QA Record

ORIGINAL

TVAN CALCULATION COVERSHEET

Title **Seismic Evaluation Report**	Plant BFN Unit 0	Page 1	of see rev. log

Preparing Organization: **NE/CEB**

Key Nouns (For EDM): Seismic, Component Qualification, Piping, Pipe Support

Calculation Identifier: **CD-N0001-990113**

Applicable Design Document(s): BFN-50-C-7100
BFN-50-C-7107, BFN-50-C-7306

UNID System(s) 001

Each time these calculations are issued, preparer must ensure that the original (R0) RIMS/EDM accession number is filled in.

Rev	(for EDM use)	EDM Accession Number
R0		R14 990909 102
R1		
R2		
R3		

	R0	R1	R2	R3
DCN, EDC, NA	N/A			
Prepared	F Caramante FC 9/8/99			
Checked	9/8/99			
Design Verified	9/8/99			
Approved				
Approval Date	9-9-99			
SAR Affected?	Yes ☐ No ■	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Revision applicability	Entire calc ■	Entire calc ☐ Selected pgs ☐	Entire calc ☐ Selected pgs ☐	Entire calc ☐ Selected pgs ☐

	Yes	No
Quality Related?	■	☐
Safety related? If yes, mark Quality Related yes	☐	■
These calculations contain unverified assumption(s) that must be verified later?	☐	■
These calculations contain special requirements and/or limiting conditions?	☐	■
These calculations contain a design output attachment?	☐	■
Calculation Classification	D	
Microfiche generated	☐	■
Number		

Statement of Problem:

The Main Steam piping downstream of the outboard MSIV's is desired to be capable of with standing an earthquake so that any leakage through the MSIV's from the Reactor side can be contained and diverted to the main condenser. This calculation supports the MSIV leakage tech spec change at BFN.

Abstract

This calculation is ~~documents the "Browns Ferry Nuclear Plant - Increased MSIV~~ Leakage Tech Spec Change Submittal Seismic Evaluation Report", (200918-R-002); August 1999, By EQE International, Oakland, CA. Additionally, Bounding Calculations (200918-C-002) "Seismic evaluation for the Condensers" and (200918-C-001) "Seismic verification of the main steam drain piping and supports associated with the MSIV alternate leakage treatment pathway" are contained in this calculation.

☒ Microfilm and return calculation to Calculation Library. Address: POB-1A-BFN

☐ Microfilm and return calculation to:

☐ Microfilm and destroy.

TVA 40532 [02-1999]

NEDP-2-1 [02-19-1999]

This Page Added By Revision 0

1.0 PURPOSE

The purpose of this calculation is to document the results of the additional seismic evaluation performed on the BFN condensers, as part of the seismic adequacy verification of the components associated with the MSIV Alternate Leakage Treatment (ALT) pathway.

2.0 SCOPE & METHODOLOGY

The BFN condensers are the terminal boundary points of the MSIV alternate leakage treatment (ALT) pathway, hence, they are necessary to maintain structural integrity following a Design Basis Earthquake (DBE). The condensers are located in the Turbine Building and are not designated as Seismic Class I systems.

As part of the plant specific seismic verification of the non-seismic components using the earthquake experience-based approach as outlined in the BWROG Report (Reference 1), the following reviews are performed to demonstrate that the BFN condensers fall within the bounds of the experience database and/or exhibit adequate seismic capacity:

- Review of the condenser design codes and standards, design characteristics and parameters, and support/anchorage configurations.
- Verification walkdown to identify potential seismic interaction concerns.
- Engineering evaluations of the condenser and support configurations.

The BFN condensers are evaluated using both seismic experience data from past earthquakes and engineering analysis. Analytical evaluations of the condenser and support anchorage are performed in accordance with the guidelines in the Generic Implementation Procedure (GIP, Reference 5), and the general requirements of the American Institute of Steel Construction (AISC, Reference 6), as applicable.

3.0 REFERENCES

1. "BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control Systems", GE NEDC-31858P, Revision 2, September 1993.

2. Safety Evaluation of GE Topical Report, NEDC-31858P, Revision 2, "BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control Systems", U.S. Nuclear Regulatory Commission, March 3, 1999.

3. "Browns Ferry - Unit 2, MSIV Seismic Verification Summary Report", EQE Report No. 200918-R-001, Revision 0, August 1999.

4. "Browns Ferry - Unit 3, MSIV Seismic Verification Summary Report", EQE Report No. 200621-R-001, Revision 0, September 1998.

5. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment", Rev. 2A, March 1993, Prepared by Winston & Strawn, EQE, et al., for the Seismic Qualification Utility Group (SQUG).

6. AISC, "Manual of Steel Construction", Eighth Edition, 1980.

7. TVA Calculation No. CD-N0001-980039, "Main Steam Seismic Ruggedness Verification".

8. TVA Calculation No. CD-N0001-980038, "Main Steam Seismic Ruggedness Evaluation".

9. ASME, "Boiler and Pressure Vessel Code, Section III, Division I, Appendices", 1980 Edition.

4.0 SEISMIC EVALUATIONS

The BFN condensers consist of three single-pass, single pressure, radial flow type surface condensers. Each condenser is located beneath each of the three low pressure turbines, and is structurally independent. Table 1 lists the design data for BFN condensers and for the two experience database sites listed in the BWROG Report (i.e., Moss Landing 6 & 7, and Ormond Beach 1 & 2). Design characteristic comparisons of the BFN condensers with the above two selected database condensers are presented in details in Reference 8. These include size (surface area), weight, height, and plan comparisons. The BFN condenser design data is comparable to the data for these two database sites.

The BFN condenser anchorage was compared with the performance of similar condenser in the earthquake experience database. The shear areas of the condenser anchorage, in the directions parallel and transverse to the turbine generator axis, divided by the seismic demand, were used to compare with those presented in the BWROG Report (Reference 1). The BFN condenser anchorage shear area to seismic demand is substantially greater than the selected database sites. The condenser support anchorage was also evaluated and the results indicate that the combined seismic DBE and operational demand is less than the anchorage capacity based on the AISC allowables. Maximum stress ratios are 0.70 for bolt tension in the perimeter support feet, and 0.86 for shear in the center support built-up section. Detailed description of the BFN condenser support anchorage and anchorage evaluations are presented in Reference 8.

