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Ref. # 10 CFR 52

August 4, 2011

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555
ATTN: David B. Matthews, Director
Division of New Reactor Licensing

SUBJECT: COMANCHE PEAK NUCLEAR POWER PLANT, UNITS 3 AND 4
DOCKET NUMBERS 52-034 AND 52-035
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION NO. 5798
(SECTION 3.7.2)

Dear Sir:

Luminant Generation Company LLC (Luminant) submits herein the response to Request for Additional Information (RAI) No. 5798 (CP RAI #221) for the Combined License Application for Comanche Peak Nuclear Power Plant Units 3 and 4. The RAI addresses the SASSI analyses.

Should you have any questions regarding this response, please contact Don Woodlan (254-897-6887, Donald.Woodlan@luminant.com) or me.

The six commitments made in this letter are captured on page 2.

I state under penalty of perjury that the foregoing is true and correct.

Executed on August 4, 2011.

Sincerely,

Luminant Generation Company LLC

Rafael Flores for

Attachment: Response to Request for Additional Information No. 5798 (CP RAI #221)

D090
NRO

Regulatory Commitments in this Letter

This communication contains the following new or revised commitments which will be completed or incorporated into the CPNPP licensing basis as noted:

Number	Commitment	Due Date/Event
8290	Luminant has addressed the technical issues raised by the DNFSB letter through an initial evaluation of the existing analyses results for the structures listed in the response to item 1, as described further in item 3. The initial evaluation will be finalized and documented along with a comparison study which will be available in November 2011.	November 30, 2011
	Luminant makes the following commitments to assess changes in the standard plant seismic design:	
8291	• Identify subsections of the COL application, in particular FSAR Chapter 3 and related Appendices, which need to be updated to show new standard plant structures' configuration changes and numerical results (such as ISRS). This assessment will be submitted to the NRC by the end of October 2011.	October 31, 2011
8292	• Review the seismic design and identify updates to the COLA for any new analyses specifically required as a result of the updated standard plant methodology (e.g. evaluation for selection, if necessary based on seismic stability evaluations, of a standard plant shear key design option). This assessment will be submitted to the NRC by the end of December 2011.	December 30, 2011
8293	• Perform final confirmatory reviews of the seismic design. Provide a detailed mark-up of the COLA where changes to standard plant configuration or numerical results occur (such as FSAR Appendix 3NN) in an update tracking report (UTR) by the end of February 2012.	February 28, 2012
	Luminant makes the following commitments to assess potential change impacts on the site-specific structures' design due to changes in standard plant design methodology:	
8294	• Identify subsections of the COLA, in particular FSAR Chapter 3 and related Appendices, which may be impacted by changes in standard plant design methodology. This assessment will be submitted to the NRC by the end of October 2011.	October 31, 2011
8295	• Perform final confirmatory reviews of the seismic design, review and update the COLA if required, including detailed mark-ups of any needed changes, which will be included in a UTR by the end of February 2012.	February 28, 2012

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RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 5798 (CP RAI #221)

SRP SECTION: 03.07.02 - Seismic System Analysis

QUESTIONS for Structural Engineering Branch 1 (AP1000/EPR Projects) (SEB1)

DATE OF RAI ISSUE: 6/3/2011

QUESTION NO.: 03.07.02-21

The Defense Nuclear Facilities Safety Board (DNFSB) issued a letter on April 8, 2011 requesting the Department of Energy (DOE) to address technical and software quality assurance issues related to potentially erroneous seismic analyses performed using the SASSI Subtraction method. The April 8, 2011 letter may be found on the DOE Departmental Representative to the DNFSB website: http://www.hss.energy.gov/deprep/.

Chapter 3, Appendix 3NN of the Comanche Peak COL FSAR states that the US-APWR standard plant employs this subtraction method. Very limited information was provided about what method was used for other seismic category I structures at Comanche Peak, Units 3 & 4. To ensure the applicant has adequately met General Design Criteria (GDC) 1 and 2 and Appendix B to Part 50, the staff requests Luminant to provide to following information:

1. Confirm whether the SASSI Subtraction method is used in the analyses of seismic category I standard and site-specific structures.
2. Provide how Luminant addressed the technical and software quality assurance issues raised by DNFSB letter in the version of SASSI which Luminant uses for analyses of all seismic category I structures part of the Comanche Peak Units 3 and 4.
3. If the SASSI Subtraction method is used by Luminant, provide an assessment to establish: a) the seismic analyses performed in support of the Comanche Peak RCOL application does not contain any errors or anomalies as identified in DNFSB letter, b) the quality assurance steps taken to ensure that any future seismic analyses in support of the Comanche Peak application will be free from errors or anomalies as identified in DNFSB letter.

ANSWER:

1. The Subtraction method, Flexible Interface – Flexible Soil Interface Nodes (Fi-FSIN), in ACS SASSI NQA Version 2.2.1 is the method that was used in the embedded analyses for Comanche Peak Units

3 and 4, which consisted of analyses for the Reactor Building (R/B) complex, Ultimate Heat Sink Related Structures (UHSRS), Power Source Fuel Storage Vaults (PSFSVs), and Essential Service Water Pipe Tunnel (ESWPT) Segments 1 and 3. The soil-structure interaction (SSI) code included in ACS SASSI NQA Version 2.2.1 includes two optional methods for substructuring that can be used to compute the soil impedances. These two methods are Flexible Interface method, which is equivalent to the SASSI 2000 Subtraction method, and the Flexible Volume method, which is more robust and accurate, but is much more intense in terms of computation efforts required by the program. The Subtraction method was selected for Comanche Peak Units 3 and 4 because of its practicality.

