RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**366-8406**
SRP Section:	**02.05.02 – Vibratory Ground Motion**
Application Section:	**2.5.2**
Date of RAI Issue:	**01/13/2016**

Question No. 02.05.02-5

The response to RAI 137-8102, Question 02.05.02-4, proposes modifications to the requirements of a COL applicant that is siting an APR1400 on a soil site. The staff requests that the applicant address the following staff concerns:

1. The proposed DCD modifications require that the (COL) best estimate (BE) shear wave velocity profile be consistent with one of the generic soil profiles (S1-S9); however, the response does not require that the upper bound (UB) and lower bound (LB) profiles also be consistent with one of the generic soil profiles (S1-S9). Because the site-specific structural responses can be governed by propagating the input motion (FIRS) through all three strain-compatible profiles (BE, LB and UB), the LB and UB profiles should also be consistent with the generic profiles to ensure that the DC responses bound the site-specific responses and consequently the DC is adequate for that site.

   Additionally, for soil sites (shear wave velocity less than 8000 ft/s) that the above conditions cannot be established, site- specific SSI analyses should be performed to establish that the DC structural responses bound the site-specific structural responses (member forces and ISRS) at key locations (further guidance is provided in ISG-01).

2. In Section 2.5.2.6 and COL Information item 2.5(2), the low strain shear wave velocity of at least 1000 ft/s should only be imposed up to the structural foundation elevation (not at finished grade).

3. The DCD defines the LB and UB profiles only in terms of G_{max} without referencing any of the other parameters used to describe these profiles. Please provide an appropriate reference to SRP Section 3.7.2 for the definition of the UB and LB profiles.

4. For sites where the FIRS exceed the CSDRS, site-specific seismic response analyses should be performed to establish that the DC structural responses bound the site-specific structural responses.

In accordance with Appendix S to 10 CFR Part 50, regarding APR1400 DCD Section 2.5.2.6, please propose modifications to the APR1400 DCD, where applicable, to provide adequate requirements for a COL applicant to use when determining if the COL site soil profile is consistent with the APR1400 generic soil profiles, as detailed in (1) - (4) above. In addition to DCD modification in Section 2.5.2.6, if applicable, propose changes in Section 3.7, where necessary, including COL information item(s), as appropriate.

Response

1. To ensure that the DC responses bound the site-specific responses, the DCD Tier 2, Subsection 2.5.2.6, 2.5.6 and Table 1.8-2 will be modified as follows:

   (i) the requirement for the site-specific weight densities of subsurface soils is to be no less than 2,002.3 kg/m^3 (125 lb/ft^3); (ii) the profiles of site-specific soil properties are generally increasing with depth from the ground surface in a manner similar to the general profile shapes shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11; (iii) the site-specific soil profiles have no inverse condition, i.e., the soil properties of a deeper soil layer are less than the properties of the soil layer above it; and (iv) the site-specific best estimate (BE), lower bound (LB), and upper bound (UB) strain-compatible soil shear wave velocity profiles, including backfill, are consistent with one of the APR1400 generic site conditions S1 through S9 considered for the standard design as shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11. The lower bound and upper bound shear wave velocity profiles are obtained, as defined in SRP Section 3.7.2 (Reference 8), from the mean properties plus or minus one standard deviation, maintaining the minimum variation of $1.5G_{BE}$ for the upper bound range and $G_{BE}/1.5$ for the lower bound range, where G_{BE} denotes the best estimate low-strain shear modulus. The lower bound low-strain shear wave velocity for the site-specific soil profile is not to be less than 304.8 m/s (1,000 ft/s) up to the structural foundation elevation

   In the DCD Tier 2, Subsection 2.5.2.6, it is stated that, for soil sites that the above conditions are not satisfied, a site-specific seismic analysis is performed to generate in-structure response spectra at key locations. To clarify the structural responses bound condition, DCD Tier 2, Subsection 2.5.2.6, item e and the corresponding COL items (COL 2.5(5) and 2.5(6)) will be modified.

2. To impose the location of the minimum low strain shear wave velocity requirement of 1000 ft/s, DCD Tier 2, Subsection 2.5.2.6, 2.5.6 and Table 1.8-2 will be revised as follows:

   a. For a site with a low-strain shear wave velocity greater than 304.8 m/s (1,000 ft/s) up to the structural foundation elevation, the site-specific GMRS at the finished grade are completely enveloped by the APR1400 CSDRS shown in Figures 3.7-1 and 3.7-2.

