PMComanchePeakPEm Resource

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Sent: Monday, August 22, 2011 2:29 PM
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Cc: ComanchePeakCOL Resource; Galvin, Dennis
Subject: Comanche Peak RCOL Chapter 3 section 3.7.2 - RAI Number 226
Attachments: RAI 5947 (RAI 226).docx

The NRC staff has identified that additional information is needed to continue its review of the combined license application. The NRC staff's request for additional information (RAI) is contained in the attachment. Luminant is requested to inform the NRC staff if a conference call is needed.

The response to this RAI is due within 35 calendar days of August 22, 2011.

Note: The NRC staff requests that the RAI response include any proposed changes to the FSAR.

thanks,

Stephen Monarque
U. S. Nuclear Regulatory Commission
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Request for Additional Information (RAI) No. 5947, COLA, Revision 2

RAI Letter Number 226

8/22/2011

Comanche Peak Units 3 and 4
Luminant Generation Company, LLC.
Docket No. 52-034 and 52-035
SRP Section: 03.07.02 - Seismic System Analysis
Application Section: FSAR 3.7.2

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

03.07.02-23

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

03.07.02-***
This is a follow-up question to RAI Letter Number 60 (2879) Question 03.07.02-16

This request for additional information (RAI) is necessary for the staff to determine if the application meets the requirements of 10 CFR Part 50, Appendix A, General Design Criteria 2; 10 CFR Part 50 Appendix S; and 10 CFR Part 100. This information is also important for the staff to determine if the application conforms with the guidance in NUREG-0800, 'Standard Review Plan for the Review of Safety Analysis for Nuclear Power Plants,' Chapter 3.7.2, 'Seismic System Analysis.'

After reviewing the response to RAI Letter Number 60 (2879) Question 03.07.02-16, the staff has the following questions regarding the material in Appendices 3KK through 3NN of the FSAR:

Appendix 3KK-UHSRS

1. The response to item 1 states that there are 16 convective modes below 0.7 Hz, but Part 4 of the response states that the SASSI analysis frequencies were selected to cover the range from 1 Hz up to the cutoff frequency. The staff requests that the applicant clarify whether the convective effects were included in the SASSI analysis. The applicant is also requested to clarify how the convective effects were included in the SSI evaluation of the UHSRS.

2. Four of the six cutoff frequencies shown in the response to item 2 are less than the 50 Hz value recommended in ISG-01. The applicant is requested to provide justification for using the lower cutoff frequencies and should state if the models are adequately refined to transmit frequencies up to 50 Hz. If the models are not sufficiently refined to transmit frequencies up to 50 Hz, the applicant is requested to provide justification for using the models with lower cutoff frequencies.

3. Some of the transfer functions in Figures 1 through 12 contain sharp peaks, and some of the peaks occur at frequencies that do not align with the SASSI analysis frequencies. It appears that some of the peaks may be spurious and could be due to interpolation errors, or errors caused by use of the SASSI subtraction

method. The applicant is requested investigate the cause of these very narrow banded peaks and provide justification to the staff that the peaks are real and not spurious. Examples are the peaks at 7 Hz in Figure 1, the peak at 35.5 Hz in Figure 2, the peak at 25 Hz in Figure 3, the peak at 26 Hz in Figure 8, and the peaks at 12.5, 21, and 48 Hz in Figure 12. For all peaks that are determined to be real, the applicant should add analysis frequencies that correspond to the peak response frequencies.

4. In the response to item 4, the applicant stated that frequencies were added to the SASSI analysis as needed to produce smooth interpolation of the transfer functions to accurately capture peaks, and additional frequencies were added to observe that the results did not change. The addition of analysis frequencies to capture peaks does not appear to be reflected in Figures 1 through 12. The applicant is requested to update any analysis frequencies as required and provide such information to the staff for review and update Figures 1 through 12 on your response.

5. Table 4 indicates that the maximum passing frequencies for numerous soil layers are less than 50 Hz, which is the frequency recommended in ISG-01 for SSI and structural models. The applicant is requested to provide justification for its position that the use of lower passing frequencies in the soil leads to accurate or conservative results for the SSI analysis.

Appendix 3LL-ESWPT

6. Several of the cutoff frequencies shown in the response to item 2 are less than the 50 Hz value recommended in ISG-01. The applicant is requested to provide justification for using the lower cutoff frequencies and should state if the models are adequately refined to transmit frequencies up to 50 Hz. If the models are not sufficiently refined to transmit frequencies up to 50 Hz, the applicant should provide justification for using the referenced models.