2. Luminant has addressed the technical issues raised by the DNFSB letter through an initial evaluation of the existing analyses results for the structures listed in the response to item 1, as described further in item 3. The initial evaluation will be finalized and documented along with a comparison study which will be available in November 2011. The comparison study will be an SSI analysis sensitivity study for the embedded PSFSVs using three different SSI methods [Subtraction/FI-FSIN, Modified Subtraction/Flexible Interface – Excavated Volume Boundary Nodes (FI-EVBN), Direct/Flexible Volume (FV)]. The accuracy of the results obtained from the three different methods in terms of the acceleration transfer functions (ATF) and in-structure response spectra (ISRS) will be evaluated and compared for selected key locations in the three orthogonal directions. The SSI analyses will be performed for the lower bound and high bound soil profiles. Among the site-specific structures, the PSFSVs are selected for the comparison study because they have embedment depths that are representative of the other two site-specific structure types (UHSRS and ESWPT). The R/B complex is a standard plant structure with seismic design margins much greater than the site-specific seismic demands, as documented in FSAR Section 3.7.1 and Appendix 3NN. Therefore, the R/B complex is not selected for a comparison study since its design, relative to the Comanche Peak Units 3 and 4 sites, is not sensitive to potential anomalies outlined in the DFNSB letter.

   Refer to item 3(b) regarding software quality assurance issues raised by the DNFSB letter in the version of SASSI which Luminant uses for analyses of all seismic category I structures that are part of the Comanche Peak Units 3 and 4 COLA.

3. The following assessments are provided:

   a) A number of investigative studies performed recently (References 1, 2 ,3, 4, 5) have identified that in certain cases under certain site conditions the Subtraction method could produce some spurious peaks and valleys in the computed ATF and this could introduce inaccuracies in the computed ISRS. Typically, in most situations where the Subtraction method results in anomalous behavior, very sharp ATF peaks are produced which are much higher than they should be. Even though the Subtraction method could result in anomalous behavior in certain conditions, it would have numerical instabilities that would most likely produce unrealistically high results. Although investigations have shown it is unlikely that the Subtraction method will produce unconservative results, this cannot be entirely ruled out as a possibility on a generic basis.

      For Comanche Peak Units 3 and 4, the seismic input is a CSDRS spectrum shape tied to a 0.1 g PGA. The frequency content is rich in the lower and intermediate frequencies (up to approximately 20 Hz) that can typically be considered the threshold above which the Subtraction method numerical instabilities could influence results. Also, the Comanche Peak site-specific soil layering is a very stiff soil as documented in FSAR Table 2.5.2-227. The average shear wave velocity of the limestone rock formation (Layer C), upon which seismic category I structures are founded, is greater than 5800 ft/sec. Thus, the combination of the CSDRS seismic input tied to a low 0.1 g PGA, with such stiff soil under seismic category I foundations, results in site conditions that are not critical with regard to potential numerical instabilities associated with the Subtraction method.

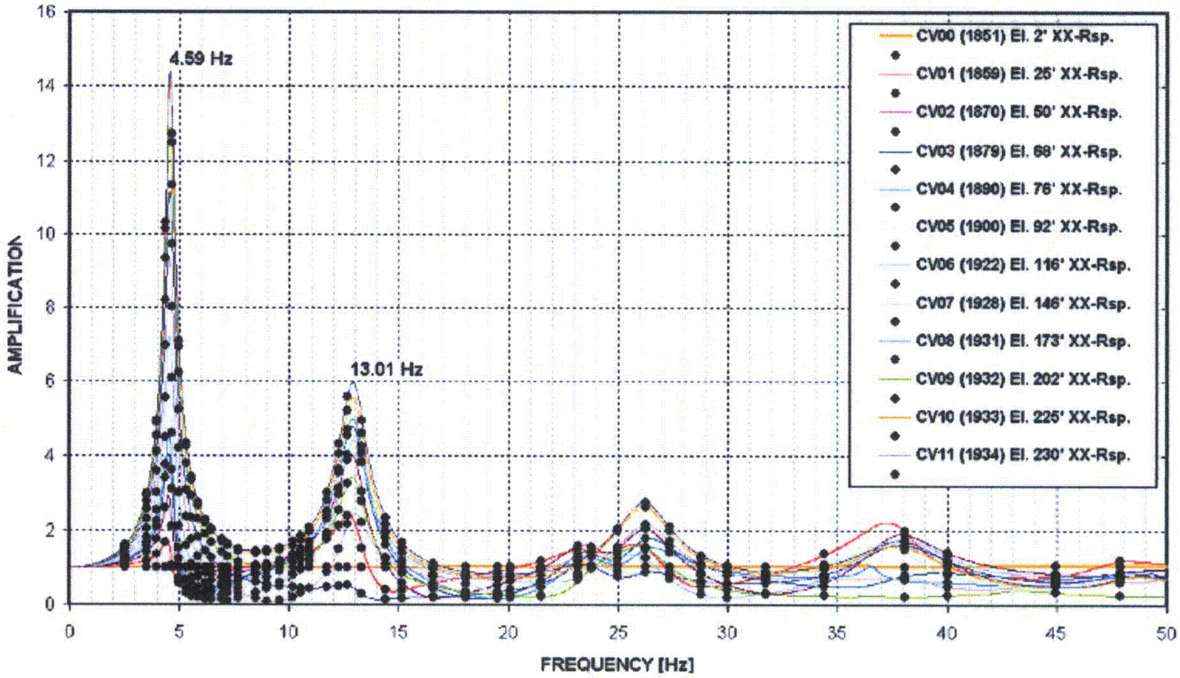
Review of the computed ATF for the Comanche Peak embedded structure analyses indicated that there are no anomalies associated with the Subtraction method that could significantly affect the computed ISRS or cause unconservative results. Most of the computed ATF functions are smooth over the entire frequency range from 0 to 50 Hz, which was the highest cut-off SSI frequency.