A composite comparison of the ground response spectra of selected earthquake experience database sites with the conservatively estimated BFN DBE ground spectrum (i.e., 0.2g Housner input spectrum at rock outcrop scaled by 1.6 to account for soil amplification) is shown in Figure 1. In general, the earthquake experience database sites have experienced strong ground motions that are in excess of the BFN DBE at the frequency range of interest (i.e., about 1 Hz. and above), with the exception of the Ormond Beach site. Many of the database site ground motions envelope the conservatively estimated BFN DBE ground spectrum by large factors in various frequency bands within the 1 Hz. and above range. Figures 2 and 3 show the individual comparison plots of the conservatively estimated BFN DBE ground spectrum with the Moss Landing and Ormond Beach site spectra, respectively.

EQE INTERNATIONAL

SHEET NO. 6
JOB NO. 200916 JOB BFN MSIV TECH SPEC CHANGE BY B DATE 8-24-99
CALC. NO. C-002 SUBJECT ADDITIONAL SEISMIC EVALUATIONS FOR THE BFN CONDENSERS CHK DATE 8/30/99

The Ormond Beach Power Plant was affected by the magnitude 5.8, Point Mugu Earthquake in 1973, which was considered to be a relatively moderate earthquake, and was substantially lower than the 1989 Loma Prieta Earthquake (Magnitude 7.1) as experienced in the Moss Landing Power Plant as well as those experienced by most of the other database sites.

To ensure that adequate seismic margins exist in the BFN condensers in the event of a plant DBE, additional seismic evaluation was performed to verify the overall structural integrity of the condensers, as shown in pages 7 to 9 of this calculation. Results of the evaluation indicate that the condenser shell stresses due to the seismic DBE loads are small. Maximum stress ratios, based on AISC allowables, are 0.12 for combined axial and bending and 0.10 for shear.

CONDENSER SHELL

Check combined stresses in the condenser shell due to seismic Loads (DBE).

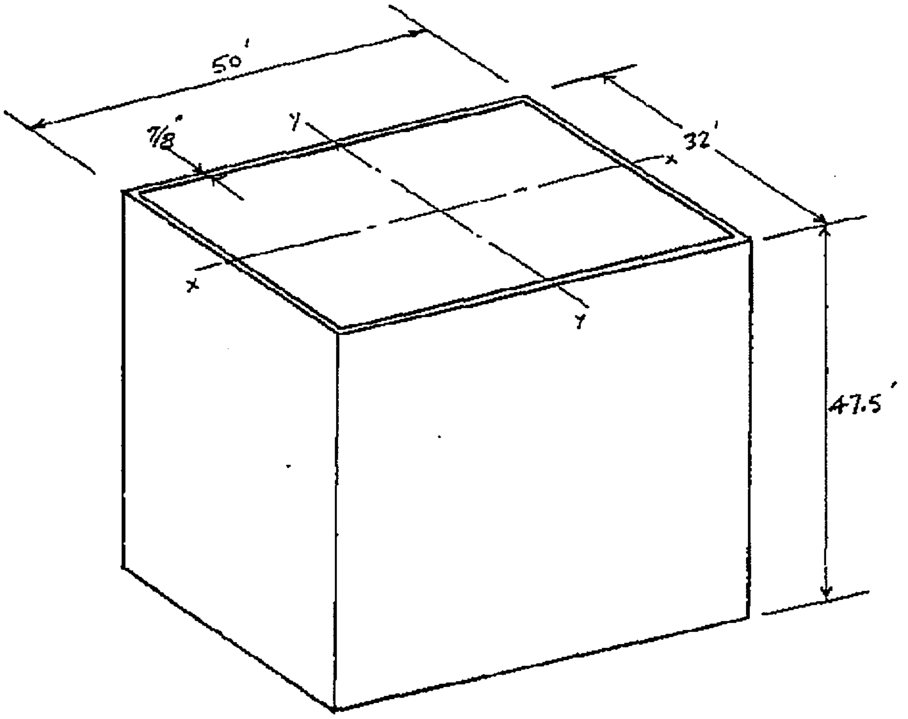
From Figure 1, BFN 5% damped DBE Ground Spectrum

a_h = horizontal acceleration = 0.32g
a_v = vertical acceleration = 0.2g (2/3 × horiz.)

P = Condenser dead wt., including contents = 2070^k (Ref. 8)

C.G. = center of gravity of overall condenser = 12.72' (Ref. 8)

Condenser overall dimensions = 50' x 32' x 47.5' (h) (Ref. 8)
shell Thickness = 7/8"
shell Material = ASTM A285C (F_y = 30 ksi) (Ref. 9)



SHEET NO. 8

JOB NO. 200918 JOB BFN MSIV BY TBeji DATE 8-24-99

CALC. NO. C-002 SUBJECT Condenser Shell Evaluation CHK'D DATE 8/30/99

CONDENSER SHELL (CONT'd)

- section properties :

$$A = (7/8'')(2)(50' + 32')(12) = 1722 \quad IN^2$$

$$I_{xx} = 2 \times \frac{7/8\ (32' \times 12)^3}{12} + 2 \times (7/8 \times 50' \times 12)\left(\frac{32' \times 12}{2}\right)^2 = 4.70 \times 10^7 \quad IN^4$$

$$\Rightarrow \quad S_{xx} = \frac{I_{xx}}{(32' \times 12)/2} = 2.45 \times 10^5 \quad IN^3$$

$$I_{yy} = 2 \times \frac{7/8\ (50' \times 12)^3}{12} + 2 \times (7/8 \times 32' \times 12)\left(\frac{50' \times 12}{2}\right)^2 = 9.20 \times 10^7 \quad IN^4$$

$$\Rightarrow \quad S_{yy} = \frac{I_{yy}}{(50' \times 12)/2} = 3.07 \times 10^5 \quad IN^3$$

- Axial + Bending stresses

$$f_a = \frac{P(1+a_v)}{A} = \frac{2070^k(1+0.2)}{1722} = 1.44 \quad ksi$$

$$f_{bx} = \frac{M}{S_{xx}} = \frac{(2070^k \times 0.32g)(12.72' \times 12)}{2.45 \times 10^5} = 0.41 \quad ksi$$

$$f_{by} = \frac{M}{S_{yy}} = \frac{(2070^k \times .32g)(12.72' \times 12)}{3.07 \times 10^5} = 0.33 \quad ksi$$

$$\text{Combined stress} = f_a + f_{bx} + f_{by} = 1.44 + .41 + .33 = 2.18 \quad ksi$$

AISC Allowables (Ref. 6)

$$F_b = 0.6 \times 30^{ksi} = 18 \quad ksi \quad \gg \quad 2.18 \quad ksi \quad \underline{ok}$$

$$D/c = \frac{2.18}{18} = 0.12 \quad \ll 1.0 \quad \underline{ok}$$

EQE INTERNATIONAL

SHEET NO. 9

JOB NO. 200918 JOB BFN MSIV BY FBei DATE 8-24-99

CALC. NO. C-002 SUBJECT Condenser shell Evaluation CHK'D DATE 8/30/99

CONDENSER SHELL (Cont'd)