7. Tables 12, 13, and 14 indicate that the maximum passing frequencies for numerous soil layers are less than 50 Hz, which is the frequency recommended in ISG-01 for SSI and structural models. The applicant should provide justification that the use of lower passing frequencies in the soil leads to accurate or conservative results for the SSI analysis.

8. In the response to item 10, the applicant mentions the examination of transfer functions to verify that interpolations were reasonable and also mentions comparisons between transfer functions, spectra, accelerations, and soil pressures for the various soil profiles. The applicant is requested to provide comparisons of the interpolated and uninterpolated transfer functions to the staff for review and to state the acceptance criteria for the transfer functions. The applicant is also requested to provide the comparisons of transfer functions, spectra, accelerations, and soil pressures for the various soil profiles to the staff for review.

Appendix 3MM-PSFSV

9. Several of the cutoff frequencies shown in the response to item 2 are less than the 50 Hz value recommended in ISG-01. The applicant is requested to provide justification for using the lower cutoff frequencies and should state if the models

are adequately refined to transmit frequencies up to 50 Hz. If the models are not sufficiently refined to transmit frequencies up to 50 Hz, the applicant is requested to provide justification for using the referenced models.

10. Tables 18 indicates that the maximum passing frequencies for numerous soil layers are less than 50 Hz, which is the frequency recommended in ISG-01 for SSI and structural models. The applicant is requested to provide justification that the use of lower passing frequencies in the soil leads to accurate or conservative results for the SSI analysis.

Appendix 3NN-PSFSV – PCCV-CIS, and R/B on Common Basemat

11. The DCD applicant has committed to replacing the lumped mass SSI model of the R/B complex with a more detailed three-dimensional finite element model. In this context, the applicant is requested to clarify if the model descriptions and results contained in Appendix 3NN of the FSAR and in Calculations SSI-12-05-100-003, 4DS-CP34-20080048 and any other calculations that are based on the lumped mass stick model of the R/B complex are obsolete. If the model descriptions and results are obsolete, the applicant is requested to provide a roadmap for updating the calculations. If the model descriptions and results are not obsolete, the applicant is requested to provide the technical basis and justification for using lumped mass stick models when the DCD applicant is using more detailed SSI models.

12. Some of the transfer functions in Appendices A, B, and C of SSI-12-05-100-003 contain sharp peaks, and some of the peaks occur at frequencies that do not align with the SASSI analysis frequencies. It appears that some of the peaks may be spurious and could be due to interpolation errors, or errors caused by use of the SASSI subtraction method. The applicant is requested investigate the cause of these very narrow banded peaks and provide justification to the staff that the peaks are real and not spurious. Examples are the peaks at 7 Hz in Figure A.2 of Calculation SSI-12-05-100-003, Rev. C, the peak at 4.8 Hz in Figure A.14 of Calculation SSI-12-05-100-003, Rev. C, the peak at 7 Hz in Figure B.29 of Calculation SSI-12-05-100-003, Rev. B, the peak at 9 Hz in Figure B.38 of Calculation SSI-12-05-100-003, Rev. B, the peak at 7.8 Hz in Figure C.5 of Calculation SSI-12-05-100-003, Rev. B, and the peak at 11 Hz in Calculation SSI-12-05-100-003, Rev. B. Numerous other examples exist. For all peaks that are determined to be real, the applicant is requested to add analysis frequencies that correspond to the peak response frequencies, or otherwise provide a basis and justification for the correctness of the results.

13. Based on the response to item 6, the staff understands that maximum passing frequencies in the soil profiles are less than 50 Hz, which is the frequency recommended in ISG-01 for SSI and structural models. The applicant is requested to provide justification that the use of lower passing frequencies in the soil leads to accurate or conservative results for the SSI analysis.

14. In the response to item 7, the applicant has stated that the lower boundary used in the SASSI model is approximately 1.75 times the effective building diameter below the building foundation. The applicant is requested to provide the technical basis and justification including parametric studies for the selection of the location of the lower boundary in the SSI model.

15. In the response to item 10, the applicant makes reference to direct integration time history analysis using ANSYS that was used to benchmark the SASSI model of the R/B complex. The staff is unaware of any ANSYS models that used direct integration time history analyses and thus requests clarification of this statement. If the statement is correct, the applicant is requested to provide details on the origin and documentation of the models, including the type of damping employed in the models.