3. DCD Tier 2, Subsection 2.5.2.6, 2.5.6 and Table 1.8-2 will be revised referencing the other parameters used (refer to the response 1).

4. In the DCD Tier 2, Subsection 2.5.2.6, item e, it is stated that for sites where the FIRS exceed the CSDRS, site-specific seismic analyses are performed. To clarify the structural responses bound condition, DCD Tier 2, Subsection 2.5.2.6, item e and the corresponding COL items (COL 2.5(5) and 2.5(6)) will be modified.

Impact on DCD

DCD Tier 2, Subsections 2.5.2.6, 2.5.6, 2.5.7, and Table 1.8-2 will be revised as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical and Environmental Report.

(i) the requirement for the site-specific weight densities of subsurface soils is to be no less than 2,002.3 kg/m^3 (125 lb/ft^3) ~~and the site-specific strain-compatible soil hysteresis damping ratio profile is to be equal to or less than that shown in Table 3.7A-1~~; (ii) the profiles of site-specific soil properties ~~(weight density, strain-compatible soil shear and compression wave velocity, and strain-compatible soil hysteresis damping ratio)~~ are generally increasing with depth from the ground surface in a manner similar to the general profile shapes shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11; (iii) the site-specific soil profiles have no inverse condition, i.e., the soil properties of a deeper soil layer are less than the properties of the soil layer above it; and (iv) the site-specific best estimate (BE), lower bound (LB), and upper bound (UB) strain-compatible soil shear wave velocity profiles, including backfill, ~~is~~are consistent with one of the APR1400 generic site conditions S1 through S9 considered for the standard design as shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11. ~~The site-specific upper bound and lower bound low-strain shear wave velocity profiles are to be bounded by the APR1400 generic low-strain shear wave velocity profiles S1 through S9 considered for the standard design.~~ The lower bound and upper bound shear wave velocity profiles ~~correspond to the G_{max}/1.5 and 1.5G_{max} of the site-specific low-strain soil shear modulus profile where G_{max} is the low-strain maximum shear modulus.~~ are obtained, as defined in SRP Section 3.7.2 (Reference 8), from the mean properties plus or minus one standard deviation, maintaining the minimum variation of 1.5G_{BE} for the upper bound range and G_{BE}/1.5 for the lower bound range, where G_{BE} denotes the best estimate low-strain shear modulus. The lower bound low-strain shear wave velocity for the site-specific soil profile is not to be less than 304.8 m/s (1,000 ft/s) up to the structural foundation elevation

In addition, according to the NRC DC/COL-ISG-017 (Reference 5), the FIRS of the nuclear island are completely enveloped by the GSDRS-compatible free-field

~~(i) the requirement for the site-specific weight densities of subsurface soils is to be no less than 2002.3 kg/m^3 (125 lb/ft^3) and the site-specific strain-compatible soil hysteresis damping ratio profile is to be less than shown in Table 3.7A-1, (ii) the site-specific soil properties (weight density, strain-compatible soil shear and compression wave velocity, and strain-compatible soil hysteresis damping ratio) have their profiles generally increasing with depth from the ground surface in a manner similar to the general profile shapes shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11, (iii) the site-specific soil profiles have no inverse condition, i.e., the soil properties of a deeper soil layer are less than the properties of the soil layer above it, and (iv) the site-specific soil profiles are bounded by the soil profiles of the generic site conditions S1 through S9 considered for the standard design as shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11~~

c. For soil sites, ~~the lower bound of the site-specific strain-compatible soil profile is greater than the lower bound of the generic strain-compatible soil profiles used in the APR1400 seismic analyses shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11~~ (COL 2.5(3)).

d. ~~For a site with a low-strain shear wave velocity of supporting medium for the nuclear island higher than 1,494 m/s (4,900 ft/s) overlaying a hard rock with a low-strain shear wave velocity greater than 2,804 m/s (9,200 ft/s), the site-specific GMRS determined at the finished grade are completely enveloped by the APR1400 HRHF response spectra shown in Figures 3.7-12 and 3.7-13 (COL 2.5(4)).~~

e. If the requirements a, b, and c listed above are not satisfied, a site-specific seismic

