

2nd 3.7/3.8 Bi-weekly Meeting dated 02/04/2016

AGENDA (proposed, not yet confirmed by the NRC)

1. RAI 252-8299, Q 03.07.02-11; KHNP is to ask clarifying questions regarding SRP 3.7.2.II.4 SSI sensitivity studies and benchmarking problems (specific questions still needed)

KHNP understands that the sensitivity studies mentioned in SRP Section 3.7.2.II.4 are relevant to demonstrate that the site-specific SSI response as computed is not sensitive to some site parameters; they are more relevant to the site-specific COL applicant.

The sensitivity studies are not necessary as long as the modeling of the SSI system satisfies established guidelines that were developed from generic studies. For example, generic studies for foundation uplift indicate that as long as the foundation contact ratio is greater than 0.8, the linear elastic SSI analysis assumption is valid and there is no need to modify the linear elastic seismic response due to foundation uplift effects.

KHNP would like to know that NRC's positions of SRP Section 3.7.2.II.4 and what kind of sensitive studies performed in design standard design.

NRC Feedback (02/02/2016):

The separation of soil from sidewalls and the use of benchmark problems still need to be addressed in response to this RAI. Regarding the separation of soil from sidewalls, we are looking for technical basis that demonstrates the adequacy of their full/perfect bond assumption between the structure and soil media throughout the entire embedment depth. For their use of benchmark problems (essentially the applicant's V & V program), while this aspect is typically confirmed in detail in audit space, the applicant should provide a summary of their V & V program in response to this RAI.

KHNP Response:

KHNP could not find an appropriate benchmark problem for the separation of soil from side walls. Thus, a sensitivity study for the separation of soil from sidewalls will be performed using ACS SASSI Nuclear Island (NI) model of APR1400. Two or three generic soil profiles which are expected to be most affected by de-bonding of the side soil will be used in the sensitivity study. For considering the separation of soil from sidewalls, the rigid springs which connect backfill nodes to structure nodes will be removed from the ACS SASSI model. The separation depth of soil from sidewalls will be determined according to the following method presented in ASCE4-98.

Method in ASCE 4-98, Subsection 3.3.1.9

To assume no connectivity between structure and lateral soil over the half of the embedment or 20 ft (6 m), whichever is less.

2. RAI 252-8299, Q 03.07.02-14; NRC is to provide feedback regarding KHNP's draft response (attached)

In the KHNP draft response, the following sub-items are discussed with the NRC staff using the draft response.

- A description of the method of seismic design and analysis applicable to these structures

Draft response: The seismic analysis procedure, including soil-structure interaction analysis, which is applied to the NI structures is also applied to the non-seismic Category I structures. According to the past and on-going construction experience of APR1400 type NPPs, concrete structures of the TGB and the CB are designed using the seismic design method that is applied to Seismic Category I concrete structures. The specific seismic analysis and design work which is expected to be performed by COL applicant is not mentioned in the COL information (DCD Tier 2, Section 3.7.5) because the seismic analyses and design of the TGB and the CB are outside the scope of the APR1400 standard design. Should this be included in the COL information?

- A description of how the potential effects of sliding and uplift have been considered for these structures

Draft Response: The COL applicant is to check and consider the potential effects of sliding and uplift for the TGB and CB using the same approach that is used in the stability check for the NI common basemat, as described in APR1400-E-S-NR-14005-P. This is not mentioned in the COL information because the seismic analyses and design of the TGB and the CB are outside the scope of the APR1400 standard design. Should this be included in the COL information?

NRC Feedback (02/02/2016):

The RAI response needs additional clarification and, consistent with their response, the applicant should proposed DCD and technical report markups (currently there's none) as follows.