03.07.02-24

This question is a follow-up to RAI Letter Number 60 (2879), Question 03.07.02-11.

This request for additional information (RAI) is necessary for the staff to determine if the application meets the requirements of 10 CFR Part 50, Appendix A, General Design Criteria 2; 10 CFR Part 50 Appendix S; and 10 CFR Part 100. This information is also important for the staff to determine whether the application conforms with the guidance in NUREG-0800, 'Standard Review Plan for the Review of Safety Analysis for Nuclear Power Plants,' Chapter 3.7.2, 'Seismic System Analysis.'

After reviewing the response to RAI 60-2879 Question 03.07.02-11, the staff has the following questions regarding the material in Appendices 3KK through 3NN of the FSAR:

1. The input motions or spectra used in the evaluation of the UHSRS in Appendix 3KK are never shown or defined. The applicant is requested to show plots of the input spectra used for the SSI analyses.

2. On the top of p. 3KK-3 it is stated that it is not required to model the convective mass. In the third paragraph on p 3KK-4, the applicant states that the response spectrum analysis includes sloshing effects and uses 0.5% damping for the simulation of sloshing effects. The applicant is requested to explain how the sloshing effects are included in the analysis if the convective mass is not modeled.

3. The first sentence on p. 3KK-5 states that the spectra used for this approach were confirmed to be higher than the enveloped base spectra calculated from the SASSI analysis. The applicant is requested to provide the comparison between the referenced spectra and the SASSI spectra.

4. In p. 3KK-5, the applicant states that the response spectrum model of the UHSRS considered a flexible base slab configuration where the slab was supported using soil springs calculated using ASCE 4 methodology. The applicant is requested to provide details of this model configuration including details of the spring calculation.

5. The second paragraph of Section 3KK.3 states that the soil pressures used for design are conservative relative to the soil pressure distributions predicted by SASSI. The applicant is requested to provide the soil pressure comparisons to the staff.

6. The applicant is requested to provide the specific location and node numbers of all nodes used for the generation of ISRS that are shown in Appendices 3KK through 3NN.

7. The input motion used in the analyses of the ESWPT segments are never shown or defined in Appendix 3LL. The applicant is requested to provide the seismic input for staff review. The applicant is also requested to explain Note 3 to Table 3LL-7 and discuss how the input for the response spectrum to segment 2 relates to the site-specific input at the foundation level of the R/B complex.

8. According to Note 3 of Table 3LL-7, ESWPT segment 2 is evaluated using a response spectrum analysis in ANSYS. The applicant should describe the configuration of that segment that was used for the modal analysis supporting the response spectrum evaluation.

9. Section 3LL.3 states that Table 3LL-4 shows frequencies and descriptions of modal responses obtained from the fixed-base ANSYS analysis of ESWPT segment 1. The applicant is requested to describe the configuration of the fixed-base model of segment 1 of the ESWPT, which is a buried structure.

10. The applicant is requested to clarify whether the results in shown in Tables 3LL-9, 3LL-10, and 3LL-11 are ANSYS output or SASSI output and to label the tables accordingly.

11. The staff notes that on p. 3LL-1, the applicant mentions the "…dynamic analysis of the SASSI 3D model in the frequency domain…". In contrast, on p. 3LL-3 the applicant refers to "nodal accelerations obtained from the time history analysis ", when evidently referring to results from the SASSI models. The applicant is requested to clarify the above statements and to use clear and consistent terminology when referring to a software program or analysis methodology in all places in the FSAR. Other examples appear in the second sentence of Subsection 3MM.3 and in Subsection 3NN.1 of Appendix 3MM of Revision 1 of the FSAR.

12. The applicant is requested to explain how the bearing pressures in Table 3LL-13 were developed and also to describe how the seismic wall pressures were developed and applied in the static evaluations of ESWPT segments 1 and 3.

13. The staff requests that the applicant provide a complete description of the development and application of the accelerations and dynamic soil pressures applied to segment 3 of the ESWPT per note 4 of Table 3LL-8.