Representative examples are given in Figures 1 through 8 below for the computed ATF for various locations and soil cases for the RB complex, PSFSV, ESWPT and UHSRS. With a few exceptions, all curves are smooth and do not indicate any sharp peaks that could be a Subtraction method numerical instability. For the PSFSV ATF in the Z-direction (Figure 4), a number of sharp peaks, corresponding to data plot points are visible particularly above 40 Hz. Even assuming that these high-frequency peaks are spurious peaks associated with the Subtraction methodology and not associated with interpolation of data, they do not affect the ISRS, which have significant values at much lower frequencies due to the CSDRS-shaped seismic input motion. Another exception occurs for a UHSRS ATF as shown in Figure 8, where a sharp peak occurs at approximately 26 Hz. Due to the narrow bandwidth of the ATF spike and the fact that the ISRS peaks have much larger bandwidth than the ATF peaks, ATF spikes such as the one shown in Figure 8 will have negligible influence on the ISRS, and will result only in increases in ISRS amplitude, which is in the conservative direction.

In conclusion, the review of all ATF plots for the existing Comanche Peak Units 3 and 4 ACS SASSI NQA Version 2.2.1 analyses results indicates that there are no issues related to the ISRS computation due to application of the Subtraction method that could affect the design significantly or in an unconservative manner.

In addition to the technical assessment described above, Luminant is performing additional comparison studies for the PSFSV structures, as described in the response to Item 2 above, using the newer, more advanced ACS SASSI NQA Version 2.3.0 and all three embedded analysis methods.