- The RAI response states that the seismic analysis and design of the TGB and the CB are outside the scope of the APR1400 standard design. However, DCD Tier 2 Figure 1.2-1, *Typical APR 1400 Site Arrangement Plan*, indicates that the TGB and the CB are within the scope of the design certification. The information above appears to be inconsistent. Therefore the applicant should correct any inconsistencies between Figure 1.2-1 (and any other DCD Section as necessary) and the RAI response and provide respective proposed markups in the RAI response, including clarifying in DCD Section 3.7.2.7.1 that the TGB and the CB are site-specific structures as applicable.
- The RAI response states that the TGB and CB are designed using the seismic design method that is applied to Seismic Category I structures. While this design approach is consistent with the indication in the RAI response that criterion (b) from DCD Section 3.7.2.7.1 is applied to TGB and CB, both the aforementioned design approach and application of criterion (b) to the TGB and CB appear to be inconsistent with DCD Tier 2, Table 3.2-1 which show ACI 318 and AISC 360 (as opposed to ACI 349 and AISC N690 for seismic Category I structures) as the design basis codes/standards for the TGB and CB. The applicant should correct this apparent inconsistency between their response and DCD Table 3.2-1 and provide respective DCD markups as applicable.
- Editorial comment – verify whether or not the last paragraph intended to refer to technical report 14006-P rather than 14005-P.

Consistent with the RAI response including the aforementioned clarifications, the applicant should propose markups to DCD Section 3.7.2.7.1 that provide a summarized description of the analysis and design approach that will be implemented by a COL applicant [e.g. applicable seismic analysis methods, applicable codes/standards, and seismic ground motion input consistent with COL information item 3.7(1)]. The proposed markups should also describe the application of criterion (b) to the TGB and CB. Additionally, the applicant should propose markups to Technical Report 14005-P (SSSI Analysis) with the relative displacements information provided in the RAI response.

3. RAI 129-8085, Q 03.08.01-4.a.; NRC is to provide an update regarding the NRC's position with regards to the use of multiple editions and addenda of the ASME code
4. RAI 226-8235, Q 03.07.02-5; KHNP is to provide a schedule of when a draft revised response can be provided

RCS mass and hydro dynamic effects were considered in design sections of tank wall and slabs. The structural analysis results using response spectrum and equivalent static analysis methods are used in section designs, they do not directly use seismic analysis results.

KHNP will provide supplementary response with additional explanation for NRC's additional comments by February 26, 2016.

Additional Items Suggested by KHNP

1. RAI 226-8235 Question 03.07.02-6; SSSI analysis

During the October, 2015 meeting regarding DCD Section 3.7, it was discussed that the SSSI analysis should use a representative partial model since ACS SASSI code size limitations are not a suitable justification for assuming structures are surface mounted for SSSI analysis. In response to the comments made during the meeting, KHNP has plans to re-perform SSSI analysis of the NI+EDGB using the direct embedded option and confirm the current results of the SSI analysis, since the results of the SSSI analysis using the surface mounted option results in the EDGB being affected by the SSSI analysis.

Staff Feedback on KHNP Responses to RAI Question 3.7.1-4, -7, and -8 (02/02/2016)

1 Generic Soil Profiles in APR1400 DCD (RAI 3.7.1-4)

APR1400 DCD and technical reports have descriptions of low-strain soil profiles and strain-compatible soil profiles. The applicant's response to RAI 182-8160, Question 01.07.01-4 further clarifies that the low-strain P-wave velocities were used in the SSI analyses related to the CSDRS and HRHF RS inputs. The strain-compatible shear wave velocities were used in all SSI analyses. Based on the DCD, technical reports, and the RAI response, the staff understands which soil profiles were used as generic soil profiles in the DCD SSI analyses.

However, since strain compatible soil profiles are applicable only to COL applications pertaining to their specific sites, the DCD needs only to make sure that a COL applicant compare its strain-compatible soil profiles with DCD generic soil profiles. To make this concept clear in the DCD, the applicant is requested to revise the DCD to use the term "generic soil profiles" to refer the soil profiles used in the DCD SSI analyses, not strain-compatible shear wave velocities or low-strain P-wave velocities, and keep only the generic soil profiles in Tables 3.7A-1 through 3.7A-9. For the HRHF input motion, DCD Section 3.7B.3, High Frequency Site Profiles, should be enhanced to include only the generic soil profile used in the HRHF SSI analysis, and include a table or add a column to Table 3.7A-9 for the HRHF generic soil profile.

This change may affect DCD Section 2.5 regarding the HRHF generic soil profile.

