TVA

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

October 31, 2008

TVA-BFN-TS-418
TVA-BFN-TS-431

10 CFR 50.90

U.S. Nuclear Regulatory Commission
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Mail Stop OWFN, P1-35
Washington, D. C. 20555-0001

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 – TECHNICAL SPECIFICATIONS (TS) CHANGES TS-418 AND TS-431 – EXTENDED POWER UPRATE (EPU) – SUPPLEMENTAL RESPONSE TO ROUND 19 REQUEST FOR ADDITIONAL INFORMATION (RAI) AND RESPONSE TO ROUND 22 RAIs REGARDING STEAM DRYERS (TAC NOS. MD5262, MD5263, AND MD5264)

By letters dated June 28, 2004 and June 25, 2004, (ADAMS Accession Nos. ML041840109 and ML041840301), TVA submitted license amendment applications to NRC for the EPU of BFN Unit 1 and BFN Units 2 and 3, respectively. The proposed amendments would change the operating licenses to increase the maximum authorized core thermal power level of each reactor by approximately 14 percent to 3952 megawatts.

On August 12, 2008, NRC staff issued a Round 19 RAI (ML082340002) regarding the EPU steam dryer analyses. By letters dated September 2, 2008 (ML082490169) and October 3, 2008, (ML082810471) TVA provided responses to the Round 19 RAI and noted that additional information would be subsequently provided. Enclosure 1 provides supplemental information for two Round 19 RAIs and the response to four draft RAIs regarding the steam dryer analyses that are expected to be issued as Round 22. As noted in Enclosure 1, the completed responses to two additional Round 22 RAIs are planned to be provided by November 14, 2008.

As discussed in Enclosure 1, the steam dryer analyses for Units 1 and 2 are being re-performed to include stress results at EPU conditions. The Unit 1 stress analyses and the Unit 2 load report have been completed and are enclosed. The Unit 2 stress report will be provided by November 14, 2008. Additionally, the scale model test report for Units 1 and 2 is enclosed. These analyses are provided in Enclosure 2, CDI Report No. 08-15P, "Stress Assessment of Browns Ferry Nuclear Unit 1 Steam Dryer with Tie-Bar

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Modifications," Enclosure 3, CDI Report No. 08-04P, "Acoustic and Low Frequency Hydrodynamic Loads at CLTP Power Level on Browns Ferry Nuclear Unit 1 Steam Dryer to 250 Hz," Enclosure 4, CDI Report No. 08-05P, "Acoustic and Low Frequency Hydrodynamic Loads at CLTP Power Level on Browns Ferry Nuclear Unit 2 Steam Dryer to 250 Hz," and Enclosure 5, CDI Report No. 08-14P, "Flow-Induced Vibration in the Main Steam Lines at Browns Ferry Nuclear Units 1 and 2, With and Without Acoustic Side Branches, and Resulting Steam Dryer Loads." Enclosure 6 provides calculation package 0006982.304, "Extended Power Uprate Main Steam Line Strain Gauge Vibration Monitoring," discussed in the response to RAI EMCB.199/156.

Note that Enclosures 2, 3, 4, and 5 contain information that Continuum Dynamics, Inc. (CDI) considers to be proprietary in nature and subsequently, pursuant to 10 CFR 2.390(a)(4), CDI requests that such information be withheld from public disclosure. Enclosure 7 provides an affidavit from CDI supporting this request. Redacted versions of the proprietary enclosures with the CDI proprietary material removed, which are suitable for public disclosure, will be provided by November 14, 2008.

TVA has determined that the additional information provided by this letter does not affect the no significant hazards considerations associated with the proposed TS changes. The proposed TS changes still qualify for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9).

No new regulatory commitments are made in this submittal. If you have any questions regarding this letter, please contact me at (256)729-2636.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 31st day of October, 2008.

Sincerely,

Michael K. Brandon
Interim Manager of Licensing
and Industry Affairs

Enclosures:

1. Supplemental Response to Round 19 Request for Additional Information (RAI) and Response to Round 22 RAIs Regarding Steam Dryers
2. CDI Report No. 08-15P, "Stress Assessment of Browns Ferry Nuclear Unit 1 Steam Dryer with Tie-Bar Modifications" (Proprietary Version)
3. CDI Report No. 08-04P, "Acoustic and Low Frequency Hydrodynamic Loads at CLTP Power Level on Browns Ferry Nuclear Unit 1 Steam Dryer to 250 Hz" (Proprietary Version)

4. CDI Report No. 08-05P, "Acoustic and Low Frequency Hydrodynamic Loads at CLTP Power Level on Browns Ferry Nuclear Unit 2 Steam Dryer to 250 Hz" (Proprietary Version)

5. CDI Report No. 08-14P, "Flow-Induced Vibration in the Main Steam Lines at Browns Ferry Nuclear Units 1 and 2, With and Without Acoustic Side Branches, and Resulting Steam Dryer Loads" (Proprietary Version)

6. Structural Integrity Associates, Inc. Calculation Package 0006982.304, "Extended Power Uprate Main Steam Line Strain Gauge Vibration Monitoring"

7. CDI Affidavit

Enclosures
cc (Enclosures):