- Shear

$$P_H = P \times a_h = 2070^k \times 0.32g = 662.4^k$$

$$A_V = 2 \times (32' \times 12)\ 7/8'' = 672\ in^2$$

$$f_v = \frac{662.4}{672} = 1.0\ ksi$$

$$F_V = 0.4 \times 30 = 12\ ksi \gg f_v = 1.0\ ksi$$ ok

$$D/C = \frac{1.0}{12} = 0.1 \ll 1.0$$ ok

EQE INTERNATIONAL

SHEET NO. 10

JOB NO. 200918 JOB BFN MSIV TECH SPEC CHANGE BY DATE 8/24/99
CALC. NO. C-002 SUBJECT ADDITIONAL SEISMIC EVALUATIONS FOR THE BFN CONDENSERS CHK DATE 8/30/99

Table 1

Comparison of Browns Ferry and Selected Database Condensers

Design Attributes	Moss Landing Units 6 & 7	Ormond Beach Units 1 & 2	Browns Ferry
Condenser Manufacturer	Ingersoll-Rand	Southwestern	Foster Wheeler
Flow Type	Single Pass	Single Pass	Single Pass
Condenser Dimensions (LxWxH)	65 ft. x 36 ft. x 47 ft.	52 ft. x 27 ft. x 20 ft.	58 ft. x 32 ft. x 47 ft.
Condenser Surface Area	435,000 sq. ft.	210,000 sq. ft.	222,000 sq. ft.
Condenser Shell Material	Cu Bearing ASTM A-285C	Cu Bearing ASTM A-285C	ASTM A-285C
Condenser Shell Thickness	3/4"	3/4"	7/8"
Condenser Operating Weight	3,115 kips	1,767 kips	2,076 kips
Tube Material	Al-Brass	90-10 Cu-Ni	Al-6XN
Tube Size	1" dia.	1" dia.	7/8" dia.
Tube Length	65 ft.	53 ft.	50 ft.
Tube Wall Thickness	18 BWG	20 BWG	22 BWG

Table 1 (cont.)

Comparison of Browns Ferry and Selected Database Condensers

Design Attributes	Moss Landing Units 6 & 7	Ormond Beach Units 1 & 2	Browns Ferry
Number of Tubes	25,590	15,220	19,480
Tube Sheet Material	Muntz	Muntz	ASTM A-285C
Tube Sheet Thickness	1-1/2"	1-1/4"	1-1/4"
No. of Tube Support Plates	15	14	15
Tube Support Plate Material	Not Given	Cu Bearing ASTM A-285C	ASTM A-285C
Tube Support Plate Thickness	3/4"	5/8"	7/8"
Tube Support Plate Spacing	48 in.	36 in.	39 in.
Water Box Material	2% Ni Cast Iron ASTM A-48 Class 30	Cu Bearing ASTM A-285C	ASTM A-285C
Expansion Joint	Rubber Belt	Stainless Steel	Rubber Belt
Hotwell Capacity	20,000 gal.	34,338 gal.	28,000 gal. (max.)

Figure 1

Comparison of Browns Ferry DBE Ground Spectrum with Selected Database Site Spectra

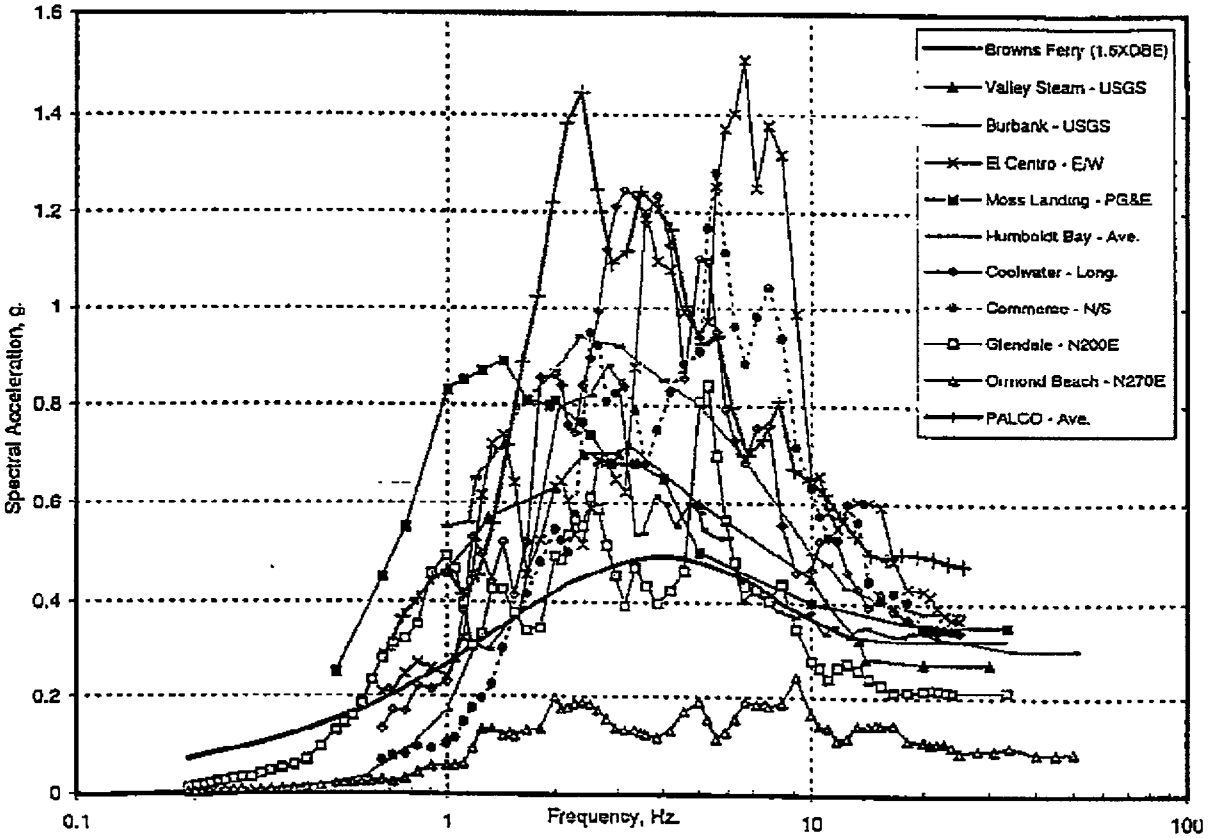


Figure 2
Comparison of Browns Ferry DBE and Moss Landing Power Plant Ground Spectra