SASSI PCCV Stick Model – Transfer Functions for NS Translation



SASSI Rigid Base Model – Transfer Functions for PCCV NS Translation

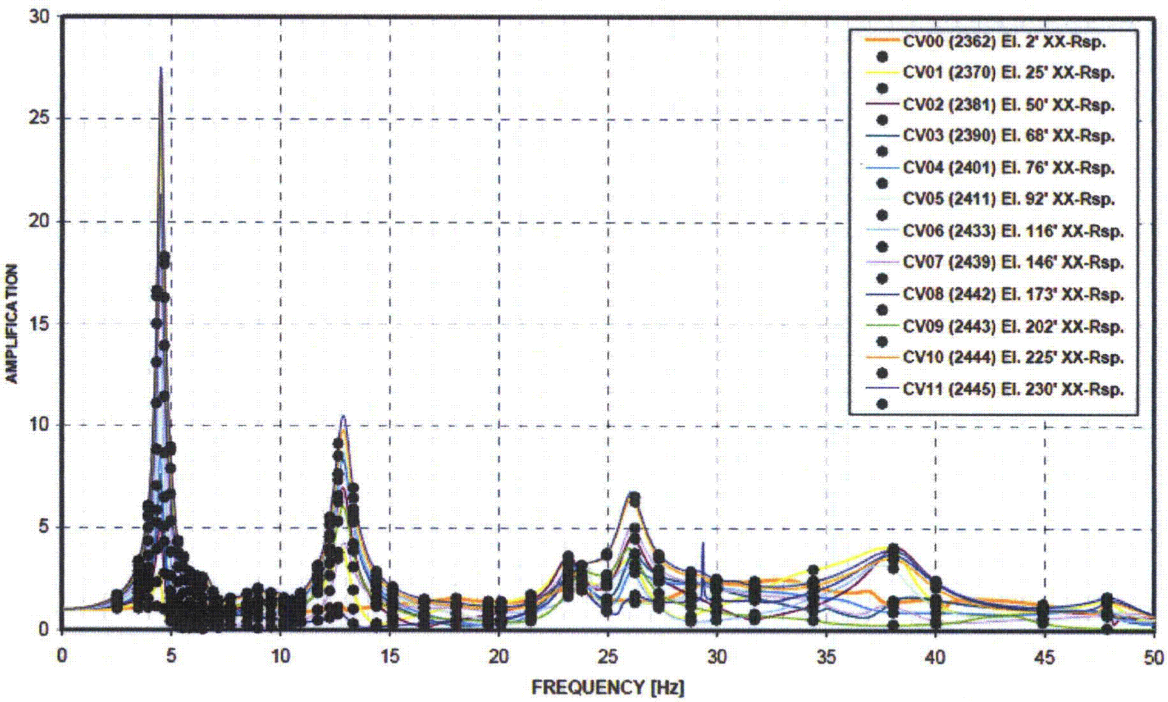
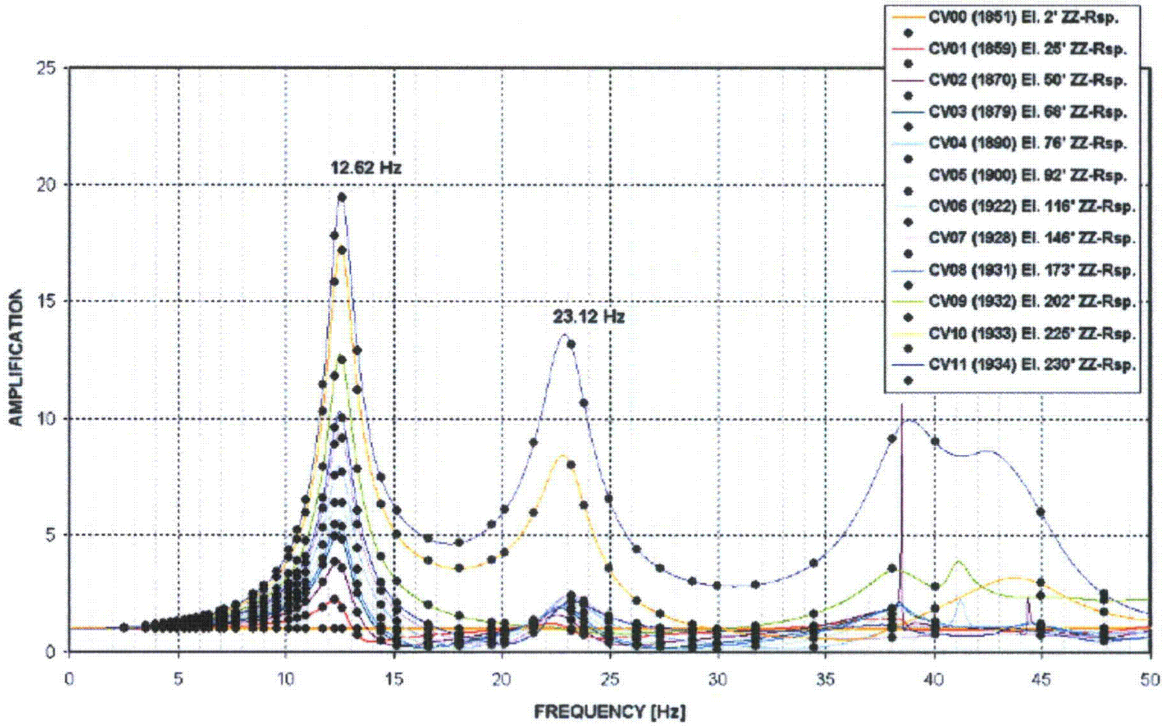


Figure 1. Computed ATF for RB Complex PCCV Structure for All Elevations in NS Direction

SASSI PCCV Stick Model – Transfer Functions for Vert. Translation



SASSI Rigid Base Model – Transfer Functions for PCCV Vert. Translation

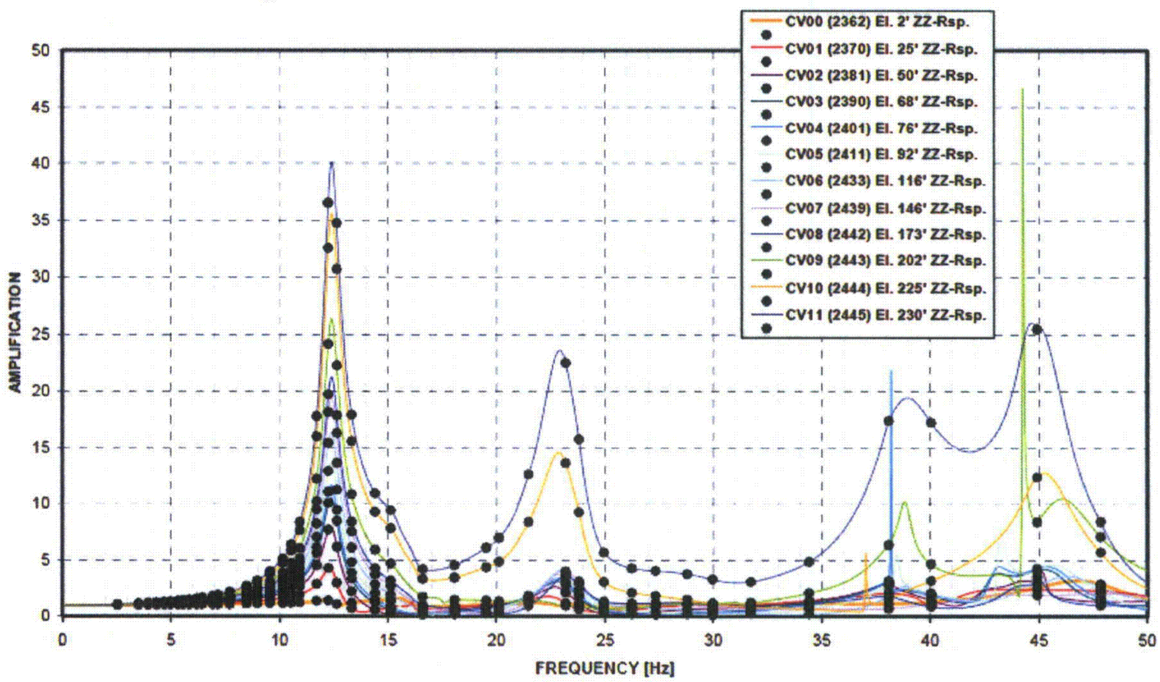


Figure 2. Computed ATF for RB Complex PCCV Structure for All Elevations in Z- Direction