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ENCLOSURE 1

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

TECHNICAL SPECIFICATIONS (TS) CHANGES TS-431 AND TS-418
EXTENDED POWER UPRATE (EPU)

SUPPLEMENTAL RESPONSE TO ROUND 19 REQUEST FOR ADDITIONAL INFORMATION (RAI) AND RESPONSE TO ROUND 22 RAIs REGARDING STEAM DRYERS

SUPPLEMENTAL RESPONSE TO ROUND 19 RAI

NRC RAI EMCB.147 (Unit 2 only)

Provide analysis and plots for Unit 2 similar to those provided for Unit 1 in response to RAI EMCB.172. Provide an explanation why the 19-percent power data shown in Figures 3.2 through 3.5 in CDI Report No. 08-05P, *Acoustic and Low Frequency Hydrodynamic Loads at CLTP Power Level on Browns Ferry Nuclear Unit 2 Steam Dryer to 250 Hz*, are higher than the data at CLTP for frequencies above about 120 Hz. Provide justification for removing any signal from the Unit 2 CLTP source strengths without reliable background noise signals. TVA should include stress and stress ratio tables in CDI Report 08-16P, *Stress Assessments of Browns Ferry Nuclear Unit 2 Steam Dryer with Tie Bar and Hood Modifications*, using unfiltered MSL signals.

Supplemental Response to EMCB.147 (Unit 2 only)

As discussed in the response to RAI EMCB.147 in the October 3, 2008, submittal, "Supplemental Response to Round 19 RAI and Response to Rounds 20 and 21 RAI" (ML082810471), the Unit 2 steam dryer stress analysis is being re-performed with newly acquired low flow (LF) and companion electrical interference check (EIC) signals taken at 5% power. The current licensed thermal power (CLTP) signals have not been changed. The data being used in the Unit 2 stress analysis is illustrated in Figures 3.2 through 3.5 of Enclosure 4, CDI Report No. 08-05P, "Acoustic and Low Frequency Hydrodynamic Loads at CLTP Power Level on Browns Ferry Nuclear Unit 2 Steam Dryer to 250 Hz." The Unit 2 stress report is in progress and will be submitted by November 14, 2008. The requested information for RAI EMCB.147 will be provided based upon the revised Unit 2 stress analysis.

NRC RAI EMCB.192/150 (Unit 1/Unit 2)

Provide the following information about the planned acoustic side branches (ASBs) for Units 1 and 2, including validation results:

(a) Identify which safety/relief valves the ASBs will be installed on;

(b) Provide the lengths of the various ASBs and the acoustic resonance frequencies associated with them;

(c) Describe the power level(s) at which these (new) acoustic resonances will be excited. If the new resonances are excited, discuss whether it will be locked in;

(d) Provide the estimated minimum alternating stress ratio of the dryer at flow conditions corresponding to the acoustic resonance of the standpipe-ASB combination; and,

(e) Address whether the ASBs will be designed by means of the scale-model test, if so provide the corresponding test results for review.

Supplemental Response to EMCB.192/150 (Unit 1/Unit 2)

As discussed in the response to RAI EMCB.192/150 in the October 3, 2008, submittal, TVA planned on addressing the potential for safety relief valve (SRV) resonance at EPU conditions by utilizing frequency based (0 to 250 Hertz (Hz)) bump-up factors determined by the 1/8 scale model tests (SMT). Based upon further discussion with NRC, TVA has revised the methodology for utilizing bump-up factors to apply a velocity squared bump-up factor of 1.35 at all frequencies outside the SRV resonance frequency. At the SRV resonance frequency (100 to 120 Hz), bump-up factors based on the 1/8 SMT will be applied. Plots of the bump-up factors utilized for Units 1 and 2 are shown in Figure 9.1 in Enclosure 5, CDI Report No. 08-14P, "Flow-Induced Vibration in the Main Steam Lines at Browns Ferry Nuclear Units 1 and 2, With and Without Acoustic Side Branches, and Resulting Steam Dryer Loads."

TVA is applying the revised bump-up factors to determine a load that can be used to predict the steam dryer stresses at EPU conditions. This analysis has been completed for Unit 1 and is included as Section 6 of Enclosure 2, CDI Report No. 08-15P, "Stress Assessment of Browns Ferry Nuclear Unit 1 Steam Dryer with Tie-Bar Modifications."

The revised Unit 1 stress analysis includes the following changes:

- Utilized a companion EIC signal for LF conditions as previously described in the response to RAI EMCB.EMCB.198 in the October 3, 2008 submittal.
- Evaluated stress results at EPU conditions by the use of bump-up factors as described above.

New Unit 1 results based on the above changes indicate a minimum alternating stress ratio with frequency shifts of SR-a = 2.79 at CLTP and SR-a = 2.03 at EPU.