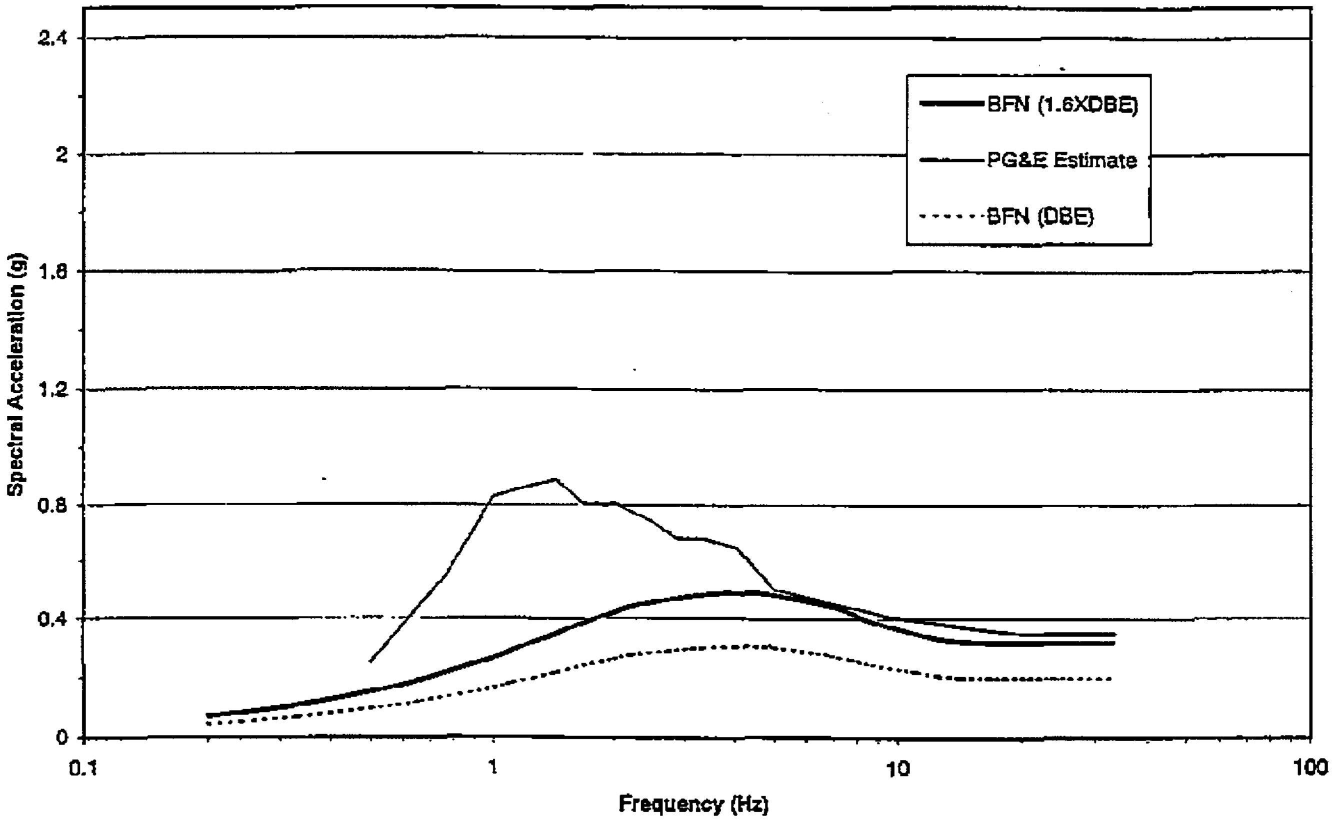
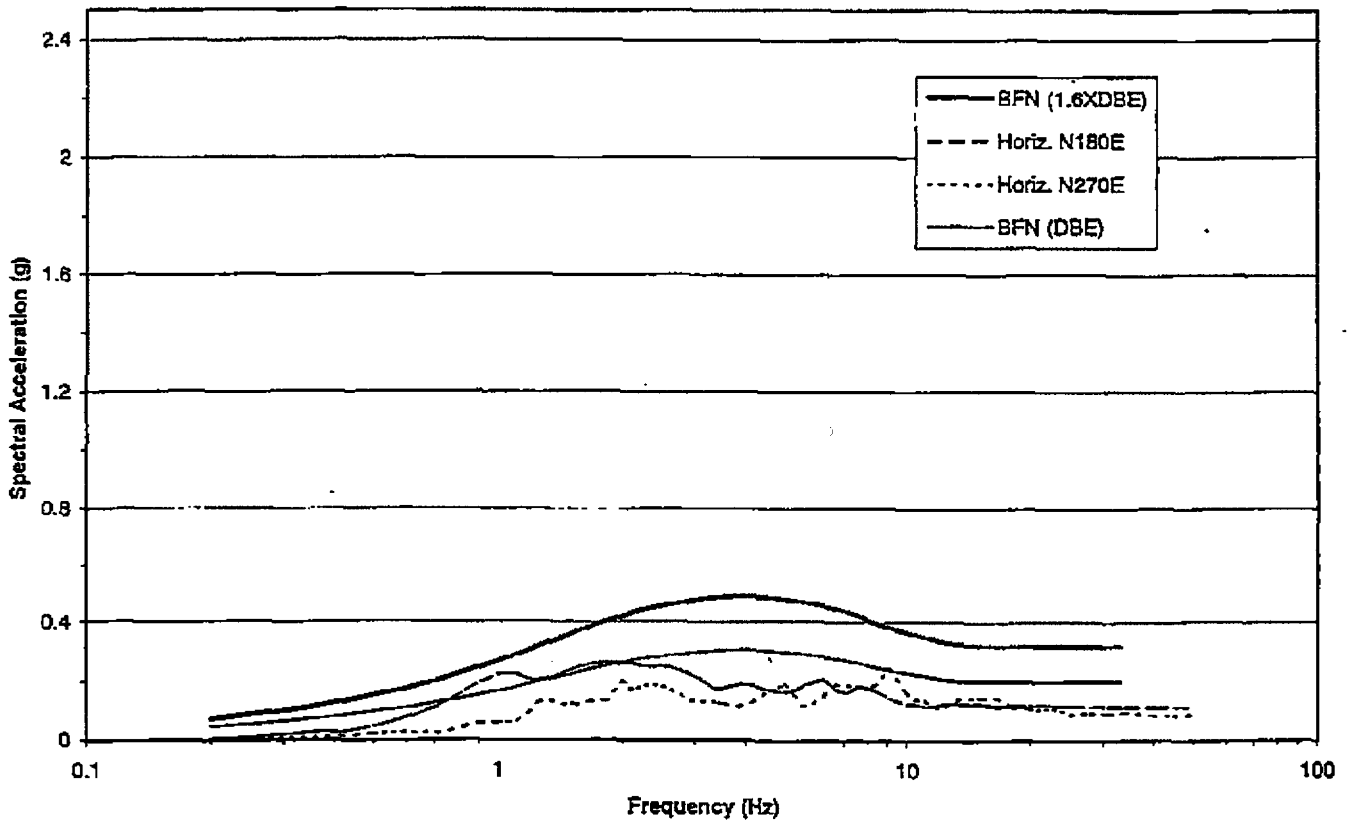