For a HRHF site, the site-specific profile needs to be consistent with generic soil profile S9. The site-specific GMRS determined at the finished grade are completely enveloped by the APR1400 HRHF response spectra shown in Figures 3.7-12 and 3.7-13 (COL 2.5(4)). In addition, according to the NRC DC/COL-ISG-017 (Reference 5), the FIRS of the seismic Category I structures are completely enveloped by the HRHF-compatible free-field response motions at the bottom elevation of each seismic Category I structure.

seismic Category I structures are

than 304.8 m/s (1,000 ft/s), the submaterials are completely excavated to expose competent material with a low-strain shear wave velocity equal to or greater than 304.8 m/s (1,000 ft/s), and the GMRS are defined as a free-field motion on the hypothetical outcrop after the excavation. For a site where the ~~nuclear island is~~ located on hard rock with a shear wave velocity greater than 2,804 m/s (9,200 ft/s), the site-specific GMRS can be defined at the foundation level. For this case, GMRS could be referred to as foundation input response spectra (FIRS) for the seismic Category I structures. The site-specific GMRS need to be transferred to the foundation elevations of each seismic Category I structure to obtain FIRS of each seismic Category I structure. The COL applicant is to confirm that the site meets the following requirements:

up to the structural foundation elevation

a. For a site with a low-strain shear wave velocity greater than 304.8 m/s (1,000 ft/s) ~~at the finished grade in the free field~~, the site-specific GMRS at the finished grade are completely enveloped by the APR1400 CSDRS shown in Figures 3.7-1 and 3.7-2. In addition, according to the NRC DC/COL-ISG-017 (Reference 5), the FIRS of ~~the nuclear island~~ are completely enveloped by the CSDRS-compatible free-field response motions at the bottom elevation of ~~the nuclear island~~ shown in Figures 3.7A-12 through 3.7A-14 (COL 2.5(2)).

each seismic Category I structure

each seismic Category I structure

b. For hard rock sites with a low-strain shear wave velocity of supporting medium for ~~the nuclear island~~ greater than 2,804 m/sec (9,200 ft/s), FIRS of ~~the nuclear island~~ are completely enveloped by the CSDRS (COL 2.5(2)).

each seismic Category I structure

c. For soil sites, the lower bound of the site-specific strain-compatible soil profile is greater than the lower bound of the generic strain-compatible soil profiles used in the APR1400 seismic analyses shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11 (COL 2.5(3)).

d. For a site with a low-strain shear wave velocity of supporting medium for the nuclear island higher than 1,494 m/s (4,900 ft/s) overlaying a hard rock with a low-strain shear wave velocity greater than 2,804 m/s (9,200 ft/s), the site-specific GMRS determined at the finished grade are completely enveloped by the APR1400 HRHF response spectra shown in Figures 3.7-12 and 3.7-13 (COL 2.5(4)).

develop

e. If the requirements a, b, and c listed above are not satisfied, a site-specific seismic analysis is performed to ~~generate~~ in-structure response spectra at key locations using the procedure described in Appendix 3.7A. The site-specific in-structure

The site-specific strain-compatible properties are to be consistent with the assumptions used in the SSI analyses including embedment and extent of backfill, as described in Appendix 3.7A.

developed

response spectra ~~generated~~ are compared with the corresponding in-structure response spectra provided in Appendix 3.7A ~~(COL 2.5(5))~~. In addition, if the ~~site-specific GMRS determined at the finished grade are not enveloped by the HRHF response spectra~~, site-specific seismic response analyses are performed using the procedure described in Appendix 3.7B and in the EPRI White Paper, "Seismic Screening of Components Sensitive to High Frequency Vibratory Motions" (Reference 6) (COL 2.5(6)).

If the site-specific in-structure response spectra are not enveloped by the corresponding CSDRS-based in-structure response spectra, site-specific member forces are calculated and compared with CSDRS-based member forces at key locations to determine whether further site-specific seismic design is required (COL 2.5(5)).

item d above is not satisfied

2.5.2.7 Soil Uniformity

The APR1400 is designed for appl

have extreme variation within the standard plant structure footprint. The subsurface may consist of layers that dip with respect to the horizontal. If the dip is less than 20 degrees, the generic analysis using horizontal layers is applicable as described in NUREG/CR-0693 (Reference 7). The physical properties of the foundation medium may or may not vary systematically across a horizontal plane. The methodology for checking uniformity is to calculate from the boring logs a series of "best-estimate" planes beneath the standard plant structure footprint that define the top and bottom of each soil or rock layer. These planes should represent and delineate stratigraphic boundaries, lithologic changes, and unconformities, but most important, they should represent boundaries between layers having different shear wave velocities. Shear wave velocity is the primary property used for defining uniformity of a site.