RESPONSE TO DRAFT ROUND 22 RAI

NRC RAI EMCB.199/156 (Units 1 and 2)

In the stress assessment of the Unit 1 steam dryer, TVA has employed submodeling approach, as shown in Enclosure 6 of the letter dated June 16, 2008 for estimating the complete three-dimensional stress distribution at the two locations having the lowest alternating stress ratios: (1) the intersection between the bottom of the inner hood, stiffener and base plate, and (2) the bottom of the skirt/drain channel junction. For each of these two locations, TVA creates two submodels, one based on shell elements and the other based on solid elements. The NRC staff noted that TVA applied its submodeling approach two different ways. For the first location, TVA simulates the stress profile of the full-model analysis in the submodel using shell elements by applying static loading on a short section of the stiffener. For the second location, TVA applies the prescribed displacement at specific intervals along a vertical line in the drain channel using a submodel with shell elements and performs the 3-D analysis iteratively by changing the location of the vertical line until the stress profile in the submodel matches the stress profile of the full-model analysis. The applied loads displacements from the submodel with shell elements are applied to a corresponding submodel with solid elements. Finally, TVA determines a stress reduction factor for each location by comparing the solid submodel results to the corresponding shell submodel results (the largest ratio of the (Pm + Pb) stress intensity from the sub-models) and applies it to the appropriate stresses in the full-model steam dryer analysis.

The above-described submodeling approach is not typical. In a typical submodeling approach, as employed in the general purpose finite element codes such as ANSYS and ABAQUS, the results from the full model analysis are interpolated onto the nodes on the appropriate part of the boundary of the submodel. These nodes and any loads applied to the local region determine are used to perform the detailed finite element analysis of the submodel from which the stress ratios may be determined.

As TVA's submodeling approach is different than the typical approach, it is essential that the approach is validated for each of the two applications by performing the dynamics analysis for a representative structural dynamic model. Therefore, TVA is requested to provide the following:

a. A description of the representative structural dynamic model;

b. An analysis of the model using a typical submodeling approach;

c. An analysis of the model applying the TVA's submodeling approach employed to determine the stresses at the intersection between the bottom of the inner hood, stiffener and base plate;

d. An analysis of the model using the TVA's submodeling approach employed to determine the stresses at the bottom of the skirt/drain channel junction; and,

e. A comparison of the results obtained in (b) using the typical submodeling approach with those in (c) and (d) using the TVA's approach. This should include an assessment of the validity of the TVA's submodeling approach for each of the two applications mentioned above.

TVA Response to EMCB.199/156 (Units 1 and 2)

As requested by RAI EMCB.199/156, TVA has performed an analysis of a representative structural model using both the typical submodeling approach and TVA's submodeling approach for obtaining the three dimensional stress distribution in a weld. The representative model addresses both the weld connecting the inner hood to the hood stiffener and the weld connecting the drain channel to the dryer skirt. In addition to the objectives noted in the RAI, TVA's analysis of the representative model was expanded to address the following considerations:

- Comparison of the full shell representative model to a full solid representative model,
- Comparison of results considering both static and dynamic loading of the full representative model,
- Comparison of the typical submodeling approach to TVA's submodeling approach while varying the size of the submodel.

The results of this study confirm that the TVA approach provides conservative stress reduction factors which can be applied to adjust stresses extracted from the CDI shell element analysis of the BFN steam dryers to account for the true stress distribution in the welds at the joints in question. Complete documentation of this study, including representative model description, analysis procedure and results, is included in Enclosure 6, Structural Integrity Associates, Inc. Calculation Package 0006982.304, "Extended Power Uprate Main Steam Line Strain Gauge Vibration Monitoring."

NRC RAI EMCB.200/157 (Units 1 and 2)

As part of the presentation provided during the October 14, 2008, public meeting, TVA provided the following equation for the steam line unsteady pressure at CLTP:

$P_{CLTP}=C_{CLTP}(CLTP-EIC_{CLTP})-C_{LF}(LF-EIC_{LF})$,

where P is the steam line unsteady pressure, C is the coherence factor between upper and lower locations, LF is the low flow signal, and EIC is the signal taken with zero excitation voltage.

The equation implies that the coherence factors between the upper and lower strain gage locations are the same for both the CLTP signal and the corresponding EIC signal. However, it appears to the staff that the equation may not be conservative in all cases. In the event the coherence between the EIC signals on the upper and lower arrays is 0, it appears that the coherent portion of the signals at CLTP or LF already excludes the incoherent EIC signals. Therefore, it appears that subtracting the EIC autospectra from the individual CLTP and LF signals and then multiplying by the coherence removes the EIC noise twice.

Address whether the EIC noise reduction procedure proposed removes the EIC noise twice. If the proposed does, provide the means to more appropriately account for the coherence of the EIC signals.

TVA Response to EMCB.200/157 (Units 1 and 2)

The response to this RAI is planned to be provided by November 14, 2008.

NRC RAI EMCB.158 to EMCB.161 (Unit 2)

For Unit 2, TVA is substituting low flow (LF; 5 percent power) and EIC signals at the lower strain gage location on main steam line MSL 'A' for the corresponding signals at the lower strain gage location on MSL 'D' because all the strain gages on the MSL 'D' lower location are damaged. During the October 14, 2008 public meeting it was indicated that the MSL 'A' and MSL 'D' are similar and therefore the substitution for the damaged strain gages is acceptable.

NRC RAI EMCB.158 (Unit 2)

Provide the comparisons of the following data associated with MSLs 'A' and 'D:'

(1) piping layouts,

(2) strain gage locations, and

(3) locations and dimensions of SRVs.

