PMNorthAnna3COLPEmails Resource

From: Patel, Chandu
Sent: Thursday, June 05, 2014 3:40 PM
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Cc: PMNorthAnna3COLPEmails Resource; Weisman, Robert; Carpentier, Marcia; Chakravorty, Manas; Xu, Jim; Buckberg, Perry
Subject: RAI Letter 121, RAI 7520, FSAR Section 3.7.1, North Anna 3 COLA (52-017)
Attachments: RAI Letter 121 RAI_7520.docx

By letter dated November 26, 2007, Dominion Virginia Power (Dominion) submitted a Combined License Application for North Anna, Unit 3, pursuant to Title 10 of the *Code of Regulations,* Part 52. The U.S. Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this COLA.

The NRC staff has identified that additional information is needed to continue portions of the review and a Request for Additional Information (RAI), is enclosed. To support the review schedule, Dominion is requested to respond within 30 days of the date of this request. If the RAI response involves changes to the application documentation, Dominion is requested to include the associated revised documentation with the response.

Sincerely,
Chandu Patel
Lead Project Manager for NA3 COLA

Hearing Identifier: NorthAnna3_Public_EX
Email Number: 1171

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Request for Additional Information 121

Issue Date: 06/05/2014
Application Title: North Anna, Unit 3 - Docket Number 52-017
Operating Company: Dominion
Docket No. 52-017
Review Section: 03.07.01 - Seismic Design Parameters
Application Section: 03.07.01

QUESTIONS

03.07.01-7

FSAR Section 3.7.1.1.4.2 indicates that the Foundation Input Response Spectra (FIRS) and associated Performance Based Surface Response Spectra (PBSRS) for all Seismic Category I structures are presented in FSAR Section 2.5.2.6. It is also noted that the full and partial soil/rock columns used in the site response analyses described in FSAR Sections 2.5.2.5 and 2.5.2.6 consider only the effect of in situ saprolite soil above Zone III rock. Further, FSAR Section 3.7.1.1.4 indicates that this in situ soil material will be removed and replaced with granular fill or concrete fill as appropriate. However, FSAR Sections 2.5.2.5 and 2.5.2.6 do not provide the information on whether and how the effect of backfill material was considered in developing the FIRS and PBSRS. Because the FIRS are used as the input to the soil-structure interaction (SSI) analyses for the Category I structures, the development of the FIRS to consider structure specific soil properties is essential to the adequate seismic design as required by 10CFR50 Appendix S. Therefore, the staff requests that the applicant provide the technical basis for computing FIRS and PBSRS which only considers soil/rock columns with in-situ saprolite and not the granular or concrete fill that will be surrounding or beneath the Seismic Category I structures up to the finished grade elevation.

03.07.01-8

FSAR 3.7.1.1.4.1 indicates that best estimate (BE), lower bound (LB), and upper bound (UB) soil/rock profiles are calculated so that they are strain-consistent with the FIRS ground motions, for each Seismic Category I structure. Because the strain-consistent soil profiles are important to the SSI analysis for determining the seismic demands for the design, the staff requests that the applicant describe the methodology used to interpolate/combine the strain compatible profiles from the results of the probabilistic site response analyses provided in FSAR Section 2.5.2, which are performed separately for full and partial soil/rock columns, high frequency (HF) and low frequency (LF) events, and 10^{-4} and 10^{-5} hazard levels; explain how this methodology ensures that the strain levels represented by the BE, LB and UB profiles are indeed consistent with the FIRS ground motions.

In addition, FSAR 3.7.1.1.4.1 indicates that “companion” strain-compatible profiles were developed for the RB/FB, CB, and FWSC, considering the granular fill and concrete fill instead of the in situ saprolite. These “companion” profiles are provided in FSAR Tables 3.7.1-202, 204, and 206 for the RB/FB, CB, and FWSC respectively. This FSAR section does not describe how these companion profiles are used in the subsequent SSI analysis. To ensure the adequacy of appropriate profiles in the the site-specific SSI analysis, the applicant is requested to address the following:

(a) Explain how these companion profiles are used in the site-specific SSI analysis

(b) Provide a description of how these “companion” Vs, Vp, and damping profiles were developed.

(c) Since FSAR 3.7.1.1.4.1 states that “randomized structural fill and concrete fill properties” were used in the development of the “companion” profiles, clarify whether all the probabilistic site response analyses described in FSAR Section 2.5.2 were repeated for full and partial soil/rock columns with granular fill and concrete fill.

Furthermore, the staff identified that FSAR Section 3.7.1.1.4.1 contains technically ambiguous information affecting the staff’s evaluation. Therefore, the staff requires the applicant to provide clarifications for the following:

(d) On FSAR page 3-6, the expression $(V_S)_{FIRS}/\sqrt{1.5}$ is used to develop the lower bound and upper bound shear wave velocity profiles where the notation $(V_S)_{FIRS}$ is not defined. Confirm that the notation $(V_S)_{FIRS}$ refers to the shear wave velocity of the best estimate (BE) profile;

(e) On FSAR page 3-7 (top paragraph) it is stated that: “For soil layers below water table, a minimum shear wave velocity of 4800 ft/sec is maintained and, as needed, the Poisson’s ratio is adjusted to obtain the minimum P-wave velocity.” However, the SSI input properties in the FSAR Tables 3.7.1-201 through 206 do not include the elevation of the water table assumed. Because the elevation of the water table is an important parameter in developing the SSI input properties used in the SSI analysis, the staff requests that the applicant provide this information and its technical basis. Also clarify whether the minimum value of 4800 ft/s refers in fact to the P-wave velocity, not the shear wave velocity.