1.1 Staff Feedback on KHNP Response to RAI 3.7.1-4:

Although the RAI response generally addressed the RAI questions, the staff finds that the proposed markup to the APR1400 DCD does not reach a sufficient level of clarity regarding the DCD generic soil profiles and how they compare to COL strain-compatible soil profiles. The revised DCD still uses terms such as "low-strain", "strain-compatible", and "generic" when describing soil profiles. It also describes site response analysis to consider modulus reduction and hysteretic damping curves. Therefore, the staff requests the applicant to expand the revision of the DCD Sections 3.7 and Appendices 3.7A and 3.7B to describe only generic soil profiles. The revision should also remove the description of site response analysis and degradation models in the DCD, while the newly added COL 3.7(11) and COL 3.7(12) should remain (with a minor change). Associated with the requested revision of the DCD, the applicant should ensure that technical reports APR1400-E-S-NR-14001-P Rev. 0 and APR1400-E-S-NR-14004-P Rev. 1 to have descriptions indicating which soil profiles in the reports are the DCD generic soil profiles.

Other reasons for the requested revision of the DCD include:

1. to leave the determination of “strain-compatible” P-wave velocities to the purview of COLA because DCD need only to describe generic P-wave velocities,
2. to be consistent with other certified standard designs, and
3. to avoid confusion and improve efficiency for future COL and DC applications .

Two examples of suggested changes to the DCD are provided below, which are highlighted in yellow:

COL 3.7(12), “the COL applicant ...with ~~strain-compatible~~ generic soil properties...”

DCD Section 3.7.1.2, “Damping values of soil to be used in soil-structure interaction analysis are ~~obtained from generic modulus reduction and hysteretic damping curves recommended by EPRI TR-102293 (reference 11) based on site response analysis of soil columns for the standard plant profiles considering shear strain computability~~ provided in Tables 3.7A-1 through 3.7A-9.”

KHNP Response:

DCD will be revised to eliminate use of the terms “low-strain” and “strain-compatible”, and to use only the term “generic” when describing soil profiles. The description of site response analysis and degradation models in the DCD will be removed. The newly added COL 3.7(11) and COL 3.7(12) will remain with a minor change. The technical reports APR1400-E-S-NR-14001-P Rev. 0 and APR1400-E-S-NR-14004-P Rev. 1 will be revised to have descriptions indicating which soil profiles in the reports are the DCD generic soil profiles.

2 Staff Feedback on KHNP Response to RAI Question 3.7.1-7

The markup in Section 3.2.3, General Procedures of APR1400-E-S-NR-14001-NP, Rev. 0 has left two paragraphs not deleted on page 6 of the RAI response. The staff does not see the reason why those two paragraphs remain, but please explain it if there is a technical reason for that. Otherwise, the response and DCD markup are acceptable.

KHNP Response:

The markup of the RAI response will be revised to additionally delete following two paragraphs in Section 3.2.3, General Procedures of APR1400-E-S-NR-14001-NP, Rev. 0.

(1) The target and target ranges of values for these other design ground-motion time-history parameters shall be the median (m) values and the median (m) \pm one standard deviation (σ), i.e., $m \pm \sigma$, ranges. The determination of these target and target ranges of values is based on the methodologies and ground motion databases as described in NRC RG 1.60 and relevant NUREG reports, namely, NUREG-0003 (Reference 11) and NUREG/CR-6728. The determination of the target and target ranges of values for these other design ground-motion time-history parameters is described below.

(2) The PGA of the CSDRS is 0.3g for both the horizontal and vertical components of ground motion. Thus, the target maximum acceleration (A) of the CSDRS-compatible time histories is generated as 0.3g. Also, the CSDRS adopt the horizontal and vertical NRC RG 1.60 DRS for the frequency range below 9 Hz. The CSDRS are enhanced from the spectra values of the NRC RG 1.60 DRS in the high frequency range from 9 to 50 Hz. Two paragraphs will be deleted in revised answer.

3 Staff Feedback on KHNP Response to RAI Question 3.7.1-8

The response and DCD markup are acceptable.

Meeting Information

SCHEDULE

Date: Thursday, 2016-02-04

Time: 08:00-09:00 (WDCC Time)

Conference Lines

Toll Number: [1517-268-4034](tel:15172684034)

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