TVA Response to EMCB.158 (Unit 2)

The requested information for main steam lines (MSL) A and D is provided below. This information provides the similarity of the piping layouts for the two steam lines. The substitution of the LF signals for MSL D is based on the similarity of the signals as discussed in the response to RAI EMCB.159.

(1) Piping layouts for MSLs A and D are provided in Figure EMCB.158-1.

(2) Strain gage locations on Unit 2 are provided in Table EMCB.158-1.

(3) The locations of the SRVs are depicted on Figure EMCB.158-1. SRV dimensions are provided on Figure EMCB.158-2.

Table EMCB.158-1: BFN Unit 2 Distance from Reactor Pressure Vessel Nozzle to MSL Strain Gage Arrays

MSL	Upper (feet)	Lower (feet)
A	9.5	38.1
B	9.5	39.8
C	9.5	39.5
D	9.5	38.2

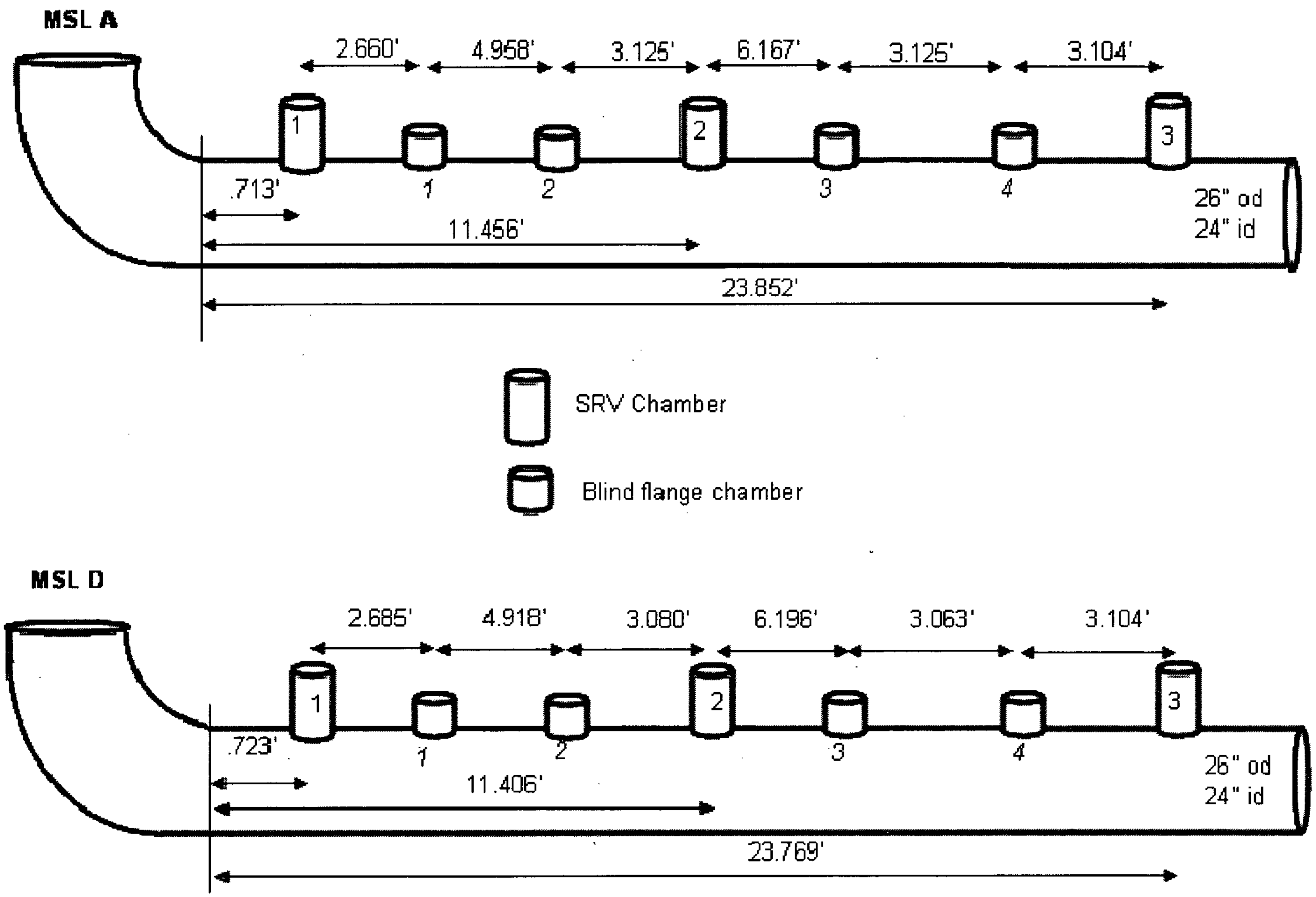
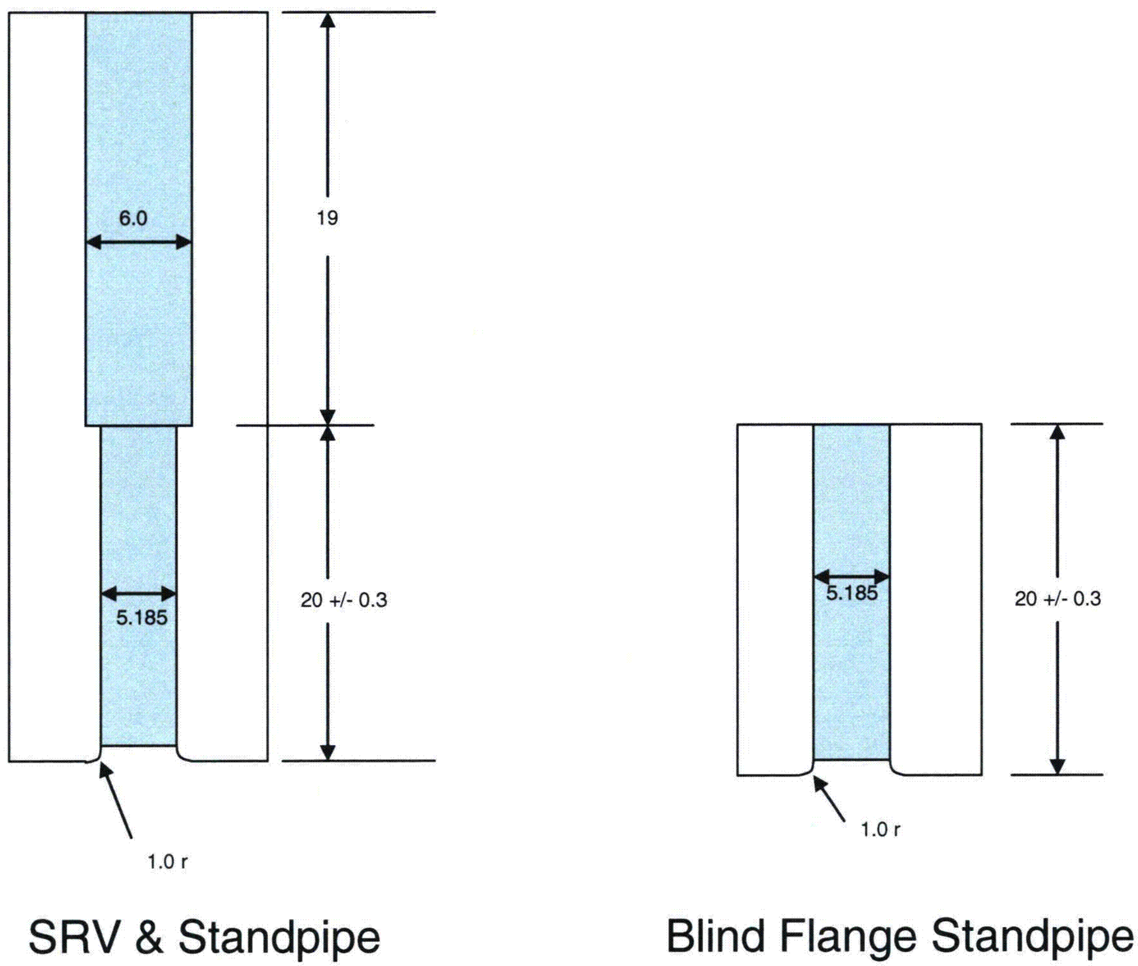