Figure 3
Comparison of Browns Ferry DBE and Ormond Beach Power Plant Ground Spectra



5.0 CONCLUSIONS

The comparisons of the condenser seismic experience data, supplemented by the additional condenser evaluation and the anchorage capacity evaluations demonstrate that the conclusions presented in the BWROG Report (Reference 1) can be applied to the BFN condensers. That is, a significant failure of the condenser in the event of a DBE at BFN is highly unlikely and contrary to the large body of historical earthquake experience data.

ENCLOSURE 3

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 2 and 3

PROPOSED TECHNICAL SPECIFICATIONS (TS) CHANGE TS-399 INCREASED MAIN STEAM ISOLATION VALVE (MSIV) LEAKAGE

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) DATED NOVEMBER 23, 1999

RESPONSE TO NRC STAFF QUESTIONS ON DOSE METHODOLGY

Item 1

TVA's letter of September 28, 1999, contains the statement that the change request is based on the utilization of the Boiling Water Reactor Owners' Group (BWROG) methodology described in NEDC-31858P, Revision 2, BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control Systems. Page E-10 of the submittal contains a similar statement. However, the staff has reason to question these statements:

a. Page 3 of the TVA submittal contains the statement "This analysis uses the holdup and plateout factors described in NEDC-31858P...." Was the methodology of NEDC-31858P Revision 2 used as stated on page 1 of the letter and on page E-10 of the submittal, or were selected parameters used as stated on page 3?

b. The analysis summary provided by TVA indicates that TVA has ratioed the previous MSIV leakage results obtained for a leakage of 11.5 scfh to 100 scfh, and that TVA also ratioed these results for the increase in power rating (1.05x), and the 1.02x instrument penalty. The staff compared the values for 11.5 scfh tabulated in the summary with the values provided by GE to TVA in 1992 (ND-Q2031-920075R1) and observed identical results. The results provided in 1992 were based on the NEDC-31858P revision 1. GE made several changes in the analysis methodology for revision 2. Revision 1 was never approved by the NRC as a topical report.

Please confirm that the TVA analysis was performed using the methodology of NEDC-31858 Revision 2, including all incorporated assumptions, parameters, and methods. If the revision 2 methodology as described in the approved BWROG topical report was not used, please correct the submittal and provide sufficient information for the NRC staff to make a finding of the acceptability of the methodology TVA did use.

TVA Response to Item 1

There were no changes in dose methodology between NEDC-31858P Revision 1 and Revision 2. Note that the NEDC Appendix C (Dose Methodology) is dated September 1991 in both Revision 1 and 2. Therefore, the reference in the September 28, 1999, submittal to Revision 2 of NEDC-31858 is appropriate and the March 3, 1999, NRC Safety Evaluation Report (SER) is likewise applicable. NEDC-31858 was subsequently issued in final form as NEDC-31858P-A in August 1999.

As noted in the response to RAI Item 2 below, TVA has reperformed the MSIV leakage dose calculations. These were performed in accordance with the NEDC-31858 methodology as reviewed in the NRC SER.

NRC Item 2

TVA's ratioing of the dose results obtained with a leak rate of 11.5 scfh to reflect the proposed higher leak rate appears to assume that the BWROG deposition model is linear with regard to flow rate. Table 8-3 of NEDC-31858P Revision 2 indicates that the doses increased by approximately a factor of three when the leakage was increased a factor of two. Please justify the assumption of linear proportionality.

TVA Response to Item 2

After further review, we agree that using a linear extrapolation to scale the MSIV leakage contribution to dose is not conservative. Therefore, TVA has performed the specific MSIV dose calculations rather than using extrapolation factors for the MSIV leakage dose contribution. These were completed in accordance with the NEDC methodology as reviewed in the NRC SER.

This new analysis resulted in a reduction of the requested MSIV allowable leakage rate. Therefore, TVA is providing an amended change request as part of this response as contained in Enclosures 4 and 5.

NRC Item 3

The information TVA provided is not clear with regard to the leakage rate actually assumed in the radiological calculations. Page E1-14 of the submittal indicates that the radiological calculations were based on a total net MSIV leakage of 400 scfh. The analysis input tabulation for the TVA analysis indicates that the MSIV leakage is "...200 scfh/valve (400 scfh maximum which equates to 100 scfh/valve average), this translates to a time dependent total flow for 4 valves of:..<list>." The specified list shows time dependent leakage rates ranging from 172.54 cfh to 24.73 cfh. Please confirm that the calculations assumed a total of 400 scfh for the entire release period.

TVA Response

The base calculation for MSIV leakage contribution to dose was provided by GE to TVA in 1992 (Calculation ND-Q2031-920075 R1). For the accuracy of the remaining dose calculations, an MSIV source removal term is needed to properly account for the remainder of the net mass release from the primary containment. In other words, the increased MSIV leakage reduces the source concentration of radioisotopes in primary containment that are modeled in other leakage pathways.

The time dependent flow listing referred to in the RAI is this MSIV leakage source reduction term as converted from standard cubic feet per hour (scfh) to cubic feet per hour (cfh). The conversion factor is based on time dependent temperature and pressures. As noted in Item 2, TVA has reperformed the dose calculations as discussed in Enclosure 4.

NRC Item 4

Page C-28 of NEDC-31858P Revision 2, discusses the fraction of MSIV leakage that will flow to the HP turbine. Based on the proposed alternative leakage path and assuming loss of offsite power and single failure, what is the fraction of MSIV leakage to the HP turbine is assumed in your analyses. If the fraction is greater than 0.01 (page C-30 of NEDC-31858P Revision 2), please confirm that doses from this release path were addressed in the TVA analyses.