Response Transfer Function for Node 01872 Lower Bound Rock, No Fill, with Additional Frequencies

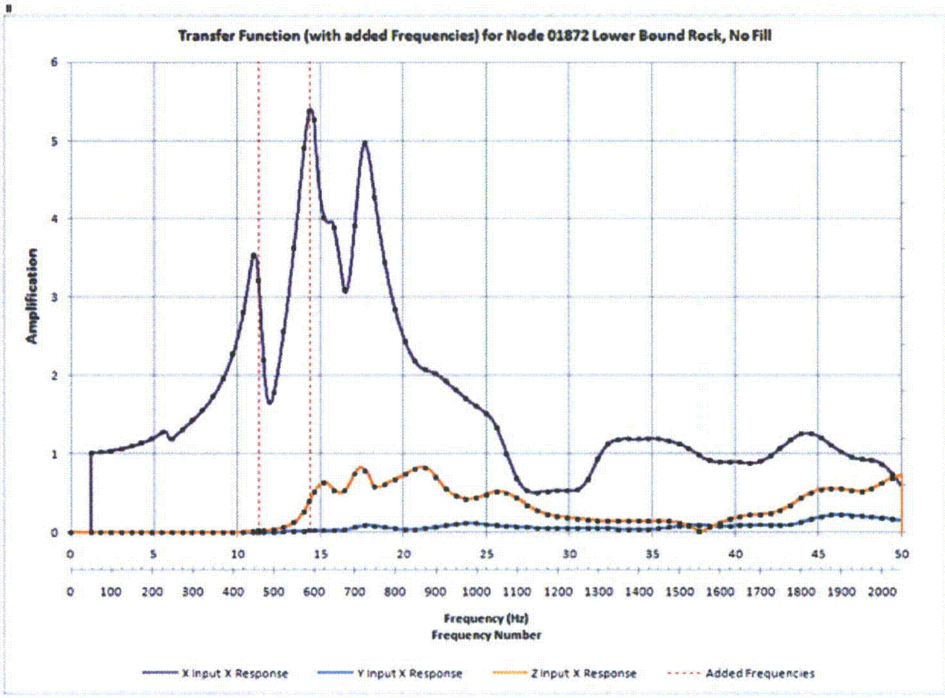


Figure 3. Computed ATF for PSFSV Structure for All Elevations in X Direction

Response Transfer Function for Node 02020 High Bound Soil, with added frequencies

