Staff Feedback on KHNP Responses to RAI Question 3.7.1-3

In letter MKD/NW-16-0779L, dated August 3, 2016

1 RAI Question 3.7.1-3

The response to Part (a) compares the results from the applicant's method (M1), which uses an equivalent strong motion duration and the Fourier transform of the entire time histories, and the results from another method using a strong motion defined based on a 5% to 75% of cumulative Arias intensity rise $T_{5\text{-}75}$ (M2). This comparison concludes that from 2 Hz to 50 Hz, M1 and M2 led to similar results; however from 0.2 Hz to 2 Hz, M2 led to large dips in power spectra and response spectra as compared to M1, as shown in Figures 19 through 24 of this RAI response. The applicant indicates that this occurs "because the truncation of the full-duration time histories to a shorter-duration time histories affects the long period (low-frequency) motion contents and amplitudes." However, the third method (M3) in the RAI response suggests that the differently-truncated time histories that are not based on the same $T_{5\text{-}75}$ windows, do no show these large dips in their PSD estimates, as shown in Figures 30, 33, and 36. Therefore, truncation of the full-duration time histories is not the cause for the large dips, and the reasoning as quoted above does not appear to be correct. Furthermore, the justification of M1 using M2, which led to large dips in the power spectra, thus appears to be inadequate. The staff finds that M3 is consistent with SRP 3.7.1 Revision 4, Appendix B guidance. Therefore, the staff request the applicant to provide a comparison of the PSD estimates using M1 and those using M3 in order to justify the validity of M1. In addition, the applicant is requested to propose DCD changes to include these comparisons to support Figures 3.7-9 through 3.7-11, and include a description of M1 and the associated technical justification in DCD Tier 2 Section 3.7.1.1.2.

The RAI response on page 3 states that the SRP 3.7.1, Revision 4 references NUREG/CR4357, Appendix A. This is not correct because SRP 3.7.1, Revision 4 actually references Appendix B of NUREG/CR-5347. The staff request the applicant to correct this when updating the RAI response.

KHNP INPUT

The justification for estimating PSD, related description, and figures are described in Revised response to RAI 182-8160, Question No. 03.07.01-3.

The response to Part (b) presents PSD assessment in Figures 37-48, which uses method M3 and is consistent with the SRP 3.7.1 Rev. 4, Appendix B guidance. Since Figures 3.7-20 through 3.7-22 of the DCD is based on M1, the applicant is requested to provide in the DCD comparisons of these figures to Figures 42, 45, and 48 of this RAI response in order to technically justify the validity of M1. Similar to Part (a), the associated description in DCD Section 3.7.1.1.3 referencing Figures 3.7-20 through 3.7-22 should be updated to reflect the technical justification of M1.

KHNP INPUT

The related description, and figures are described in Revised response to RAI 182-8160, Question No. 03.07.01-3.

In addition, Equation 3-3a of this RAI response, as well as a very similar equation used in the RAI Response to Part (a) do not appear to be correct. The derivation in Equation 3-3a does not make sense mathematically. The calculated values for T_S do not in general equal to $T_{100} - T_0$ (neglecting superscript i for clarity). Using the CSDRS-EW time history as an example (see Figure 10), T_5= 4 s, T_{75}=12.8 s, so T_s = (12.8 – 4) / 0.7 = 12.6 s; however, T_{100} - T_0 = 20.48 s.

KHNP INPUT

The Staff interpretation of the definition of "$T_{100} - T_0$" (neglecting superscript) is not consistent with the intent. The intent of "$T^i_{100} - T^i_0$" in Equation 3-3a is the "equivalent stationary duration for normalized accumulated energy from 0% to 100% but maintaining the slope of the normalized accumulated energy from 5% to 75%". Thus, for the example of CSDRS-EW time history, the "$T^i_{100} - T^i_0$" in Equation 3-3a is T^i_{100} - T^i_0 = 16.267 – 3.139 = 13.128 s = (T^i_{100} - T^i_0)/(75% -5%) = (12.985 – 3.795) / 0.7 = 9.19/0.7 = 13.128 s. The calculation in the RAI response, namely, T_s = (12.8 – 4) / 0.7 = 12.6 s was not numerically approximate and, therefore, was not numerically quite accurate. The accurate calculation as indicated in Figure 3-35 of Technical Report APR1400-E-S-NR-14001-P, Rev. 0 (see attached page) should be T_s = (12.985 – 3.795) / 0.7 = 13.128 s, not the entire duration of 20.48s.