PMComanchePeakPEm Resource

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Cc: ComanchePeakCOL Resource; Ward, William
Subject: Comanche Peak RCOL- Section 3.7.2 - RAI # 60
Attachments: RAI 2879 (RAI 60).doc

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.

The response to this RAI is due within 42 calendar days of September 15, 2009**.**

Note: If changes are needed to the safety analysis report, the NRC staff requests that the RAI response include the proposed wording change

thanks,

Stephen Monarque
U. S. Nuclear Regulatory Commission
NRO/DNRL/NMIP
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Request for Additional Information (RAI) No. 2879

RAI # 60

9/15/2009

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: 3.7.2

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

03.07.02-1

RAI 3.7.2-1

NUREG-0800, Standard Review Plan (SRP) 3.7.2, "Seismic System Analysis," establishes the criteria the NRC staff will use to evaluate whether an applicant meets the NRC's regulations.

In order to evaluate the site response analyses supporting the Comanche Peak Nuclear Power Plant combined license application (COLA), the NRC staff needs the following detailed information for both the site-independent and site-specific analyses:

1. The name and revision of the software used for the site response analysis.
2. The elevation at which the control motions are defined.
3. The response spectra corresponding to the control motions.
4. The low-strain and strain-compatible free-field properties including the shear moduli, the unit weights, the damping ratios, and the layer thicknesses for the soil column for all cases considered.
5. The cut-off frequencies used in the analyses.
6. The soil column natural frequencies determined from the site response analyses.
7. The free-field amplification spectra from the site response analyses at critical elevations in the soil columns.
8. The strain levels in the soil columns.

03.07.02-2

RAI 3.7.2-2

NUREG-0800, Standard Review Plan (SRP) 3.7.2, "Seismic System Analysis," establishes the criteria the NRC staff will use to evaluate whether an applicant meets the NRC's regulations.

In appendix 3NN (page 3NN-2) of the COLA, Luminant states that the soil-structure interaction (SSI) analyses uses input stiffness and damping properties of the backfill that are compatible to the strains generated by the design input motion and that these properties are obtained from site response analysis using time histories that are applied as outcrop motion on the surface of the rock subgrade.

In order for the NRC staff to evaluate the suitability of the soil column properties and seismic input, describe in detail how the strain-compatible backfill properties are generated. At a minimum, the description should include the program used, the output options specified (within versus outcrop motion), the soil column configuration used for each site response analysis, and the soil properties used for each of the site response analyses used to support the computer model SASSI analyses listed in Section 3NN.4.

03.07.02-3

RAI 3.7.2-3

In Appendix 3NN (page 3NN-3) of the COLA, Luminant states that the site response analyses converts the design motion that is defined as outcrop motion to within-layer motion that depends on the properties of the overlying backfill above the rock surface. In order for the NRC staff to evaluate the suitability of the seismic input, describe in detail how the conversion from outcrop motion to within motion was performed. At a minimum, the description should include the program used, the output options specified (within versus outcrop motion), the soil column used to generate each spectrum, and the soil properties used to generate each spectrum.

Also, given that SSI analyses use input stiffness and damping properties of the backfill that are compatible to the strains generated by the design input motion, address whether the above process leads to whole column within motion being used as input to the SASSI model.

03.07.02-4

RAI 3.7.2-4

NUREG-0800, Standard Review Plan (SRP) 3.7.2, "Seismic System Analysis," establishes the criteria the NRC staff will use to evaluate whether an applicant meets the NRC's regulations**.**

In Appendix 3NN, Figure 3NN-1 shows that in the upper 200 ft of the limestone, the maximum and minimum shear wave speeds for each profile differ by more than a factor of two. This suggests that the soil site may not be uniform for the purposes of performing frequency-independent impedance function SSI analysis.

Provide the technical basis and justification for the assumption of a uniform soil site that was used in the SSI analysis of the standard plane facilities and estimate the error that may have been introduced through the use of this assumption.

03.07.02-5

RAI 3.7.2-5

It is stated in Section 3.7.2.4.1 of the COLA that the dynamic properties of the rock subgrade at Comanche Peak Nuclear Power Plant (CPNPP), Units 3 and 4 are considered to be strain independent because the mean shear wave velocity of the top 400 ft of the subgrade below the SC-I and SC-2 structures is greater than 3,500 ft/s. Typically, the value of 3,500 ft/s is used as guidance for developing a lower boundary in an SSI model. In contrast, the shear wave velocity assigned to “generic rock” per Regulatory Guide 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," is the much higher value of 9,200 ft/s.