TVA Response to Item 4

The BFN alternate leakage treatment (ALT) flow path is shown in Figure 3-1 of Attachment 4 of the September 28, 1999, TS-399 submittal. The ALT path is from the outboard side of the MSIVs through Flow Control Valve (FCV)-1-58 to the condenser and satisfies the sizing requirements of NEDC-31858P-A paragraph 6.1.1(2) which states that the ALT flow path should, based on the radiological dose methodology, be at least 1 square inch internal cross sectional area. FCV-1-58 has Emergency Diesel Generator power available and, hence, does not rely on the availability of offsite power.

The orificed bypass path around FCV-1-58 shown in Figure 3-1 addresses Section 5.2 of the NRC safety evaluation dated March 3, 1999, which states that a secondary path to the condenser, having an orifice, should exist. This secondary path is considered a contingency alignment in the event of the unlikely failure of FCV-1-58 and is not sized to meet the 1-inch path provision discussed in the NEDC specified for the credited ALT path. Moreover, NEDC-31858 does not prescribe that a secondary ALT which path is fully redundant to the credited ALT path in terms of sizing be available in the event of a single failure.

Therefore, the MSIV increased leakage dose calculations assume the primary ALT path is available which meets the 0.01 ratio criteria referenced on page C-30 of NEDC-31858P-A and the fraction of leakage going to High Pressure (HP) turbine is specifically accounted for in the MSIV dose calculations. In this situation, the dose contribution from this HP turbine pathway is very small (truncated to zero in the 1992 (ND-Q2031-920075R1)) calculations. As discussed in Item 2 above, TVA has reperformed the dose calculations for the MSIV leakage dose contribution. These were completed in accordance with the NEDC methodology which includes the HP turbine path.

NRC Item 5

TVA has revised the X/Q values for its control room in its analyses of the increased MSIV leakage. For the top of stack release, the X/Q values are on the order of 1.0E-16 seconds(sec)/m^3 for the Unit 1 intake and 1.0E-10 sec/m^3 for the Unit 3 intake. The staff understands that these X/Q values were derived using the ARCON96 methodology. The discussion on page 30 of the documentation for ARCON96 (NUREG/CR-6331 Rev 1) addresses the case of elevated stacks with close-in intakes and notes that the concentrations experienced under light wind conditions could be much higher than predicted by ARCON96. The document notes that if ARCON96 predicts all concentrations are near zero, another method should be used to estimate maximum concentrations. Please provide a justification for the use of ARCON96 for the BFNP stack release point that addresses this caution in view of the negligible X/Q values determined by TVA. The staff is particularly concerned with these X/Q values given the reduction in overall margin already implied by the relatively large amount of unfiltered control room inleakage.

TVA Response to Item 5

Prior to adopting the ARCON96 methodology, Revision 8 and earlier versions of calculation ND-Q0031-920075 used X/Q methods based on Regulatory Guides 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, and 1.145, Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants. Due to the concerns with ARCON96 regarding its ability to model stack releases at BFN, TVA has reverted to the Regulatory Guides 1.145 and 1.111 methodology. The top of the stack to control bay ARCON96 values reported in the March 30, 1999, submittal have been replaced by utilizing the Regulatory Guide 1.145 and 1.111 along with actual BFN meteorological data for a period of 11 years and restricting the data to the sector from the offgas stack to the control bay intakes in accordance with the Regulatory Guides. The resulting X/Q values are:

X/Q (sec/m^3)			
Release Point	**Time Period**	**Unit 1/2 Control Room Intake**	**Unit 3 Control Room Intake**
Top of Stack (fumigation)	0-30.0 minutes	3.40E-5	3.02E-5
Top of Stack (non-fumigation)	30.0 minutes- 2 hours	9.08E-13	1.41E-7
	2 hours - 8 hours	3.41E-13	4.50E-8
	8 hours - 1 day	2.09E-13	2.54E-8
	1 day - 4 days	7.21E-14	7.36E-9
	4 days - 30 days	1.57E-14	1.24E-9

The top of the stack dose contribution to the control room is small in comparison to the dose resulting from increased MSIV leakage, and the use of these Regulatory Guide based X/Q's rather than the ARCON96 X/Qs has a minor impact on net doses. TVA continues to use ARCON96 methodology to estimate ground level releases. The resulting net allowable MSIV leakage rate is provided in the amended TS change request in Enclosures 4 and 5.

NRC Item 6

The release rate from the condenser to the environment as modeled in NEDC-31858P Revision 2 methodology apparently assumes the mechanical vacuum pump (MVP) will be tripped. Due to a previous modification at BFNP, the MVP no longer trips on a MSLRM signal. When TVA analyzed the consequences of removing the automatic functions initiated by the MSLRMs, releases via this MVP (and others) were considered by TVA (BFNP FSAR §14.6.2.8.1). The 1850 cfm flow rate of the MVP is significantly greater than the 400 scfh flow rate of the MSIV leakage, suggesting that holdup in the condenser may be limited. Please describe if and how this impact is considered in your analyses.

TVA Response to Item 6

The Main Steam Line Radiation Monitor (MSLRM) MVP trip on high radiation has not been removed. Refer to BFN Final Safety Analysis Report (FSAR) Section 7.12.1.3 for a discussion of this function.

The MVPs pumps are only used during startup at very low reactor powers to establish an initial vacuum prior to placing the steam jet air ejectors (SJAEs) in service. The SJAEs are the preferred method of maintaining condenser vacuum since they provide dilution steam for control of combustible offgas products and SJAE flow is treated by the normal offgas system. Operating Instructions require the MVPs not be used above 5% reactor power and the MVPs will auto-trip and isolate on increasing condenser vacuum (when operating vacuum is established by the SJAEs). The MVPs have no auto-start capability.

Based on the above, the assumption that the MVPs are not in service is appropriate for the MSIV dose calculations for TS-399 since these calculations are based on accidents occurring at full reactor power.

NRC Item 7

The analysis input tabulation provided includes a value for turbine building free volume and turbine building exhaust rate. These parameters appear to imply that credit is being taken for holdup in the turbine building. Page C-70 of NEDC-31858P Revision 2 states that no credit has been taken for holdup in the turbine building. In its letter dated June 12, 1998, TVA stated in response to question #6 that holdup in the turbine building was not credited in assessing the consequences of MSIV leakage. Please confirm that the analyses do not credit holdup in the turbine building.

TVA Response to Item 7

The MSIV leakage dose analyses do not credit fission product holdup by the turbine building. The turbine building volumes listed in the analysis inputs tabulation are results from a previous calculation revision and, as noted, do not enter into the dose calculations.