Figure EMCB.158-1: BFN2 MSLs A & D Piping Layout



Shaded area represents acoustic chamber
Dimensions in inches

Figure EMCB.158-2: Schematic of SRVs and Blind Flange Standpipes

NRC RAI EMCB.159 (Unit 2)

Demonstrate that (1) the filtered signals for MSL 'A' upper and MSL 'D' upper are similar for both the low flow (5 percent power) and CLTP-flow conditions for Unit 2, (2) the filtered signals for MSL 'A' lower and MSL 'D' lower are similar for the CLTP flow conditions, and (3) the bump-up factors for MSL 'A' lower and MSL 'D' lower are similar.

TVA Response to EMCB.159 (Unit 2)

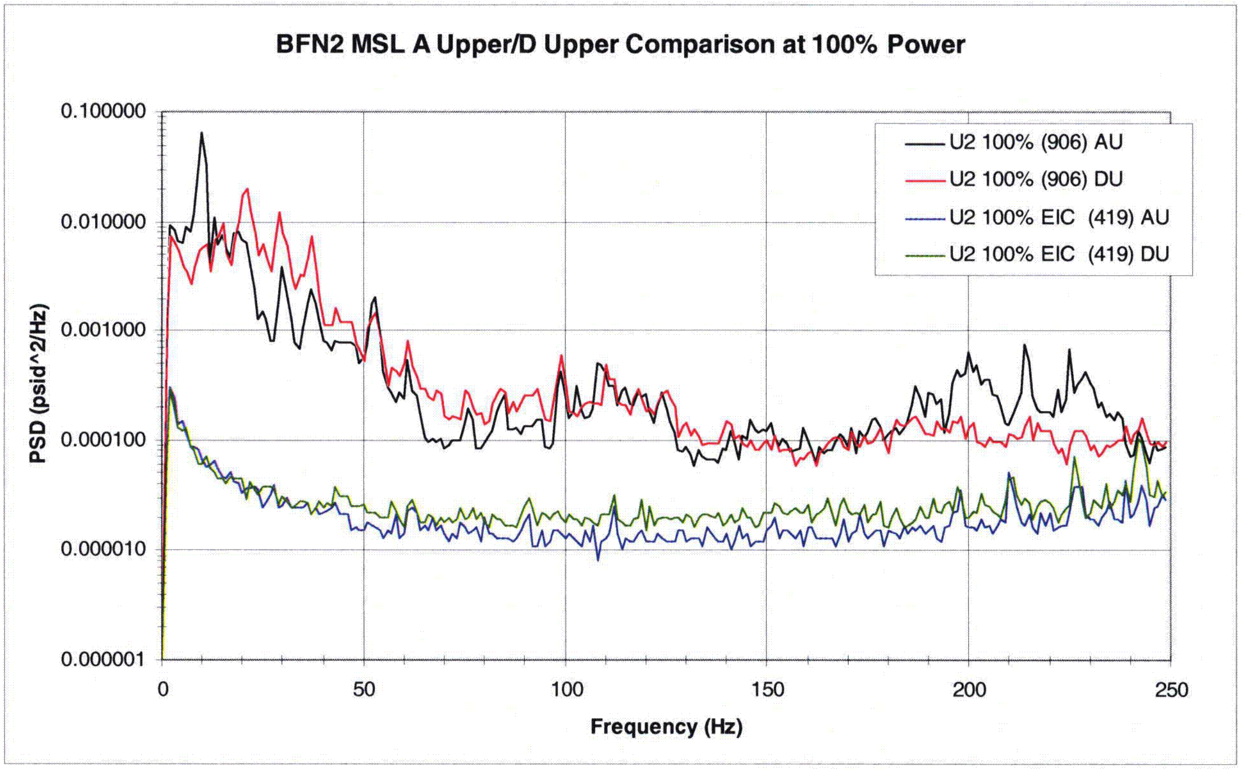
Due to the inoperability of strain gages on the MSL D Lower array, data could not be obtained for this array when the 5% power signals were taken. This requires substitution of MSL D data with that of the symmetrical MSL A (non-dead leg lines) for the LF signal only. The inoperable strain gages do not affect the CLTP signals since they were taken at an earlier time when the strain gages were operable.

Substitution of the LF data for MSL D is described in Section 3 of Enclosure 4, CDI Report No. 08-05P. Although LF data is available for MSL D Upper, LF data for both MSL D Upper and MSL D Lower is substituted to preserve the relationship between the signals for coherence filtering.

(1) Figure EMCB.159-1 provides the power spectral density (PSD) plots for MSL A Upper and MSL D Upper at CLTP and LF conditions with their companion EICs. For substitution, the LF MSL A Upper signal is scaled based on the LF MSL D Upper signal. This reduces the substituted signal in the frequency ranges where the MSL A Upper signal is greater than the MSL D Upper signal. Reducing the LF substituted signal provides a conservative signal to be removed from the CLTP signal.

(2) Figure EMCB.159-2 provides the PSD plots for MSL A Lower and MSL D Lower at CLTP (with companion EIC signal) and 30% power conditions when the strain gages were operable. A companion EIC signal at 30% power was not taken at that time. These figures show that these signals had a good comparison and substitution was appropriate.

(3) Figure 9.1 of Enclosure 5, CDI Report No. 08-14P, provides a comparison of the bump-up factors for MSLs A and D. Peak bump-up factors in the SRV resonance range of 100 to 120 Hz are 2.58 for MSL A Upper, 2.16 for MSL A Lower, 3.13 for MSL D Upper, and 3.43 for MSL D Lower. These results show that the SRV resonance response is different for MSLs A and D. However, substitution is only being performed for the LF signal which was taken at 5% power where there is no SRV resonance. The MSL D Lower strain gages will be repaired prior to power ascension at EPU conditions and substitution of data will not be required.