The distribution of bearing reactions under the basemat is a function of the subgrade modulus, which in turn is a function of the shear wave velocity and soil profile. Site-specific data should be provided to evaluate the variation of subgrade modulus or shear wave velocity across the footprint and to demonstrate the site is within the range considered for design of the standard plant structure basemat. The deeper that the non-uniform layer is located below the foundation, the less influence it has on the bearing pressures at the basemat.

. Further structural integrity (including member forces) and functionality evaluations are also required for a HRHF site if the site specific in-structure response spectra exceed the HRHF-based in-structure response spectra

The COL applicant i

standard plant structure footprint based on the geologic investigation in accordance with NRC RG 1.132 (COL 2.5(7)). Subsurface conditions may be considered uniform if the geologic and stratigraphic features can be correlated from one boring or sounding location to the next with relatively smooth variations in thicknesses or properties of the geologic units. An occasional anomaly or a limited number of unexpected lateral variations may

2.5.4.12 Techniques to Improve Subsurface Conditions

If necessary to improve subsurface conditions, the plans, summaries of specifications, and methods of quality control are described in the site-specific information.

(i) the requirement for the site-specific weight densities of subsurface soils is to be no less than 2,002.3 kg/m^3 (125 lb/ft^3) ~~and the site-specific strain-compatible soil hysteresis damping ratio profile is to be equal to or less than that shown in Table 3.7A-1~~; (ii) the profiles of site-specific soil properties ~~(weight density, strain-compatible soil shear and compression wave velocity, and strain-compatible soil hysteresis damping ratio)~~ are generally increasing with depth from the ground surface in a manner similar to the general profile shapes shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11; (iii) the site-specific soil profiles have no inverse condition, i.e., the soil properties of a deeper soil layer are less than the properties of the soil layer above it; and (iv) the site-specific best estimate (BE), lower bound (LB), and upper bound (UB) strain-compatible soil shear wave velocity profiles, including backfill, ~~is~~are consistent with one of the APR1400 generic site conditions S1 through S9 considered for the standard design as shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11. ~~The site-specific upper bound and lower bound low-strain shear wave velocity profiles are to be bounded by the APR1400 generic low-strain shear wave velocity profiles S1 through S9 considered for the standard design.~~ The lower bound and upper bound shear wave velocity profiles ~~correspond to the G_{max}/1.5 and 1.5G_{max} of the site-specific low-strain soil shear modulus profile where G_{max} is the low-strain maximum shear modulus.~~ are obtained, as defined in SRP Section 3.7.2, from the mean properties plus or minus one standard deviation, maintaining the minimum variation of 1.5G_{BE} for the upper bound range and G_{BE}/1.5 for the lower bound range, where G_{BE} denotes the best estimate low-strain shear modulus. The lower bound low-strain shear wave velocity for the site-specific soil profile is not to be less than 304.8 m/s (1,000 ft/s) up to the structural foundation elevation

completely enveloped by the CSDRS-compatible free-field response motions at the bottom elevation of the nuclear island for a site with the

~~(i) the requirement for the site-specific weight densities of subsurface soils is to be no less than 2002.3 kg/m^3 (125 lb/ft^3) and the site-specific strain-compatible soil hysteresis damping ratio profile is to be less than shown in Table 3.7A-1, (ii) the site-specific soil properties (weight density, strain-compatible soil shear and compression wave velocity, and strain-compatible soil hysteresis damping ratio) have their profiles generally increasing with depth from the ground surface in a manner similar to the general profile shapes shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11, (iii) the site-specific soil profiles have no inverse condition, i.e., the soil properties of a deeper soil layer are less than the properties of the soil layer above it, and (iv) the site-specific soil profiles are bounded by the soil profiles of the generic site conditions S1 through S9 considered for the standard design as shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11~~

COL 2.5(3) The COL applicant is to confirm that ~~the lower bound of the site-specific strain-compatible soil profile for a soil site is greater than the lower bound of the generic strain-compatible soil profiles used in the APR1400 seismic analyses~~.