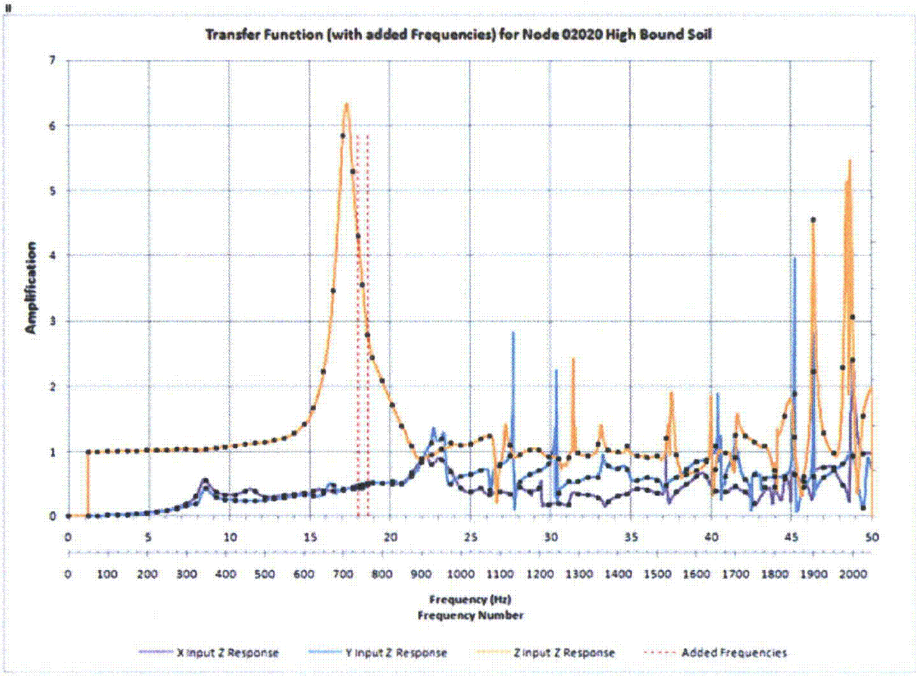


Figure 4. Computed ATF for PSFSV Structure for All Elevations in Z- Direction

Y-Response Transfer Function for Node 02672 Lower Bound Soil

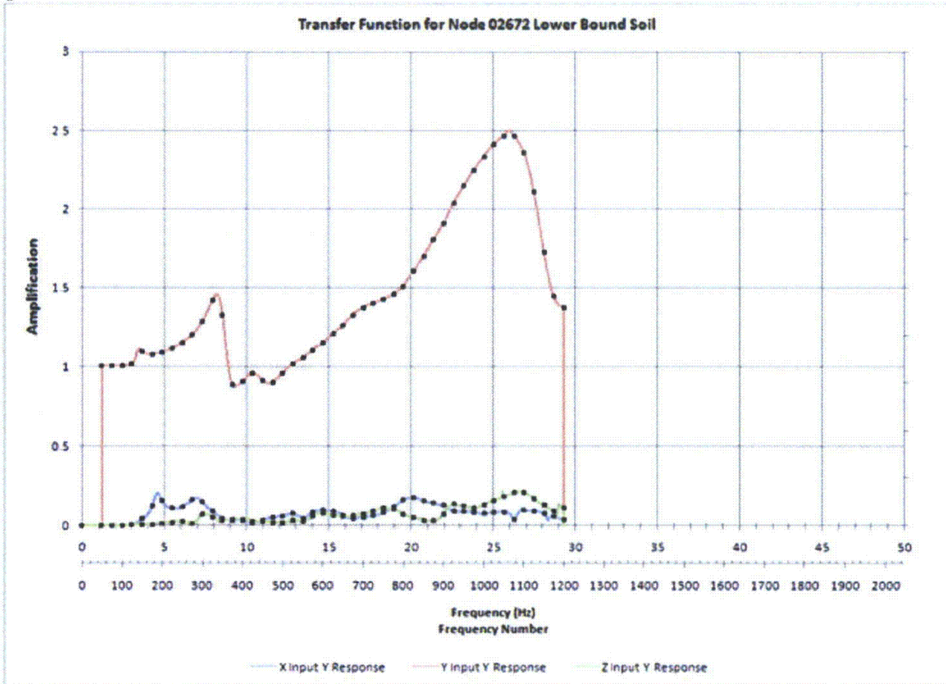


Figure 5. Computed ATF for ESWPT Structure for All Elevations in X Direction

Z-Response Transfer Function for Node 02672 Lower Bound Soil

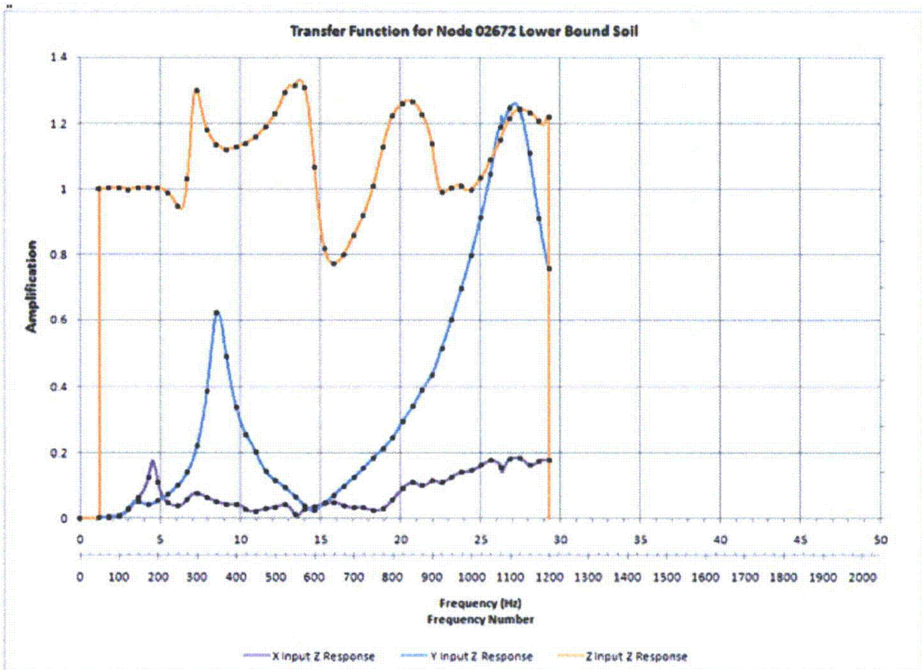


Figure 6. Computed ATF for ESWPT Structure for All Elevations in Z Direction

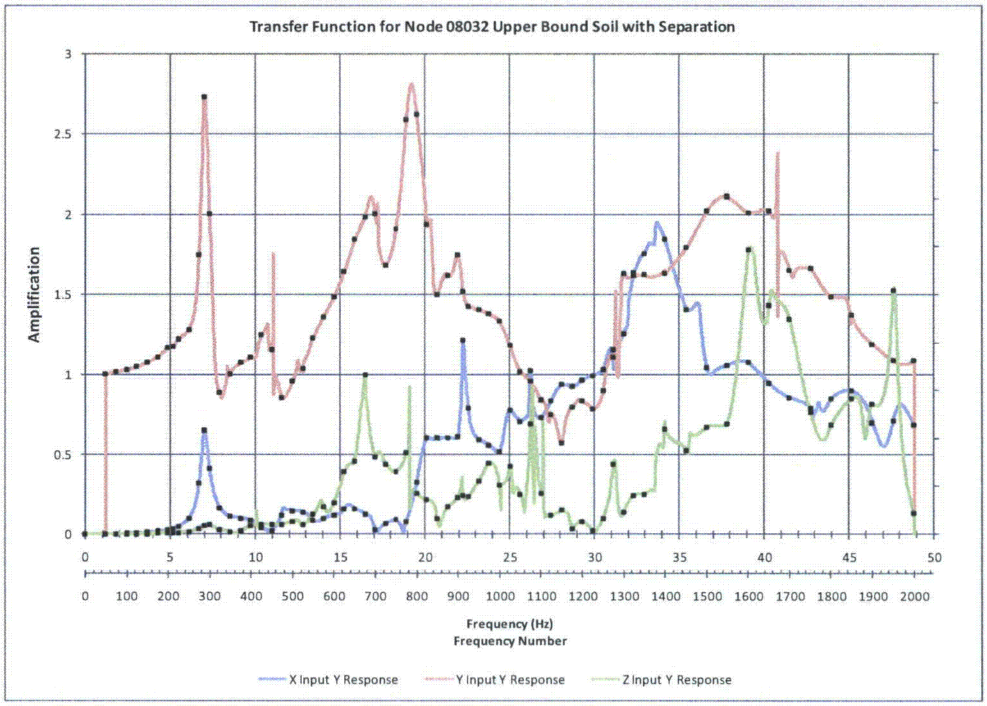


Figure 7. Transfer Function for UHSRS Basin 1 West Wall, Soil Case Upper Bound Separate Soil Case, (Node 8032) (a) X-direction Response, (b) Y-direction Response, and (c) Z-direction Response

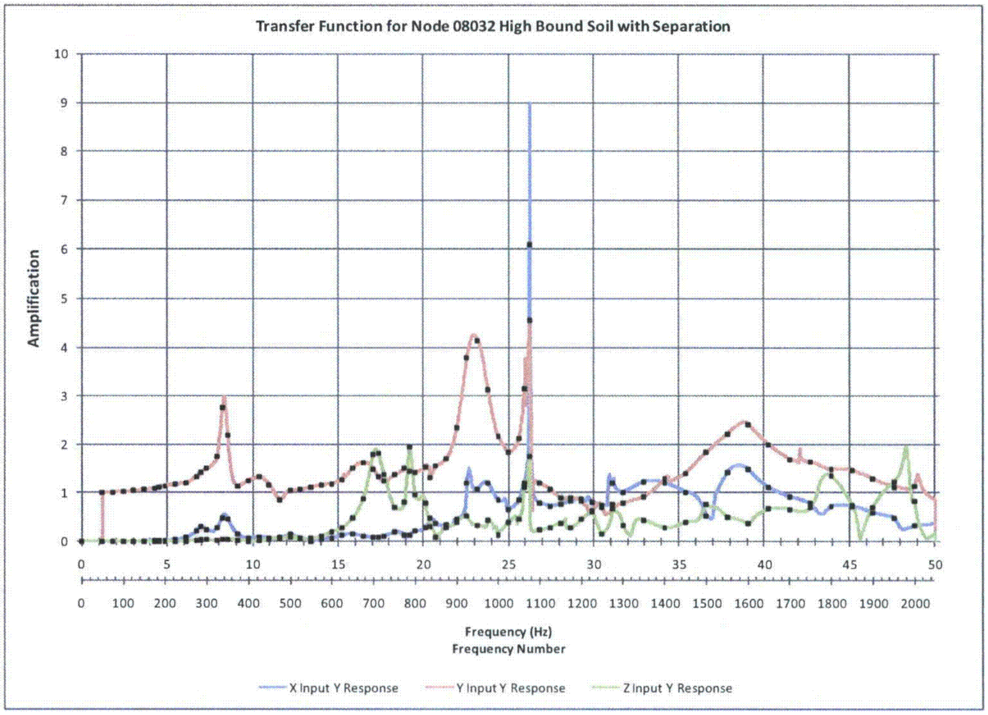


Figure 8. Transfer Function for UHSRS Basin 1 West Wall, Soil Case High Bound Separated Soil Case (Node 8032) (a) X-direction Response, (b) Y-direction Response, and (c) Z-direction Response

b) Luminant is addressing the quality assurance issues raised by the DNFSB internally through a condition report, which will be finalized concurrently with the technical assessment discussed in Item 2 above. Any future seismic analyses that may be performed in support of the Comanche Peak application will utilize the more advanced ACS SASSI NQA Version 2.3.0 (or later version), which includes the Modified Subtraction/FI-EVBN method that is much more stable in the high frequency range than Subtraction/FI-FSIN method. This method has been accepted by DNFSB and DOE to be used for future nuclear defense applications and for review of current applications that used the Subtraction method.

   The ACS SASSI NQA Version 2.3.0 documentation contains detailed guidelines and warnings on the use of the Subtraction/FI-FSIN, Modified Subtraction/FI-EVBN and Flexible Volume/FV methods to minimize the possibility for misapplication of the Subtraction method.