14. In the first paragraph of Subsection 3MM.1 of Appendix 3MM of Revision 1 of the FSAR, the applicant states that "Further, the translation of the model from ANSYS to SASSI is confirmed by comparing the results from the modal analysis of the fixed base structure in ANSYS and the SASSI analysis of the model resting on a half-space with high stiffness. The close correlation between the SASSI transfer function results and the ANSYS eigenvalues results ensures the accuracy of the translation." The applicant is requested to provide these comparisons to the staff for review.

15. On p. 3MM-2 of Appendix 3MM of Revision 1 of the FSAR, the applicant states that “The natural frequencies and descriptions of the associated modal responses of the fixed-base model are presented in Table 3MM-3 for the PSFSV and these frequencies are compared to structural frequencies calculated from the transfer functions of the SASSI model.” The staff is unable to find any such comparisons in Appendix 3MM and it is not clear to the staff which ANSYS model (fine or coarse mesh) was used for calculating the modal responses. The applicant is requested to clarify which model was used and to present the referenced comparisons to the staff for review.

16. In Subsection 3MM.3 of Appendix 3MM of Revision 1 of the FSAR, the applicant states that the maximum displacements of the PSFSV are summarized in Table 3MM-7. The applicant is requested to clarify if theses displacements are absolute displacements, or maximum relative displacements within the structure.

17. In Appendices 3KK through 3NN of Revision 1 of the FSAR, it is stated that the site-specific SASSI analyses are conducted using methods and approaches consistent with ASCE 4. The applicant is requested to specifically identify which methods and approaches from ASCE 4 are incorporated in the SASSI analyses and how these methods are the same as or differ from guidance provided in the SRP.

18. The site-specific SSI analysis of the R/B-PCCV-CIS is based on lumped-mass stick models. The SSI analysis of the R/B-PCCV-CIS for the DC Standard Plant was originally based on lumped-mass stick models, but the Standard Plant applicant has since committed to performing the SSI analysis with a detailed three-dimensional distributed-mass model of the R/B-PCCV-CIS. The applicant is requested to state how their approach to the site-specific SSI analysis of the R/B-PCCV-CIS is affected, if at all, by the commitment of the DCD applicant to use distributed mass models.

19. In Subsection 3NN.3 of Appendix 3NN of Revision 1 of the FSAR, the applicant states that “The geometry and properties of the lumped-mass-stick model representing the above ground portion of the building are identical to those of the lumped mass stick model used for the R/B-PCCV-containment internal structure seismic analysis, as addressed in Appendix 3H.” The applicant also refers to Appendix 3H on the bottom of p. 3NN-4 and in the last sentence of Subsection 3NN.3. Appendix 3H describes an uncoupled model of the R/B-PCCV-CIS, and that uncoupled model was later superseded by a coupled model that was documented in subsequent technical reports by MHI. The applicant is requested to describe their strategy for incorporating the results from the subsequent technical reports supporting the DCD into the FSAR.

20. In Appendices 3KK, 3LL, and 3MM, the applicant evaluated the potential for separation of backfill from the embedded portion of the structures. In contrast, the SSI evaluation of the R/B-PCCV-CIS that is documented in Appendix 3NN appears not to have considered the potential for backfill separation per the Acceptance Criteria guidelines in SRP 3.7.2.II.4. The applicant is requested to explain why the potential for backfill separation was not considered in the SSI analysis of the R/B-PCCV-CIS.

03.07.02-25

This question is a follow-up to RAI Letter Number 60 (2789), Question 03.07.02-2.

In the response to RAI 3.7.2-2, the applicant stated the following: “Two site response analyses were performed for each of the four profiles using the two horizontal acceleration time histories compatible to the horizontal spectra of the input design ground motion. The input design ground motion matches the Regulatory Guide 1.60 minimum spectra anchored to 0.1g peak acceleration and envelopes the site-specific FIRS spectra.”

The above statement is inconsistent with the statement in CP COL 3.7(6) of the FSAR which states that “The FIRS are compared to the minimum design earthquake which is defined as the certified seismic design response spectra (CSDRS) scaled to a 0.1 g peak ground acceleration (PGA).” The statement is inconsistent because on p. 3.7-3 of DCD (R3), it is stated that the CSDRS are derived from the RG 1.60 spectra by modifying the control points to broaden the spectra in the higher frequency range. That is, the CSDRS and RG 1.60 spectra are not the same.

Please explain the inconsistencies described above and correct the information in the RAI response to reflect the spectra used as input motion for soil-structure interaction analysis in Appendix 3NN.