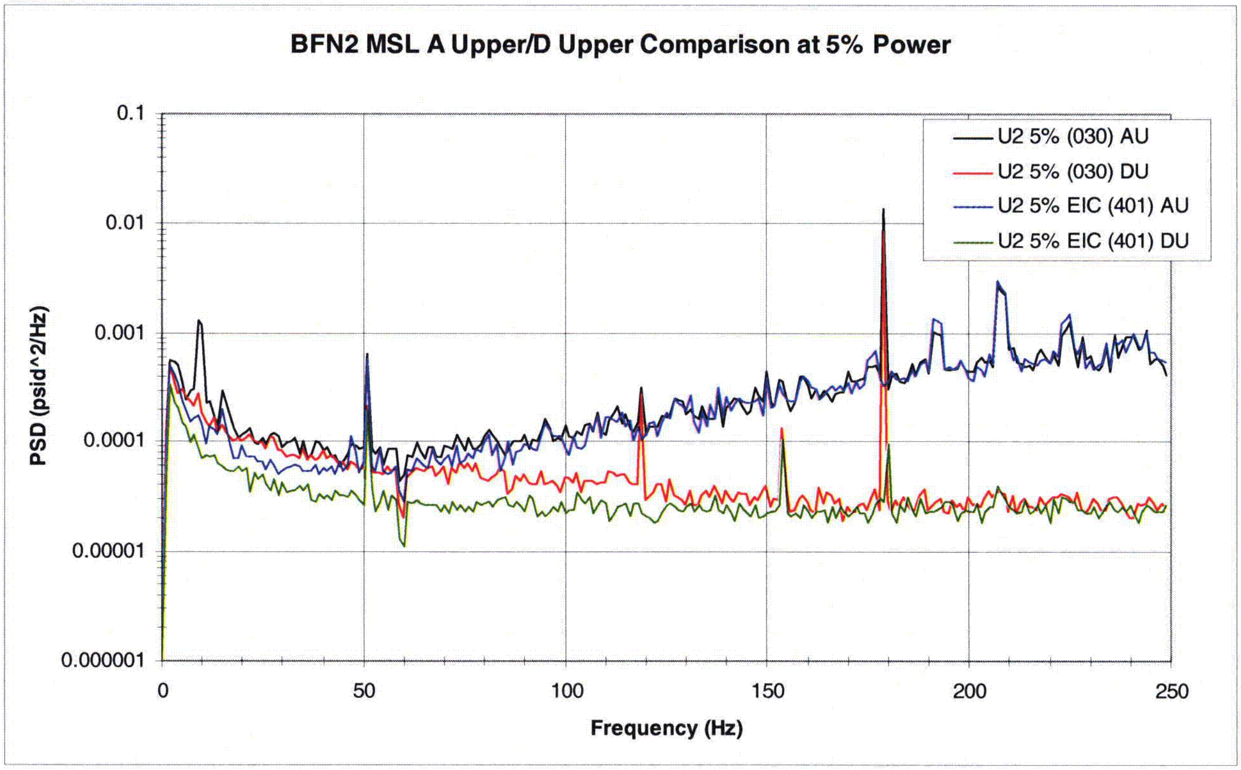
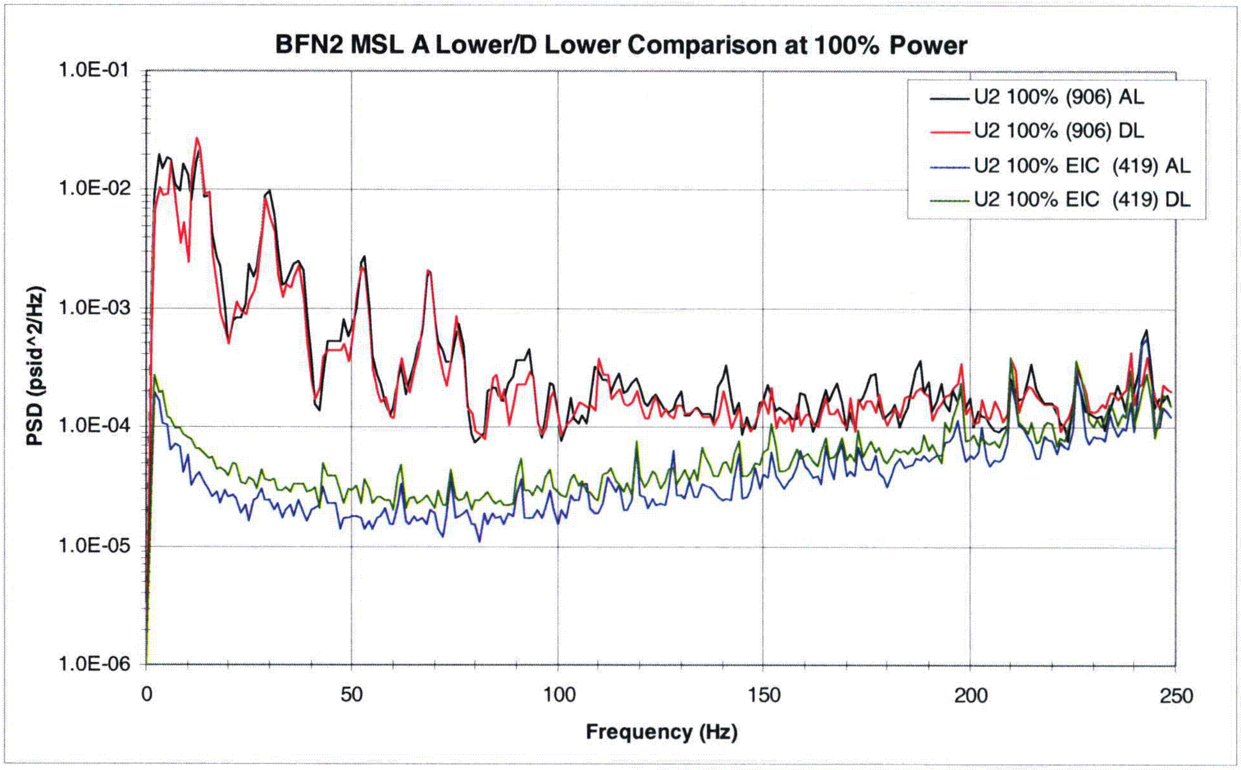