NRC Item 8

The analysis input tabulation provides a flow rate of 24,750 for the SGTS with all three trains running. However, previous submittals to the NRC and §14.6.3.6 of the August 1999 FSAR indicate the SGTS flow to be 22,000 cfm. Please explain the difference in flow rates.

TVA Response to Item 8

BFN has tested the SGTS flow to be between 22,000 cfm and 22,500 cfm. The flow used in the dose analysis is 22,500 plus a typical 10% variance for a total of 24750 cfm. This is a conservative assumption since the higher SGTS flow will reduce building and SGTS train hold-up times which would provide for additional decay of fission products. This assumption is also conservative since more isotopes are calculated to be released earlier in the accident sequence when the X/Q values are less favorable.

NRC Item 9

The information TVA provided indicates that TVA considered a potential release via the hardened wetwell vent. TVA's analysis assumes 10 cfh with a decay period of eight hours, which does not appear to be consistent. If the 10 cfm is expected damper leakage (i.e., bypass leakage), why is the pathway not considered earlier in the event. Intentional flow initiated at eight hours would likely have a higher flow rate given the size of the pathway (14"). Such intentional flow is beyond the design basis. Please provide an explanation of these assumptions.

TVA Response to Item 9

The Hardened Wetwell Vent (HWWV) release path is modeled as a potential leakage path in the dose analysis. The calculation models leakage from the primary containment into HWWV only, not the intentional operation of the HWWV which is reserved for the mitigation of beyond design basis events.

The 10 cfh value is based on the Primary Containment Leak Rate Test Program leak rate criteria for the HWWV valves as listed in Table 5.2-2 of the FSAR. The HWWV line is over 500 feet long and is a 14-inch pipe. Assuming slug flow in the 14-inch line (13.25 inches inner diameter) at 10 cfh yields a travel time to exit the HWWV piping of:

T (hours) = pipe volume/leakage flow rate
T (hours) = (pipe length x pipe cross section)/leakage flow rate
T (hours) = (500 feet x π x radius^2) / leakage flow rate
T (hours) = (500 feet x 3.14 x ((13.25 inches/ (2 x 12 inches/foot))^2) / 10 feet^3/hour
T (hours) $\cong$ 48 hours

In the dose calculation, 8 hours is used as the commencement point for HWWV contribution, which is clearly conservative.

ENCLOSURE 4

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 2 and 3

PROPOSED TECHNICAL SPECIFICATIONS (TS) CHANGE TS-399
INCREASED MAIN STEAM ISOLATION VALVE (MSIV) LEAKAGE

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI)
DATED NOVEMBER 23, 1999

PROPOSED TECHNICAL SPECIFICATION (TS) CHANGE TS-399 DESCRIPTION AND EVALUATION OF PROPOSED CHANGE

I. DESCRIPTION OF PROPOSED TS CHANGE

In a letter dated September 28, 1999, TVA requested a change to the Units 2 and 3 TS Surveillance Requirement (SR) 3.6.1.3.10 to increase the allowed MSIV leakage from 11.5 standard cubic feet per hour (scfh) per valve to 200 scfh for individual MSIVs with a 400 scfh combined maximum pathway leakage for all four MSIV lines.

In the November 23, 1999, request for additional information, NRC questioned the use of extrapolation factors to calculate the dose associated with an increased MSIV leakage criteria. After further review TVA agreed that using a linear extrapolation to scale the MSIV leakage did not provide conservative dose resulting from the increased MSIV leakage. Subsequently, TVA performed calculations to determine the MSIV leakrate dose concentration. The recalculation resulted in a combined maximum pathway leakage of 168 scfh.

Therefore, TVA has revised the requested change to increase the allowed MSIV leakrate from 11.5 scfh per valve to 100 scfh for individual MSIVs with a 150 scfh combined maximum pathway leakage for all four MSIV lines. The TS Bases are likewise being revised to match the proposed change. A marked-up copy showing the exact TS and Bases changes is provided in Enclosure 5.

II. REASON FOR THE PROPOSED CHANGE

As discussed in the September 28, 1999, TS change request, refurbishment of a MSIV to meet the 11.5 scfh criteria is a man-hour intensive effort which accumulates approximately 4.5 man-rem during a complete rebuild. With a 100 scfh limit for individual MSIVs and 150 scfh combined maximum pathway, no Unit 2 MSIVs would have required rework in the last four operating cycles, and only one valve during the two most recent Unit 3 operating cycles.

The change would lower personnel radiation exposure and improve the performance integrity of the MSIVs by reducing the number of maintenance activities associated with restoring the leakage to an overly strict lower limit. Approval of this proposed TS change would also be an economic benefit to TVA in terms of direct costs and a reduction in outage activities.

III. SAFETY ANALYSIS

Radiological Dose Assessment

In the November 23, 1999, Request For Additional Information, the staff questioned the appropriateness of extrapolating the results of the earlier dose calculations to determine the affects of a larger MSIV leakage criteria. After subsequent review, TVA determined that using a linear extrapolation to scale the MSIV leakage did not provide conservative dose results from the increased MSIV leakage. To address the issue, TVA reperformed the dose calculations to determine the MSIV leakage dose rather than use a linear extrapolation method. The contribution from MSIV leakage was calculated using the methodology described by NEDC-31858P Revision 2, Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control Systems.

For this TS change, the offsite dose calculations and control room dose calculations have been revised using a total net MSIV leakage of 168 scfh for all four MSIV lines. The table below provides the dose in man-rem from 168 scfh MSIV leakage.

Dose Comparison at 168 scfh MSIV Leakage.			
	Control Room	2-Hour Exclusion Boundary	30-Day Low Population Zone
Thyroid	29.48	5.840	85.97
Gamma	0.6827	0.1665	0.4815
Beta	0.1576	0.1006	0.4839

The revised calculation show that the dose contribution from the increased MSIV leakrate is far below the 10 CFR 20.1201(a)(1)(ii) limits. Also, 10 CFR 100 and GDC-19 dose limits are maintained. For conservatism, TVA has chosen to reduce the allowable total MSIV leakage to 150 scfh in the amended TS change request.