In order for the NRC staff to evaluate the impact of treating the subgrade material as strain independent, quantify the effects of this assumption on critical response parameters in the SSI analyses.

03.07.02-6

RAI 3.7.2-6

It is stated in Section 2.4.1 of Technical Report MUAP-08002 (R0), '*Enhanced Information for PS/B Design'*, which is listed as Ref. 3.7-33 of the US-APWR design certification document (DCD), that site-specific SSI analysis will be performed to validate the site-independent SSI analysis and the assumptions used for the standard plant design. According to FSAR Table 3.7.2-1R of the CPNPP COLA, a model SASSI analysis of the SC-I PS/Bs has not been performed.

Explain how the assumptions used for the standard plant design and frequency-independent impedance function SSI analysis documented in Ref. 3.7-33 of the US-APWR DCD are validated in the absence of a site-specific SSI analysis.

03.07.02-7

RAI 3.7.2-7

Section 3.7.2.4.1 of the CPNPP COLA states that the top of the water table is no higher than elevation 780 ft for the purposes of seismic analysis. According to FSAR Section 3.7.2 of the CPNPP COLA, the top of the limestone layer is at elevation 782 ft. This implies that the water table is at least 2 ft below plant grade, which is inconsistent with US-APWR DCD Tier 1, FSAR Table 2.1-1, where the maximum water table is shown as 1 ft below grade. Provide clarification for the apparent inconsistency between the COLA and DCD Sections.

03.07.02-8

RAI 3.7.2-8

In response to combined license information COL 3.7(23), Luminant stated, in FSAR Section 3.7.2.4.1 of the COLA, that the results of Appendix 3NN demonstrate that the soil pressures on the reactor building (R/B) lateral walls and basemat are enveloped by the US-APWR standard design. This conclusion appears to be based on a comparison of in-structure response spectra (ISRS) from the standard plant R/B model to the ISRS of the site-specific SASSI R/B model as shown in Appendix 3NN. The standard plant R/B SSI model is a surface-founded model with seismic input represented by the certified seismic design response spectra (CSDRS). The site-specific R/B SSI model is SASSI model with partial embedment with the seismic input represented by the minimum required response spectra, which are defined by the shape of the CSDRS anchored at 0.1*g*.

In order for the NRC staff to evaluate the statement regarding soil pressures on the lateral walls and basemat of the R/B, the following information should be provided:

1. A quantitative evaluation of how much of the difference in the ISRS between the standard plant SSI model and the site-specific SSI model is due to the difference in seismic input, and how much is due to the presence of embedment in the site-specific model.
2. A more thorough explanation of how conclusions regarding soil pressures along the lateral walls and basemat are drawn given that the standard plant SSI model is founded on the surface of the soil.

03.07.02-9

RAI 3.7.2-9

In response to COL 3.7(23), Luminant stated, in FSAR Section 3.7.2.4.1 of the COLA, that the range of subgrade properties considered in the auxiliary building (A/B) and turbine building (T/B) SSI lumped parameter models envelope site-specific variations related to subgrade stratigraphy and foundation flexibility.

Explain specifically what is meant by saying that the lumped parameter models "envelope" site-specific variations in these parameters. What variables or parameters are compared to draw this conclusion? Also, provide a demonstration that the response of a series of uniform soil columns with a range of subgrade properties "envelopes" the critical responses of non-uniform site-specific soil column profiles.

03.07.02-10

RAI 3.7.2-10

In response to COL 3.7(23), Luminant, in Section 3.7.2.4.1 of the COLA, stated because the embedment effects are neglected in the site-independent SSI analyses of the A/B and T/B, this yields conservative results that envelope the site specific responses.

In order for the NRC staff to evaluate the SSI analyses of the A/B and T/B, explain specifically what is meant by saying that the results of the site-independent SSI analyses envelope site specific responses. Describe what variables or parameters are compared to draw this conclusion and explain the basis for this conclusion given that site-specific SSI analyses of the A/B and T/B are not reported in the COLA.

03.07.02-11

RAI 3.7.2-11

NUREG-0800, Standard Review Plan (SRP) 3.7.2, "Seismic System Analysis," establishes the criteria the NRC staff will use to evaluate whether an applicant meets the NRC's regulations.