COL 2.5(4) ~~The COL applicant is to confirm that the site-specific GMRS determined at the finished grade are completely enveloped by the HRHF response spectra for a site with a low-strain shear wave velocity of supporting medium for the nuclear island higher than 1,494 m/s (4,900 ft/s) overlaying hard rock with a low-strain shear wave velocity greater than 2,804 m/s (9,200 ft/s).~~

The COL applicant is to confirm that the site-specific profile for a HRHF site is consistent with generic soil profile S9 and the site-specific GMRS determined at the finished grade are completely enveloped by the APR1400 HRHF response spectra shown in Figures 3.7-12 and 3.7-13. In addition, the COL applicant is to confirm that the FIRS of the seismic Category I structures are completely enveloped by the HRHF-compatible free-field response motions at the bottom elevation of each seismic Category I structure.

2.5.4.12 Techniques to Improve Subsurface Conditions

If necessary to improve subsurface conditions, the plans, summaries of specifications, and methods of quality control are described in the site-specific information.

2.5.5 Stability of Slopes

No assumptions in regard to slope stability are used in the evaluation of the APR1400 standard design.

The stability of all natural and manmade slopes, including embankments and dams, that are vital to the safety of APR1400, is included in site-specific information.

2.5.6 Combined License Information

each seismic Category I structure

COL 2.5(1) The COL applicant is to provide the site-specific information on geology, seismology, and geotechnical engineering as required in NRC RG 1.206 (Reference 1).

COL 2.5(2) The COL applicant is to confirm that the FIRS of ~~the nuclear island~~ are completely enveloped by the CSDRS-compatible free-field response motions at the bottom elevation of ~~the nuclear island~~ for a site with the low-strain shear wave velocity greater than 304.8 m/s (1,000 ft/s) ~~at the finished grade in the free field~~. Alternately, the COL applicant is to up to the structural foundation elevation at the FIRS of ~~the nuclear island~~ are completely enveloped by the CSDRS for a hard rock site with a low-strain shear wave velocity of supporting medium for ~~the nuclear island~~ greater than 2,804 m/s (9,200 ft/s).

each seismic Category I structure

COL 2.5(3) The COL applicant is to confirm that the lower bound of the site-specific strain-compatible soil profile for a soil site is greater than the lower bound of the generic strain-compatible soil profiles used in the APR1400 seismic analyses.

COL 2.5(4) The COL applicant is to confirm that the site-specific GMRS determined at the finished grade are completely enveloped by the HRHF response spectra for a site with a low-strain shear wave velocity of supporting medium for the nuclear island higher than 1,494 m/s (4,900 ft/s) overlaying hard rock with a low-strain shear wave velocity greater than 2,804 m/s (9,200 ft/s).

The COL applicant's site-specific strain-compatible properties are to be consistent with the assumptions used in the SSI analyses including embedment and extent of backfill, as described in Appendix 3.7A.

COL 2.5(5) The COL applicant is to perform a site-specific seismic analysis to ~~generate~~ develop in-structure response spectra at key locations using the procedure described in Appendix 3.7A if COL 2.5(2) and COL 2.5(3) above are not met. ~~In addition, the COL applicant is to confirm that the site-specific in-structure response spectra so generated are enveloped by the corresponding in-structure response spectra provided in Appendix 3.7A.~~ T ~~, strain-compatible properties, embedment and extent of backfill~~

COL 2.5(6) The COL applicant is to perform a site-specific seismic response analysis using the procedure described in Appendix 3.7B and the EPRI White Paper "Seismic Screening of Components Sensitive to High Frequency Vibratory Motions" (Reference 6), if COL 2.5(4) is not met.

COL 2.5(7) The COL applicant is to perform an evaluation of the subsurface conditions within the standard plant structure footprint based on the geologic investigation in accordance with NRC RG 1.132.

COL 2.5(8) The COL applicant is to confirm that the dynamic properties of SFG to be used in construction of the APR1400 seismic Category I structures satisfy the SFG requirements provided in Table 2.0-1.

If this requirement is not satisfied, the COL applicant is to calculate the site-specific member forces and compare them with CSDRS member forces at key locations to determine whether further site-specific seismic design is required.

1. Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, June 2007.

2. Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants," Rev. 2, U.S. Nuclear Regulatory Commission, October 2003.

3. Regulatory Guide 1.138, "Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants," Rev. 2, U.S. Nuclear Regulatory Commission, December 2003.

4. Regulatory Guide 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," U.S. Nuclear Regulatory Commission, March 2007.