References

1. “Some Insights and Brief Guidance for Application of Subtraction /Flexible Interface Method to Seismic SSI Analysis of Embedded Nuclear Facilities,” GPTech Technical Investigation Report, GPT-TIR-01-0930-2010, September 30, 2010

2. Ghiocel, D.M., Short, S. and Hardy, G.”Seismic Motion Incoherency Effects for Nuclear Complex Structures On Different Soil Site Conditions,” OECD NEA Seismic SSI Workhop in Ottawa, October 6-8, 2010

3. The DOE Team Report with Case Studies on the Subtraction Method, presented at the DNFSB meeting, Washington D.C., January 19, 2011

4. “ACS SASSI Application to Linear and Nonlinear Seismic SSI Analysis of Nuclear Structures Subjected to Coherent and Incoherent Inputs,” 3-Day Seminar Handouts, North Marriot Convention Center, Bethesda, MD, January 25-27, 2011

5. Ghiocel, D.M.,“Flexible Volume (FV, Direct) vs. Flexible Interface (FI-FSIN/Subtraction, FI-EVBN): A Series of Case Studies,” Briefing Presentation for DNFSB, Washington D.C., March 30, 2011

Impact on R-COLA

None.

Impact on S-COLA

None; this response is site-specific.

Impact on DCD

None.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 5798 (CP RAI #221)

SRP SECTION: 03.07.02 - Seismic System Analysis

QUESTIONS for Structural Engineering Branch 1 (AP1000/EPR Projects) (SEB1)

DATE OF RAI ISSUE: 6/3/2011

QUESTION NO.: 03.07.02-22

On May 12, 2011, Mitsubishi Heavy Industries, Ltd. (MHI), submitted a revised completion plan for US-APWR Seismic and Structural Analyses (ML11136A235). This plan identifies that significant changes are being made to the seismic design methodology as described in the US-APWR DCD, Section 3.7, and associated technical reports. The plan also identifies the documentation MHI plans to submit or make available for audit to address US-APWR standard plant seismic design issues. The NRC staff requests the applicant provide an assessment of all changes made (or to be made) to the Comanche Peak COL seismic design given MHI's planned changes to the US-APWR standard plant seismic design methodology.

Provide a technical methodology and approach for reconciliation of the Comanche Peak standard plant model with the updated USAPWR soil-structure interaction (SSI) model and overall seismic design approach. Also, explain changes or variances (if any) to the site-specific structures given the changes in the seismic design methodology, as some of the principles were applied to the non-standard plant structures.

ANSWER:

The US-APWR standard plant seismic design envelopes by a very large margin the site-specific seismic demands at Comanche Peak Units 3 and 4, as documented in FSAR Section 3.7.1 and Appendix 3NN. The updated methodology used in the standard plant SSI analyses is basically the same as that used in the existing site-specific analyses of the standard plant. For example, the updated methodology for the US-APWR standard plant SSI models, which includes ACS SASSI models on layered soil profiles with OBE damping applied to uncracked models, is the same as that applied in the existing site-specific analyses of the standard plant. Although some changes in the seismic design methodology will produce standard plant seismic demand results that are numerically different from previous standard plant analyses, the large envelope margin for Units 3 and 4 is not anticipated to be changed. For this reason, Luminant does not plan to rerun the site-specific SSI analyses of the standard plant.

Luminant makes the following commitments to assess changes in the standard plant seismic design:

- Identify subsections of the COL application, in particular FSAR Chapter 3 and related Appendices, which need to be updated to show new standard plant structures' configuration changes and numerical results (such as ISRS). This assessment will be submitted to the NRC by the end of October 2011.
- Review the seismic design and identify updates to the COLA for any new analyses specifically required as a result of the updated standard plant methodology (e.g. evaluation for selection, if necessary based on seismic stability evaluations, of a standard plant shear key design option). This assessment will be submitted to the NRC by the end of December 2011.
- Perform final confirmatory reviews of the seismic design. Provide a detailed mark-up of the COLA where changes to standard plant configuration or numerical results occur (such as FSAR Appendix 3NN) in an update tracking report (UTR) by the end of February 2012.

Methods applied in the standard plant seismic design are intended to provide a design that is suitable for a broad range of hypothetical site and seismic conditions that do not necessarily apply to Comanche Peak Units 3 and 4. Attributes and inputs used for the seismic design of site-specific structures are those specific to the site. For example, OBE damping is used in the seismic analyses. Analyzed soil conditions at Comanche Peak are limited to a relatively narrow range specific to the site, and not the broader range presented in the US-APWR standard plant design. The evaluation and use of structural properties such as cracked versus uncracked stiffnesses is based on best estimates using the site-specific seismic input motion. Because changes in the standard plant design are being implemented with respect to generic seismic design conditions, Luminant does not plan to alter the site-specific structure designs, which have been performed in accordance with applicable provisions in the SRPs and RGs and other industry and NRC guidance.

An assessment of any potential changes to be made to the Comanche Peak COLA seismic design for site-specific structures will be documented subsequent to MHI's completion of the planned changes to the US-APWR standard plant seismic design methodology.

Luminant makes the following commitments to assess potential change impacts on the site-specific structures' design due to changes in standard plant design methodology:

- Identify subsections of the COLA, in particular FSAR Chapter 3 and related Appendices, which may be impacted by changes in standard plant design methodology. This assessment will be submitted to the NRC by the end of October 2011.
- Perform final confirmatory reviews of the seismic design, review and update the COLA if required, including detailed mark-ups of any needed changes, which will be included in a UTR by the end of February 2012.

The above completion dates are based on the current DCD analyses schedule.

<u>Impact on R-COLA</u>

None.

<u>Impact on S-COLA</u>

None; this response is site-specific.

<u>Impact on DCD</u>

None.