In order for the NRC staff to evaluate the structural analyses of the ultimate heat sink related structures (UHSRS), essential service water pipe tunnel (ESWPT), power source fuel storage vault (PSFSV), and R/B-pre-stressed concrete containment vessel (PCCV)-containment internal structure (CIS), describe the roles of ANSYS and SASSI models in each of the analyses described in COLA, FSAR Appendices 3KK, 3LL, 3MM, and 3NN. In each case, at a minimum, the description should include the type of analysis (e.g. static, response spectrum, frequency domain SSI), the input and output for each code, and how the results of the two codes are integrated in the analysis. Separate descriptions should be provided for each of the analyses documented in Appendices 3KK, 3LL, 3MM, and 3NN.

03.07.02-12

RAI 3.7.2-12

NUREG-0800, Standard Review Plan (SRP) 3.7.2, "Seismic System Analysis," establishes the criteria the NRC staff will use to evaluate whether an applicant meets the NRC's regulations.

In order for the NRC staff to evaluate the methodology used in the SSI analysis of the ESWPT, describe how the results in COLA FSAR Tables 3LL-6, 3LL-7, and 3LL-8 were developed and how they were used in the analysis. The description should include a clarification of note 1 to Table 3LL-6, note 3 of Table 3LL-7, and note 4 of Table 3LL-8.

03.07.02-13

RAI 3.7.2-13

NUREG-0800, Standard Review Plan (SRP) 3.7.2, "Seismic System Analysis," establishes the criteria the NRC staff will use to evaluate whether an applicant meets the NRC's regulations.

In order for the NRC staff to evaluate the methodology used in the SSI analysis of the ESWPT, describe in detail how the results in COLA FSAR Tables 3LL-9, 3LL-10, 3LL-11, 3LL-12, and 3LL-13 were developed and how they are used in the analysis. The description should include whether the results were output from SASSI or ANSYS and if the results were used as input to either SASSI or ANSYS. The description should also include the loads, load combinations, and load distributions used for the structural evaluation and technical justification for why the selected loading leads to conservative results.

03.07.02-14

RAI 3.7.2-14

In order for the NRC staff to evaluate the methodology used in the SSI analysis of the PSFSVs, describe in detail how the results in COLA FSAR Tables 3MM-6 (appendix 3MM) were developed and how they are used in the analysis. The description should include whether the results were output from SASSI or ANSYS and if the results were used as input to either SASSI or ANSYS. The description should also include the loads, load combinations, and load distributions used for the structural evaluation and technical justification for why the selected loading leads to conservative results.

03.07.02-15

RAI 3.7.2-15

FSAR Sections 3KK.4 and 3LL.4 of the COLA, Appendices 3KK and 3LL respectively, reference American Society of Civil Engineers (ASCE) 4-98 for justification of ISRS peak clipping. The NRC staff has not reviewed or endorsed ASCE 4-98 for generation of ISRS and this standard is currently being revised. Provide technical justification for spectral peak clipping recognizing that peak clipping is not discussed in RG 1.122, "Development of Floor Design Response Spectra for Seismic Design of Floor-Supported Equipment or Components" (February 1978) or in SRP 3.7.2.

03.07.02-16

RAI 3.7.2-16

NUREG-0800, Standard Review Plan (SRP) 3.7.2, "Seismic System Analysis," establishes the criteria the NRC staff will use to evaluate whether an applicant meets the NRC's regulations.

In order to evaluate the site-specific SSI analyses reported in COLA FSAR Appendices 3KK, 3LL, 3MM, and 3NN, the NRC staff requests the following detailed information:

1. The natural frequencies of each of the structures in the fixed base condition.
2. The cutoff frequencies for each analysis.
3. The SASSI analysis frequencies used for each of the cases considered.
4. The basis for the selection of the SASSI analysis frequencies.
5. A comparison of transfer functions at critical locations to the selected analysis frequencies to determine the appropriateness of the frequency selection.

6. The soil layer thicknesses used in the SASSI analyses, and a demonstration that the layer thicknesses comply with the maximum layer thicknesses given by the "1/5 wavelength" guideline for SASSI analyses in each of the soil cases considered.
7. The location of the lower boundary used in the SASSI analyses.
8. The lower boundary condition used for the SASSI analyses.
9. A description of critical locations in the various structures under seismic loading.
10. A description of the benchmarking that was performed to validate the results of the SASSI models.