5. NRC DC/COL-ISG-017, "Interim Staff Guidance on Ensuring Hazard-Consistent Seismic Input for Site Response and Soil Structure Interaction Analyses," U.S. Nuclear Regulatory Commission, August 2009.

The COL applicant is to develop the site specific in-structure response spectra and compare them with the corresponding HRHF-based in-structure response spectra to determine whether further structural integrity (including member forces) and functionality evaluations are required.

6. “Seismic Screening of Components Sensitive to High Frequency Vibratory Motions,” EPRI White Paper, June 2007.

7. NUREG/CR-0693, "Seismic Input and Soil-Structure Interaction," U.S. Nuclear Regulatory Commission, February 1979.

8. NUREG-0800, Standard Review Plan, Section 3.7.2, “Seismic System Analysis,” Rev. 4, U.S. Nuclear Regulatory Commission, September 2013.

Table 1.8-2 (2 of 29)

Item No.	Description
COL 2.5(1)	The COL applicant is to provide the site-specific information on geology, seismology, and geotechnical engineering as required in NRC RG 1.206.
COL 2.5(2)	The COL applicant is to confirm that the foundation input response spectra (FIRS) of the nuclear island are completely enveloped by the CSDRS-compatible free-field response motions at the bottom elevation of the nuclear island for a site with the low-strain shear wave velocity greater than 304.8 m/s (1,000 ft/s) at the finished grade in the free field. Alternately, the COL applicant is to confirm that FIRS of the nuclear island are completely enveloped by the CSDRS for a hard rock site with a low-strain shear wave velocity of supporting medium for the nuclear island greater than 2,804 m/s (9,200 ft/s).
COL 2.5(3)	The COL applicant is to confirm that ~~the lower bound of the site-specific strain-compatible soil profile for a soil site is greater than the lower bound of the generic strain-compatible soil profiles used in the APR1400 seismic analyses~~.
COL 2.5(4)	~~The COL applicant is to confirm that the site-specific GMRS determined at the finished~~ (i) the requirement for the site-specific weight densities of subsurface soils is to be no less than 2,002.3 kg/m^3 (125 lb/ft^3) and the site-specific strain-compatible soil hysteresis damping ratio profile is to be less than shown in Table 3.7A-1, (ii) the site-specific soil properties (weight density, strain-compatible soil shear and compression wave velocity, and strain-compatible soil hysteresis damping ratio) have their profiles generally increasing with depth from the ground surface in a manner similar to the general profile shapes shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11, (iii) the site-specific soil profiles have no inverse condition, i.e., the soil properties of a deeper soil layer are less than the properties of the soil layer above it, and (iv) the site-specific soil profiles are bounded by the soil profiles of the generic site conditions S1 through S9 considered for the standard design as shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11
COL 2.5(6)	The COL applicant is to perform a site-specific seismic response analysis using the procedure described in Appendix 3.7B and the EPRI White Paper, "Seismic Screening of (i) the requirement for the site-specific weight densities of subsurface soils is to be no less than 2,002.3 kg/m^3 (125 lb/ft^3) ~~and the site-specific strain-compatible soil hysteresis damping ratio profile is to be equal to or less than that shown in Table 3.7A-1~~; (ii) the profiles of site-specific soil properties ~~(weight density, strain-compatible soil shear and compression wave velocity, and strain-compatible soil hysteresis damping ratio)~~ are generally increasing with depth from the ground surface in a manner similar to the general profile shapes shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11; (iii) the site-specific soil profiles have no inverse condition, i.e., the soil properties of a deeper soil layer are less than the properties of the soil layer above it; and (iv) the site-specific best estimate (BE), lower bound (LB), and upper bound (UB) strain-compatible soil shear wave velocity profiles, including backfill, ~~is~~are consistent with one of the APR1400 generic site conditions S1 through S9 considered for the standard design as shown in Tables 3.7A-1 through 3.7A-9 and Figures 3.7A-3 through 3.7A-11. ~~The site-specific upper bound and lower bound low-strain shear wave velocity profiles are to be bounded by the APR1400 generic low-strain shear wave velocity profiles S1 through S9 considered for the standard design.~~ The lower bound and upper bound shear wave velocity profiles ~~correspond to the G_{max}/1.5 and 1.5G_{max} of the site-specific low-strain soil shear modulus profile where G_{max} is the low-strain maximum shear modulus.~~ are obtained, as defined in SRP Section 3.7.2, from the mean properties plus or minus one standard deviation, maintaining the minimum variation of 1.5G_{BE} for the upper bound range and G_{BE}/1.5 for the lower bound range, where G_{BE} denotes the best estimate low-strain shear modulus. The lower bound low-strain shear wave velocity for the site-specific soil profile is not to be less than 304.8 m/s (1,000 ft/s) up to the structural foundation elevation components not designed for the extreme wind loads do not impact either the function or integrity of adjacent seismic Category I SSCs.