ENCLOSURE 5

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 2 and 3

PROPOSED TECHNICAL SPECIFICATIONS (TS) CHANGE TS-399 INCREASED MAIN STEAM ISOLATION VALVE (MSIV) LEAKAGE

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) DATED NOVEMBER 23, 1999

MARKED-UP TS PAGES

I. AFFECTED PAGE LIST

Unit 2	Unit 3
3.3-16	3.6-16
B 3.6-35	B 3.6-35

II. **MARKED-UP PAGES**

SEE ATTACHED

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.1.3.5	Verify the isolation time of each power operated, automatic PCIV, except for MSIVs, is within limits.	In accordance with the Inservice Testing Program
SR 3.6.1.3.6	Verify the isolation time of each MSIV is ≥ 3 seconds and ≤ 5 seconds.	In accordance with the Inservice Testing Program
SR 3.6.1.3.7	Verify each automatic PCIV actuates to the isolation position on an actual or simulated isolation signal.	24 months
SR 3.6.1.3.8	Verify each reactor instrumentation line EFCV actuates to the isolation position on a simulated instrument line break signal.	24 months
SR 3.6.1.3.9	Remove and test the explosive squib from each shear isolation valve of the TIP System.	24 months on a STAGGERED TEST BASIS
SR 3.6.1.3.10	Verify leakage rate through each MSIV is ≤ ~~11.5 scfh~~ when tested at ≥ 25 psig. 100 scfh and that the combined maximum pathway leakage rate for all four main steam lines is ≤ 150 scfh	In accordance with the Primary Containment Leakage Rate Testing Program
SR 3.6.1.3.11	Verify combined leakage through water tested lines that penetrate primary containment are within the limits specified in the Primary Containment Leakage Rate Testing Program.	In accordance with the Primary Containment Leakage Rate Testing Program

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.1.3.9

The TIP shear isolation valves are actuated by explosive charges. An in place functional test is not possible with this design. The explosive squib is removed and tested to provide assurance that the valves will actuate when required. The replacement charge for the explosive squib shall be from the same manufactured batch as the one fired or from another batch that has been certified by having one of the batch successfully fired. The Frequency of 24 months on a STAGGERED TEST BASIS is considered adequate given the administrative controls on replacement charges and the frequent checks of circuit continuity (SR 3.6.1.3.4).

SR 3.6.1.3.10

100

The analyses in References 1 and 5 are based on leakage that is less than the specified leakage rate. Leakage through each MSIV must be ≤ ~~11.5~~ scfh when tested at ≥ P_t (25 psig). This ensures that MSIV leakage is properly accounted for in determining the overall primary containment leakage rate. The Frequency is specified in the Primary Containment Leakage Rate Testing Program.

The combined maximum pathway leakage rate for all four main steam lines must be ≤ 150 scfh when tested at ≥ 25 psig. If the leakage rate through an individual MSIV exceeds 100 scfh, the leakage rate shall be restored below the alarm limit value as specified in the Containment Leakage Rate Testing Program referenced in TS 5.5.12.

SR 3.6.1.3.11

Surveillance of water tested lines ensures that sufficient inventory will be available to provide a sealing function for at least 30 days at a pressure of 1.1 Pa. Sufficient inventory ensures there is no path for leakage of primary containment atmosphere to the environment following a DBA. Leakage from containment isolation valves that terminate below the suppression pool water level may be excluded from the total leakage provided a sufficient fluid inventory is available as described in 10 CFR 50, Appendix J, Option B.

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.1.3.5	Verify the isolation time of each power operated, automatic PCIV, except for MSIVs, is within limits.	In accordance with the Inservice Testing Program
SR 3.6.1.3.6	Verify the isolation time of each MSIV is ≥ 3 seconds and ≤ 5 seconds.	In accordance with the Inservice Testing Program
SR 3.6.1.3.7	Verify each automatic PCIV actuates to the isolation position on an actual or simulated isolation signal.	24 months
SR 3.6.1.3.8	Verify each reactor instrumentation line EFCV actuates to the isolation position on a simulated instrument line break signal.	24 months
SR 3.6.1.3.9	Remove and test the explosive squib from each shear isolation valve of the TIP System.	24 months on a STAGGERED TEST BASIS
SR 3.6.1.3.10	Verify leakage rate through each MSIV is ≤ ~~11.5 scfh~~ when tested at ≥ 25 psig. 100 scfh and that the combined maximum pathway leakage rate for all four main steam lines is ≤ 150 scfh	In accordance with the Primary Containment Leakage Rate Testing Program
SR 3.6.1.3.11	Verify combined leakage through water tested lines that penetrate primary containment are within the limits specified in the Primary Containment Leakage Rate Testing Program.	In accordance with the Primary Containment Leakage Rate Testing Program

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.1.3.9

The TIP shear isolation valves are actuated by explosive charges. An in place functional test is not possible with this design. The explosive squib is removed and tested to provide assurance that the valves will actuate when required. The replacement charge for the explosive squib shall be from the same manufactured batch as the one fired or from another batch that has been certified by having one of the batch successfully fired. The Frequency of 24 months on a STAGGERED TEST BASIS is considered adequate given the administrative controls on replacement charges and the frequent checks of circuit continuity (SR 3.6.1.3.4).

SR 3.6.1.3.10

The analyses in References 1 and 5 are based on leakage that is less than the specified leakage rate. Leakage through each MSIV must be ≤ ~~11.5~~ scfh when tested at ≥ P_t (25 psig). This ensures that MSIV leakage is properly accounted for in determining the overall primary containment leakage rate. The Frequency is specified in the Primary Containment Leakage Rate Testing Program.

100

The combined maximum pathway leakage rate for all four main steam lines must be ≤ 150 scfh when tested at ≥ 25 psig. If the leakage rate through an individual MSIV exceeds 100 scfh, the leakage rate shall be restored below the alarm limit value as specified in the Containment Leakage Rate Testing Program referenced in TS 5.5.12.

SR 3.6.1.3.11

Surveillance of water tested lines ensures that sufficient inventory will be available to provide a sealing function for at least 30 days at a pressure of 1.1 Pa. Sufficient inventory ensures there is no path for leakage of primary containment atmosphere to the environment following a DBA. Leakage from containment isolation valves that terminate below the suppression pool water level may be excluded from the total leakage provided a sufficient fluid inventory is available as described in 10 CFR 50, Appendix J, Option B.

ENCLOSURE 6

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 2 and 3

PROPOSED TECHNICAL SPECIFICATIONS (TS) CHANGE TS-399 INCREASED MAIN STEAM ISOLATION VALVE (MSIV) LEAKAGE

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) DATED NOVEMBER 23, 1999

COMMITMENT LISTING

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1. Section XI surveillance testing will consist of disassembly and inspection on a rotating basis (one check valve each refueling outage) in accordance with Position 2 of GL 89-04.

2. The piping and components within the boundaries of the MSIV ALT path are considered to be within the scope of the BFN Section XI IST and ISI programs, and, accordingly, will be inspected and tested in accordance with the IST/ISI programs. Additional detail is provided (in the response) for certain aspects of the program pertaining to the RAI questions.