03.07.01-9

FSAR 3.7.1.1.4.1 indicates that Vp profiles were developed using FSAR Equation 3.7.1.1-3, on the basis of the strain-iterated Vs profiles and Poisson's ratio values provided in FSAR Section 2.5.4. However, FSAR Table 2.5.4-208 provides two sets of Poisson's ratio (high strain and low strain) for the subsurface materials. No specific value of the Poisson’s ratio used in developing Vp profile is provided in this FSAR section. Because the Poisson’s ratio is an important parameter in developing the SSI input properties used in the SSI analysis, the staff requests that the applicant provide the numerical values of Poisson's ratio assumed in the development of the Vp profiles in FSAR Tables 3.7.1-201 through 206, and their technical justification. The applicant is also requested to identify the soil/rock material assumed for each layer in FSAR Tables 3.7.1-201 through 206. The staff needs this information to determine that the soil properties used in the SSI analysis are properly established.

03.07.01-10

DC/COL-ISG-017 provides guidance on ensuring hazard-consistent seismic input for SSI analysis. FSAR 3.7.1.1.4.2 indicates that the “NEI check” is performed for the RB/FB and CB to ensure that the guidance of ISG-17 is met with regards to the adequacy of the input motion for embedded SSI analyses. This FSAR section further indicates that the NEI check is conducted by convolving the full column and partial column outcrop FIRS from the bottom of basemat elevation to the surface. The convolution is done through deterministic best estimate (BE), lower bound (LB), and upper bound (UB) profiles with no further degradation, and the resulting envelope of the surface response spectra is compared to the PBSRS. Regarding the NEI check for the RB/FB and CB, the staff needs additional clarifications as follows:

(a) Explain whether the NEI check for the partial column outcrop FIRS is performed using the full column BE, LB, and UB profiles, with “surface” defined at the finished grade elevation.

(b) Explain why the envelopes of the surface response spectra for the full column outcrop FIRS (e.g., FSAR Figures 3.7.1-210 and 211) have substantially higher amplitudes than the corresponding envelopes for the partial column outcrop FIRS (e.g., FSAR Figure 3.7.1-214 and 215).

(c) Explain why the PBSRS shown in FSAR Figures 3.7.1-212 and 213 are different from those shown in FSAR Figures 3.7.1-216 and 217.

(d) Explain whether the BE, LB, and UB profiles used in the NEI check correspond to profiles with in situ saprolite (FSAR Tables 3.7.1-201 and 203) or profiles with granular fill (FSAR Tables 3.7.1-202 and 204). Provide the technical justification for either case.

03.07.01-11

FSAR 3.7.1.1.4.2 indicates that the NEI check is not applicable to the development of SSI input response spectra for the FWSC because this structure is analyzed as a surface structure. However, FSAR Section 3.7.2 indicates that the concrete fill below the FWSC basemat is represented as an integral part of the structural model used in the SSI analysis (FSAR Figure 3.7.2-209-b). As such, the model for the concrete fill and the superstructure should be treated as an embedded structure and the SSI input motion should be specified at the bottom of the concrete fill. Therefore, the NEI check should be performed to ensure that the PBSRS is enveloped by the SSI input motion when convolved to the ground surface.The applicant is requested to provide the following information:

(a) Provide the technical justification for defining the control motions used in the SSI analysis at the bottom of the basemat and not at the bottom of the concrete fill. Staff notes that, from the point of view of the SSI analysis, the combined FWSC-concrete fill is an embedded structure and as such, the control motions for SSI analysis should be defined at the bottom of the concrete fill to be consistent with the NEI approach. The NEI check should be applicable in this case.

(b) Explain why the FWSC SSI input response spectra shown in FSAR Figure 3.7.1-234 differs substantially from the SSI input response spectra for the CB shown in FSAR Figure 3.7.1-231, both in amplitude (lower) and in frequency content (shift to lower frequencies), even though the FWSC is situated at a higher elevation and is supported on similarly stiff material.

03.07.01-12

FSAR Section 3.7.1.1.5 describes the development of design ground motion time histories using Option 1, Approach 2 of SRP 3.7.1 acceptance criteria II.1.B.ii for all Seismic Category I structures and full and partial column cases. Because the adequacy of the time histories is important in establishing the structural seismic demands for the design, the staff requests that the applicant provide the following information regarding these time histories:

(a) Provide numerical results of the spectral matching checks specified in SRP 3.7.1 acceptance criteria II.1.B.ii (Option 1, Approach 2), items (a) through (d). In FSAR Figures 3.7.1-235 through 240, under predictions were observed below about 0.2 Hz. Discuss; (1) whether any safety related SSCs fall in that frequency range and (2) if any such conditions exist provide justification of this under prediction.
(b) Provide power spectral density (PSD) functions of the time histories and discuss whether there are any significant dips in the PSDs that could be associated with gaps in frequency content.
(c) In some spectral matching procedures additional corrections are applied to the velocity and displacement time histories, which are not reflected in the acceleration time history. As a result, the three ground motion histories (acceleration, velocity, and displacement) contain slightly different information, or they are not fully compatible with one another. It is unclear from your submittal at which step corrections were applied. To demonstrate that the generated time histories acceleration, velocity, and displacement are compatible please describe your process in applying corrections between the three time histories, and how you ensured that the baseline drift did not negatively affect the results of spectral matching procedure.