Table 1.8-2 (2 of 29)

Item No.	Description
COL 2.5(1)	The COL applicant is to provide the site-specific information on geology, seismology, and geotechnical engin 06.
COL 2.5(2)	The COL applicant is to confirm that the foundation input response spectra (FIRS) of ~~the nuclear island~~ are completely enveloped by the CSDRS-compat motions at the bottom elevation of ~~the nuclear island~~ for a site with the low-strain shear wave velocity greater than 304.8 m/s (1,000 ft/s) ~~at the finished grade in the free field~~. ~~Alternatively~~, the COL applicant is to confirm that FIRS of ~~the nuclear island~~ are completely enveloped by the CSDRS for a hard rock site with a low-strain shear wave supporting medium for ~~the nuclear island~~ greater than 2,804 m/s (9,200 ft/s).
COL 2.5(3)	The COL applicant is to confirm that the site-specific profile for a HRHF site is consistent with generic soil profile S9 and the site-specific GMRS determined at the finished grade are completely enveloped by the APR1400 HRHF response spectra. In addition, the COL applicant is to confirm that the FIRS of the seismic Category I structures are completely enveloped by the HRHF-compatible free-field response motions at the bottom elevation of each seismic Category I structure.
COL 2.5(4)	~~grade are completely enveloped by the hard rock high frequency (HRHF) response spectra for a site with a low-strain shear wave velocity of supporting medium for the nuclear island higher than 1,494 m/s (4,900 ft/s) overlaying a hard rock with a low-strain shear wave velocity greater than 2,804 m/s (9,200 ft/s).~~
COL 2.5(5)	The COL applicant is to perform a site-specific seismic analysis to ~~generate~~ in-structure response spectra at key locations using the procedure described in Appendix 3.7A if COL 2.5(2) and COL 2.5(3) above are not met. ~~In addition,~~ the COL applicant is to confirm that he site-specific in-structure response spectra so generated are enveloped by the orresponding in-structure response spectra provided in Appendix 3.7A.
COL 2.5(6)	The COL applicant is to perform a site-specific seismic response analysis using the e EPRI White Paper, “Seismic Screening of bratory Motions,” if COL 2.5(4) is not met.
COL 2.5(8)	on of the subsurface conditions within the standard plant structure footprint based on the geologic investigation in accordance with ural fill granular to be isfy the requirements
COL 3.2(1)	The COL applicant is to identify the seismic classification of site-specific SSCs that should be designed to withstand the effects of the SSE.
COL 3.2(2)	The COL applicant is to identify the quality group classification of site-specific systems and components and their applicable codes and standards.
COL 3.3(1)	The COL applicant is to demonstrate that the site-specific design wind speed is bounded by the design wind speed of 64.8 m/s (145 mph).
COL 3.3(2)	The COL applicant is to demonstrate that the site-specific seismic Category II structures adjacent to the seismic Category I structures are designed to meet the provisions described in Subsection 3.3.1.2.
COL 3.3(3)	The COL applicant is to provide reasonable assurance that site-specific structures and components not designed for the extreme wind loads do not impact either the function or integrity of adjacent seismic Category I SSCs.

each seismic Category I structure

up to the structural foundation elevation

each seismic Category I structure

each seismic Category I structure

develop

~~, strain-compatible properties, embedment and extent of backfill~~

The COL applicant's site-specific strain-compatible properties are to be consistent with the assumptions used in the SSI analyses including embedment and extent of backfill, as described in Appendix 3.7A.

If this requirement is not satisfied, the COL applicant is to calculate the site-specific member forces and compare them with CSDRS member forces at key locations to determine whether further site-specific seismic design is required.

The COL applicant is to develop the site specific in-structure response spectra and compare them with the corresponding HRHF-based in-structure response spectra to determine whether further structural integrity (including member forces) and functionality evaluations are required.