Figure EMCB.159-1: BFN2 MSL A Upper and MSL D Upper Comparison



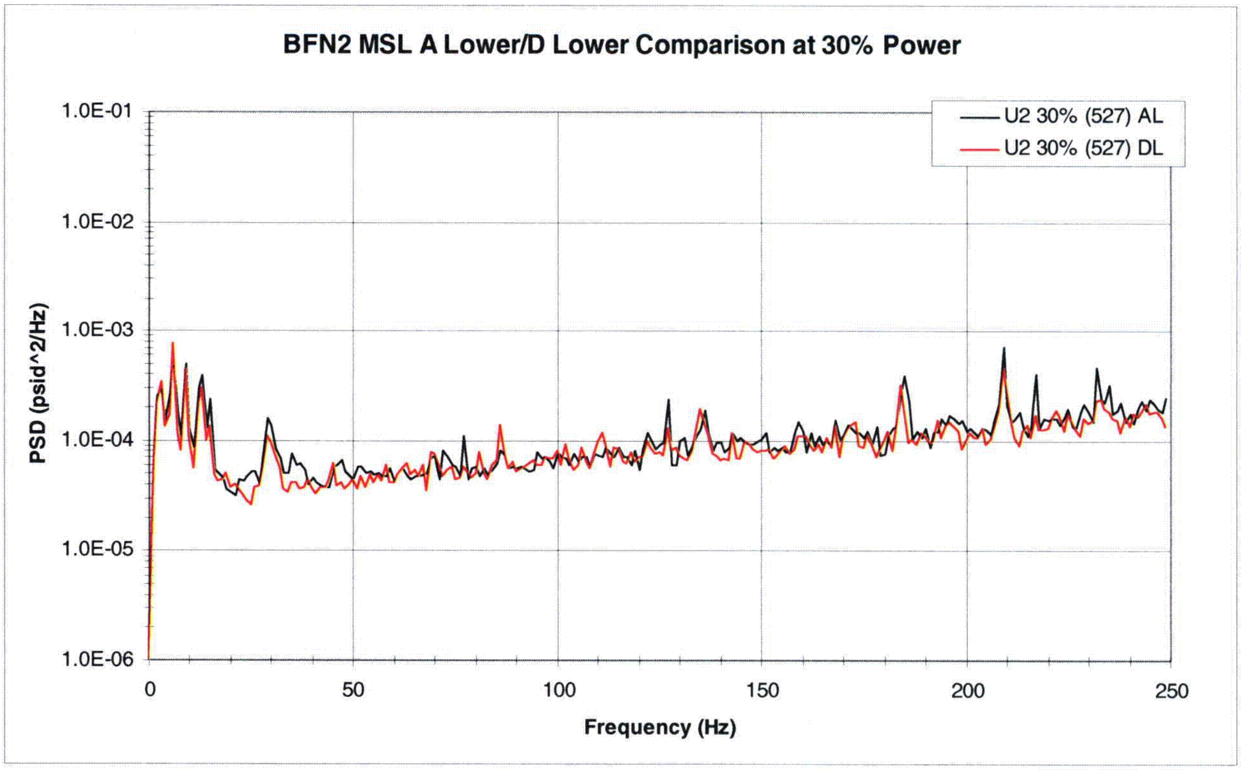


Figure EMCB.159-2: BFN2 MSL A Lower and MSL D Lower Comparison

NRC RAI EMCB.160 (Unit 2)

On slide 10 of the presentation provided during the October 14, 2008, public meeting, TVA provided graphs of the MSL EIC signals. For example, the variable frequency drive (VFD) spectral peaks are sometimes up to 4 orders of magnitude higher than the EIC signals used in the noise removal process. The EIC signals are, therefore, a very small fraction of the total dynamic input range of the measuring system. For example, if it is assumed that the measuring system is accurate within 0.1 percent of the dynamic input range, this error level is already about 10 times higher than the broadband level of the EIC signal, which is used for noise removal. Address the uncertainties in the EIC signals while it is removing the noise from the Unit 2 CLTP signals.

TVA Response to EMCB.160 (Unit 2)

The response to this RAI is currently planned to be provided by November 14, 2008.

NRC RAI EMCB.161 (Unit 2)

In the information provided to date, it appears to the NRC staff that the EIC signals of Unit 2 show a high degree of anomaly and seem to be unrepeatable. For example, on slide 14 in the presentation slides provided during the October 14, 2008 public meeting, the low flow EIC signal obtained from the most recent measurements on MSL 'C' Upper in Unit 2 is higher than the total low flow signal at frequencies above 130 Hz. These results of the upper strain gages on MSL 'C' appear to be incorrect because the EIC signal constitutes the electrical interference noise portion of the low flow signal and therefore it ought to be smaller than the low flow signal. Address how this anomaly will be dealt with as well as the steps that will be taken to ensure the reliability of all strain gage signals obtained at low flow conditions in Unit 2.

TVA Response to EMCB.161 (Unit 2)

TVA has compared the 5% power and EIC signal on MSL C Upper presented on slide 14 of the October 14, 2008 meeting to three other 5% power and EIC signals that were taken during the same unit startup. The MSL C Upper 5% power signal from slide 14 was atypically low compared to the other power signals. All MSL C Upper EIC signals were similar with the same relative magnitude. The use of the atypical low signal for MSL C Upper is conservative since the use of a lower LF signal reduces the amount of noise that is removed from the CLTP signal. TVA is implementing steps in the MSL strain gage processing procedure to ensure additional examination of data sets to identify any anomalous signals prior to use.