^{0.178}*\{\exp(-0.0892*0.10^{-0.491})\}*1,000$

$J_d = 1205$ in-lb/in^2

This J-R value, however, is the mean value. For purposes of this evaluation, the mean minus two sigma J-R curve was used, consistent with the methodology presented in Section 4.5 of Reference 1. The mean minus two sigma curve is obtained by multiplying the mean curve by a factor of 0.626 (see Table 4-2 of Reference 1). Therefore, the J-R value for a crack growth of 0.10 inches is:

$J_d = 1205 *0.626 = 754.76$ in-lb/in^2

The remaining values of J_d were calculated in a similar manner, varying the crack growth value, Δa. The results of the calculations are presented in Figure 1.

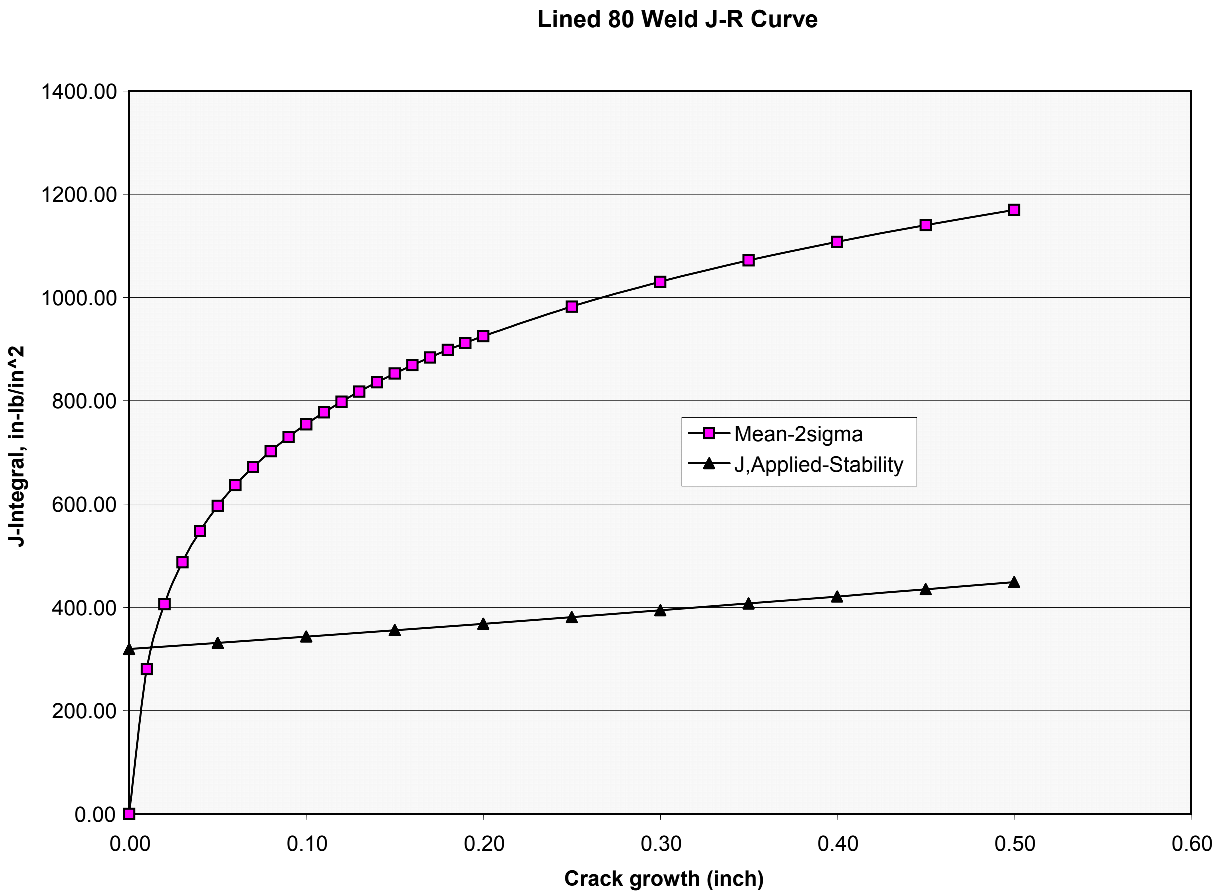
To determine if the material maintains adequate fracture toughness, the $J_{applied}$ values are also plotted in Figure 1; the $J_{applied}$ values were obtained from Figure 5-5 of Reference 1. As can be seen in the figure, the $J_{applied}$ values are shown to be well within the J-R curve limits. Therefore, BFN Heat 406L44 will maintain adequate fracture toughness throughout the period of extended operation.

The revised version of Table 4.2.1.2 is enclosed as Attachment 1 to this Enclosure.

REFERENCE

1. H.S. Mehta, T.A. Caine, and S.E. Plaxton, “10CFR50 Appendix G Equivalent Margin Analysis for Low Upper Shelf Energy in BWR/2 Through BWR/6 Vessels,” NEDO-32205-A, Revision 1, February 1994.

<u>**Figure 1**</u>



Lined 80 Weld J-R Curve
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
J-Integral, in-lb/in^2
0.00
0.10
0.20
0.30
0.40
0.50
0.60
Crack growth (inch)
Mean-2sigma
J,Applied-Stability

ATTACHMENT 1

Table 4.2.1.2: Equivalent Margin Analysis for BFN Unit 1 Weld Material

BWR/2-6 WELD
Surveillance Weld USE: %Cu = N/A 1st Capsule Fluence = N/A 2nd Capsule Fluence = N/A 1st Capsule Measured % Decrease = N/A (Charpy Curves) 2nd Capsule Measured % Decrease = N/A (Charpy Curves) 1st Capsule R.G. 1.99 Predicted % Decrease = N/A (R.G. 1.99, Figure 2) 2nd Capsule R.G. 1.99 Predicted % Decrease = N/A (R.G. 1.99, Figure 2)
Limiting Beltline Weld USE: %Cu = 0.27 54 EFPY 1/4T Fluence = 1.33E+18 n/cm2 R.G. 1.99 Predicted % Decrease = N/A (Linde 80 Weld Material) (R.G. 1.99, Figure 2) Adjusted % Decrease = N/A (R.G. 1.99, Position 2.2)
For the specific copper and fluence for the BFN Unit 1 Linde 80 weld material, the vessel welds meet the requirements of the BWRVIP-74-A equivalent margin analysis.